# Three-Year Integrated M.Sc. M.Ed. Course

## Curriculum Framework

## PAC 23.17

## 2022-23


**Convenor**

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# Regional Institute of Education, Bhopal

## National Council of Educational Research and Training

# PREFACE

The integrated MSc. M.Ed. programme is a professional development programme aimed at preparing teacher and teacher education professionals spanning all Science subjects such as Physics, Chemistry, Botany, Zoology; Mathematics and Education. This innovative integrated Programme is designed in such a way that it will not only provide required teacher or teacher educator to perform teaching, learning and assessment activities but also provide integrated qualification of M.Sc. M.Ed. in 3 years instead of normal degrees of M.Sc. and M.Ed. separately in 4 years.

RIE, Bhopal through its Department of Education in Science and Mathematics and the Department of Education has been producing quality teachers in Science, Mathematics and Education. This is being done by its innovative four-year integrated courses of B.Sc. B.Ed., B.A. B.Ed. and B.Ed-M.Ed course. A number of Universities, Higher Education Institutions and Teacher Education Institutions across the country, have now realized the merits of four-year integrated programmes and have initiated the same in their contexts.

The innovative four-year integrated B.Sc. B.Ed., B.A. B.Ed. programmes, which are being run successfully for about six decades in four RIEs (Ajmer, Bhopal, Bhubaneswar, Mysore) have now been recognized by the NCTE. The faculty is in constant touch with its alumni who have excelled in various capacities in KendriyaVidyalayas, NavodayaVidyalas, Central Tibetan Schools, teacher education colleges and in many prestigious public and private schools and colleges across the globe. But unfortunately such programmes have no scope for vertical mobility in the form of M.Sc. M.Ed. All these years although they have been demanding for such course, it is therefore, proposed to introduce an innovative 3-year M.Sc. M.Ed. integrated programme in the backdrop of the stipulations of the National Education Policy 2020.

It is hoped that, this course will offer career opportunities in the fields of teaching, education and allied professions such as educational consultancies, publishing houses, schools, colleges, universities, education centres, research and development organizations, etc. Some of the popular job profiles are Teacher Educators, teachers, Soft Skill Trainers, Principal/Head Master, District Education Officer, District Project Coordinator, Education Officers, Instructional Technologist, Educational Administrators, Curriculum Developers, Human Resource managers/Human Resource Development personnel, Training and Placement Officer, etc.

Dated: 20/03/23 Programme Coordinators
Bhopal,

## ACKNOWLEDGEMENTS

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Bhopal, Dated: 20/03/23

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Bhopal, Dr. Deepti Kavathekar, Dr. Dalel Singh, Rashmi Pal, Assit. Prof. RIE, Bhopal; **ERPs**- Prof. Anil Kumar, Ex-Faculty, NITTR, Prof. Manjit Sen Gupta, Former Principal, RIE, Bhopal.

# Proceedings of the Programme

The need for integrated M.Sc M.Ed course in RIE Bhopal has been demanded by the students since past many years. The basic objective of the course is to develop integrated Master in Science and Master in Educatio, Scheme and curriculum to provide vertical academic opportunities and mobilities to the graduate students of RIEs in various subjects like Science and Mathematics integrating Education.

The M.Sc. M.Ed. Syllabus was developed in the workshop mode. The first In-house meeting of PAC program entitled "Development of Innovative course in Science Education (Mathematics, Physics, Chemistry and Biological Science)" which will lead to integrated twin Post Graduate Degree (3 years M.Sc. M.Ed course) was conducted on 20/04/2022, Wednesday at 4:30pm in Department of Education in Science and Mathematics Chamber. The meeting was presided by Principal, RIE, Bhopal. During the meeting, Mathematics section presented the curriculum design of the proposed syllabus. Head DESM requested all subject coordinators to collect different Universities/ Institutes syllabus and go through them to have a framework. He also requested to come with proper preparation for presenting the subject-wise curriculum design and present it in the next meeting.

In continuation, the second in-House meeting was conducted on 17/05/2022 at 4:00 pm in Room no. 53. The respective subject co-ordinators gave their presentations regarding the progress in the formulation of the curriculum. After the presentations, each faculty member gave their opinions to modify the curriculum and scheme. The third workshop In-house meeting was conducted on 8.06.22 at 3 PM in Room no. 53. The meeting was chaired by Prof. L.K. Tiwary, Head DESM, RIE, Bhopal. At the end of the meeting following decisions were taken:

1. It was decided to bring out a separate curriculum for Botany and Zoology.
2. In place of four workshops (Physics, Chemistry, Biology), seven workshops were proposed (Mathematics, Physics, Chemistry, Botany, Zoology, Education).
3. As per approved four workshops, budget was again distributed for seven workshops equally and also the following faculty members were given the responsibility for coordinating the workshops:

i. Common workshop Coordinator – Dr. Ashwani Kumar Garg
ii. Mathematics Coordinators – Aji Thomas and Dr. Ashwani Kumar Garg
iii. Physics Coordinators – Dr. Kalpana Maski and Dr.Shivalika Sarkar
iv. Chemistry Coordinator – Prof. L.K. Tiwary
v. Botany Coordinator -Prof. P. Kulshrestha
vi. Zoology Coordinator –Prof. Jaydip Mandal
vii. Education Coordinators – Prof. Ratnamala Arya and Dr. Rashmi Sharma

As per the discussion of third in-house meeting, common workshop was conducted from 11th - 15th July in Room No. 53 at RIE, Bhopal. In this workshop, Prof. Anil Kumar, Ex-Faculty, NITTTR, Bhopal, Prof. Ramakar Raizada , Ex- Faculty , NCERT, Bhopal, Prof. M. Sengupta, Ex- Faculty, NCERT, Bhopal, Prof. B.S.P. Raju , Ex- Faculty , RIE, Mysuru, Prof. P.C Agrawal, Principal , RIE, Bhubaneswar, Prof. Ayushman Goswami, Head, Education, RIE, Ajmer and RIE Faculty from DESM and DE participated in the workshop. In this workshop, curriculum design and blueprint of the different syllabus were developed. In continuation, the subject wise workshop was conducted from 1st – 5th August, 2022 at RIE, Bhopal. In this workshop, subject – wise draft syllabus was prepared.

The six separate subject-wise workshops were conducted from 20th-26th August at RIE, Bhopal for reviewing and finalising the draft syllabus. As per recommendation of curriculum cell, NCERT, New Delhi additional workshop for Botany and Education syllabus was conducted from 15th-17th September at RIE, Bhopal for reviewing and finalise the draft syllabus. Following External and Internal RPs attended the workshop.

**Physics: IRPs-** Prof. P.C. Agarwal , RIE, Bhubaneswar, Dr. Kalpana Maski, RIE, Bhopal, Mr. L.S.Chauhan, RIE, Bhopal, Dr. Shivalika Sarkar, RIE, Bhopal, Dr. Munira Bano, RIE, Bhopal, Souvik Manna, RIE, Bhopal; **ERPs-** Dr. Jeetendra Suryawanshi, Govt. College Sendhwa, Dr. Deepak Sondhiya SAGE University Bhopal, Dr. Rashmi Sharma, Principal Rashtra Bharti Shikha Mahavidyalaya, Ujjain, Ujjain Dr. Anjuli Suhane, School of Education, IGNOU, New Delhi;

**Chemistry: IRPs-** Prof. L.K. Tiwary, RIE, Bhopal, Prof. Chitra Singh, RIE, Bhopal, Prof. Rashmi Singhai, RIE, Bhopal, Prof. Rashmi Sharma , RIE, Bhopal, Dr. R.P. Prajapati, RIE, Bhopal, Dr. Vivek Gupta, RIE, Bhopal; **ERPs-** Prof. I.P. Agrawal, Rtd. Prof., RIE, Bhopal, Prof. V. P. Gupta, Ex.. Faculity, RIE, Bhopal, Dr. Sarita Shrivastava Retd. faculity, Chemistry,

Dr. Neena Arora , Head department of Chemistry, SatyaSai college, BHEL, Bhopal, Prof. G.T. Bhandage , former Principal , RIE, Mysore;

**Mathematics: IRPs** Dr. Anuja Gupta, RIE, Bhopal, Dr. Aji Thomas, RIE, Bhopal, Dr. Ashwani K. Garg, RIE, Bhopal; **ERPs-** Prof. Anoop Rajput, NCERT, New Delhi, Dr. Saurabh Kapoor, RIE, Bhubaneswar, Prof. Raju BSP, Rtd. Prof. RIE, Mysuru, Prof. K.B.Subramaniyam, Ex-Faculty, RIE, Bhopal, Dr. Jyoti Nema, Dr. Dhirendra K. Shukla; Prof. Manoj Kumar Shukla, Head of the department, Excellence college Bhopal; Dr. Sabhakant Dwivedi, Excellence college Bhopal, Dr. Namrata Tripathi, Higher Education Satpura Bhawan Bhopal; Prof. Makhan Singh Chouhan, Excellence college Bhopal.

**Zoology: IRPs-** Dr. Bharat Pandram, RIE, Bhopal, Manisha Pande, Assistant Professor, Apeksha Arya, Assistant Professor, **ERPs-** Dr. A. Mahapatara, Rtd. Prof. RIE, Bhubaneswar, Prof. Vinay Kumar Shrivastava, Dean, B.U Bhopal, Prof. Vipin Vyas, Professor of Zoology, B.U., Bhopal, Dr. H K Garg;

**Botany: IRPs-** Prof. Jaydip Mandal, Principal RIE, Bhopal, Prof. P.K. Kulshrestha, RIE, Bhopal, Dr. Daksha Parmar, RIE, Bhopal, Ms. Srishti Mishra , Assistant Professor; **ERPs-** Prof. Reeta Sharma, Ex. faculity. Botany, RIE, Bhopal, Dr. A K Bhardwaj, Prof. of Botany IEHE Bhopal;

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# Rules and Regulations

## 1.1 Preamble

The integrated M.Sc. M.Ed. is an innovative three-year full time professional programme in the disciplines of Science (Physics, Chemistry, Botany, Zoology), Mathematics and Education. It aims at preparing teachers, teacher educators, researchers and other professionals such as curriculum and textbook developers, educational planners and administrators in the field of school education and higher education. On successful completion of the programme, the students will be awarded M.Sc. M.Ed. degree, which includes dual degrees of M. Sc. and M.Ed., with specialization in Physics/ Chemistry/ Botany/ Zoology, Mathematics and Education.

## 1.2 Need and Justification

Education around the globe is changing very fast. The role of teacher and the contents and process of teacher preparation programme at all levels of education need to be adapted to the changes accordingly. Teacher who happens to be "sage on the stage" is being transformed into 'Guide on the side'. Teacher's role, now a days, is not only to transact curriculum but also to facilitate learning by undertaking various tasks behind the curtain.

The present MSc. M.Ed. programme is a professional development programme aimed at preparing teacher and teacher education professionals spanning all Science subjects such as Physics, Chemistry, Botany, Zoology; Mathematics and Education. This innovative integrated Programme is designed in such a way that it will not only provide required teacher or teacher educator to perform teaching, learning and assessment activities but also provide integrated qualification of M.Sc. M.Ed. in 3 years instead of normal degrees of M.Sc. and M.Ed. separately in 4 years. A degree in M.Sc. M.Ed. will open up career opportunities in the fields of teaching, education and allied professions such as educational consultancies, publishing houses, schools, colleges, universities, coaching centres, research & development organizations, etc. Some of the popular job profiles are Teacher Educators, teachers, Soft Skill Trainers, Career Counsellor, Principal/Head Master, District Education Officer, District Project Coordinator, Education Officers, Home Tutors, Online Tutor/Trainer, Instructional Technologist, Educational Administrators, Curriculum Developers, Human Resource managers/Human Resource Development personnel, Training and Placement Officer, etc.

RIE, Bhopal through its Department of Education in Science and Mathematics and the Department of Education has been producing quality teachers in Science, Mathematics and Education. This is being done by its innovative four-year integrated courses of B.Sc. B.Ed., B.A. B.Ed. and B.Ed-M.Ed. It may be noted with satisfaction that a number of Universities, Higher Education Institutions and Teacher Education Institutions across the country, have now realized the merits of four-year integrated programmes and have initiated the same in their contexts.

The innovative four-year integrated B.Sc. B.Ed., B.A. B.Ed. programmes, which are being run successfully for about six decades in four RIEs (Ajmer, Bhopal, Bhubaneswar, Mysore) have now been recognized by the NCTE. The faculty remains in constant touch with its alumni who have excelled in various capacities in Kendriya Vidyalayas, Navodaya Vidyalas, Central Tibetan Schools, teacher education colleges and in many prestigious public and private schools and colleges across the globe. But unfortunately the products of such programmes have no scope for vertical mobility in the form of M.Sc. M.Ed. all these years although they have been demanding it quite so often. Consequent upon launching of the M.Sc. M.Ed. integrated programmes, the institution will become a Research Centre for Science Education and the research interests of the science faculty will be promoted. This programme is felt a necessity in view of:

1. Encouraging feedback from schools and colleges.
2. Continuous demand from the stakeholders
3. Research interests and capability of the faculty
4. Available infrastructure of the Institute
5. Forward looking vision of NEP 2020
6. Educational Scenario in the country.

It is therefore, proposed to introduce an innovative 3-year M.Sc. M.Ed. integrated programme in the backdrop of the stipulations of the National Education Policy 2020.

Recently, in a meeting of the Principals of RIEs the proposal of running M.Sc. M.Ed. integrated programme was examined and agreed upon unanimously from the point of view of its relevance in the context of the recommendation of NEP 2020 and future perspective.

### 1.3 Programme Outcome

On successful completion of the three-year integrated M.Sc. M.Ed programme, the students will be able to:-

i. Conceptualise disciplinary knowledge in **Science** including Physics, Chemistry, Botany, Zoology; **Mathematics**; and **Education** curriculum from philosophical, psychological sociological, economic and historical perspectives with special reference to India-centric knowledge.
ii. Select and use learner centric constructivist approaches, strategies and methods such as inquiry based, cooperative and collaborative learning; necessary competencies for organising learning experiences; and designing appropriate assessment strategies for facilitating Science and Mathematics learning.
iii. Design, develop and evaluate Science, Mathematics and Teacher Education curriculum
iv. Integrate Technology, Pedagogy and Content (TPACK) in Science including Physics, Chemistry, Botany, Zoology; Mathematics; and Education curriculum.
v. Exhibit 21$^{st}$ century skills in research, teaching and professional practices, including assessment, administration, supervision, curriculum design and development.
vi. Communicate effectively the acquired knowledge with scientific community and society at large and apply ICT for better delivery in classroom and beyond.

vii. Apply disciplinary knowledge to solve varied problems, including problems related to teaching-learning and assessment.
viii. Identify the classroom diversities and deal with diverse learners in inclusive classroom setup.
ix. Demonstrate core capacities and skills in career counselling, curriculum development, instructional technology, educational planning and research, etc.
x. Exhibit self-directed learning and assessment, e.g. reading with comprehension, preparing scripts for seminars, self-assessment, habit of reading, metacognition, etc.
xi. Exhibit entrepreneurship and employability skills in different fields of science, mathematics and education.
xii. Work as a team member or leader in inter-disciplinary and multi-disciplinary settings through collaborative learning, cooperative learning and team teaching during internship/project work.
xiii. Practice Research and Scientific enquir**y** to promote scientific temper and contextualized learning.
xiv. Apply knowledge, scientific principles and pedagogy in managing projects.
xv. Mobilize community to promote scientific temper and scientific practices so as to contribute to the advancement of evidence-based rational knowledge.

### 1.4 Scope

On completion of the course, students shall have:

i. **Career Opportunities:** Eligible to apply for jobs where M.Sc. (Mathematics/ Physics/ Chemistry/ Botany/ Zoology) or M.Ed. or both qualifications are required.
ii. **Academic Advancements:** Can pursue Ph.D/ NET/ JRF/ SET/ SLET/ GATE in the disciplines of Science (Physics, Chemistry, Botany, Zoology), Education and Mathematics.
iii. **Entrepreneurship:** Start-up ventures in multi-disciplinary educational institutions.

### 1.5 Programme and Duration

The duration of Post Graduate Integrated Programme of Teacher Education will be three-years divided into six semesters and shall lead to the degree of **Master of Science** (Physics/ Chemistry/ Botany/ Zoology/ Mathematics) and **Master of Education**. Each semester will consist of 24 weeks (06 months) including examination. The maximum duration for the completion of the programme will be of five years from the date of admission.

### 1.6 Equivalence

The course content of M.Sc. M.Ed. integrated programme is equivalent to the course content of M.Sc. (Physics/ Chemistry/ Mathematics/Botany/ Zoology) and M.Ed. as per the syllabi of affiliating Barkatullah University, Bhopal. Since Barkatullah University, Bhopal has adopted UGC syllabi for M.Sc. as well as M. Ed., this degree is equivalent to M.Sc. and M.Ed. degrees of any university recognised by the UGC.

The summer and inter-semester breaks of two academic years will be utilized for field attachment/internship, other practicum activities.

The students who pass this course are considered eligible to pursue Ph.D. degree in Physics / Chemistry / Mathematics / Botany/ Zoology / Education in compliance with Ph.D. regulations of UGC.

### 1.7 Eligibility Criteria

Eligibility criteria for admission in to the programme are as follows:

Graduates with four-year B.Sc. B.Ed. programme with at least 50% of marks in B.Sc. component and 50% of marks in Education component from UGC recognized institutions.

**OR**

Graduates with B.Sc. degree (PCM/CBZ) and B.Ed. with at least 50% marks in each of the B.Sc. and B.Ed. programme from UGC recognized institutions.

### 1.8 Intake

The intake for the programme will be 100. The distribution of seats is as follows:

| S. No. | Course | Number of Seats |
|---|---|---|
| 1 | M.Sc. (Physics) M.Ed. | 20 |
| 2 | M.Sc. (Chemistry) M.Ed. | 20 |
| 3 | M.Sc. (Mathematics) M.Ed. | 20 |
| 4 | M.Sc. (Botany) M.Ed. | 20 |
| 5 | M.Sc. (Zoology) M.Ed. | 20 |
| **Total** | | **100** |

### 1.9 Promotion

Promotion from one semester to the next semester will be independent of pass or fail in semester end examination provided that the candidate has satisfied minimum attendance requirements prescribed by the university subject to condition that he/she does not fail in more than two subjects. For clearing remaining subjects, he/she will be allowed to keep the Term (ATKT) and will be automatically promoted to next semester but the course will have to be completed within maximum period of five years.

In order to be successful in any of the semester end examination for the M.Sc. M.Ed. programme, a candidate must secure at least 40% marks in each subject separately and 40% marks in aggregate of all subjects offered by him/her mentioned in Structure of the course. Subject in which both theory and practical examinations are prescribed, one has to obtain 40% marks in theory and practical examination, separately.

i. A candidate with four ATKT will be eligible to continue but in any case he/she will not be allowed to have more than two ATKT in a semester.

ii. A candidate who fails in more than two subjects in any semester will not be eligible to get admission in next semester, till he/she clears it as an ex-student.

iii. No separate examination for ATKT candidates will be conducted. Odd semester ATKT examination will be held with odd semester examination and even semester ATKT examination will be held with even semester examination.

iv. A candidate who fails to clear ATKT in two attempts will not be allowed to get admission in the next semester. They will have to appear in examination as an ex-student as per the point (ii).

v. There will be no provision of revaluation in theory/ practical/ internal/ project work. However, candidates can apply for re-totalling of marks in one theory subject per semester.

vi. A candidate failing in theory subjects of a semester but securing minimum pass marks in internal/project work/practical, the marks secured will be carried forward in the next examination of the concerned subject.

### 1.10 Eligibility for Examination

a. Every student seeking admission to examination shall have to submit an application in prescribed form along with necessary fees and the following certificates from the Principal, viz. certificate of-

   (i) Having attended at least 80**%** of lectures/seminars, practicum/practical laboratory work etc. in each subject discipline and 90% in internship.

   (ii) Good conduct.

b. If the Principal of the Institute is unable to grant, in respect of any student, any of the certificates referred to in sub-para (a) above he/she shall have to forward a statement of grounds of his/her inability to do so to the Registrar for consideration of the Vice-Chancellor who may after holding such further enquiry, if any, as he/she deems necessary order for allowing the candidate for appearing in the examination or otherwise, in accordance with the merit of the case.

c. However, shortage of attendance up to 15% of prescribed percentage may be condoned by the Vice Chancellor on the recommendations of the chairperson of the Department

and/ or Principal of the Institute/College as per rules of the concerned University. There shall be no condonation, if attendance is below 65% in each subject discipline during any semester. A candidate who does not satisfy the requirements of attendance shall not be eligible to appear in the examination of the concerned subject discipline.

A candidate who fails to satisfy the requirements of the attendance in a semester is permitted to re-join the same semester.

### 1.11 Attendance

Each semester shall be taken as a unit for the purpose of calculating attendance. Candidate has to attend minimum of 80% of the total number of working hours (lectures, seminars and practical taken together) to appear in the semester end examination.

### 1.12 Medium of Instruction

The medium of instruction will be English.

### 1.13 Reservation

According to the reservation policies of the Government of India.

### 1.14 Marks and Grade system (Choice Based Credit System)

The Master of Science and Master of Education integrated programme will be introduced through Choice Based Credit System (CBCS). The CBCS provides the learner with flexibility to study the subjects/courses at their own pace but within the stipulated time period; greater choice of inter-disciplinary, intra-disciplinary and skill-based courses and mobility to different institutions for studies.

### 1.15 Course Structure with Credits

**M.Sc. M.Ed. I Semester**

| S. No. | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|
| | | T/P | Credit | Hours | Internal | External | Total |
| **1** | Core subject (Sci./Maths )-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | Core subject (Sci./Maths)-II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | Core subject (Sci./Maths)-III | T | 4 | 60 | 30 | 70 | 100 |
| **4** | Practical (Sci./Maths)-I | P | 1 | 30 | 05 | 20 | 25 |
| **5** | Practical (Sci./Maths)-II | P | 1 | 30 | 05 | 20 | 25 |
| **6** | Educational studies (CC) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | Philosophical and Sociological perspectives of Education (CC) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | Innovative approaches, strategies and methods of teaching-learning (CC) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | Application of ICT in Education (CC) | P | 2 | 60 | 50 | | 50 |

| Total | 28 | 480 | 240 | 460 | 700 |
|---|---|---|---|---|---|

**T: Theory P : Practical**

## M.Sc. M.Ed. II Semester

| S. No. | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|
| | | T/P | Credit | Hours | Internal | External | Total |
| 1 | Core subject (Sci./Maths )-I | T | 4 | 60 | 30 | 70 | 100 |
| 2 | Core subject (Sci./Maths)-II | T | 4 | 60 | 30 | 70 | 100 |
| 3 | Core subject (Sci./Maths)-III(Optional) | T | 4 | 60 | 30 | 70 | 100 |
| 4 | Practical (Sci./Maths)-I | P | 1 | 30 | 05 | 20 | 25 |
| 5 | Practical (Sci./Maths)-II | P | 1 | 30 | 05 | 20 | 25 |
| 6 | Psychology of learning and assessment (CC) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | Curriculum studies (CC) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | Research Methodology in Science & Mathematics Education-I(CC) | T | 4 | 60 | 30 | 70 | 100 |
| 9 | Development and use of digital resources & techniques in science & Mathematics Education (CC) | P | 2 | 60 | 50 | | 50 |
| Total | | | 28 | 480 | 240 | 460 | 700 |

## M.Sc. M.Ed. III Semester

| S. No. | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|
| | | T/P | Credit | Hours | Internal | External | Total |
| 1 | Core subject (Sci./Maths )-I | T | 4 | 60 | 30 | 70 | 100 |
| 2 | Core subject (Sci./Maths)-II | T | 4 | 60 | 30 | 70 | 100 |
| 3 | Core subject (Sci./Maths)-III(Optional) | T | 4 | 60 | 30 | 70 | 100 |
| 4 | Practical (Sci./Maths)-I | P | 1 | 30 | 05 | 20 | 25 |
| 5 | Practical (Sci./Maths)-II | P | 1 | 30 | 05 | 20 | 25 |
| 6 | Indian Knowledge System (CS) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | Research Methodology in Science & Mathematics Education-II(CS) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | Thematic Specialization I (Any one: TS1.1/TS2.1/TS3.1/TS4.1/TS5.1) (TSC) | T | 4 | 60 | 30 | 70 | 100 |
| 9 | Internship -I | P | 2 | 60 | 50 | | 50 |
| Total | | | 28 | 480 | 240 | 460 | 700 |

**Note:**

TS1.1 - Educational Management, Administration and Leadership

TS2.1- Curriculum Theory Planning and Development

TS3.1- Foundations of Educational Technology

TS4.1 - Understanding and development of Inclusive Education

TS5.1–Guidance and Counselling in School

## M.Sc. M.Ed. IV Semester

| S. No. | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|
| | | T/P | Credit | Hours | Internal | External | Total |
| 1 | Core subject (Sci./Maths )-I | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2** | Core subject (Sci./Maths)-II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | Core subject (Sci./Maths)-III(Optional) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | Practical (Sci./Maths)-I | P | 1 | 30 | 05 | 20 | 25 |
| **5** | Practical (Sci./Maths)-II | P | 1 | 30 | 05 | 20 | 25 |
| **6** | Historical, Political and Economic Perspectives of Education (CC) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | Educational planning, management and administration (CC) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | TS- Thematic Specialization II(Any one: TS1.2/TS2.2/TS3.2/TS4.2/TS5.2) (TSC) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | Dissertation-1: Research in Science & Mathematics Education (Planning) | P | 1 | 30 | 25 | | 25 |
| **10** | Internship – II (Thematic Specialisation Choosen) | P | 1 | 30 | 25 | | 25 |
| **Total** | | | **28** | **480** | **240** | **460** | **700** |

**Note:-**

TS1.2–Educational Planning

TS2.2–Learning and Pedagogy of School Subjects

TS3.2–ICT in Education

TS4.2–Addressing the diverse need in Inclusive setting

TS5.2 – Assessment and Appraisal in Guidance and Counselling

## M.Sc. M.Ed. V Semester

| S. No. | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|
| | | T/P | Credit | Hours | Internal | External | Total |
| **1** | Core subject (Sci./Maths )-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | Core subject (Sci./Maths)-II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | Core subject (Sci./Maths)-III(Optional) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | Practical (Sci./Maths)-I | P | 1 | 30 | 5 | 20 | 25 |
| **5** | Practical (Sci./Maths)-II | P | 1 | 30 | 5 | 20 | 25 |
| **6** | Teacher Education-I(CC) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | Thematic specialization III(Any one: TS1.3/TS2.3/TS3.3/TS4.3/TS5.2) (TSC) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | Generic Elective course (any one) (GES)<br>a. Indian values, Culture and heritage<br>b. Education for Sustainable development<br>c. Programme project and Institutional assessment<br>d. Yoga, sports and wellness<br>e. Cross-curricular pedagogical approaches<br>f. Policy evaluation researches | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | g. Self professional development | | | | | | |
| **9** | Dissertation-2: Research in Science & Mathematics Education (Execution) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | **28** | **480** | **240** | **460** | **700** |

**Note:**

TS1.3 –Educational Management, Leadership and Supervision

TS2.3 – Learners' Assessment

TS3.3 – ICT Integration in Education

TS4.3 – Concern, Challenges and Issues in Inclusive Education

TS5.3 – Career Development

**M.Sc. M.Ed. VI Semester**

| S. No. | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|
| | | T/P | Credit | Hours | Internal | External | Total |
| **1** | Core subject (Sci./Maths )-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | Core subject (Sci./Maths)-II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | Core subject (Sci./Maths)-III(Optional) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | Practical (Sci./Maths)-I | P | 1 | 30 | 5 | 20 | 25 |
| **5** | Innovative Project activities in Science/Mathematics | P | 1 | 30 | 5 | 20 | 25 |
| **6** | Vocational opportunities, Start-up and entrepreneurship in Science/ Mathematics | T | 4 | 60 | 30 | 70 | 100 |
| **7** | Teacher Education –II(CC) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | Academic writing | P | 2 | 60 | 50 | | 50 |
| **8** | Dissertation-3: Research in Science/Mathematics Education (Reporting) | P | 4 | 60 | | 100 | 100 |
| **Total** | | | **28** | **480** | **210** | **490** | **700** |

**Note:**

CC-Core Course

TSC- Thematic Specialization Course

GES- Generic Elective Course

## 1.16 Summary of the Course Credit Points

| Types of Courses | Semester - I | Semester - II | Semester -III | Semester -IV | Semester -V | Semester -VI | Credit Score |
|---|---|---|---|---|---|---|---|
| Core Course | 12 | 12 | 8 | 8 | 4 | 8 | 52 |
| Thematic Specialization Course | | | 4 | 4 | 4 | | 12 |
| Generic Elective Course | | | | | 4 | | 4 |
| Practical(ICT practical+Internship+ Academic writing ) | 2 | 2 | 2 | 1 | | 2 | 9 (4+3+2) |
| Dissertation | | | | 1 | 2 | 4 | 7 |
| Total Credits | 14 | 14 | 14 | 14 | 14 | 14 | 84 |

# Subject Wise Three-Year Integrated M.Sc. (Physics, Chemistry, Mathematics, Zoology, Botny) M.Ed. Course

## (1). Three-Year Integrated M.Sc. (Physics) M.Ed. Programme

## (A) Course Structure with Credits

### M.Sc. (Physics) M.Ed. First Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP101 | Mathematical Physics | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP102 | Classical Mechanics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP103 | Quantum Mechanics | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP104 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME101 | Education Studies (CS- I) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME102 | Philosophical and Sociological perspectives of Education(CS- II) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME103 | Teacher Education I (CS- III) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME104 | Application of ICT in Education (P- I) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory** **P = Practical**

### M.Sc. (Physics) M.Ed. Second Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | | Assessment Scheme | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Int. | Ext. | Total |
| **1** | MP201 | Classical Electrodynamics- I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP202 | Condensed Matter Physics I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP203 | Electronic Devices | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP204 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME201 | Psychology of Learning and Development (CS- IV) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME202 | Curriculum Studies(CS- V) | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **7** | ME203 | Research Methodology In Science & Mathematics Education I (CS- VI) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME204 | Development and Use of Digital Resources and Techniques in Science and Mathematics Education(P- II) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory P = Practical**

## M.Sc. (Physics) M.Ed. Third Semester

| **S.** | **Paper Code** | **Subject Name** | **Teaching-Learning** | | | **Assessment Scheme** | | |
|---|---|---|---|---|---|---|---|---|
| | | | **Hours** | **Internal** | **Hours** | **Internal** | **Hours** | **Internal** |
| **1** | MP301 | Digital Electronics & Microprocessor | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP302 | Quantum mechanics II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP303* | Statistical mechanics | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP304 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME301 | Indian Knowledge System(CS- VII) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME302 | Research Methodology in Science& Mathematics Education- II(CS-VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME303* | TS- I Thematic Specialization I (Any One: TS1.1/TS2.1/TS3.1 /TS4.1/TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME304 | INTERNSHIP-I (P- III) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory P = Practical**

## M.Sc. (Physics) M.Ed. Fourth Semester

| **S.** | **Paper Code** | **Subject Name** | **Teaching-Learning** | | | **Assessment Scheme** | | |
|---|---|---|---|---|---|---|---|---|
| | | | **Hours** | **Internal** | **Hours** | **Internal** | **Hours** | **Internal** |
| **1** | MP401 | Nuclear and Particle Physics | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2** | MP402 | Atomic and Molecular Physics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP403 | Classical Electrodynamics- II | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP404 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME401 | Historical, Political and Economic Perspective of Education (CS- IX) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME402 | Educational Measurement and Evaluation(CS- X) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME403 * | TS-II Thematic Specialization II (Any one: TS1.2/TS2.2/TS3.2/TS 4.2/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME404 | DISSERTATION -1: Research in Science and Mathematics Education (Planning) (P-IV) | P | 1 | 30 | 25 | | 25 |
| **9** | ME405 * | Internship-II Thematic Specialization (P- V) | P | 1 | 30 | 25 | | 25 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory** **P = Practical**

## M.Sc. (Physics) M.Ed. Fifth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP501 | Condensed Matter Physics- II | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP502 | Computer Programming and Informatics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP503* | Optional Paper | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP504 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME501 | Innovative approaches, strategies and methods of teaching-learning (CS- XI) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME502* | TS-III Thematic specialization – III (Any one: TS 1.3/TS2.3/TS3.3/TS4.3/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME503* | Generic Elective Course (GE any one) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME504 | Dissertation II: Research in Science & Mathematics Education (Execution) (P- VI) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory** **P = Practical**

## M.Sc. (Physics) M.Ed. Sixth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP601 | Molecular Spectroscopy | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP602 | Laser Physics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP603 | Optional Paper | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP604 | Project Work | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME601 | Vocational Opportunities, Start-Up and Entrepreneurship In Science/Mathematics | P | 4 | 60 | 30 | 70 | 100 |
| **6** | ME602 | Teacher Education –II | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME603 | Academic Writing | P | 2 | 60 | 50 | | 50 |
| **8** | ME604 | Dissertaion-3: Research In Science/Mathematics Education (Reporting) | P | 4 | 60 | | 100 | 100 |
| | | **Total** | | **28** | **480** | **210** | **490** | **700** |

**T= Theory P = Practical**

## (B) Syllabus with Credit Based Choice System (CBCS)

## M.Sc. (Physics) M.Ed. First Semester

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1** | MP101 | Mathematical Physics | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP102 | Classical Mechanics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP103 | Quantum Mechanics | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP104 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME101 | Education Studies (CS- I) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME102 | Philosophical and Sociological perspectives of Education(CS- II) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME103 | Teacher Education I (CS- III) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME104 | Application of ICT in Education (P- I) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory** **P = Practical**

# Paper MP101: Mathematical Physics

Semester I — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

**Course Description**

- Analyze complex functions and its applications in solving definite integrals
- Understanding the concepts of various differential equations to solve physical problems
- Importance of Green's functions, Tensors, and Group theory in various areas of physics

***Learning Outcomes***

- On completion of the course, the learners will be able to identify the basic mathematical methods used in different branches of physics.

| | |
|---|---|
| **Unit I** | Complex Algebra: Analyticity of complex functions. Cauchy Riemann equations, Cauchy theorem, Cauchy integral formula. Taylors, Maclaurin, Laurent series &mapping, Theorem of residues. Simple cases of contour integration. Jordan's lemma Integrals involving multiple valued functions. |
| **Unit II** | Differential Equations: Ordinary Differential Equation, Partial Differential Equations, Recursion relation, Orthogonality and generating functions of Bessel functions of firstand second kind, Hermite, Legendre, Associate Legendre and Laguerre Polynomials. |

| | |
|---|---|
| **Unit III** | Green's functions: Non-homogenous boundary value problems, Green's function for one dimensional problems, Eigen function expansion of Green's function, Method of constructing Green's function. |
| **Unit IV** | Tensors: Tensor-notations and conversions, Contravariant tensors, Rank of the tensors, properties of the tensors, contraction, Cartesian tensors and their transformation properties, Eigen value of second rank tensor, Quotient law, and higher rank tensor with example from piezoelectricity. |
| **Unit V** | Group Theory: Concept of a group (additive and multiplicative), Matrix representation of a group, Reducible and irreducible representation of a group, SU(2), SU(3) and O(3), Lie groups. |

**Suggested Readings:**


- Mathematical Physics, V. Balakrishnan, Ane Books.
- Mathematical Methods for Physicists, G. Arfken, Elsevier.
- Advanced Engineering Mathematics, E. Kreyzig, Pearson.
- Mathematical Physics, Chattopadhyay P.K, New Delhi : Wiley Eastern Limited.
- Vector Analysis Schuam series, Spiegel Murray, New Delhi : McGraw Hill.
- Elements of group theory of physicists, Joshi A W, New Delhi: New Age International.
- Matrices and Tensors in Physics 3rd Edition. Joshi A.W. New Delhi: New Age International.
- Mathematical Physics, Rajput B.S & Gupta B.D. New Delhi: Vikas Publication.
- Mathematics of Engineers and Physicists, L. A. Pipes.
- Mathematical Physics, S Chand, H. K. Dass & Rama Verma.
- Schaum Series, Ghatak, Goyal & Guha, M.R Spiegel.
- Mathematical Physics M. Das, P. K. Jena and B.K. Dash, Sri Krishna Prakashan, 2nd Edition, 2009


**Web Reference:**

- https://www.youtube.com/channel/UC9vycSfjzLCR_w1C59VQo5A

# Paper MP102: Classical Mechanics

Semester I — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

***Course Description***

- Analyze the key concepts of Classical Mechanics using Lagrangian and Hamiltonian dynamics
- Understanding the concept of canonical transformation and its usefulness in classical mechanics
- Importance of small oscillation and rigid body dynamics in classical mechanics
- Create interest for research and innovations in the field of Classical Mechanics.

***Learning Outcomes***

- By the end of this course, the learner should have a clear concept of various dynamics in solving physical problems in classical mechanics.

| | |
|---|---|
| **Unit I** | Mechanics of a single & system of particle, generalized co-ordinates, Galileo's relativity principle, D'Alembert Principle, Calculus of variation and Hamilton's variational principle, Laws of conservation as derived from homogeneity and isotropy of space and homogeneity of time and principle of conservation of energy. |
| **Unit II** | Constraint, Holonomic and non-Holonomic, Lagrangian and Hamiltonian formalism, Lagrangian for a free particle and system of particles, Euler Lagrange equations of motion, Hamilton's equation of motion, Reduced mass, Similarity, Virial theorem. |

| | |
|---|---|
| **Unit III** | Canonical Transformations: Canonical Transformation, Types of Generating Function, Conditions for Canonical Transformation, Integral Invariance of Poincare, Poisson Bracket, Poisson's Theorem, Lagrange Bracket, Poisson and Lagrange Brackets as Canonical Invariant, Infinitesimal Canonical Transformation and Conservation Theorems, Liouville's Theorem.<br><br>Hamilton Jacobi Theory: Hamilton-Jacobi Equation for Hamilton's Principal Function, Harmonic Oscillator and Kepler's problem by Hamilton-Jacobi Method, Action-Angle Variables for completely Separable System, Kepler's Problem in Action-Angle Variables. |
| **Unit IV** | Small Oscillation: Problem of Small Oscillations, Example of Two coupled Oscillator, General Theory of Small Oscillations, Normal Coordinates and Normal Modes of Vibration, Free Vibrations of a Linear Tri-atomic Molecule. |
| **Unit V** | Rigid Body Dynamics: Angular Momentum and Kinetic Energy of Motion about a Point. The Inertia Tensor and Moment of Inertia, Eigen values of Inertial Tensor and the Principal Axis Transformation. The Euler Equations of Motion, Torque-free motion of a rigid body. The Heavy Symmetrical Top with One Point Fixed. |

**Suggested Readings:**


- Classical Mechanics, H.Goldstein, Pearson.
- Classical mechanics, N.C.Rana & P.S. Jog, Mc Graw Hill.
- Classical Mechanics, Landau & Lifshitz, Elsevier Publication.
- Lectures on theoretical physics, Sommarfield, Academic Press.
- Introduction to Classical Mechanics, R.G.Takwale & P.S. Puranik, Mc Graw Hill.
- Classical Mechanics, Upadhyaya . J. C:Himalaya Publishing House Pvt. Ltd.
- Concept of Physics, H. C. Verma, Bharati Bhawan.
- Classical Mechanics by G. Aruldhas, PHI Learning.
- Lectures on Engineering Physics, L. Maharana, P. K. Panda, S. K. Dash and B. Ojha, Pearson Publication (2017).

# Paper MP103: Quantum Mechanics-I

Semester I — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

***Course Description***

- Understanding the basic theories, principles and postulates of quantum mechanics
- Proposes many ways in solving physical problems using Schroedinger equation
- Solving Hydrogen atom problem using quantum mechanics

***Learning Outcomes***

- By the end of this course, the learner should have a basic concept of quantum mechanics and its applications in solving many physical problems

| | |
|---|---|
| Unit I | Abstract formulation of Quantum Theory, Reviews of quantum postulates, Linear vector space, Dirac notations of Bra-Ket notation, Eigen values and Eigen vectors, Orthonormality, Completeness, Closure, Matrix representation of observables and states, Determination of Eigenvalues and Eigenstate for observables using matrix representations, Generalized uncertainty principle, Change of representation and Unitary transformations, Coordinate and momentum representations, Ehrenfest theorem. |
| Unit II | Time evolution of quantum states, Time evolution operator and its properties, Schrodinger picture, Heisenberg picture, Interaction picture, Equations of motion, Operator method solution of 1D Harmonic oscillator, Matrix representation and time evolution of creation and annihilation operators, Density matrix. |
| Unit III | Theory of Angular Momentum, Equations of motion in Schrodinger and Heisenberg pictures, Symmetry, Invariance and conservation laws, Relation between rotation and angular momentum, Commutation rules, Matrix representations, Addition of angular momenta and Clebsch-Gordon coefficients, Pauli spin matrices. |
| Unit IV | Hydrogen atom, Reduction to equivalent one body problem, Radial equation, Energy eigen values and eigen functions, degeneracy, radial probability distribution. Free particle problem incoming and outgoing spherical waves, expansion of plane waves in terms of spherical waves, Bound states of a 3-D square well, particle in a sphere. |
| Unit V | Identity particles, Symmetry and Antisymmetric wave functions, Symmetric and Anti-symmetric spin wave functions of two identical particles, Exchange Forces, Application to Helium atom. |

**Suggested Readings:**


- Principles of Quantum Mechanics, R. Shankar, Springer.
- Modern Quantum Mechanics, J. J. Sakurai, Addison-Wesley.
- Advanced Quantum Mechanics, F. Schwabl, Springer.
- Quantum Mechanics, LI Schiff, Mc Graw Hill.

- Quantum Mechanics, AP Messiah, Dover Publications Inc.
- A Textbook of Quantum Mechanics, Mathews and Venkatesan, Mc Graw Hill.
- Introduction to Quantum Mechanics, David J. Griffiths

## Semester – 1

### Paper MP104: Practical (P-I)

Credits: 1.5
Duration: 3 hours
Experiment: 20
Record: 7.5

Max. Marks: 37.5
Passing Marks: 15
Viva: 10

1. Finding out Lande'g Factor by ESR Set up
2. Frank-Hertz Experiment
3. Determination Planck's constant by using photo cell.
4. Compton effect
5. Design of a regulated power supply
6. To study the electrical polarized light by using Babinet's Compensator.

### Practicals (P-II)

Credits: 1.5
Duration: 3 hours
Experiment: 20
Record: 7.5

Max. Marks: 37.5
Passing Marks: 15
Viva: 10

1. Determination of Rydberg Constant
2. e/m by Helical Coil / Braun tube
3. Stefan's Constant Determination
4. Study the electronic charge by Milikan's oil drop experiment
5. Study the e/m of electrons using Magnetron method.
6. Study the Malus law for plane polarized light.

**Suggested Readings:**


1. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methuen and Co. Ltd, 36 Essex Street W.C., London.
2. Advanced Level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, Heinemann Educational Publishers.
3. Advanced Practical Physics , S. P. Singh, Pragati Prakasan, Volume- I and Volume – II.
4. **Web Reference:** https://www.youtube.com/c/AllLabExperiments

## M.Sc. (Physics) M.Ed. Second Semester

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP201 | Classical Electrodynamics-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP202 | Condensed Matter Physics I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP203 | Electronic Devices | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP204 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME201 | Psychology of Learning and Development (CS- IV) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME202 | Curriculum Studies(CS-V) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME203 | Research Methodology In Science & Mathematics Education I (CS-VI) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME204 | Development and Use of Digital Resources and Techniques in Science and Mathematics Education (P- II) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **240** | **460** | **700** |

**T= Theory P = Practical**

# Paper MP201: Classical Electrodynamics-I

Semester II — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

***Description***

- Understand the fundamentals of Classical Electrodynamics
- Develop competencies required to solve problems based on Electrodynamics
- Apply Maxwell's equations for developing critical thinking in free space and inside matter

***Learning Outcomes***

- By the end of this course, the learner should have a basic concept of electrodynamics and its application to boundary value problems.

| | |
|---|---|
| **Unit I** | Boundary value problems in Electrostatics- methods of images, field due to a point charge outside a plane conducting medium, field due to a point charge near a spherical conductor. |
| **Unit II** | Boundary value problems in Magnetostatics: Biot and Savart Law, differential equations of magnetostatics and Ampere's law, vector potential and magnetic inductionfor a circular current loop, magnetic fields of a localized current distribution, magnetic moment, macroscopic equations, and methods of solving boundary value problems in magneto statics. |
| **Unit III** | Laplace's Equation, Separation of variables (Cartesian & spherical co-ordinates), Multipole Expansion, Polarization (Bound Charges), Field inside a dielectric, Linear dielectrics. |
| **Unit IV** | Maxwell's equation in free space and inside matter, Scalar and vector potentials, Gauge transformations, Coulomb and Lorentz gauges, Equation of Continuity, Pointing Theorem. |
| **Unit V** | Covariant Formulation of Maxwell's Equation:<br>Lorentz transformation; Scalars, vectors and Tensors; Maxwells equations and equations of continuity in terms of Aμ and Jμ; Electromagnetic field tensor and its dual; Covariant form of Maxwell‟s equations; Lagrangian for a charged particle in presence of external electromagnetic field and Maxwell's equation as Euler-Lagrange equations. |

**Suggested Readings:**


- Classical Electrodynamics, John David Jackson, Wiley.

- Introduction to Electrodynamics, David Griffiths, BenjaminCummings.
- Electrodynamics of Continuous Media, L. D. Landau and E. M.Lifshitz & L. P.Pitaevskii, Oxford.
- Electrodynamics .Meerut, Gupta ,Kumar ,Singh, Pragati Prakashan.
- Electromagnetic Fields, T. V. S. Arun Murthy, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi.


# Paper MP202: Condensed Matter Physics-I

Semester II — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

***Course Description***

- Learn crystal structure and various phenomena of crystals
- Understand lattice vibration for solving problems based on inelastic scattering of photons by phonon
- Proposes band theory of solids to explain origin of band gap
- Understand superconductivity and its applications
- Developing skills and competencies on condensed matter physics

***Learning Outcomes***

- By the end of this course, the learner should have a basic concept of crystal structure, lattice vibration, origin of band gap, and superconductivity.

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|---|---|
| **Unit I** | Crystal structure: Bravais lattice in two and three-dimension Simple crystal structures: Hexagonal close packed structure, Diamond structure.<br><br>Reciprocal lattice, Reciprocal lattice of bcc and fcc lattice. Relation between crystal lattice axes and crystal reciprocal lattice axes. Bragg diffraction. Condition in term of reciprocal lattice vector. Brillouin zones. |
| **Unit II** | Lattice vibration and phonons: Lattice dynamic of a diatomic linear lattice. Lattice vibrational spectrum. The concept of phonons momentum of phonons. Inelastic scattering of photons by phonons. Inelastic scattering of neutrons by phonons. Inelastic scattering of X-Ray. |

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| **Unit III** | Thermal properties of solids: Phonon heat capacity, Density of states in 1D and 3D,<br>Debye $T^3$ law, Einstein model of the density of states, Anharmonicity, Thermal Expansion, Thermal Conductivity. |
| **Unit IV** | Band theory of Solids: Periodic potential and Bloch's theorem, Kronig Penney model, weak potential approximation, density of states in different dimensions, energy gaps, Fermi surface and Brillouin zones. Origin of energy bands and band gaps, effective mass, tight-binding approximation and calculation of simple band structures.<br>Motion of electrons in lattices, Wave packets of Bloch electrons, semi-classical equations of motion, motion in static electric and magnetic fields, theory of holes, cyclotron resonance. |
| **Unit V** | Superconductivity: Phenomenology, review of basic properties, Meissner effect, Type-I and Type-II superconductors, thermodynamics of superconductors, London's phenomenological theory, flux quantization, Copper instability, BCS theory of superconductivity, Superconducting ground state and gap equation at T= 0K. Josephson effects, Ginzburg- Landau theory, SQUID, High Tc superconductors: Elementary ideas. |

**Suggested Readings:**


- Introduction to Solid State Physics, Kittel C, New York: Wiley.
- Principles of Solid State Physics, Levy R.A, San Diego : Academic Pres.
- Solid State Physics, Pillai .S.O. New Delhi : Wiley Eastern Limited.
- Elements of XRay diffraction. Cullity B.D. New Delhi :Pearson Education.
- Elementary Solid State Physics. Omar Ali . New Delhi :Pearson Education.
- Elements of Solid State Physics. Srivastava .J.P. Delhi :Prentice Hall of India.


# Paper MP203: Electronic Devices

Semester II — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

***Course Description***

- Develop an understanding of basic Electronic devices
- Analyze IV Characteristics of Electronic devices like BJT, MOSFET and MESFET.
- Learn to apply the functioning of Electronic devices.
- Analyze electronic circuit such as amplifiers and oscillators
- Use the knowledge of OPAMPs in instrumentation.
- Learn the various modes of propagation and radio waves in everyday life.

***Learning Outcomes***

- By the end of this course, the learner should have a basic concept of different electronic devices like BJT, JFET, MOSFET, MESFET along with amplifiers and oscillators.

| | |
|---|---|
| **Unit I** | Transistors: BJT, JFET, MOSFET and MESFET, structure derivations of the equations for I-V characteristics under different condition, microwave devices, tunnel diode, transfer electron devices (Gunn diode), avalanche transits time devices. Impart diodes and parametric devices. |
| **Unit II** | Amplifiers: Negative feedback & its advantages in amplifiers. Various types of couplings in amplifiers. RC Coupled common emitter amplifier, its frequency response curve. Differential amplifier- Circuit configurations- dual input, balanced output differential amplifier- DC analysis- AC Analysis, inverting and non-inverting inputs CMRR- constant current bias level translator |
| **Unit III** | Operational Amplifiers: Block diagram of a typical Op-amp with negative feedback-voltage series feedback – effect of feedback on closed loop gain input persistence output resistance bandwidth and output offset voltage-follower. Practical op-amp input offset voltage – input bias current – input offset current, total output offset voltage, CMRR, frequency response. DC and AC amplifier summing scaling and averaging amplifiers, Logarithimic amplifier, voltage comparator, integrator and differentiator. |
| **Unit IV** | Oscillators: Positive feedback & Brakhausen Criteria of Oscillators, Oscillators principle – Oscillator types – frequency stability – response – The phase shift oscillator. Wein bridge oscillator – LC tunable oscillators – Multivibrators – Astable, Monostable and Bistable – Multivibrators – square wave and Triangular wave generators. |
| **Unit V** | Communication Principles: Modulation and Demodulation, Amplitude modulation (AM), Frequency modulation (FM) and Phase Modulation (PM), Pulse Modulation, Radio wave Propagations, Radio Spectrum, AM/FM Radio Transmitters and Receivers, Radar Communication, Microwave and Satellite Communications, Optical Fibre Communications. |

**Suggested Readings:**


- Optical Electronics, Ajoy Ghatak and Thyagrajam, Cambridge India.
- Electronic Devices and Circuits, J. Millman and C. C. Halkias and S. McGraw-Hill.
- Integrated Electronics, J. Millman, C. C. Halkias and C. D. Parikh, McGraw-Hill.
- Introduction to Semiconductor Materials and Devices, M. S. Tyagi, Wiley.
- Digital Design, M. Mano, Pearson.
- Digital principles and Applications, A.P. Malvino and D.P.Leach, McGraw- Hill.
- Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky, Prentice Hall of India Pvt. Ltd.
- Operational Amplifier and Linerar Integrated Circuit Technology by Ramakant A. Gayakwad.

- Fundamental Principles of Electronics, Basudev Ghosh, Books and Allied (P) Ltd., 8/1 Chintamoni Das Lane, Kolkata – 700009
- Hand Book of Electronics, S. L. Gupta, V. Kumar, Pragati Prakashan, Begum Bridge, Meerut – 250001.
- Text Book of Electronics, B. B. Swain, Kitab Mahal, Cuttack – 753003.
- Electronic Devices and Circuits, S. Salivahanan and N. S. Kumar, Tata McGraw Hill Eduation Private Limited, New Delhi.


## Paper MP204: Practicals (P-I)

| | |
|---|---|
| Credits: 1.5 | Max. Marks: 37.5 |
| Duration: 3 hours | Passing Marks: 15 |
| Experiment: 20 | Viva: 10 |
| Record: 7.5 | |

1. Study of Energy gap of germanium crystal by four-probe method
2. Hall effect :

i. Calibration of Magnetic field
ii. Measurement of Hall angle and mobility
iii. Determination of Hall Voltage and Hall Co-efficient

3. Study of Ferro Magnetic behaviour : Coercivity, retentivity and Saturation Magnetisation
4. Study of Magnetic susceptibility of a solution by Quinck's Method
5. Study of Magnetic susceptibility of a solid by Guoy's Method.
6. Study of dispersion relation of a monoatomic and diatomic lattice.

# Practicals (P-II)

| | |
|---|---|
| Credits: 1.5 | Max. Marks: 37.5 |
| Duration: 3 hours | Passing Marks: 15 |
| Experiment: 20 | Viva: 10 |
| Record: 7.5 | |

1. I-V characteristics of MOSFET and its application as a switch.
2. Study of RC Coupled Common Emitter Amplifier.

3. Study of Multivibrator Circuits.
4. Study the performance of inverting and non-inverting amplifiers using an OPAMP.
5. Study the AM modulation and demodulation of a given radio signal.
6. Study the performance of Wein Bridge Oscillator.

**Suggested Readings:**


1. An Advanced Course in Practical Physics, D. Chattopadhyay, P. C. Rakshit, New Central Book Agency (P) Ltd., 8/1 Chintamoni Das Lane, Kolkata – 700009.
2. Advanced Practical Physics, S. P. Singh, Pragati Prakasan, Volume- I and Volume – II.


**Web Reference:**

- https://www.youtube.com/c/AllLabExperiments

**M.Sc. (Physics) M.Ed. Third Semester**

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP301 | Digital Electronics & Microprocessor | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP302 | Quantum mechanics II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP303* | Statistical mechanics | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP304 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME301 | Indian Knowledge System(CS- VII) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME302 | Research Methodology in Science& Mathematics Education- II(CS-VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME303* | TS- I Thematic Specialization I (Any One: TS1.1/TS2.1/TS3.1/TS 4.1/TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME304 | INTERNSHIP-I (P- III) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory P = Practical Int. = Internal Ext. = External**

# Paper MP301: Digital Electronics and Microprocessor

Semester III
Credit-3
Course Code: DC 3.1
Hours/ Week- 3

Max. Marks: 75
Sessional: 15
Terminal: 60

***Course Description***

- Appreciate knowledge of number system and integrated circuits.
- Understand basics of microprocessor.
- Develop skills and competencies required for the application of knowledge of different electronic devices using microprocessor.

***Learning Outcomes***

- By the end of this course, the student will learn basic mathematical operations like addition, subtraction, multiplication, division and some logical operations using its Arithmetic Logical Unit (ALU) and operations on floating – point numbers.
- Understand how data in microprocessors can move from one location to another.
- Learn to use parity checker, encoders, decoders and related ICs.

| | |
|---|---|
| **Unit I** | Boolean laws and Theorem. Binary, decimal, octal and hexa decimal number and inter conversion. Simple combinational circuits. Karnaugh map pairs, Quads and octets. Karnaugh simplications. Don't care conditions. The ASCII code. Excess III code. Gray code. |
| **Unit II** | Binary addition, Subtraction, unsigned binary numbers. Sign magnitude numbers. 2's compliment representation. 2's compliment arithmetic. Arithmetic building blocks.<br>The adder and subtractor. |
| **Unit III** | Multiplexers, Demultiplexer. 1-of-16 decoder. BCD to decimal decoder. 7 segment decoders. Encoders. Exclusive OR gates. Parity generators-checkers. |
| **Unit IV** | 7400 devices. A-01 gates. Positive and negative logic. 74C00 devices. CMOS logic gates. Flip flop. Shift registers, counters. A/D and D/A converters. A/D and D/A accuracy and resolution. |
| **Unit V** | Semiconductor memory, (RAM, ROM & EPROM). Basic architecture of Intel 7585 and 7586 microprocessor. Microprocessor and its architecture-data. Address and control buses. ALU registers, program counters. Flow chart and assembly language. Writing some programs in assembly language for 7585 and 7586 microprocessors. |

**Suggested Readings:**


- Digital principles and applications, A.P. Malvino and Donald P. Leach, Tata Mcgraw-Hill.

- Microprocessor Architecutre, Programming and Applications with 7585/7586,Rames S. Gaonkar, Wiley-easter Ltd.
- Digital electronics, Morris Mano, Pearson education.
- Microprocessor and Microcomputers, B.Ram, Dhanpat Rai publications.
- Microwave Devices and Circuits. Liao S.Y, New Delhi:Pearson Education India.
- Digital Circuits and Systems, K. R. Venugopal and K. Shaila, Tata McGraw Hill Education Private Limited, New Delhi.


# Paper MP302: Quantum Mechanics – II

Semester III | Max. Marks: 75
Credit-3 | Sessional: 15
Hours/ Week- 3 | Terminal: 60

***Course Description***

- Understand time independent and time dependent perturbation theory.
- Apply approximation methods in Quantum Mechanics.
- Understand Scattering theory in Quantum Mechanical Approach.

***Learning Outcomes***

- By the end of this course, the students will learn how to handle realistic problems through different approximation techniques.

| | |
|---|---|
| **Unit I** | Time-Independent Non-Degenerate Perturbation Theory, First and Second Order Correction, Perturbed Harmonic Oscillator, Anharmonic Oscillator, The Stark Effect, Quadratic Stark Effect and Polarizability of Hydrogen atom, Degenerate Perturbation Theory, Removal of Degeneracy, Parity Selection Rule, Linear Stark Effect of Hydrogen atom. |
| **Unit II** | Variational Methods: Theory, Ground State and First Excited State of One-Dimensional Harmonic Oscillator, Ground State energy of the Delta function potential, Ground State of H-atom and He-atom, Hydrogen molecul |

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|---|---|
| **Unit III** | WKB Approximation, Quantization rule, Tunneling through a barrier, Qualitative discussion of α-decay, Time dependent perturbation theory, Interaction picture, Constant and harmonic perturbations, Fermi's Golden rule, Sudden and adiabatic approximations. |
| **Unit IV** | Scattering amplitude and differential cross Section, Relation between Lab and CM cross-sections, Born Approximation. Application to Coulomb and Screened Coulomb Potential, Partial Wave Analysis for Elastic and Inelastic Scattering, Effective Range and Scattering Length, Hard-Sphere Scattering, Resonance Scattering from a Square Well Potential, Scattering of identical particles. |
| **Unit V** | Relativistic Quantum Mechanics, Klein-Gordon equation, Dirac equation, Covariant form, Adjoint equation, Plane wave solution and momentum space spinors, Spin and magnetic moment of the electron, Non-relativistic reduction, Helicity and chirality, Properties of γ matrices, Charge conjugation, Normalization and completeness of spinors. |

**Suggested Readings:**

- Quantum Mechanics, B.H. Bransden & C.J. Joachain, Pearson Education.
- Principles of Quantum Mechanics, R. Shankar, Springer.
- Modern Quantum Mechanics, J.J. Sakurai, Addison-Wesley.
- Advanced Quantum Mechanics, Schwabl F., Springer.
- Quantum Mechanics, A.S. Davydov, Pergamon.
- Advanced Quantum Mechanics, J. J. Sakurai Pearson.
- Introduction to Quantum Mechanics, D.J. Griffiths, Pearson.
- Quantum Mechanics, LI Schiff, Mc Graw Hill.
- Quantum Mechanics, AP Messiah, Dover Publications Inc.
- Quantum Mechanics, Ghatak A. K. and Lokanathan S., Macmillan.

# Paper MP303: Statistical Mechanics

Semester III — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

**Course Description:**

- Develop knowledge of macroscopic and microscopic properties.
- Differentiate between various types of distribution functions inorder to explain the behaviour of the particles.
- Develop the sense of appreciation regarding the development in the field ofStatistical Mechanics.

**Learners Outcomes:**

- By the end of this course, the students should understand the basic concept of statistical

mechanics.

- The Learners will understand use of distribution functions and its applications in different areas of physics.

| | |
|---|---|
| **Unit I** | Foundation of statistical mechanics, specification of states of a system contact between statistics and thermodynamics, classical ideal gas entropy of mixing and Gibb's paradox. Microcanonical ensemble, phase space. |
| **Unit II** | Liouville theorem, canonical and grand canonical ensembles, partition function, calculation of statistical quantities, energy and density fluctuations. Statistics of ensembles, statistics of indistinguishable particles, density matrix, Maxwell Boltzmann. |
| **Unit III** | Fermi Dirac and Bose- Einstein statistics, properties of ideal Bose gases, Bose- Einstein condensation, properties of ideal Fermi gas, electron gas in metals, Boltzmann transport equation |
| **Unit IV** | Phase Transitions: Thermodynamic description of phase transitions, phase transitions of second kind, Discontinuity of specific heat, change in symmetry in a phase transition of second kind. |
| **Unit V** | Ising model : Definition of Ising model, One Dimensional Ising model, Ising Model in the zeroth and first approximation, Applications of Ising model. |

**Suggested Readings:**


- Fundamentals of Statistical Mechanics, B.B.Laud, .New Delhi :New AgeInternational Publication.
- Statistical Mechanics, R K Pathria & Paul D Beale, Elsevier.
- Statistical Mechanics, Huang K, New York:John Willey & Sons.
- Statistical Mechanics, F. Reif.
- Statistical Mechanics, Loknathan and Gambhir. Delhi :Prentice Hall of India.
- Statistical Physics, Landau L.D and Lifshitz E.M, Oxford: Butterworth-Heinemann.
- An Introduction to Equilibrium Statistical Mechanics, Palash Das, I. K. International Publishing House Pvt. Ltd. (2012).


## Paper MP304: Practical (P-I)

Credits: 1.5
Duration: 3 hours
Experiment: 20
Record: 7.5

Max. Marks: 37.5
Passing Marks: 15
Viva: 10

1. BCD to Seven segment display.
2. A/D and D/A conversion.
3. Experiments using various types of memory elements.
4. Motor Speed control, Temperature control using 7586 Microprocessor
5. Propagation of EM waves in a transmission line – Lecher wire.
6. Study of RS and JK flip flop operations.

## Practical (P-II)

Credits: 1.5
Duration: 3 hours
Experiment: 20
Record: 7.5

Max. Marks: 37.5
Passing Marks: 15
Viva: 10

1. Study of multiplexer/ De-multiplexer.
2. Resistors and Counters.
3. PPI 8251 interfacing with microprocessor for serial communication
4. Study the De Morgan's theorem and verification of relationships in Boolean Algebra.
5. Study the performance of a resistive ladder D/A converter.
6. Study the performance of a weighted-resistor D/A converter.

**Suggested Readings :**

- Intermediate Practical Physics, Yarwood T. M., Macmillan Newyork
- Practical Physics, Anchal Srivastav and R. K. Shukla, New Age International Publishers
- A Text Book of Advanced Practical Physics, Samir Kumar Ghosh, New Central Book Agency (P) Ltd.

**Web Reference:**

- https://www.youtube.com/c/AllLabExperiments

**M.Sc. (Physics) M.Ed. Fourth Semester**

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP401 | Nuclear and Particle Physics | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP402 | Atomic and Molecular Physics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP403 | Classical Electrodynamics- II | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP404 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME401 | Historical, Political and Economic Perspective of Education (CS- IX) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME402 | Educational Measurement and Evaluation(CS- X) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME403* | TS-II Thematic Specialization II (Any one: TS1.2/TS2.2/TS3.2/TS4.2/ TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME404 | DISSERTATION -1: Research in Science and Mathematics Education (Planning) (P-IV) | P | 1 | 30 | 25 | | 25 |
| **9** | ME405* | Internship-II Thematic Specialization (P- V) | P | 1 | 30 | 25 | | 25 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory P = Practical**

# Paper MP401: Nuclear and Particle Physics

| | |
|---|---|
| Semester IV | Max. Marks: 75 |
| Credit-3 | Sessional: 15 |
| Course Code: DC 4.1 | Terminal: 60 |
| Hours/ Week- 3 | |

**Course Description:**

- Explore the field of nuclear structure.
- Proposes of different nuclear models.
- Understand fundamentals of nuclear physics and radioactive decay ($\alpha$, $\beta$ decay).
- Understand the basics of elementary particles and their interactions.
- Appreciate research and innovation in the field of nuclear and particle physics.

**Learners Outcomes:**

- By the end of this course, the learners should understand how shell model and other models were conceptualized.
- Analyze the features of the deuteron problem and nuclear forces.
- Know in detail about the classification of elementary particles.

| | |
|---|---|
| **Unit I** | Nuclear Interaction and Nuclear reaction: Nuclear Charge Distribution, Deutron Problems, Nucleon- Nucleon Potential, e-n scattering, Form factor, Nuclear forces, exchange and tensor forces, meson theory of nuclear forces, Direct and compound nuclear reaction mechanism, reciprocity theorem, Rotational spectra, Determination of quadrupole moment and magnetic moment |
| **Unit II** | Nuclear models: Properties of nucleus, Semi- empirical mass formula, Liquid drop model, Bohr-wheeler's theory of nuclear fission,Shell model, spin orbit interaction, magic number, spin and angular momenta of nuclear ground state, nuclear quadrupole moment. |

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| **Unit III** | Accelerators and Detectors: Linear accelerator (Linac), Study of cyclotron, Frequency modulated cyclotron (synchrocyclotron), particle detectors: Gas, Scintillation and GM counter |
| **Unit IV** | Nuclear decay: ß Decay, general features of ß ray spectrum, Fermi theory of ß decay, selection rules, parity in ß decay, nuclear isomerism, Alpha decay: Potential barrier around a nucleus, V∼r diagram, Nuclear potential well, height of the barrier, wave mechanical expression, tunneling, Geiger–Nuttall law. |
| **Unit V** | Elementary particles: Classification of elementary particles, fundamental interaction, Gellman-Nisijima formula, parameters of elementary particles. Symmetry and conservation laws, symmetry schemes of elementary particles SU (3), Quantum numbers of Elementary particles, Parity non conservation Quark model, Spin parity determination of $\pi$ |

**Suggested Readings:**

- Atomic and Nuclear physics, S.N. Ghoshal, S Chand.
- Nuclear Physics: Roy and Nigam.
- Introduction to Particle Physics D. J. Griffiths.
- Nuclear and Particle physics, D.C. Tayal, Himayala publishing house.
- Introduction to Nuclear physics, KRANE, JOHN WlLEY & SONS.
- Nuclear physics Principles & Application, Lilley, JOHN WlLEY & SONS.
- Theoretical Nuclear Physics, John M. Blatt and V. F. Weisskopf, Dover Publication, Inc.
- Atomic and Nuclear Physics, A. B. Gupta and Dipak Ghosh, Books and Allied Publisher (1997).

# Paper MP402: Atomic and Molecular Physics

Semester IV — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

**Course Description:**

- Develop an understanding of the atomic and molecular structure.
- Develop an understanding of the interaction of atomic and molecular systems with external homogeneous static electric and magnetic fields.
- Solve problems related to Atomic and Molecular Physics and their application to Molecular Spectra of diatomic molecules, Vibrational and Rotational energy levels.

**Learners Outcomes:**

- By the end of this course, the students should learn the details of atomic and diatomic

molecular (diatomic) structuresin terms of quantum mechanical treatment elaborately beyond the basic models.

| | |
|---|---|
| **Unit I** | Quantum states of one electron atom. Atomic orbitals. Hydrogen spectrum, Pauli's principle, Spectra of alkali elements, Spin orbit interaction and fine structure of alkali Spectra. |
| **Unit II** | Methods of molecular quantum mechanics, Thomas Fermi statistical model, Hartree and Hartree fock method, two electron system. Interaction energy in L-S and J-J coupling, hyperfine structure (qualitative), line broadening mechanisms (general ideas) Width of spectral lines. |
| **Unit III** | Types of molecules. Diatomic linear. Symmetric top, asymmetric top and sphericaltop molecules. Rotational spectra of diatomic molecules as a rigid rotator, Energy level and Spectra of non-rigid rotator, intensity of rotational lines, isotopic shift, Zeeman, Paschen Back and Stark Effect |
| **Unit IV** | Vibrational energy of diatomic molecule, diatomic molecule as a simple harmonic oscillator, Energy levels and spectrum, Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule PQR branches. |
| **Unit V** | Introduction to Ultraviolet, Visible and Infrared Spectroscopy, Instrumentation and Applications. |

**Suggested Readings:**


- Fundamentals of Molecular Spectroscopy-C.B. Banwell, Tata McGraw Hill.
- Modem Spectroscopy-J.M.Hollons, Wiley.
- Molecular Spectra and Molecular Structure, G. Herzberg, Van Nostrand.
- Modern Spectroscopy, J. M. Hollas, John Wiley.
- Atomic and Molecular Spectra, Rajkumar.
- Introduction to Atomic Spectra, White H.E, McGraw Hill.
- Molecular Structure & Spectroscopy, Aruldhas G . Prentice Hall of India.
- Elements of Spectroscopy, Gupta Kumar & Sharma, Meerut:PragatiPrakashan.
- Fundamentals of Molecular Spectroscopy, Banwell C.N & McCash E.M, TataMcGraw Hill.

# Paper MP403: Classical Electrodynamics – II

Semester IV — Max. Marks: 75
Credit-3 — Sessional: 15
Hours/ Week- 3 — Terminal: 60

**Course Description:**

- Understand boundary value problems in metallic interface and waveguides in different modes
- Understand the concept of retard potential and its applications in electrodynamics
- Develop the knowledge of Relativistic Electrodynamics.

**Learners Outcomes:**

- By the end of this course, the learners should solve electromagnetic problems.
- The Learner will understand the concept of wave guide, retarded potentials and relativistic kinetics in electrodynamics.

| | |
|---|---|
| **Unit I** | Electromagnetic waves in a conducting medium, complex refractive index, Boundaryvalue problems in presence of metallic interface: reflection and refraction from metallic surface, |
| **Unit II** | Waveguides: Transverse electric (TE), Transverse magnetic (TM) and TEM waves, Rectangular wave guide (TE and TM modes), cut off frequency, phase velocity and group velocity, Resonant Cavity. |

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| **Unit III** | Radiation by relativistic particles Retarded potentials, Lienard-Wiechert potentials, spectral and angular distribution of radiation from a point charge ,total power radiation, Larmor's formula its relativistic generalization , synchrotron radiation, radiation damping , dipole radiation, quadrupole and magnetic dipole radiation, Thomson scattering of high frequency waves |
| **Unit IV** | Relativistic kinematics: Principle of relativity, Einstein's postulates, intervals, proper time, the Lorentz transformation, four vectors, four-velocity. Relativistic mechanics: charged particle motion in uniform and non-uniform fields, Relativistic electrodynamics, electromagnetic field. |
| **Unit V** | Lagrangian Formulation of Electrodynamics: Lagrangian for a free relativisticparticle, for a charged particle in an E.M. field, for free electromagnetic field, for interacting charged particles and fields, Energy-momentum tensor and related conservation laws. |

**Suggested Readings:**


- Electrodynamics, Gupta ,Kumar ,Singh .Merut: Pragati Prakashan.
- Classical electrodynamics, Jackson. New York: Wiley.
- Introduction to electrodynamics, Griffith D.J, New Delhi :Pearson EducationIndia.
- Elements of Plasma Physics, Gosawami S N, New Delhi:New AgeInternational.
- Plasma state and matter, Sen S.N. Merrut : Pragati Prakashan.


## Paper MP404: Practical (P-I)

Credits: 1.5 Max. Marks: 37.5
Duration: 3 hours Passing Marks: 15
Experiment: 20 Viva: 10
Record: 7.5

1. Determine the operating voltage, slope of the plateau and dead time of a GM – Counter.
2. Study of GM counter and determine rate of disintegration of given radioactive sample.
3. To Calibrate the given scintillation counter and measure the energy emitted by an unknown radioactive source.
4. Study of Hydrogen spectrum using hydrogen discharge tube.
5. Study of reflection and total internal reflection by optical fiber.
6. Determination of half life of the given radioactive sample.

## Practical (P-II)

Credits: 1.5 Max. Marks: 37.5
Duration: 3 hours Passing Marks: 15
Experiment: 20 Viva: 10
Record: 7.5

1. To study dependence of radiation on angle for a simple diode antenna.
2. To study the reflection, refraction of microwaves.
3. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
4. Determination of absorption coefficient of Aluminium using Gamma ray spectrometer.
5. Determination of the range and energy of alpha-particles using spark counter.
6. Determination of e/m of electron by Normal Zeeman Effect using Fabry Perot Etalon.

**Suggested Readings :**


- Intermediate Practical Physics, Yarwood T. M., Macmillan Newyork
- Practical Physics, Anchal Srivastav and R. K. Shukla, New Age International Publishers
- A Text Book of Advanced Practical Physics, Samir Kumar Ghosh, New Central Book Agency (P) Ltd.


**Web Reference:**

- https://www.youtube.com/c/AllLabExperiments

## M.Sc. (Physics) M.Ed. Fifth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP501 | Condensed Matter Physics- II | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP502 | Computer Programming and Informatics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP503* | Optional Paper | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP504 | Practicals | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME501 | Innovative approaches, strategies and methods of teaching-learning (CS- XI) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME502* | TS-III Thematic specialization – III (Any one: TS 1.3/TS2.3/TS3.3/TS4.3/ TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME503* | Generic Elective Course (GE any one) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME504 | Dissertation II: Research in Science & Mathematics Education (Execution) (P- VI) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T= Theory P = Practical**

# Paper MP501: Condensed Matter Physics- II

| | |
|---|---|
| Semester V | Max. Marks: 75 |
| Credit-3 | Sessional: 15 |
| Course Code: DC 5.1 | Terminal: 60 |
| Hours/ Week- 3 | |

***Course Description:***

- Understand lattice vibration in Harmonic approximation
- Understand the concept of different types of magnetism
- Classify defects in crystals and its importance in lattices
- Conceptualize semiconductors and its need in solid state physics
- Develop interest for research and innovations in the field of Condensed Matter Physics

***Learners Outcomes:***

- By the end of this course, the learner should able to understand basic as well as the advanced theoretical treatments involved in Magnetism and Semiconductors.

| | |
|---|---|
| **Unit I** | Born-oppenheimer Approximation, Hamiltonian for Lattice vibrations in the harmonic approximation, Normal modes of the system and quantitation of lattice vibrations-phonons. |
| **Unit II** | Magnetism: Diamagnetism, Paramagnetism of atoms with permanent magnetic moment, Pauli paramagnetism of conduction electrons, Weiss theory of ferromagnetism, Curie-Weiss Law for susceptibility, Heisenberg model- Condition for ferro and antiferro-magnetic order, Bloch's $T^{3/2}$ Law, Antiferromagnetic order, Neel Temperature, Ferromagnetic domains, hysteresis. |
| **Unit III** | Defects in crystals: Lattice defects, Frenkel and Schottky defects. Line defects, edge and screw dislocations – Burger‟s Vector, planner (stacking) faults-twin planes and grain boundaries, dislocation densities, dislocation multiplication and slip, strength of crystal, color centers. polarons and excitons. |
| **Unit IV** | Physics of Semiconductors: Energy Band Structure, Direct and Indirect band gap semiconductors, Impurities and Imperfection in semiconductors, carrier concentration in thermal equilibrium, |

| | |
|---|---|
| | Electron Transport Phenomenon, Thermal Effects in Semiconductors, Excess Carrier in semiconductors, recombination, Law of mass action, Occupation probabilities. |
| **Unit V** | Dielectric and Ferroelectric Properties of Solids: Dielectric function of electron gas and pl asma oscilations, Dielectric function in the general framework of screening, Dielectric properties of insulators: macroscopic electrostatic Maxwell equations, theory of local field, Clausius-Mossotti relation.<br>Ferroelectric crystals, Classification of ferroelectric crystals, Hysteresis, Application. |

**Suggested Readings:**


- Solid State Physics, Kittel, Wiley.
- Solid State Physics, Pillai .S.O. New Delhi: Wiley Eastern Limited.
- Theoretical Solid State Physics, haug, Elsevier.
- Elements of Solid State Physics, Srivastava .J.P. Delhi: Prentice Hall of India.
- Elementary Dislocation theory, Weertman and Weertman, OUP USA.
- Optical Properties of Thin Solid Films, Heavens, Dover Publications.
- Physics of thin films, Chopra, Elsevier.

# Paper MP502: Computer Programming and Informatics

Semester: V
Credit-3
Course Code: DC 5.2
Hours/ Week- 3

Max. Marks: 75
Sessional: 15
Terminal: 60

***Course Description:***

- Use computer programming
- Write program focusing on numerical methods
- Execute program on the computer

***Learners Outcomes:***

- By the end of this course, the learner should solve mathematical problems independently using numerical methods

| | |
|---|---|
| **Unit I** | Conceptual framework of computer languages (Algorithm, Flowcharts). Need of structured programming. Top-down, bottom-up and modular programming design. Introduction to C languages- basic structure of C program Character set, keyword and identifiers, C data types, variable and data type declaration. Various operators like arithmetic, relational, logical, assignment, conditional, increment and decrement operators. Evaluation of expression and operator precedence. |
| **Unit II** | Input and output statement, control statement (If, If-else, If nested if-else statements,switch, while, Do...while and for statements) Simple C programs like search of primenumber between given range of numbers, finding the smallest and largest of three numbers, sum of algebraic series, factorial of given number, roots of a quadratic equation, binary to decimal and decimal to binary conversion etc. |
| **Unit III** | Functions: need of functions, calling the function by value and by reference, category of functions: no argument no return, argument but not return, argument withreturn. Recursion. One and two dimensional arrays. String and string handling functions like sprintf (), strcpy (), sscanf (), strlen (), sizeorf (), strcmp () etc. Simple programs using user define functions, arrays and string functions. |
| **Unit IV** | Network Terminals, Types of network, Internet: History of Internet Service Provider (ISP), introduction to type of internet, Accont-shell/Ac, TCP/IP a/c, Types of connectivity – Dialup, Leased lines, Satellite, IP Address – Class A, Class B, Class C, Domain Name address, URL-absolute and relative, Search engine, Web enabled technology (Email and HTML) : Web Browser, Internet Explorer, Netscape Navigator, Station and Dynamic web page, Introduction to HTML, HTML tags. |

| | |
|---|---|
| | Creation of simple forms using text Password, text area, radio, submit, Reset and Hidden, Brief idea about HTTP. |
| **Unit V** | Programming Language: Python: Introduction of Numpy, Scipy, And Matplotlib. |

**Suggested Readings:**


- Programming in ANSI, Balgurusamy E. New Delhi : Tata McGraw Hill.
- Programming in C, Day P. and Ghosh M. New Delhi :Oxford Univ. Press.
- Programming with C, Gottfried B.S. New Delhi : Tata McGraw Hill.
- Let us C, kenetker Y. New Delhi.BPB Publication.
- C Programming language, Kernighan B.W and Ritchie D.K, New Delhi Prentice Hall of India.
- Internet and Web Page design, Dr. P.D. Murarka "O' level module M1.2.
- Programming in Python, Mark Lutz, R S Salaria, Khanna Publishing.
- Let Us Python, Yashavant Kanetkar & Aditya kanetkar, BPB Publication.
- Introduction to programming in Python, Robert Sedgewick, Kevin Wayne andRobert Dondero, Addison Wesley.
- Schaum's Outline of Programmng with C++, John R. Hubbard, McGraw Hill Education India.

# Paper MP503*: Environmental Physics

Semester V
Credit-4
Course Code: DE 5.1
Hours/ Week- 5

Max. Marks: 100
Sessional: 20
Terminal: 80

***Course Description:***

- Acquire a basic understanding and knowledge about the environment and its allied problems
- Analyse different renewable sources of energy, pollution, and degradation
- Solve environmental problems by using the knowledge of physics
- Understand environmental changes, remote sensing and global climate

***Learners Outcomes:***

- By the end of this course, the learner should have a basic concept of environmental physics and its applications in different environmental models.

| | |
|---|---|
| **Unit I** | Essentials of Environmental Physics: Structure and thermodynamics of the atmosphere. Composition of air. Greenhouse effect. Transport of matter, energy andmomentum in nature. Stratification and stability of atmosphere. Laws of motion, hydrostatic equilibrium, Laws of thermodynamics and the human body. |
| **Unit II** | Physics of radiation, Laws of radiation (Kirchoffs law, Planck's law, Wien's displacement law, etc.) Solar and terrestrial spectra, UV radiation, Ozone depletion, IR absorption, Terrestial radiation, Earth as a black body, Green house effect, Global warming. |
| **Unit III** | Elements of weather and climate. Stability and vertical motion of air. Horizontal motion of air and water. Pressure gradient forces. Viscous forces. Inertia forces.Reynolds number. Enhanced Greenhouse Effect. Global climate models. |
| **Unit IV** | Hydrosphere, Hydrologic cycle, water in atmosphere, Clouds: physics of cloud formation, growing droplets in clouds, thunder storms, Wind: measuring the wind, physics of wind creation, principle of forces acting on air masses, gravitational force,pressure gradient, Coriolis inertial force, frictional force, cyclones and anti-cyclones,global convection, global wind patterns. |
| **Unit V** | Soil and hydrologic cycle, surface tension, water flow, water evaporation, soil temperature, Energy sources and combustion processes. Renewable sources of energy: Solar energy, wind energy, bio energy, hydropower, fuel cells, nuclear energy. |

**Suggested Readings:**


- Solar Energy, G.N. Tiwari, Narosa Publication.
- The Physics of Atmosphere, J. T. Hougtion, Cambridge University Press.
- An Introduction to Solar Energy for Scientists and Engineers, John Wiley, SolWieder.
- The Physics of Monsoons R.N. keshavamurthy and MShanker Rao, AlliedPublishers.

# Paper MP503*: Material Science

Semester V
Credit-4
Course Code: DC 5.1
Hours/ Week- 5

Max. Marks: 100
Sessional: 20
Terminal: 80

***Course Description:***

- Develop knowledge and proficiency in construction as regards to material technology
- Understand the basic concepts and properties of Material
- Learn about material fundamental and processing

***Learners Outcomes:***

- By the end of this course, the learner should have a clear concept about the classification of materials, many material properties and its applications in many advanced research fields.

| | |
|---|---|
| **Unit I** | Classification of Materials: Types of materials: Crystalline, Polycrystalline, Amorphous (Introduction and their structure), Elementary idea of polymers (structureand properties methods of polymerization, Glasses: Structure and properties. Type of Glasses, Fracture in glasses, Composite Materials: Introduction, their types and properties, Different types of bonding, Medalung energy for ionic crystal. |
| **Unit II** | Phase Transitions : Thermodynamics of phase transformation, Free-energy calculation, I and II order transformation, Hume-Rother rule, solid-solid solution and types of solid-solutions, phase rule, Eutectic and peritectic phase diagrams, Lever rule, phase diagrams of Mg-Al, Fe-C kinetics of transformations, Homogenous and Heterogeneous nucleation, Growth kinetics. |
| **Unit III** | Diffusion in Materials:- Mechanism of diffusion, Energy of formation and motion, longdistance motion, Rate theory of diffusion, Einstein relation (relation between diffusivity and mobility), Fick's laws of diffusion and solution of Fick's second law, Kirkendal effect. Diffusion of vacancies in ionic crystals, Experimental determination of Diffusion coefficient. |
| **Unit IV** | Elastic and Anelastic Behaviour: Atomic modules for elastic behavior, Elastic deformation in single crystals, Elastic anisotropy, Elastic constant and elastic module (Cubic System, Isotropic body), Rubber like elasticity, anelastic behavior, Thermo-eleastic effect and relaxation process. |
| **Unit V** | Transport Properties of Solids: Electrical conductivity of metals and alloys, Extrinsic,intrinsic semiconductors and amorphous semiconductors, Scattering of electrons byphonons, impurity |

| | |
|---|---|
| | etc. Relaxation time, Carrier mobility and its temperature dependence, Mathiessio's rule for resistivity, Temperature dependence of metallic resistivity. |

**Suggested Readings:**


- Introduction to Solids, L. V. Azaroff, McGraw Hill Education.
- Introduction to Solid State Physics, C. Kittle, Wiley.
- Materials and engineering: Raghawan, PHI.
- Diffusion Kinetics for Atoms in Crystals: Manning, Van Nostrand Reinhold Inc,USA.
- Theoretical Solid State Physics, haug, Elsevier.
- Materials Science and engineering, Callister, Wiley.

# Paper MP503*: Communication Electronics

Semester V
Credit-4
Course Code: DE 5.1
Hours/ Week- 5

Max. Marks: 100
Sessional: 20
Terminal: 80

**Course Description:**

- Understand about generation and propagation of ground waves, sky waves and space waves
- Learn about generation and propagation of microwaves
- Understand various modulation and its need in communication systems

**Learners Outcomes:**

- By the end of this course, the learners should learn the basic concepts of processing of digital signals, signal transmission and high speed data transfer in modern day communication systems and networks.

| | |
|---|---|
| **Unit I** | Ground Waves, sky wave, space wave, propagation, maximum usable frequency, skip distance, virtual height, fading of signals, Satellite communication: orbital satellite, geostationary satellites, orbital pattern, look angles, orbital spacing, satellitesystem, link modules. |
| **Unit II** | Propagation of microwaves, atmospheric effects on propagation, Fresnel Zoneproblem used in microwave communication systems, Advantages and disadvantages of microwave transmission loss in free-space. |
| **Unit III** | Amplitude modulation: generation of AM waves, demodulation of AM waves, DSBSCmodulation, Generation of DSBSC waves, coherent detection of DSBSC waves, SSB modulation, generation and detection of SSB waves, vestigial sideband modulation. |
| **Unit IV** | Pulse-Modulation system, sampling theorem, Low pass and Band pass signals, PAM, channel BW for a PAM signal, Natural Sampling, Flat top sampling, signals recovery through Holding, Quantization of signals, Differential PCM Delta Modulation, Adaptive Delta Modulation, CVSD. |
| **Unit V** | Base-band signal receiver, probability of error, optimum filter, white noise, matched filter and probability of error, coherent reception correlation, PSK, FSK, non-coherent detection of FSK, differential PSK, QPSK, calculation of error probability for BPSK, BFSK, and QPSK. |

**Suggested Readings:**


- Digital Communications, W. Tomasi, Pearson Education India.
- Microwave, K. C. Gupta, New Age International.
- Microwave Devices & Circuits, S.Y. Lio, Prentice Hall, New Jersey.
- Digital Signal Processing, J. G. Proakis and D. G. Pearson.
- Electronic Communication, D. Roddy and J. Coolen, Pearson.
- Measurement, Instrumentation and Experimental Design in Physics andEngineering, M.Sayer and A. Mansingh PHI Learning.
- Discrete Time Signal Processing, A.V. Oppenheim and R. W. SchaferPearson.
- Electronic Communication systems, W. Tomasi, Pearson.

# Paper MP504: Practicals (P-I)

| | |
|---|---|
| Credits: 1.5 | Max. Marks: 37.5 |
| Duration: 3 hours | Passing Marks: 15 |
| Experiment: 20 | Viva: 10 |
| Record: 7.5 | |

1. Programming in FORTRAN: Introduction to FORTRAN, Structure of a FORTRAN Program, Input and Output Structures, Control Structures, Arrays, Sub Programs, Data Files.
2. Programming in C and Python : Structure of C Program, Compilation, Variables and Data types, Initializing Variables, Arithmetic Operation, Data Input and Data Output, Control Structure decision making and Looping students, Arrays
3. Numerical Techniques : Interpolation, Solution of Algebric Equation, Least –square curve fitting linear algebra and
4. Matrix manipulation: Eigen Values and Eigen Vectors, Matrix Inversion
5. Numerical Differentiation, Numerical Integration, Numerical Solution of Ordinary Differential equations.
6. Euler and Runge- Kutta methods, random number generation.

**Suggested Readings:**

- Computer Programming in Fortran 77, V. Rajaraman, Publisher:PHI

## Practicals (P-II)

Credits: 1.5 Max. Marks: 37.5
Duration: 3 hours Passing Marks: 15
Experiment: 20 Viva: 10
Record: 7.5

1. Study the curie temperature of ferromagnetic material.
2. Study the temperature and frequency dependent dielectric properties of different materials using LCR meter/Impedance analyzer.
3. Study the hysteresis curve of a ferroelectric material using P-E loop tracer.
4. Study of Ultrasonic in Solid and Liquid medium.
5. Determination of transition temperature ($T_C$) of a Superconducting sample (YBCO).
6. Magnetoresistance of a Semiconducting material.
7. To study the magnetic hysteresis (B-H curve) of a given ferromagnetic material.

**Suggested Readings:**

- Intermediate Practical Physics, Yarwood T. M., Macmillan Newyork
- Practical Physics, Anchal Srivastav and R. K. Shukla, New Age International Publishers
- A Text Book of Advanced Practical Physics, Samir Kumar Ghosh, New Central Book Agency (P) Ltd.

**Web Reference:**

- https://www.youtube.com/c/AllLabExperiments

**Dissertation Physics**
**(Proposal Development) (PC 5.1A)**

**Contact hours/week: 4** **MM-50**
**Credit - 2** **Passing Marks- 20**

**Course Learning Outcomes**

The purpose of offering project work proposal is to encourage the students in research and innovation in frontier areas of Physics. Through this course they would be introduced to various stages of research planning and implementation. Students will be able to design and perform scientific research under the supervision of a faculty and learn to work independently. During the course of her/his project work, students are expected to learn different experimental or theoretical techniques for carrying out scientific research problems, particularly to collect and interpret data.

**Strategies for the evaluation of project work:**

- The Students will complete the dissertation work under the supervision of faculty members of Physics.
- Regular monitoring as per the steps/processes indicated below is essential.
- Weightage as indicated against each step is to be assigned through seminar mode.

| Identification of Problems | Review of Literature | Methodology | Analysis | Total |
|---|---|---|---|---|
| 10 | 10 | 15 | 15 | 50 |

## M.Sc. (Physics) M.Ed. Sixth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MP601 | Molecular Spectroscopy | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MP602 | Laser Physics | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MP603 | Optional Paper | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MP604 | Project Work | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME601 | Vocational Opportunities, Start-Up and Entrepreneurship In Science/Mathematics | P | 4 | 60 | 30 | 70 | 100 |
| **6** | ME602 | Teacher Education –II | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME603 | Academic Writing | P | 2 | 60 | 50 | | 50 |
| **8** | ME604 | Dissertaion-3: Research In Science/Mathematics Education (Reporting) | P | 4 | 60 | | 100 | 100 |
| **Total** | | | | **28** | **480** | **210** | **490** | **700** |

**T= Theory P = Practical**

# Paper MP601: Molecular Spectroscopy

Semester VI
Credit-3
Course Code: DE 6.1
Hours/ Week- 3

Max. Marks: 75
Sessional: 15
Terminal: 60

Course Description:

- Understand key concepts and theories of spectroscopy
- Apply fundamental knowledge for experiments concerned with MolecularSpectroscopy
- Learn basic concepts of Raman Effect and Mossbauer Effect and its need in spectroscopy

Learners Outcomes:

- By the end of this course, the students will learn different spectroscopy techniques to characterize the structure and composition of materials.

| | |
|---|---|
| **Unit I** | Nuclear Magnetic Resonance Spectroscopy: Concept of Nuclear Magnetic resonancespectroscopy, Interaction between nuclear spin and magnetic field, population of energy level, relaxation processes, spin-spin interaction and spin-spin coupling between two and more nuclei (Qualitative) |
| **Unit II** | Franck Condon principles, dissociation andpre-dissociation, dissociation energy. Born Oppenheimer-approximation, vibrational coarse structure of electronic spectra (bands progression and sequence), Raman Spectra |
| **Unit III** | Raman effect, quantum theory of Raman effect, Molecular polarizability in Raman effect, Vibrational Raman spectra, vibration-rotation Raman Spectra of diatomic molecules, application of Raman spectroscopy in the structure determination. |
| **Unit IV** | Mossbauer Spectroscopy: Mossbauer Effect, principles of Mossbauer spectroscopy, recoil less emission of gamma emission line width and resonance absorption, application of Mossbauer spectroscopy, (Isomer shift, Quadrupole splitting magnetic field effect). |
| **Unit V** | Electron Spin Resonance Spectroscopy : Elementary Idea about ESR, Principle of ESR, ESR Spectometer, Splitting of electron energy levels by a magnetic field, G-Values, simple experimental setup of ESR. ESR spectra of free radicals in solution. |

**Suggested Readings:**


- Fundamentals of Molecular Spectroscopy, C. N. Banwell, Tata McGraw Hill.
- NMR and Chemistry, J W Akitt & B E Mann, Stanley Thornes.
- Molecular Spectra and Molecular Structure, G. Herzberg, Van Nostrand.

- Modern Spectroscopy, J. M. Hollas, John Wiley.
- Elements of Spectroscopy, Gupta Kumar & Sharma, Meerut: Pragati Prakashan.
- Introduction to Molecular Spectroscopy, Barrow G.M. New Delhi: McGraw Hill.
- Laser Spectroscopy: Basic concepts and instrumentation, Demtröder W, NewYork: Springer.
- Spectra of Diatomic Molecules, Herzberg G. Boston: Springer.
- Optoelectronics, Wilson and Hawkes, Europe: Prentice Hall.
- Spectroscopy of Organic Compounds, P S Kalsi, New Age International Publishers
- Elementary Organic Spectroscopy, Y R Sharma, S. Chand and Co. Ltd.

# Paper MP602: Laser Physics

Semester VI
Credit-3
Course Code: DC 6.2
Hours/ Week- 3

Max. Marks: 75
Sessional: 15
Terminal: 60

***Course Description:***

- Understand the basic concepts of Lasers
- Understand the working principle of different laser systems
- Realize the various applications of lasers

***Learners Outcomes:***

- By the end of this course, the learner should have a basic concept of laser and the working principle of different laser systems.

| | |
|---|---|
| **Unit I** | Overview: Gaussian beam, Monochromaticity, Directionality, Coherence; Atomicenergy levels. |
| **Unit II** | Einstein's quantum theory of radiation; Boltzmann distribution, Population inversion, Rate equations, Stability conditions, Conditions for light amplification, Three level and four level lasers; Pumping mechanisms; Stable and unstable resonators, Laser Cavity, Longitudinal and Transverse Modes, Mode Selection, Gain in a RegenerativeLaser Cavity; Qswitching, Mode locking, Laser amplification, Frequency conversion. |
| **Unit III** | Laser systems: Ultrafast and power lasers; Gas lasers: He-Ne, CO2, Excimer lasers; Solid state lasers: Diode pumped solid state lasers, Lamp pumping and thermal issues; Ruby, Nd-YAG, Fibre lasers; Semiconductor lasers: Laser materials, Laser structure, Frequency control of laser output, Modern diode laser. |
| **Unit IV** | Applications of laser: Laser cooling; Laser barcode scanner, Laser trimming, Cutting, Welding, Drilling and Tracking, Pattern formation by laser etching, LIDAR, Holography, Interferometry, Microscopy. |
| **Unit V** | Introduction to optical fibers, propagation of light through a cladded fiber, modes of propagation, types of optical fiber, applications, advantages, attenuation,fiber losses, optical windows, dispersion, bandwidth distance product, fiber optic communication. |

**Suggested Readings*:***


- Principals of Laser, Svelto, Springer.
- Optical electronics, Yarive, Holt, Rinehart and Winston.
- Laser spectroscopy, Demtroder, Springer- Verlag Berlin Heidelberg GmbH
- Laser spectroscopy : Basic Concepts and Instrumentation, Demotroder,Springer- Verlag

Berlin Heidelberg GmbH.
- Non linear optics, B.B. Laud, New Age International.
- Lasers: Fundamental and Applications, Graduate Text in Physics, 2nd edition, K. Thyagarajan, Ajoy ghatak, Springer.
- Polarization of light, Ajoy Ghatak and Arun Kumar, Mc Graw Hill Education.
- Introduction to Fibre Optics, Ajoy Ghatak and K. Thyagarajan, CambridgeUniversity Press.
- Introduction to Holography, Vincent Toal, CRC Press.
- Optical fiber communication system, Agrawal G P, Wiley-Interscience.
- Optical fiber communications, Keiser G, Mc Graw Hill.

# Paper MP603*: Plasma Physics

Semester VI
Credit-4
Course Code: DC 6.1
Hours/ Week- 5

Max. Marks: 100
Sessional: 20
Terminal: 80

**Course Description:**

- Learn about plasmas, the fourth state of matter
- Develop insights on the inner workings of sun and other stars, and fascinating astrophysical objects such as black holes and neutron stars.
- Appreciate predictions of space weather, medical treatments and even water purifications.

**Learners Outcomes:**

- By the end of this course, the student will learn fluid approach and kinetic statistical approach to describe different plasma phenomena.
- In addition, the learner will classify electromagnetic waves that can propagate in magnetized and non-magnetized plasmas, and describe the physical mechanisms generating these waves.

| | |
|---|---|
| **Unit I** | Occurrence of Plasma in Nature: Criteria for plasmas, Single particle motion in uniform and non-uniform electric (E) and magnetic (B) fields, Time varying E and Bfield. Adiabatic invariants |
| **Unit II** | Magnetic mirrors, Fluid equation of motion. Fluid drifts parallel and perpendicular to B. Plasma Oscillations, Electron Plasma waves, Ion Waves, Validity of Plasma approximation. |
| **Unit III** | Electrostatic electron and ion perpendicular to B, Electromagnetic waves with B0=0. Propagation Vector (K) perpendicular and parallel to B0. Alfven waves. Diffusion in weakly and fully ionized plasmas. Decay of Plasma by Diffusion. |
| **Unit III** | Two stream instability, Gravitational Instability, Weibel instability, Equations of kinetictheory, Derivation of the Fluid Equations Landau damping. Ion acoustic shock waves. |
| **Unit IV** | The pondermotive Force, Parametric Instabilities-Frequency matching, Instabilities- Frequency matching, Instability threshold, Oscillting two stream instability, Plasma Echoes, The Problem of controlled Fusion, Magnetic confinement – Torous, Mirrors, Pinches, Plasma Heating Laser induced Fusion. |

**Suggested Readings:**


- Electrodynamics, Gupta Kumar Singh. Meerut: Pragati Prakashan.
- Introduction to electrodynamics, Griffith D.J. New Delhi :Pearson EducationIndia.

- Introduction to Plasma Physics and controlled fusion, Chen F.F. New York: Plenum Press.
- Elements of Plasma Physics. Gosawami S N, New Delhi: New Age International.
- Plasma state and matter, Sen S.N. Merrut: Pragati Prakashan.
- Introduction to Plasma Physics and controlled fusion, Chen F.F. New York: Plenum Press.

# Paper MP603*: Bio-Physics

Semester VI
Credit-4
Course Code: DE 6.1
Hours/ Week- 5

Max. Marks: 100
Sessional: 20
Terminal: 80

**Course Description:**

- Understand basics of effects of vibration in human bodies, cell physiology, molecularmotors, enzymes, probability, and heredity.
- Learn the Reynolds number and DNS.
- Learn the thermodynamics inside the human cell.

**Learners Outcomes:**

- By the end of this course, the student will learn the importance of heat and thermodynamics in the field of Bio-physics and various mechanisms inside a cell.

| | |
|---|---|
| **Unit I** | Introduction: Nature and scope of biophysics, Doppler effect, effects of vibration in humans, physics of hearing, heartbeat, human eye, polarizing materials, polarizer, analyzer, spectroscopy fundamentals, heat as a form of energy, the concept of free energy, the puzzle of biological order, units and dimensions, dimensional analysis, molecules as spatial arrangements of atoms, internal energies of molecules. |
| **Unit II** | Random Walk: Brownian motion, random walk, diffusion, friction, diffusion at subcellular level, functions of two variables, biological applications of diffusion, permeability of artificial membranes, bacterial metabolism, the Nernst relation, frictional dissipation, diffusion from a point: Gaussian profile. Life at Low Reynolds Number: Friction in fluids, sedimentation, low Reynolds number, relative importance of friction and inertia, biological applications, swimming and pumping, stirring, foraging, vascular networks, viscous drag at DNA replication. |
| **Unit III** | Entropy, Energy and Electrostatics: Microscopic view of entropic forces, fixed volume approach, fixed pressure approach, osmatic pressure, osmatic flow, electrostatic interactions, the gauss law, charged surfaces and ion clouds, special properties of water, hydrogen bond, solubility, nonpolar objects. |
| **Unit IV** | Mechanics in Cell: Electro- osmatic effects, ion pumping, eukaryotic membrane potential, the Ohmic conductance, mitochondria as factories, distribution of energy, respiration, chemiosmotic mechanism. |

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|---|---|
| **Unit V** | Cell Structure: Cell physiology, internal gross anatomy, external gross anatomy, small molecules, medium-size molecules, big molecules, macromolecular assembly, molecular devices, the plasma membrane, molecular motors, enzymes and regulatory proteins, flow of information. Probability and Heredity: The probabilistic facts of life, discrete distributions, continuous distributions, mean and variance, addition and multiplication rules, the ideal gas law, average kinetic energy, distribution of molecular velocities, the Boltzmann distribution |

**Suggested Readings:**


- Physics in Molecular Biology, Kim Sneppen and Giovanni Zocchi, Cambridge University Press.
- Biological Physics, Energy, Information, Life, Philip Nelson, W. H. Freeman & Co, NY.
- Biophysics: Searching for Principles, William Bialek, and Princeton University Press.
- An Introduction to Systems Biology, Uri Alon, Chapman and Hall/CRC.
- Mathematical Biology, I. An Introduction, J. D. Murray, 3rd Ed., Springer.

# Paper MP603*: Computational Physics

Semester VI
Credit-4
Hours/ Week- 5

Max. Marks: 100
Sessional: 20
Terminal: 80

**Course Description:**

- Use of computational physics for solving concerning problems
- Develop a sense of appreciation among students for the contribution done in computational physics

**Learners Outcomes:**

- By the end of this course, the students should learn advanced numerical techniques which are useful in various disciplines of Physics and Mathematics.
- In addition, students shall be able to develop algorithms based on these numerical methods,which may be implemented using computer programming languages.

| | |
|---|---|
| **Unit I** | Finite & Infinite Series, Root Finding (Bisection, Secant and Newton Raphson Methods), Solving First & Second Order differential Equations including Simultaneous Equations (Euler & Runge Kutta), Systems of inhomogeneous linearequations |
| **Unit II** | Numerical Integration Trapezoidal, Simpson and Quadrature methods, NumericalDifferentiation. |
| **Unit III** | Schroedinger Equation- Finding the Eigenvalues & Eigenfunctions, Applications to Particle in a box, Harmonic Oscillator and Hydrogen atom. |
| **Unit IV** | Matrices – Arrays of variable Size, Matrix Operations, Eigen values and Eigenvectors, Matrix Inversion, Solving Systems of Linear Equaitions |
| **Unit V** | Error Analysis, Interpolation, Fourier transformation, Random numbers and Monte-Carlo Methods, Equation of motions. |

**Suggested Readings:**


- Numerical Recipes in C: The Art of Scientific Computing, William H. Press,Brian
- P. Flannery, Saul A. Teukolsky, William T. Vetterling (2nd Ed., Cambridge University Press.
- Mathematical Methods for Physicists, George Arfken, Hans Weber, Frank E.Harris, 7th Ed., Elsevier.
- Lab. Manual for Computer Programming & Numerical Methods, Dept. of Physics & Astrophysics, University of Delhi.
- Computational Physics : An Introduction, R. C. Verma, P. K. Ahluwalia and
- K. C. Sharma, New Age International (P) Limited, Publishers.

## Paper MP604: Practical (P-I)

Credits: 1.5 Max. Marks: 37.5
Duration: 3 hours Passing Marks: 15
Experiment: 20 Viva: 10
Record: 7.5

- To measure the thickness of thin wire with a He- Ne Laser
- To measure the angle of a wedge plate (say, one side of a biprism) using Haidinger fringes with laser light
- To study the wavelength and velocity of ultrasonic waves on solid medium by pulse echo interferometer.
- To measure Young's modulus of the material of a wire with a diffraction strain gauge
- To determine the polarizing angle for glass using laser light and hence obtain the refractive index of glass using Brewster's law.
- NMR Spectroscopy of Paramagnetic Samples.

## Practical (P-II)

Credits: 1.5 Max. Marks: 37.5
Duration: 3 hours Passing Marks: 15
Experiment: 20 Viva: 10
Record: 7.5

1. Study the D33 coefficient of poled and un-poled piezoelectric crystals.
2. Study the optical bang gap of a material using UV-Visible spectrophotometer.
3. Study the molecular vibrations of a material using IR- spectroscopy.
4. Study the e/m of electrons using Zeeman Effect
5. To determine the width of a slit using a laser beam.
6. To study the wavelength and velocity of ultrasonic waves in polar and apolar liquids by multi frequency interferometer.

**Suggested Readings:**


- Intermediate Practical Physics, Yarwood T. M., Macmillan Newyork
- Practical Physics, Anchal Srivastav and R. K. Shukla, New Age International Publishers
- A Text Book of Advanced Practical Physics, Samir Kumar Ghosh, New Central Book Agency (P) Ltd.


**Web Reference:**

- https://www.youtube.com/c/AllLabExperiments

**M.Sc. (Physics) M.Ed. Semester-VI**

**Dissertation Physics**
**(Proposal Development) (PC 6.1A)**

**Contact hours/week: 12** **MM- 150**

**Credit - 6** **Passing Marks- 60**

**Course Learning Outcomes**

The purpose of offering dissertation work proposal is to encourage the students in research and innovation in frontier areas of Physics. Through this course they would be introduced to various stages of research planning and implementation. Students will be able to design and perform scientific research under the supervision of a faculty and learn to work independently and in a group. During the course of her/his dissertation work, students are expected to learn different experimental or theoretical techniques for carrying out scientific research problems, particularly to collect and interpret data.

Following the completion of this course, students should be able demonstrate ability to plan and strategize a scientific research problem, and implement it within a reasonable time frame. It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of their experimental work. In addition, students will be able to handle laboratory equipments. Also, students will be able to utilize sophisticated instruments for analysis, data collection and interpretation. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills.

**Strategies for the evaluation of dissertation work :**

- The Students will complete the dissertation work under the supervision of faculty members of Physics.
- Regular monitoring as per the steps/processes indicated below is essential.
- Weightage as indicated against each step is to be assigned through seminar mode.

| Identification of Problems | Review of Literature | Methodology | Analysis | Findings | Viva-Voce | Tota |
|---|---|---|---|---|---|---|
| Internal | | | | Internal and External | | 150 |
| 10 | 20 | 20 | 25 | 25 | 50 | |

# 2. Three-Year Integrated M.Sc. (Chemistry) M.Ed. Programme

## (A) Course Structure with Credits

| S. No. | Paper Code | Subject Name | Teachin-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hours | Internal | Hours | Internal | Hours | Internal |
| **1** | MCT101 | Inorganic Chemistry - I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT102 | Organic Chemistry - I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT103A – MCT103B | Optional (Mathematics for Chemists/Biology for Chemists) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP104 | Practical – I (Inorganic Chemistry-I) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP105 | Practical – II (Organic Chemistry-I) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET106 | Educational studies (CS-I) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET107 | Philosophical Perspectives of Education (CS-II) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET108 | Teacher Education I (CS-III) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP109 | Self Development (P-I) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **450** | **240** | **460** | **700** |

**T: Theory P: Practical**

## M.Sc. (Chemistry) M.Ed. Semester-II

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Int. | Ext. | Total |
| **1** | MCT201 | Physical Chemistry-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT202 | Group Theory and Spectroscopy-I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT203 | Computer for Chemists | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP204 | Practical – I (Physical Chemistry-I) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP205 | Practical – II (Organic Chemistry-II) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET206 | Psychology of Learning and Development (CS-IV) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET207 | Curriculum studies (CS-V) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET208 | Sociology of Education-I (CS-VI) | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **9** | MEP209 | Academic Writing (P-II) | P | 2 | 60 | 50 | - | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T: Theory P: Practical**

# M.Sc. (Chemistry) M.Ed. Semester-III

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/ | Credit | Hours | Int | Ext | Tota |
| **1** | MCT301 | Inorganic Chemistry - II | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT302 | Organic Chemistry - II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT303 | Spectroscopy-II and Diffraction Methods | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP304 | Practical – I (Inorganic Chemistry-II) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP305 | Practical – II (Organic Chemistry-III) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET306 | Cross Curricular Pedagogical Approaches (CS-VII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET307 | Teacher Education -II (CS-VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET308A - MET308E | TS- I Thematic Specialization – I (Any one) (TS1.1/TS2.1/TS3.1/TS4.1/TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP309 | Internship-I (P - III) (Teacher Education) | P | 2 | 60 | 50 | - | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T: Theory P: Practical**

### Thematic Specialization:

TS1.1-Educational Management, Administration and Leadership (MET308A)
TS2.1–Curricilium theory, Planning and Development (MET308B)
TS3.1–Foundations of Educational Technology (MET308C)
TS4.1–Understanding and Development of Equitable and Inclusive Education (MET308D)
TS5.1–Guidance & Counselling in School (MET308E)

# M.Sc. (Chemistry) M.Ed. Semester-IV

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/ | Credit | Hours | Int | Ext | Tot |
| **1** | MCT401 | Application of Spectroscopy-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT402 | Physical Chemistry-II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT403 | Environmental Chemistry | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP404 | Practical – I (Physical Chemistry-II) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP405 | Practical – II (Inorganic Chemistry-III) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET406 | Historical, Political and Economic Perspectives of Education (CS-IX) | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **7** | MET407 | Research Methodology – I (CS-X) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET408A – MET408E | TS-II Thematic Specialization - II (Any one)(TS1.2/TS2.2/TS3.2/TS4.2/ TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP409 | Dissertation-I: Research in Education (Planning) (P - IV) | P | 1 | 30 | 25 | - | 25 |
| **10** | MEP410 | Internship-II (Thematic Specialization) (P - V) | P | 2 | 60 | 50 | - | 50 |
| | | Total | | **29** | **510** | **265** | **460** | **725** |

**T: Theory P: Practical**

## Thematic Specialization:

TS1.2–Educational Planning (MET408A)

TS2.2–Learning and Pedagogy of School Subjects (MET408B)

TS3.2–ICT in Education (MET408C)

TS4.2–Addressing the diverse needs in Inclusive setting (MET408D)

TS5.2 – Assessment and Appraisal in Guidance and Counselling (MET408E)

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Int. | Ext. | Total |
| **1** | MCT501 | Application of Spectroscopy-II | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT502 | Biochemistry | T | 4 | 60 | 30 | 70 | 100 |
| **3 (a)** | MCT503A | Green Chemistry | T | 2 | 30 | 15 | 35 | 50 |
| **3 (b)** | MCT503B<br>MCT503C<br>MCT503D<br>MCT503E<br>MCT503F<br>MCT503G | Optional Papers – Select any one<br>Organotransition Metal/<br>Polymers/<br>Heterocyclic Chemistry/<br>Physical Organic Chemistry/<br>Chemistry of Materials/<br>Industrial Chemistry (Heavy | T | 2 | 30 | 15 | 35 | 50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Chemical and Petroleum) | | | | | | |
| **4** | MCP504 | Practical – I (Inorganic Chemistry-IV) | P | 1 | 30 | 5 | 20 | 25 |
| **5** | MCP505 | Practical – II (Organic Chemistry-IV) Project | P | 1 | 30 | 5 | 20 | 25 |
| **6** | MET506 | Research Methodology-II (CS-XI) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET507 | Indigenous Knowledge System (CS – XII) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET508A – MET508E | TS – III Thematic Specialization – III (Any one) ( TS 1.3/TS 2.3/TS 3.3/TS 4.3/TS 5.3) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP509 | Dissertation-II: Research in Education (Execution) (P-VI) | P | 1 | 30 | 25 | - | 25 |
| | | | **Total** | **27** | **450** | **215** | **460** | **675** |

# M.Sc. (Chemistry) M.Ed. Semester-V

**T: Theory P: Practical**

**Thematic Specialization:**

TS1.3 –Educational Leadership and Supervision (MET508A)
TS2.3 – Learner's Assessment (MET508B)
TS3.3 – ICT Integration in Education (MET508C)
TS4.3 – Concern, Challenges and Issues in Inclusive Education (MET508D)
TS5.3 – Career Development (MET508E)

# M.Sc. (Chemistry) M.Ed. Semester-VI

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Int. | Ext. | Total |
| 1 | MCT601 | Solid State Chemistry | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MCT602 | Photochemistry | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MCT603A<br>MCT603B<br>MCT603C<br>MCT603D | Optional Papers – Select any two [Organic Synthesis/ Chemistry of Natural Products/ | T | 2+2 | 30+30 | 15+15 | 35+35 | 50+50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | MCT603E<br>MCT603F | Analytical Chemistry/<br>Electrochemistry/<br>Medicinal chemistry/<br>Industrial Chemistry<br>(Pesticides and Glass Industries)] | | | | | | |
| 4 | MCP604 | Practical – I (Physical Chemistry-III) | P | 1 | 30 | 5 | 20 | 25 |
| 5 | MCP605 | Innovative Project activities in Science/Mathematics (Chemistry) (P-VI) | P | 1 | 30 | 5 | 20 | 25 |
| 6 | MET606 | Education for Sustainable Development (CS-XIII) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | MET607A<br>MET607B<br>MET607C<br><br>MET607D | Generic Elective Course (GE) (Any One)<br>I – Indian Values Culture & Heritage<br>II – Vocational Opportunities<br>III – Programme and Institutional Assessment<br>IV – Physical Education, Yoga & Wellness | T | 4 | 60 | 30 | 70 | 100 |
| 8 | MEP608 | Application of ICT in Education (P-VII) | P | 2 | 60 | 50 | - | 50 |
| 9 | MEP609 | Dissertation-3: Research in Education (Reports Submission) (P-VIII) | P | 4 | 60 | 50 | 50 | 100 |
| **Total** | | | | **28** | **480** | **260** | **440** | **700** |

**T: Theory P: Practical**

## (B) Syllabus with Credit Based Choice System (CBCS)

| **No.** | **Paper Code** | **Subject Name** | **Teaching-Learning** | | | **Assessment Scheme** | | |
|---|---|---|---|---|---|---|---|---|
| | | | **T/P** | **Credit** | **Hours** | **Int.** | **Ext.** | **Total** |
| **1** | MCT101 | Inorganic Chemistry - I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT102 | Organic Chemistry - I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT103A – MCT103B | Optional (Mathematics for Chemists/Biology for Chemists) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP104 | Practical – I (Inorganic Chemistry-I) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP105 | Practical – II (Organic Chemistry-I) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET106 | Educational studies (CS-I) | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **7** | MET107 | Philosophical Perspectives of Education (CS-II) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET108 | Teacher Education I (CS-III) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP109 | Self Development (P-I) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **450** | **240** | **460** | **700** |

**T: Theory P: Practical**

**M.Sc. (Chemistry)**

# M.Ed. Semester-I

## Inorganic Chemistry-I (MCT101)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Total Hours | 60 | |
| Total Credits | 04 | |

**Learning Outcomes:**

The learner –

- Understands the stereochemistry and b onding pattern in main group elements.
- Compares the stability of metal complexes in terms of their thermodynamic parameters.
- Proposes and understands the reaction mechanism of transition metal complexes.
- Appreciates the need of molecular orbital theory to be applied for octahedral, tetrahedral and square planer complexes.
- Classifies the acids and bases as hard and soft.

| | |
|---|---|
| **Unit-I** | **Stereochemistry and Bonding in Main Group Compounds**<br>VSEPR, Walsh diagram (triatomic and penta-atomic molecules), $d_{\pi}$-$p_{\pi}$ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. |
| **Unit-II** | **Metal-Ligand Equilibrium in Solution**<br>Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry and spectrophotometry. |
| **Unit-III** | **Reaction Mechanism of Transition Metal Complexes**<br>Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anion |

| | |
|---|---|
| | reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the *trans* effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. |
| **Unit-IV** | **Metal-Ligand bonding**<br>Limitation of crystal field theory, molecular orbital theory for bonding in octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. |
| **Unit-V** | **HSAB Theory**<br>Classification of acids and bases as hard and soft; HSAB principle, theoretical basis of hardness and softness; Lewis-acid base reactivity approximation; donor and acceptor numbers, E and C equation; applications of HSAB concept. |

**Books Suggested:**


1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetiochemistry, R.1. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty,Pergamon.


# M.Sc. (Chemistry) M.Ed. Semester-I

## Organic Chemistry-I (MCT102)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Total Hours | 60 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Understands the localized and delocalized bonding pattern in organic molecules.
- Differentiates threo and erythro isomers, streospecific and steroselective synthesis.
- Makes conformational analysis of cycloalkanes and decalines.
- Analyses the reaction mechanisms like $SN^1$, $SN^2$, mixed $SN^1$and$SN^2$ neighboring group participations, etc.

| | |
|---|---|
| **Unit-I** | **Nature of Bonding organic Molecules**<br>Delocalized chemical bonding-conjugation, cross conjugation, resonance**,** hyper conjugation, bonding in fullerences, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternate and non-alternate hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, catenanes and rotaxanes. |
| **Unit-II** | **Stereochemistry**<br>Strain due to unavoidable crowding Elements of symmetry, chirality, molecules with more than one chiral center, threo and ertythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spirane) chirallity due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus. |
| **Unit-III** | **Conformational analysis and linear free energy relationship**<br>Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituents and reaction constants, Taft equation. |
| **Unit-IV** | **Reaction Mechanism: Structure and Reactivity**<br>Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtir-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotopes effects |
| **Unit-V** | **Aliphatic Nucleophilic Substitution**<br>The $S_N2$, $S_N1$ mixed $S_N1$ and $S_N2$ and SET mechanism. The neighboring group mechanism, neighboring group participation by σ and π bonds, anchimeric assistance. Classical and nonclassicalcarbocations, phenonium ions, norbornyl systems, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The $S_N1$ mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity. |

**Book Suggested:**

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.

6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic &Professionsl.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan, India
10. Stereochemistry of Organic Compounds, D.Nasipuri, New Age International.
11. Stereochemisty of Organic Compounds, P.S. Kalsi, New Age International.

| | |
|---|---|
| **Unit-I** | **Vectors:** Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus.<br>**Matrix Algebra**: Addition and multiplication; inverse, adjoint and transpose of matrices. |
| **Unit-II** | **Differential Calculus**<br>Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.). |
| **Unit-III** | **Integral calculus**<br>Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus.<br>Functions of several variables, partial differentiation, co-ordinate transformations (e.g.Cartesian to spherical polar). |
| **Unit-IV** | **Elementary Differential equations**<br>First-order and first degree differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. second order differential equation and their solutions. |
| **Unit-V** | **Permutation and Probability**<br>Permutations and combinations, probability and probability theorems average, variance root means square deviation examples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit. |

**M.Sc.**

# (Chemistry) M.Ed. Semester-I

### Mathematics for Biology Students (MCT103A)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Total Hours | 60 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Learns the techniques of addition, multiplication and transpose of matrices taking examples from chemistry.
- Applies differential and integral calculus for solving problems of chemistry.
- Applies first order and second order differential equations for solving the problem of chemical kinetics, quantum chemistry, etc.

- Analyses the chemical systems by applying the concept of permutation, combination & probability theory.

**Book Suggested:**

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemistry, Doggett and Suiclific, Logman.
3. Mathematical for Physical chemistry: F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Barante, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley

# M.Sc. (Chemistry) M.Ed. Semester-I

**Biology for Mathematics Students (MCT103B)**

| | **External** | **Internal** |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Total Hours | 60 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Differentiates between prokaryotic & eukaryotic cells, plant and animal cells.
- Draws and studies the structure of monosaccharides, disaccharides and polysaccharides
- Gains fundamentals of lipid, amino acids, peptides, protein and nucleic acids and appreciates their biological importance.
- Feels the importance of biological concepts in the understanding chemistry.

| **Unit-I** | **Cell Structure and Functions**<br><br>Structure prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and |
|---|---|

| | |
|---|---|
| | animal cells. Overview and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP – the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to bio-molecules, building blocks of biomacromolecules. |
| **Unit-II** | **Carbohydrates**<br><br>Conformation of monosaccharides, structure and functions of important derivatives of mono-saccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysaccharides cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoporteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. |
| **Unit-III** | **Lipid**<br><br>Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile |

| | |
|---|---|
| | acids, prostaglandins. Lipoproteins-compositiion and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-oxidation of fatty acids. |
| **Unit-IV** | **Amino-acids, Peptides and Proteins**<br><br>Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. force responsible for holding of secondary structures. A-helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domina structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical/enzymatic/mass spectral, racemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH). |
| **Unit-V** | **Nucleic Acids**<br><br>Purine and pyrimidine bases of nucleic acids, base pairing via H bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA |

| | |
|---|---|
| | and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside. |

**Book Suggested:**

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

**Practical-I Inorganic Chemistry (MCP104)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Qualitative Analysis | 8 |
| Chromatography | 4 |
| Preparation | 3 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**1. Qualitative Analysis**

Qualitative analysis of inorganic mixture containing eight radicals including insoluble and rare earth.

**2. Chromatography**

Separation of cations and anions by Column Chromatography: Ion exchange Separation of cations and anions by Paper Chromatography.

**3. Preparations**

Preparation of selected inorganic compounds and their studies by I.R. electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

1. $VO(acac)_2$
2. $TiO(C_9H_8NO)_2H_2O$
3. cis-K $[Cr(C_2O_4)_2(H_2O)_2]$
4. Na $[Cr(NH_3)_2(SCN)_4]$
5. $Ni(acac)_2$
6. $K_3[Fe(C_2O_4)_3]$
7. Prussian Blue, Turnbull's Blue.

**Books Suggested**

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.

2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.

# M.Sc. (Chemistry) M.Ed. Semester-I

**Practical-II Organic Chemistry (MCP105)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Qualitative Analysis | 8 |
| Organic Synthesis | 7 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**Qualitative Analysis:**
Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using TLC and columns chromatography, chemical tests. IR spectra to be used for functional group identification.

**Organic Synthesis:**
**Synthesis of organic compounds by applying following methods**
1. Acetylation
2. Oxidation
3. Halogenation
4. Benzoylation
5. Reduction

The Products may be characterized by Spectral Techniques.

**Books Suggested**

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H.Jeffery and J. Mendham, ELBS.
2. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
3. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
4. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
5. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.


## M.Sc. (Chemistry) M.Ed. Semester-II

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Int. | Ext. | Total |
| **1** | MCT201 | Physical Chemistry-I | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2** | MCT202 | Group Theory and Spectroscopy-I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT203 | Computer for Chemists | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP204 | Practical – I (Physical Chemistry-I) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP205 | Practical – II (Organic Chemistry-II) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET206 | Psychology of Learning and Development (CS-IV) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET207 | Curriculum studies (CS-V) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET208 | Sociology of Education-I (CS-VI) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP209 | Academic Writing (P-II) | P | 2 | 60 | 50 | - | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T: Theory P: Practical**

# M.Sc. (Chemistry) M.Ed. Semester-II

## Physical Chemistry-I (MCT201)

| | **External** | **Internal** |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Teaching Hours | 60 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Applies Schrodinger wave equation to calculate energy and wave functions for some models like particle in a box, harmonic oscillator, rigid rotator, hydrogen atom & helium atom.
- Learns to apply approximate methods like variation principle, perturbation method and molecular orbital theory to helium atom, butadiene, cyclobutadiene, etc.
- Makes detailed understanding of partial molar properties, fugacity and activity coefficient.
- Understands some important concepts of statistical thermodynamics like partition function and calculates thermodynamic properties in terms of partition function.
- Understands the basics and applications of Fermi-Dirae statistics and Bose-Einstein statistics.

| | |
|---|---|
| **Unit-I** | ***Introduction to Exact Quantum Mechanical Results***<br>Schrödinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrödinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom and helium atom. |
| **Unit-II** | **Approximate Methods**<br>The variation theorem, linear variation principle. Perturbation theory (First order and non degenerate). Applications of variation method and perturbation theory to the Helium atom. |
| **Unit-III** | **Angular Momentum**<br>Ordinary angular momentum, generalized angular momentum, Eigen functions for angular momentum, Eigen values of angular momentum operator using ladder operators, addition of angular momenta, spin, anti symmetry and Pauli exclusion principle. |
| **Unit-IV** | **Classical Thermodynamics**<br>Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems: Excess function s for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems; second order phase transitions. |
| **Unit-V** | **Statistical Thermodynamics**<br>Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro-canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translation, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition. Application of partition functions. Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics distribution Law and application to helium. |

**Books Suggested**


1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R.McWeen y, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. MOraoi, Plenum.
8. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Planum.

9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.

# M.Sc. (Chemistry) M.Ed. Semester-II

## Group Theory and Spectroscopy-I (MCT202)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Teaching Hours | 60 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Understands the concept of symmetry elements, symmetry operation and point groups.
- Understands the theories behind microwave infrared, Raman and Electronic spectroscopy
- Applies the knowledge of spectroscopy in the structural elucidation of organic and inorganic

| | |
|---|---|
| **Unit-I** | **Symmetry and Group theory in Chemistry**<br>Symmetry elements and symmetry operation, definition of group, subgroup. Conjugacy relation and classes. Point symmetry group. Schonfilies symbols, representations of groups by matrices (representation for the $C_n$, $C_{nv}$, $C_{nh}$, $D_{nh}$ group to be worked out explicity). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for $C_{2v}$ and $C_{3v}$ point group Symmetry aspects of molecular vibrations of $H_2O$ molecule. |
| **Unit-II** | **Microwave Spectroscopy**<br>Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field applications |
| **Unit-III** | **Infrared-Spectroscopy**<br>Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy. P.Q.R. branches, Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis. |
| **Unit-IV** | **Raman Spectroscopy**<br>Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS). |
| **Unit-V** | **Electronic Spectroscopy**<br>**Molecular Spectroscopy**<br>Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radio-active and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra. |

| | |
|---|---|
| | **Photoelectron Spectroscopy** Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy-basic idea. |

**Books suggested**


1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho,WileyInterscience.
3. NMR, NQR, EPr and Mossbauer Spectroscopy in Inorganic Chemistry, R.V.Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
8. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.
9. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, Harper & Row.


# M.Sc. (Chemistry) M.Ed. Semester-II

**Computer for Chemists (MCT203)**

| | **External** | **Internal** |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Teaching Hours | 60 | |
| Total Credits | 04 | |

**Teaching Learning Outcomes: The learner –**

- Appreciates the importance of computer programming in chemistry.
- Develops small computer codes involving simple formulae in chemistry.
- Develops programming in the analysis of physical chemistry data.

**This is a theory cum-laboratory co use with more emphasis on laboratory work**

| | |
|---|---|
| **Unit-I** | **Introduction to computers and Computing**<br>Basic structure and functioning of computer with a PC as illustrative example. Memory I/O devices. Secondary storage Computer languages. Operating systems with DOS as an example Introduction to UNIX and WINDOWS. Principles of programming Alogrithms and flow-charts. |
| **Unit-II** | **Computer Programming in FORTRAN/C/BASIC**<br>(The language features are listed here with reference to FORTRAN. The instructor maychoose another language such as BASIC or C the features may be replaced appropriately). Elements of the computer language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION |

| | |
|---|---|
| | AND SUBROUTINE. COMMON and DATA statement (Student learn the programming logic and these language feature by hands on experience on a personal computer from the beginning of this topic.) |
| **Unit-III** | **Programming in Chemistry**<br>Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Vander Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity and Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bond angles. |
| **Unit-IV** | **Use of Computer programmes**<br>Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method. Programmes with data preferably from physical chemistry laboratory. |
| **Unit-V** | **Internet**<br>Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera. |

**Book**

**Suggested:**


1. Fundamentals of Computer: V. Rajaraman (Prentice Hall)
2. Computers in Chemistry: K.V. Raman (Tata McGraw Hill)
3. Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)


# M.Sc. (Chemistry) M.Ed. Semester-II

**Practical-I Physical Chemistry (MCP 204)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Error analysis and statistical data analysis | 3 |
| Conductometry | 7 |
| Properties of solution | 5 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**1. Error Analysis and Statistical Data Analysis**

Errors, types of errors, minimization of errors distribution curves precision, accuracy and combination; statistical treatment for error analysis, student's t-test, null hypothesis, rejection criteria. F & Q test; linear regression analysis, curve fitting. Calibration of volumetric apparatus, burette, pipette and standard flask.

**2. Conductometry**

i. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.

ii. Determination of solubility and solubility product of sparingly soluble salts (e.g. $PbSO_4$, BaSO4) conductometrically.

iii. Determination of the strength of strong and weak acid in a given mixture conductometrically.

iv. To study of the effect of solvent on the conductance of $AgNO_3$/acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Huckel-Onsager theory.

v. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

**3. Properties of Solutions**

Determination of molecular weight of non-volatile and electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.

Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

Adsorption: To study surface tension-concentration relationship for solutions (Gibbs equation). Phase Equilibria

i. Determination of congruent composition and temperature of a binary system(e.g. diphenylamine-benzophenone system).

ii. To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).

**Books Suggested**

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

# M.Sc. (Chemistry) M.Ed. Semester-II

**Practical-II Organic Chemistry (MCP 205)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Organic Synthesis | 7 |
| Quantitative analysis | 8 |
| Record | 5 |
| Viva Voce | 5 |

Total 25

**Organic Synthesis:**

Synthesis of p-nitroaniline and p-bromoaniline. The products may be characterized by spectral techniques.

**Synthesis involving following reactions:**

1. Aromatic electrophilic substitution
2. Condensation reactions
3. Rearrangement reactions
4. Diazotization reactions

**Quantitative Analysis:**

Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method. Estimation of amines/phenols using bromate bromide solution/or acetylation method. Determination of iodine and Saponification values of an oil sample. Determination of DO, COD and BOD of water sample.

**Books Suggested**


1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.


## M.Sc. (Chemistry) M.Ed. Semester-III

| S | Pap | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T | Cr | H | I | E | T |
| 1 | MC | Inorganic Chemistry - II | T | 4 | 60 | 3 | 7 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2** | MC | Organic Chemistry - II | T | 4 | 60 | 3 | 7 | 1 |
| **3** | MC | Spectroscopy-II and Diffraction Methods | T | 4 | 60 | 3 | 7 | 1 |
| **4** | MC | Practical – I (Inorganic Chemistry-II) | P | 1 | 30 | 0 | 2 | 2 |
| **5** | MC | Practical – II (Organic Chemistry-III) | P | 1 | 30 | 0 | 2 | 2 |
| **6** | ME | Cross Curricular Pedagogical Approaches (CS-VII) | T | 4 | 60 | 3 | 7 | 1 |
| **7** | ME | Teacher Education - II (CS-VIII) | T | 4 | 60 | 3 | 7 | 1 |
| **8** | ME | TS- I Thematic Specialization – I (Any one) (TS1.1/TS2.1/TS3.1/TS4.1/TS5.1) | T | 4 | 60 | 3 | 7 | 1 |
| **9** | ME | Internship-I (P - III) (Teacher Education) | P | 2 | 60 | 5 | - | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Total** | | | | **28** | **48** | **2** | **4** | **7** |

**T: Theory P: Practical**

**Thematic Specialization:**

TS1.1-Educational Management, Administration and Leadership (MET308A)
TS2.1–Currcilium theory, Planning and Development (MET308B)
TS3.1–Foundations of Educational Technology (MET308C)
TS4.1–Understanding and Development of Equitable and Inclusive Education (MET308D)
TS5.1–Guidance & Counselling in School (MET308E)

# M.Sc. (Chemistry) M.Ed. Semester-III

## Inorganic Chemistry-II (MCT301)

| | **External** | **Internal** |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Draws Orgel and Tanabe-Sugano diagrams for $d^1 – d^9$ metal complex system.
- Understands the concept of anomalous magnetic moment and spin crossover.
- Makes detail study of metal carbonyl and understands their bonding pattern.
- Understands the structure and bonding in metal clusters like higher boranes, metalloboranes, metallic-carboranes.
- Applies ORD and CD for determination of absolute configuration and isomerism.

| | |
|---|---|
| **Unit I** | **Electronic Spectral Studies of Transition Metal Complexes**<br>Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes ($d^1$-$d^9$ states), Selection rule for electronic spectroscopy. Intensity of various type electronic transitions. Calculations of 10Dq, B and β parameters, charge transfer spectra. |
| **Unit II** | **Magnetic Properties of Transition Metal Complexes**<br>Anomalous magnetic moments, Quenching of Orbital contribution. Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover. |
| **Unit III** | **Metal π-Complexes**<br>Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls : preparation, bonding ,structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand. |

| | |
|---|---|
| **Unit IV** | **Metal Clusters**<br>Higher boranes, carboranes, metallo-boranes and metallo-carboranes compounds with metal metal multiple bonds. |
| **Unit V** | **Optical Rotatory Dispersion and Circular Dichroism**<br>Linearly and circularly polarized lights; optical rotatory power and circular birefringence, elipticity and circular dichroism; ORD and Cotton effect, Faraday and Kerr effects Assignment of electronic transitions; applications of ORD and CD for the determination of<br>(i) absolute configuration of complexes and (ii) isomerism due to non-planarity of chelate rings. |

**Books Suggested:**


1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetiochemistry, R.1. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J. A.Mc Cleverty,Pergamon.


# M.Sc. (Chemistry) M.Ed. Semester-III

## Organic Chemistry-II (MCT 302)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Proposes the mechanism for Electrophilic substitution reactions in aromatic compounds.
- Categorizes free radical reactions and proposes mechanism for aromatic substrate.
- Studies mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals.
- Classifies different types of pericyclic reactions.

| | |
|---|---|
| **Unit-I** | **Aromatic Electrophilic Substitution**<br>The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction<br>**Aromatic Nucleophilic Substitution**<br>The SNAr $SN^1$, benzyne and $SN^1$ mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richte. Sommelet-Hauser and Smiles rearrangements. |

| | |
|---|---|
| **Unit-II** | **Free Radical Reactions**<br>Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboyxlic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazoniumsalts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction. |
| **Unit-III** | **Addition Reactions**<br>Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity.Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation. |
| **Unit-IV** | **Addition to Carbon-Hetero Multiple bonds**<br>Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and usaturated carbonyl compounds. Witting reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.<br>**Elimination Reactions**<br>The E2, E1 and E1cB mechanisms and their spectrum. Orientation of the double bond. Reactitivty-effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination. |
| **Unit-V** | **Pericyclic Reactions**<br>Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, sigmatropic involving carbon moieties, 3,3- and 5,5 sigmatropic rearrangements. Claisen Cope and Aza-Cope rearrangements. Fluxional tautomerism. Ene reaction. |

**Book Suggested**


1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic &* Professionsl.

8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan, India
10. Stereochemistry of Organic Compounds, D.Nasipuri, New Age International.
11. Stereochemisty of Organic Compounds, P.S. Kalsi, New Age International.

# M.Sc. (Chemistry) M.Ed. Semester-III

**Spectroscopy-II and Diffraction Methods (MCT303)**

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes: The learner –**

- Understands the techniques of NMR and its application in structural elucidation.
- Differentiates between NMR and ESR techniques.
- Analyzes the structure by X-ray diffraction, electron diffraction and neutron diffraction methods.

**Books suggested**

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho,WileyInterscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V.Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
8. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.
9. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, harper & Row.

| | |
|---|---|
| **Unit-I** | **Nuclear Magnetic Resonance Spectroscopy**<br>Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "j" Classification (AXB, AMX, ABC, A2B2 etc.). spin decoupling; basic ideas about instrument, NMR studies of nuclei other than proton-13C, 19F and 31P. FT NMR, advantages of FT NMR. |
| **Unit-II** | **Nuclear Quadrupole Resonance Spectroscopy**<br>Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting, Application |
| **Unit-III** | **Electron Spin Resonance Spectroscopy**<br>Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, |

| | |
|---|---|
| | spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. |
| **Unit-IV** | **X-ray Diffraction**<br>Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules. |
| **Unit-V** | **Electron Diffraction**<br>Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.<br>**Neutron Diffraction** Scattering of neutrons by solids measurement techniques, Elucidation of structure of magnetically ordered unit cells. |

**M.Sc.**

# (Chemistry) M.Ed. Semester-III

## Practical-IInorganic Chemistry (MCP 304)

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Quantitative analysis | 8 |
| Chromatography | 4 |
| Preparation | 3 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**1. Quantitative analysis**

Separation and determination of two metal ions- Cu-Ni, Ni-Zn, Cu- Fe, etc involving volumetric and gravimetric methods.

**2. Chromatography**

Separation of cations and anions by Column Chromatography: Ion exchange.

**3. Preparations**

Preparation of selected inorganic compounds and their studies by I.R. electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

1. $[Co(NH_3)_6]$ $[Co(NO_2)_6]$
2. cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
3. $Hg[Co(SCN)_4]$

4. $[Co(Py)_2Cl_2]$
5. $[Ni(NH_3)_6]Cl_2$
6. $Ni(dmg)_2$
7. $[Cu(NH_3)_4]SO_4H_2O$

**Book Suggested:**

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H.Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.

# M.Sc. (Chemistry) M.Ed. Semester-III

## Practical-II Organic Chemistry (MCP 305)

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Estimations | 10 |
| Paper Chromatography | 5 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**1. Estimation**

A. Estimation of element: Estimation of Sulphur, Nitrogen and Halogens.

B. Estimation of Functional groups and simple organic compound Estimation of Carboxylic group, Aldehyde group, Ketonic group, Carbohydrate group etc.

2**. Paper Chromatography**

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of $R_f$values.

3**. Polymer Synthesis**

Synthesis of some common polymers and their characterization.

**Books Suggested**

1. The systematic Identification of Organic Compounds, R.L. Shriner and D.Y. curlin.

# M.Sc. (Chemistry) M.Ed. Semester-IV

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/ | Credit | Hours | Int. | Ext. | Total |
| **1** | MCT401 | Application of Spectroscopy-I | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT402 | Physical Chemistry-II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT403 | Environmental Chemistry | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MCP404 | Practical – I (Physical Chemistry-II) | P | 1 | 30 | 05 | 20 | 25 |
| **5** | MCP405 | Practical – II (Inorganic Chemistry-III) | P | 1 | 30 | 05 | 20 | 25 |
| **6** | MET406 | Historical, Political and Economic Perspectives of Education (CS-IX) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET407 | Research Methodology – I (CS-X) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET408A – MET408E | TS-II Thematic Specialization - II (Any one)(TS1.2/TS2.2/TS3.2/TS4.2/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP409 | Dissertation-I: Research in Education (Planning) (P - IV) | P | 1 | 30 | 25 | - | 25 |
| **10** | MEP410 | Internship-II (Thematic Specialization) (P - V) | P | 2 | 60 | 50 | - | 50 |
| | | Total | | **29** | **510** | **265** | **460** | **725** |

**T: Theory P: Practical**

**Thematic Specialization:**

TS1.2–Educational Planning (MET408A)

TS2.2–Learning and Pedagogy of School Subjects (MET408B)

TS3.2–ICT in Education (MET408C)

TS4.2–Addressing the diverse needs in Inclusive setting (MET408D)

TS5.2 – Assessment and Appraisal in Guidance and Counselling (MET408E)

# M.Sc. (Chemistry) M.Ed. Semester-IV

**Application of Spectroscopy-I (MCT401)**

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes: The Learner-**

- Explains the behaviour of molecular systems in external electromagnetic field.
- Understands the principles and theories of rotational, vibrational, NMR andMossbauer spectroscopic methods.
- Interprets the molecular spectra and finds molecular properties from molecular spectra.

| | |
|---|---|
| **Unit-I** | **Electronic Spectroscopy**<br>Electronic Spectral Studies for $d^1$ - $d^9$ systems in octahedral, tetrahedral and square planar complexes. |
| **Unit-II** | **Vibrational Spectroscopy**<br>Symmetry and shapes of $AB_2$, $AB_3$, $AB_4$, $AB_5$ and $AB_6$, mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy and applications of vibrational spectroscopy. |
| **Unit-III** | **Nuclear Magnetic Resonance Spectroscopy I**<br>General introduction and definition, chemical shift, spin –spin interaction, shielding and deshielding mechanism, mechanism of measurement of chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto). |
| **Unit-IV** | **Nuclear Magnetic Resonance Spectroscopy II**<br>Chemical exchange, effect of deuteration, complex spin–spin interactions between two, three, four and five nuclei (I order spectra), stereochemistry, hindered rotation, karplus curve variation of |

| | |
|---|---|
| | coupling constant with disordered angle, NMR shift reagents, solvent effects, Nuclear overhauser effect (NOE). |
| **Unit-V** | **Mossbauer Spectroscopy**<br>Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of $Fe^{+2}$ and $Fe^{+3}$ compounds including those of intermediate spin, (2) $Sn^{+2}$ and $Sn^{+4}$ compounds nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms. |

**Book**

**Suggested:**


1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectral : Inorganic and Coordination Compounds K.Nakamoto, Wiley.
4. Progress in Inorganic Chemistry vol., 8, ed., F.A. Cotton, vol., 15 ed. S.J.Lippard, Wiley.
5. Transition Metal Chemistry ed. R.L. Carlin vol. 3 dekker.
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, .V.Parish, Ellis Haywood.
8. Practical NMR Spectroscopy, M.L. Martin. J.J. Deepish and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C.Bassler and T.C. Morrill, John Wiley.
10. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.
13. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock , ELBS.
14. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.


# M.Sc. (Chemistry) M.Ed. Semester-IV

## Physical Chemistry-II (MCT402)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes: The Learner -**

- Describes different methods to determine rate law and derive the rate law for various chemical reactions including fast reactions
- Explains collision and activated complex theory and determination of activation parameters for a reaction and homogeneous catalysis
- Explains the importance of adsorption process, heterogeneous catalysis, Langmuir, and BET model
- Explains thermodynamic properties
- Gets the fundamentals of electrochemistry and electrochemical cells

| | |
|---|---|
| **Unit I** | **Chemical Dynamics**<br>Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dyamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis of the nuclear magnetic resonance method, dynamics of unimolecular reaction (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories for unimolecular reactions). |
| **Unit II** | **Surface Chemistry**<br>**Adsorption**<br>Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).<br>**Micelles**<br>Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles. |
| **Unit III** | **Macromolecules**<br>Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures. |
| **Unit IV** | **Non Equilibrium Theromodynamics**<br>Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electrokinetic phenomena, diffusion, electric conduction. |

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| **Unit V** | **Electrochemistry**<br>Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte - solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance. |

**Books Suggested:**


1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R.McWeen y, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kineties and Mechanism of Chemical Transformation J.Rajaraman and J.Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. MOraoi, Plenum.
8. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy,Planum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J.Sridhar, Wiley Eastern.


# M.Sc. (Chemistry) M.Ed. Semester-IV

## Environmental Chemistry (MCT403)

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Learning outcomes: The Learner -**

- Learns the different concepts of atmosphere, stratospheric and tropospheric chemistry, photochemical smog, acid rain, atmospheric aerosols, and global climate.
- Interprets gases in hydrosphere, organic matter in water, humic material, metals in aqueous environment.
- Learns chemistry of colloids with reference to environment.
- Feels the adverse effect of air pollution and the need of its control.

| | |
|---|---|
| **Unit I** | **Atmosphere**<br>Atmospheric layers, Vertical temperature profile, heat/radiation budget of the earth atmosphere systems. Properties of troposphere, thermodynamic derivation of lapse rate. Temperature inversion. Calculation of Global means temperature of |

| | |
|---|---|
| | the atmosphere. Pressure variation in atmosphere and scale height. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus, oxygen. Residence times.<br>**Atmospheric Chemistry**<br>Sources of trace atmospheric constituents: nitrogen oxides, sulphur dioxide and other sulphur compounds, carbon oxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons.<br>**Tropospheric Photochemistry**<br>Mechanism of Photochemical decomposition of $NO_2$ and formation of ozone. Formation of oxygen atoms, hydroxyl, hydroperoxy and organic radicals and hydrogen peroxide.Reactions of hydroxyl radicals with methane and other organic compounds. Reaction of OH radicals with $SO_2$ and $NO_2$. Formation of Nitrate radical and its reactions. Photochemical smog meteorological conditions and chemistry of its formation. |
| **Unit II** | **Air Pollution**<br>Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health.<br>**Acid Rain**<br>Definition, Acid rain precursors and their aqueous and gas phase atmospheric oxidation reactions. Damaging effects on aquatic life, plants, buildings and health. Monitoring of $SO_2$ and $NO_2$. Acid rain control strategies<br>**Stratospheric Ozone Depletion**<br>Mechanism of Ozone formation, Mechanism of catalytic Ozone depletion, Discovery of Antarctic Ozone hole and Role of chemistry and meteorology. Control Strategies.<br>**Green House Effect**<br>Terrestrial and solar radiation Spectra, Major greenhouse gases and their sources and Global warming potentials. Climate change and consequences.<br>**Urban Air Pollution**<br>Exhaust emissions, damaging effects of carbon monoxide. Monitoring of CO. Control strategies. |
| **Unit III** | **Aquatic Chemistry and Water Pollution**<br>Redox chemistry in natural waters. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water, acid-base chemistry of fresh water and sea water. Aluminium, nitrate and fluoride in water. Petrification. Sources of water pollution. Treatment of waste and sewage. Purification of drinking water, techniques of purification and disinfection. |
| **Unit IV** | **Environmental Toxicology**<br>**Toxic heavy metals:** Mercury, lead, arsenic and cadmium. Causes of toxicity.<br>Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects. |

| | |
|---|---|
| | **Toxic Organic Compound:** Pesticides, classification, properties and uses of organ chlorine and ionospheres pesticides detection and damaging effects.<br>**Polychlorinated biphenyls:** Properties, use and environmental continuation and effects.<br>**Polynuclear Aromatic Hydrocarbons:** Source, structures and as pollutants. |
| **Unit V** | **Soil and Environmental Disasters**<br>Soil composition, micro and macronutrients, soil pollution by fertilizers, plastic and metals. Methods of remediation of soil. Bhopal gas tragedy, Chernobyl, three mile island, Minamata Disease, Saveso (Italy), London smog. |

**Books Suggested**


1. Environmental Chemistry, Colin Baird, W.H. Freeman Co. New York, 1998.
2. Chemistry of Atmospheres, R.P. Wayne, Oxford.
3. Environment Chemistry, A.K. De, Wiley Eastern, 2004.
4. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
5. Introduction to atmospheric Chemistry, P.V. Hobbs, Cambridge.


# M.Sc. (Chemistry) M.Ed. Semester-IV

**Practical-I Physical Chemistry (MCP404)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Chemical Kinetics | 5 |
| Potentiometry/pH metry | 5 |
| Polarimetry | 5 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**1. Chemical Kinetic**s

i. Determination of the effect of (a) Change of temperature (b) Charge of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reaction.

ii. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.

iii. Determination of the velocity constant for the oxidation of iodide ions by hydrogen peroxide study the kinetics as an iodine clock reactions.

iv. Flowing clock reactions (Ref : Experiments in Physical Chemistry by Showmaker)

v. Determination of the primary salt effect on the kinetics of ionic reaction and testing of the Bronsted relationship (iodide ion is oxidised by persulphate ion).

vi. Oscillatory reaction.

**2. Potentiometry/pH metry**

1. Determination of strengths of halides in a mixture potentiometrically.
2. Determination of the valency of mercurous ions potentiometrically.
3. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
4. Determination of temperature dependence of EMF of a cell.
5. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
6. Acid-base titration in a non-aqueous media using a pH meter.
7. Determination of activity and activity coefficient of electrolytes.
8. Determination of the dissociation constant of acetic acid in DMSO. DMF, acetone and dioxane by titrating it with KOH.
9. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Sderjeant method.
10. Determination of thermodynamic constants, DG, DS, and DH for the reaction by e.m.f. method. Zn + $H_2SO_4$ -> $ZnSO_4$ + 2 H

**3. Polarimetry**

1. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
2. Enzyme kinetics-inversion of sucrose.

**Books Suggested**

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

# M.Sc. (Chemistry) M.Ed. Semester-IV

**Practical-II Inorganic Chemistry (MCP405)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Duration | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Quantitative determinations of a three component mixture | 5 |
| Chromatographic Separations | 5 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**1. Quantitative determinations of a three component mixture:**

One volumetrically and two gravimetrically

a. $Cu^{+2}$, $Ni^{+2}$, $Zn^{+2}$

b. $Cu^{+2}$, $Ni^{+2}$, $Ag^{+1}$

**2. Chromatographic Separations**

a. Cadmium and zinc

b. Zinc and magnesium.

c. Thin-layer / paper chromatography-separation of nickel, manganese, cobalt and zinc. Determination of $R_f$ values.

**Books Suggested**

1. Inorganic Experiments, J. Derek Woolings, VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad.

# M.Sc. (Chemistry) M.Ed. Semester-V

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Int. | Ext. | Total |
| **1** | MCT501 | Application of Spectroscopy-II | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT502 | Biochemistry | T | 4 | 60 | 30 | 70 | 100 |
| **3 (a)** | MCT503A | Green Chemistry | T | 2 | 30 | 15 | 35 | 50 |
| **3 (b)** | MCT503B<br>MCT503C<br>MCT503D<br>MCT503E<br>MCT503F<br>MCT503G | Optional Papers – Select any one<br>Organotransition Metal/<br>Polymers/<br>Heterocyclic Chemistry/<br>Physical Organic Chemistry/<br>Chemistry of Materials/<br>Industrial Chemistry (Heavy | T | 2 | 30 | 15 | 35 | 50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Chemical and Petroleum) | | | | | | |
| **4** | MCP504 | Practical – I (Inorganic Chemistry-IV) | P | 1 | 30 | 5 | 20 | 25 |
| **5** | MCP505 | Practical – II (Organic Chemistry-IV) Project | P | 1 | 30 | 5 | 20 | 25 |
| **6** | MET506 | Research Methodology-II (CS-XI) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET507 | Indigenous Knowledge System (CS – XII) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | MET508A – MET508E | TS – III Thematic Specialization – III (Any one) ( TS 1.3/TS 2.3/TS 3.3/TS 4.3/TS 5.3) | T | 4 | 60 | 30 | 70 | 100 |
| **9** | MEP509 | Dissertation-II: Research in Education (Execution) (P-VI) | P | 1 | 30 | 25 | - | 25 |
| | | | **Total** | **27** | **450** | **215** | **460** | **675** |

**T: Theory P: Practical**

## Thematic Specialization:

TS1.3 –Educational Leadership and Supervision (MET508A)
TS2.3 – Learner's Assessment (MET508B)
TS3.3 – ICT Integration in Education (MET508C)
TS4.3 – Concern, Challenges and Issues in Inclusive Education (MET508D)
TS5.3 – Career Development (MET508E)

# M.Sc. (Chemistry) M.Ed. Semester-V

**Application of Spectroscopy-II (MCT501)**

| | **External** | **Internal** |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes: The Learner -**

- Identifies functional groups using IR and UV visible spectroscopic data.
- Interprets Cotton effect curves for obtaining absolute configuration of chiral molecules with chromophores.
- Determines chemical structure by UV-Vis, IR, $^{1}$HNMR, $^{13}$CNMR and mass spectral data.

| | |
|---|---|
| **Unit I** | **Ultraviolet and Visible spectroscopy**<br>Various electronic transitions (185-800 nm) Beer-Lambert law, Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. |
| **Unit II** | **Infrared Spectroscopy**<br>Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. |
| **Unit III** | **Nuclear Magnetic Resonance of paramagnetic Substances in Solution:**<br>The contact and pseudo contact shifts, factor affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclide with emphasis on $^{195}$Pt and $^{119}$Sn NMR. |
| **Unit IV** | **Carbon-13 NMR Spectroscopy**<br>General considerations, chemical shift (aliphatic olefinic , alkyne, aromatic, heteroaromatic and carboynl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOESY, DEPT, HMBC and HMQC techniques. |
| **Unit V** | **Mass Spectrometry**<br>Introduction ion production EI, CIFD, ESI and FAB, factors affecting fragmentation, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak. Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Structure elucidation of simple molecules using UV- visible, IR, NMR and mass spectral techniques. |

**Book Suggested:**


1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock,ELBS.
3. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry vol., 8, ed., F.A. Cotton, vol., 15 ed. S.J. Lippard, Wiley.
5. Transition Metal Chemistry ed. R.L. Carlin vol. 3 dekker.
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, .V. Parish, Ellis Haywood.

8. Practical NMR Spectroscopy, M.L. Martin. J.J. Deepish and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morril, John Wiley.
10. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.
13. Structural Method in Inorganic Chemistry, E.A.V. Ebsworth , D.W.H. Rankin and S. Cradock, ELBS.
14. Introduction of NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley

# M.Sc. (Chemistry) M.Ed. Semester-V

**Biochemistry (MCT502)**

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes:The Learner** -

- Describes the structure and biological functions of proteins and explains the role of metals in biology.

- Explains the roles of metals in biological systems and toxic effects of metals.
- Learns the use of metals in biological systems, various aspects of coordination chemistry related to bioinorganic research, metallobiopolymers, their structure, function, role of metal ion, etc.
- Gets the knowledge of Biochemistry of metals like Na, K, Fe, Ca and Mn.

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| **Unit I** | **Metal Ions in Biological Systems**<br>Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and $K^+/Na^+$ pump.<br>**Bioenergetics and ATP Cycle.**<br>DNA polymerisation, glucose storage, metal complexes in transmission of energy; chlorophyll's, photosystem I and photosystem II in cleavage of water.<br>**Transport and Storage of Dioxygen**<br>Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanin and hemerythrin, model synthetic complexes of iron, cobalt and copper. |
| **Unit II** | **Electron Transfer in Biology**<br>Structure and function of metal of proteins in electron transport processes cytochromes and iron-sulphur proteins, synthetic models.<br>**Nitrogen fixation**<br>Biological nitrogen fixation, and its mechanism, nitrogenase, Chemical nitrogen fixation. |
| **Unit III** | **Enzymes**<br>Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michael's-Menten and Lineweaver Burk plots, reversible and irreversible inhibition.<br>**Mechanism of Enzyme Action**<br>Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase.<br>**Kinds of Reactions Catalysed by Enzymes**<br>Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisation reactions, β-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. |
| **Unit IV** | **Co-Enzyme Chemistry**<br>Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, |

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| | pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.<br>**Enzyme Models**<br>Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality Biometric chemistry, crown ether, cryptates. Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionospheres, micelles synthetic enzymes or synzymes.<br>**Biotechnological Applications of Enzymes:** Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese making, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA Technology. |
| **Unit V** | **Biological Cell and its Constituents**<br>Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coils transition.<br>**Bioenergetics**<br>Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.<br>**Biopolymer Interactions**<br>Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibrium and various types of binding processes in biological systems. Hydrogen ion titration curves.<br>**Cell Membrane and Transport of Ions**<br>Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction. |

**Book Suggested:**


1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, 1. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Inorganic biochemistry vol. I and II ed. G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vol 18 and 38 ed J.J. Lippard, Wiley.
5. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
6. Understanding Enzymes, Trevor Palmer, Prentice Hall.
7. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, chemistry.
8. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
9. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
10. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael ID. Trevan, John Wiley.

11. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
12. Enzyme Structure and Mechanism, AFersht, W.H. Freeman
13. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

# M.Sc. (Chemistry) M.Ed. Semester-V

**Green Chemistry (MCT 503A)**

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|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes: The Learner –**

- Learns the concepts of green chemistry.
- Applies green chemistry for sustainable development.
- Adopts greener methods to synthesize organic and inorganic compounds.

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| **Unit I** | Introduction of Green Chemistry, need of Green chemistry, limitations/obstacles in their pursuits of the goals of Green Chemistry, twelve principals of green chemistry their explanations and examples, designing a green synthesis using these principles, prevention of waste bi-product, Atom Economy-maximum incorporation of the materials used in the process into final products. |
| **Unit II** | **Organic Synthesis in benign Green solvents**- use of different solvent (benign) for synthesis. Organic Synthesis in water- introduction, Different synthesis in water such as Pinacol Coupling, Aldol Condensation, Mannich type reactions, pericyclic reactions, Benzoin condensation, Oxidation, Reductions Wurtzs reaction organic Synthesis in Supercritical carbon- dioxide (SC-$CO_2$) for dry cleaning, use of supercritical Carbon-dioxide in some organic reactions- Diels- Alder reaction, Friedel-craft reaction, Hydrogenation, Coupling reactions, Free Radicals bromination.<br>Organic Synthesis using ionic liquids-types of ionic liquids, preparation of ionic liquids, Synthetic applications, Organic Synthesis using Polyethylene Glycol and its solution introduction, characteristics of the solvent and its application in different reactions. |
| **Unit III** | **Organic Synthesis using Green Reagents** –use of different Green reagents such as oxygen, singlet oxygen, Ozone, Hydrogen peroxide, Di-oxiranes, per-oxy acids, polymer supported reagents. Organic Synthesis using phase transfer catalysis-mechanism of phase transfer catalysis (PTC), types of phase transfers catalysts. Organic Synthesis using Crown Ethers and Bio-catalysts. |

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| **Unit IV** | **Use of Alternate Energy Process in Chemical Synthesis-**<br>a) Microwave Assisted Organic Synthesis-Introduction, Microwave assisted reactions in Water- Hofmann elimination, hydrolysis of benzl chloride, benzamide and methyl benzoate, oxidation of toluene, Microwave assisted reactions in Organic Solvents Diels-Alder reactions, Fries Rearrangement, Aromatic Substitutions, Esterifiaction |
| **Unit V** | **Organic Synthesis in Solid State- Solid State Reactions at room temperature-** Aldol Condensation, Grignard Reactions, Reformat sky Reaction, Solid State Reactions. Some Oxidation Reaction Solid State Reactions using Solid support- protections reactions, Oxidations, Reductions, Isomerisation.<br><br>**Photo Induced Organic Synthesis**- Introduction, Photochemical reactions-industrial application of Photochemistry- The Barton Reactions, Photochemical Synthesis of Vitamin D and related compounds, Photo-oxygenation, Photonitrosation. |

**Reference Books:-**


1. V.K. Ahluwalia & M. R. Kidwai: "New Trends in Green Chemistry ", Anamalya Publishers, 2005.
2. V.K. Ahluwalia: Green Chemistry A textbook, Narosa Publishers.
3. P.T. Anastes & J.K Warmer: "Oxford Green Chemistry theory & Practical", University Press, 1998.
4. M.C. Cann & M.E. Connely: "Real world cases in Green Chemistry Americal Chemical Society, Washington, 2000.
5. M.A. Ryan & M. Tinnesand: "Introduction to Green chemistry", Americal Chemical Society, Washington, 2002


# M.Sc. (Chemistry) M.Ed. Semester-V

## Organotransition Metal (MCT503B)

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| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes: The Learner -**

- Describes the structure and bonding in transition metal organometallic compounds.

- Describes the reactivity and reaction mechanism of various organometallic compounds.
- Describes the multicentric bonding in different organotransition metal compounds.
- Applies the acquired knowledge to explain the catalysis by various transition metal-organic compounds.

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| **Unit I** | **Alkyls and Aryls of Transition Metals**<br>Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.<br>**Compounds of Transition Metal-Carbon Multiple Bond**<br>Alkylidenes, alkylidynes, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis. |
| **Unit II** | **Transition Metal -Complexes**<br>Transition metal π -Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparation, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis. |
| **Unit III** | **Transition organometalic compounds:**<br>Transition metal compounds with bonds to hydrogen, boron, silicon |
| **Unit IV** | **Homogeneous Catalysis:**<br>Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxoreaction), explanation reactions, activation of C-H bond. |
| **Unit V** | **Fluxional Organometallic Compounds**<br>Flexionality and dynamic equilibrium in compounds such as $n^2$ olefine, n'-allyl and dienyl complexes. |

**Book Suggested-**


1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley,
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh New Age International.


# M.Sc. (Chemistry) M.Ed. Semester-V

**Polymers (MCT503C)**

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| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning outcomes: The Learner -**

- Acquires the knowledge about the polymers
- Interprets the structure of polymers using analytical techniques
- Classifies different types of inorganic molecules.

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| **Unit I** | **Basics**<br>Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition/radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems. |
| **Unit II** | **Polymer Characterization**<br>Polydispersion-average molecular weight concept. Number, weight and viscosity, average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. |
| **Unit III** | **Analysis and testing of polymers**<br>Chemical analysis of polymers, mechanical testing-tensile strength, flexural strength. Fatigue impact; tear resistance, Hardness and abrasion resistance. |
| **Unit IV** | **Inorganic Polymers**<br>A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers.<br>Structure, Properties and Applications of<br>a. Polymers based on boron-borazines, boranes and carboranes.<br>b. Polymers based on Silicon, silicone's polymetalloxanes and polymetallicsiloxanes, silazanes. |
| **Unit V** | Structure, Properties and Application of Polymers<br>a. Polymers based on Phosphorous-Phosphazenes, Polyphosphates<br>b. Polymers based on Sulphur Tetrasulphurtetranitride and related compounds.<br>c. Coordination and metal chelate polymers. |

**Books Suggested**

1. Inorganic Chemistry, J.E. Huheey, Harper Row.
2. Developments in Inorganic polymer Chemistry, M.F. Lappert and G.J. Leigh.
3. Inorganic polymers- N.H. Ray.
4. Inorganic polymers, Graham and Stone.
5. Inorganic Rings and Cages : D.A. Armitage.
6. Textbook of Polymers Science, F.W. Billmeyer Jr. Wiley.

7. Contemporary Polymer Chemistry, H.R. Al cock and F.W. Lambe, Prentice Hall

# M.Sc. (Chemistry) M.Ed. Semester-V

## Heterocyclic Chemistry (MCT503D)

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| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning outcomes: The Learner -**

- Comprehends nomenclature of different heterocyclic compounds.
- Interprets synthesis and reactivity of fused, six membered and smaller heterocyclic compounds.
- Categorizes and appreciates the importance of various natural products.

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| **Unit I** | **Nomenclature of Heterocycles**<br>Replacement and systematic nomenclature (HantzsMCH-Widman system) for monocyclic fused and bridged heterocycles.<br>**Aromatic Heterocycles**<br>General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. |
| **Unit II** | **Non-aromatic Heterocycle**<br>Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Atereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic synthesis-princples of heterocyclic synthesis involing cyclization reactions and cycloaddition reactions |
| **Unit III** | **Small Ring Heterocycles**<br>Three-membered and four-membered heterocycles-synthesis and reactions of azirodines, oxiranes, thiranes, azetidines, oxetanes and thietanes.<br>**Benzo-Fused Five-Membered Heterocycles**<br>Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes |
| **Unit IV** | **Meso-ionic Heterocycles**<br>General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.<br>**Six-Membered Heterocycles with one Heteroatom**<br>Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromones. |

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| **Unit V** | **Six Membered Heterocycles with Two or More Heteroatoms:** Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles: Synthesis and reactions of azepines, oxepines, thiepines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines.<br>**Heterocyclic Systems Containing P, As, Sb and B**<br>Heterocyclic rings containing phosphorus: Introduction, nomenclature, synthesis and characteristics of 5- and 6-membered ring systemsphosphorinaes, phosphorines, phospholanes and phospholes. Heterocyclic rings containing As and Sb: Introduction, synthesis and characteristics of 5- and 6-membered ring system. Heterocyclic rings. containing B: Introduction, synthesis reactivity and spectral characteristics of 3- 5- and 6 membered ring system. |

**Book Suggested:**


1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and g.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scietific Techinal.
5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, WileyInter Science.
6. An Introductiion to the Heterocyclic Compounds, R.M. Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. H Pergamon Press.


# M.Sc. (Chemistry) M.Ed. Semester-V

**Physical Organic Chemistry (MCT503E)**

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| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning outcomes:The Learner** -

- Understands chemical bonding and reactivity, various effects in organic molecules.
- Understands Acidity and basicity as well as aromaticity.
- Understands concepts of stereochemistry and stereochemical aspects in organic chemistry.
- Develops knowledge of substitution (electrophilic, nucleophilic), addition and elimination reactions.

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| **Unit I** | **Concepts in Molecular Orbital (MO) and Valence Bond (VB) Theory**<br>Introduction to Huckel molecular orbital (MO) method as a mean to explain modern theoretical methods. Advanced techniques in PMO and FMO theory. Molecular mechanics, semi empirical methods and ab initio and density functional methods. Scope and limitations of several computational programmes. |
| **Unit II** | **Quantitative MO theory: Huckel molecular orbital (HMO)**- method as applied to ethene, allyl and butadiene. Qualitative MO theory ionisation potential. Electron affinities. MO energy levels. Orbital symmetry. Orbital interaction diagrams. |

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| | MO of simple organic systems such as ethane, allyl, butadiene, methane and methyl group. Conjugation and hyper-conjugation. Aromaticity.<br>Valence bond (B) configuration mixing diagrams. Relationship between VB configuration mixing and resonance theory. Reaction profiles. Potential energy diagrams. Curve crossing model-nature of activation barrier in chemical reactions. |
| **Unit III** | **Principles of Reactivity**<br>Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrhenius equation. Transition state theory. Uses of activation parameters, Hammond's postulate, Bell-Evans Polanyi Principle. Potential energy surface model. Marcus theory of electron transfer. Reactivity and selectivity principles.<br>**Kinetic Isotope Effect**<br>Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunnelling effect. Solvent effects.<br>**Structural Effects on Reactivity**<br>Linear free energy relationships (LFER). The Hammett equation, substituent constants theories of substituent effects. Interpretation of 8-values. Reaction constants. Deviations from Hammett equation. Dual parameter correlations, inductive substituent constant. The Taft model, s1 and sR scales. |
| **Unit IV** | **Acids, Bases, Electrophiles, Nucleophiles and Catalysis**<br>Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity functions and their applicatins. hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The a-effect. Ambivalent nucleophiles. Acid-base catalysis-specific and general catalysis. Bronsted catalysis, Nucleophilic and electrophilic catalysis. Catalysis by noncovalent binding-micellar catalysis.<br>**Steric and Conformation Properties**<br>Various type of steric strain and their influence on reactivity. Steric acceleration. Molecular measurements of steric effects upon rates. Steric LFET, Conformational barrier to bond rotation-spectroscopic detection of individual conformers. Acyclic and monocyclic systems. Rotation around partial double bonds. Winstein-Holness and Curtin Hammett principle. |
| **Unit V** | **Nucleophilic and Electrophilic Reactivity**<br>Structural and electronic effects on SN and SN2 reactivity. Solvent effect, Kinetic isotope effects. Intramolecular assistance. Electron transfer nature of $SN^2$ reaction. Nucleophilicity and $SN^2$ reactivity based on curved crossing mode. Relationship between polar and electron transfer reactions, SRN mechanism. Electrophilic reactivity, general mechanism. Kinetic of $SE^2$ Ar reaction. Structural effects on rates and selectivity. Curve-crossing approach to electrophilic reactivity.<br>**Supramolecular Chemistry**<br>Properties of covalent bonds-bond length, inter-bond angles, force constant, bond and molecular dipole moments. Molecular and bond polarizability, bond dissociation enthalpy, entropy, intermolecular forces, hydrophobic effects. Electrostatic, |

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| | induction, dispersion and resonance energy, magnetic interactions, magnitude of interaction energy, forces between macroscopic bodies, medium effects. Hydrogen bond. |

**Book Suggested:**


1. Molecular Mechanics, U. Burket and N.L. Allinger, ACS Monograph 177, 1982.
2. Orgaic Chemists, Book of Orbitals: L. Salem and W.L. Jorgensen, Academic Press.
3. Mechanism and Theory in Organic chemistry, T.H. Lowry and K.C. Richadson, Harper and Row.
4. Introduction to Theoretical Organic Chemistry and Molecular Modeling.
5. Physical Organic Chemistry: N.S. Isaacs, ELBS/Longman.
6. Supramolecular Chemistry: Concepts and Perspective, J.M. Lehn, VCH.
7. The Physical Basis of Organic Chemistry: H. Maskill, Oxford University Press.


# M.Sc. (Chemistry) M.Ed. Semester-V

**Chemistry of Materials (MCT503F)**

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| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning outcomes: The Learner -**

- Understands different types of alloys and their application.
- Acquires the knowledge of preparing different types of thin films.
- Identifies different types of organic materials showing variety of properties.

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| **Unit I** | **A. Multiphase materials**<br>Ferrous alloys, Fe-C phase transformations in ferrous alloys, stainless steels, non ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.<br>**B. Glasses, Ceramics, Composites and Nanomaterials**<br>Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications.<br>Microscopic composites; dispersion-strengthened and particle-reinforced, firbre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications. |
| **Unit II** | **A. Thin Films and Langmuir-Blodgett Films**<br>Preparation techniques; evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Languir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films. |

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| | **B Liquid Crystals**<br>Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transition and clearing temperature-homeotropic, planer and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals. |
| **Unit III** | **A. Polymeric Materials**<br>Molecuar shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers.<br>**B. Ionic Conductors**<br>Types of ionic conductgors, mechanism of ionic conduction, interstitial jumps (Frenkil); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors |
| **Unit IV** | **High Tc Materials**<br>Defect perovskites, high Te superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high Tc, materials, applications of high Tc materials. |
| **Unit V** | **A. Materials of Solid State Devices**<br>Rectifiers, transistors, capacitors-IV-V compounds, low-dimentional quantum structures; optical properties.<br>**B. Organic Solids, Fullerenes, Muleuclar Devices**<br>Conducting organics, organic superconductors, magnetism in organic materials.<br>Fullerenes-doped, fullerenes as superconductors.<br>Moleuclar rectifiers and transistors, artificial phytosynthetic devices, optical storage memory and switches-sensors.<br>Nonlinear optical materials; nonlinear optical effects, second and third order-molecular hyperpolarisability an second order electric susceptibility - materials for second and third harmonic generation. |

**Book Suggested:**


1. Solid State Physics, N.W.Ashcroft and N.D.Mermin, Saunders College.
2. Materials Science and Engineering, An Introduction, W.D.Callister, Wiley.
3. Principles of the Solid State, H.V. Keer, Wiley Eastern.
4. Materials Sciences, J.C.Anderson, K.D.Leaver, J.M.Alexander and R.D. Rawlings, ELBS
5. Thermotropic liquid Crystals, Edl, G.W. Gray, John Wiley.
6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.

# M.Sc. (Chemistry) M.Ed. Semester-V

**Industrial Chemistry (Heavy Chemical and Petroleum) (MCT503G)**

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| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning outcomes: The Learner -**

- Understands industrial applications of organometallic compounds in organic reactions.
- Analyzes mechanistic path ofreactions.
- Feels the importance of industrial process for extracting petrochemical products.

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| **Unit I** | **Water, Gases and Heavy Chemicals**<br>**Water:** Water Pollutants, their classes with examples, Biochemical zoxygen demand, thermal pollution, pollution by fertilizers, detergents, pesticides and industrial wastes.<br>**Water Purification:** Classical and modern Methods - Ion exchange electro dialysis, Reverse osmosis, Softening of Hard water. Chlorination and fluoridation. |
| **Unit II** | **Gases:** Chemistry Large- Sclae productin, storage, hazards and uses of the following industrial gases: Hydrogen, oxygen, nitrogen, carbon dioxide, chlorine, fluoriene, sulphur dioxide, phosgene, acetylene, argon, neon and helium.<br>**Heavy Chemicals**: Manufacture, Physical properties, Analysis, Hazards and applications of the following chemicals :<br>HCL, $H_2SO4$, HNO, H3FO4, polyphosphoric acid,<br>NaHCO3, NA2CO3, NaOH, NaCL, Na2S2O3, Bleaching Powder, Bromine. |
| **Unit III** | **Coal & Petroleum**<br>**Coal:** Origin and economic importance of coal. Coal composition, Coal carbonization, Coal gasification, Coal Gas, Water Gas, Producer gas, coal tar industry and manufacture of coal tar based chemicals and their importance. Role as carcinogens, Non-fuel uses of coal, and C1 Chemistry based on $MeOHCOCO_2$. CH4 and $CH_2O$. |
| **Unit IV** | **Petroleum**: Origin and composition, Refining, Reforming Fractionation; Cracking; knocking and Octane number, Kerosene and Napthe; Liquified petroleum gas (I.P.G.) Synthetic Gab Synthetic Petrol, Petrochemicals, manufacture of ethylene propylene. Butedmne, xylenes, etc. Economic importance with particular reference to India. |

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| **Unit V** | **Fats & Oils**<br>Fats & Oil Natural Fats, Edible and Industrial Oils of vegetable origin, common fatty acids and glycerides. Hydrogenation of Unsaturated oils, manufacture of Vasaspati and margarine. |

# M.Sc. (Chemistry) M.Ed. Semester-V

**Practical-Inorganic Chemistry (MCP504)**

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| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Teaching hours | 6-8 hrs |
| Total Credits | 01 |

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| Preparation | 5 |
| Spectrophotometric Determination | 5 |
| Flame Photometric Determinations | 5 |
| Record | 5 |
| Viva Voce | 5 |
| | ——— |
| Total | 25 |

**Preparation**

Preparation of selected inorganic compounds and their study by IR, electronic spectra, and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following:

1. Sodium amide. Inorg. Synth., 1946, 2, 128.
2. Atomic absorption analysis of Mg and Ca.
3. Synthesis of trichlorodiphenyl antimony (V) hydrate. Inorg. Synths., 1985, 23, 194
4. Sodium tetrathionate $Na_2S_4O_6$.
5. Metal complex of dimethyl sulfoxide : $CuCl_2$.2DMSO J.Chem. Educ., 1982, 59, 57.
6. Synthesis of metal acetylacetonate: Inorg. Synths, 1957, 5, 130, 1963, 1, 183.
7. Cis and Trans [Co $(en)_2CI_2$]+.
8. Determination of Cr (III) complex. [Cr $(H_2O)_6$]$NO_3$.3HO,Inorg. synths., 1972,13, 184.
9. Preparation and use of Ferrocene. J. Chem. Edu. 1966, 43, 73; 1976, 53, 730.
10. Preparation of [Co(phenanthroline-5,6 quinone)].

**Spectrophotometric Determinations**

a. Manganese/Chromium in steel sample.
b. Nickel by extractive spectrophotometric method.
c. Fluoride/nitrite/phosphate.
d. Copper-Ethylenediamine complex: Slope-ratio method.

**Flame Photometric Determinations**

a. Sodium and potassium when present together.

b. Lithium/calcium/barium/strontium.
c. Cadmium and magnesium in tap water.

**Books Suggested**

1. Inorganic Experiments, J. Derek Woolings, VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad.

# M.Sc. (Chemistry) M.Ed. Semester-V

**Practical-II Organic Chemistry (MCP505)**

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Teaching hours | 6-8 hrs |
| Total Credits | 01 |

Multi- step Synthesis of Organic Compounds 7

Spectroscopy/Spectrophotometric Determinations 8

Record 5
Viva Voce 5

Total 25

**Multi- step synthesis of organic compound**

The exercise should illustrate the use of organic reagent and may involve purification of the product by chromatographic techniques. Photochemical reaction Benzophenone>Benzopinacol>Benzopinacolone.

**Backmann rearrangement**: Benzanilide from benzene: Benzene>Benzophenone ->Benzophenoneoxime>Benzanilide

**Benzilic acid rearrangement:**Benzilic acid from benzoin (Benzoin ->Benzil->Benzilic acid) - Synthesis of heterocyclic compounds.

**Skraup synthesis:** Preparation of quinoline from aniline

**Fischer Indole synthesis**: Preparation of 2- phenylindole from phenylhydrazine. Enzymatic synthesis Enzymatic reduction :reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S(+) ethyl -3-hydroxybutanoate and determine its optical purity-> Biosynthesis of ethanol from sucrose. Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride->. Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide.

**Spectroscopy**

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR & MS)

Spectrophotometric (UV/VIS) Estimations of the following (any one compound)

**Spectroscopic estimation**

1. Amino acids
2. Proteins
3. Carbohydrates
4. Ascorbic acid
5. Aspirin
6. Caffeine

Isolation

1. Casein from Milk
2. Lycopine from tomato
3. Piperine from black pepper
4. Caffeine from tea leaves
5. Lactos from milk

**Books Suggested**

1. The Systematic Identification of Organic Compounds, R.L. Shriner and D.Y. curlin.

# M.Sc. (Chemistry) M.Ed. Semester-VI

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/ | Credit | Hours | Int. | Ext. | Total |
| **1** | MCT601 | Solid State Chemistry | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MCT602 | Photochemistry | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MCT603A<br>MCT603B<br>MCT603C<br>MCT603D<br>MCT603E<br>MCT603F | Optional Papers – Select any two [Organic Synthesis/ Chemistry of Natural Products/ Analytical Chemistry/ Electrochemistry/ Medicinal chemistry/ Industrial Chemistry (Pesticides and Glass Industries)] | T | 2+2 | 30+30 | 15 | 35+3 | 50+5 |
| **4** | MCP604 | Practical – I (Physical Chemistry-III) | P | 1 | 30 | 5 | 20 | 25 |
| **5** | MCP605 | Innovative Project activities in Science/Mathematics (Chemistry) (P-VI) | P | 1 | 30 | 5 | 20 | 25 |
| **6** | MET606 | Education for Sustainable Development (CS-XIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | MET607A<br>MET607B<br>MET607C<br>MET607D | Generic Elective Course (GE) (Any One)<br>I – Indian Values Culture & Heritage<br>II – Vocational Opportunities<br>III – Programme and Institutional Assessment<br>IV – Physical Education, Yoga & Wellness | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **8** | MEP608 | Application of ICT in Education (P-VII) | P | 2 | 60 | 50 | - | 50 |
| **9** | MEP609 | Dissertation-3: Research in Education (Reports Submission) (P-VIII) | P | 4 | 60 | 50 | 50 | 100 |
| **Total** | | | | **28** | **480** | **260** | **440** | **700** |

**T: Theory P: Practical**

# M.Sc. (Chemistry) M.Ed. Semester-VI

**Solid State Chemistry (MCT601)**

| | |
|---|---|
| Max. Marks | 70 |
| Min Pass Marks | 28 |
| Teaching hours | 60 |
| Total Credits | 04 |

**Learning Outcomes:** The Learner -

- Interprets the structure of solid material.
- Makes in-depth study of the physical properties with emphasis to applications in the solid state.
- Analyzes the packing and efficiency of packing in solids
- Understands about the liquid crystals

| | |
|---|---|
| **Unit I** | **Solid State Reactions**<br>General principles, experimental procedure, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions. |
| **Unit II** | **Crystal Defects and Non-Stoichiometry**<br>Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects. |
| **Unit III** | **Electronic Properties and Band Theory**<br>Metals insulators and semiconductors, electronic structure of solids band theory band structure of metals, insulators and semiconductors, Intrinsic and extrinsic<br>Semiconductors, doping semiconductors, p-n junctions, superconductors. Optical Properties-Application of optical and electron microscopy. Magnetic Properties-<br>Classification of materials: Effect of temperature calculation of magnetic moment, mechanism of ferro and antiferromagnetic ordering super exchange. |
| **Unit IV** | **Organic Solids**<br>Electrically conducting solids. Organic charge transfer complex, organic metals, new superconductors. |
| **Unit V** | **Liquid Crystals:**<br>Types of liquid crystals: Nematic, Smectic, Ferroelectric, Antiferroelectric, Various theories of LC, Liquid crystal display, New materials. |

**Books Suggested:**

1. Solid state chemistry and its applications, A.R. West. Peenum.
2. Principles of the Solid State, H.V. Keer, Wiley Eastern.
3. Solid State Chemistry, N.B. Hannay.
4. Solid State Chemistry, D.K. Chakrabarty, New Wiley Eastern.

# M.Sc. (Chemistry) M.Ed. Semester-VI

**Photochemistry (MCT602)**

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|---|---|
| Max. Marks | 70 |
| Min Pass Marks | 28 |
| Teaching hours | 60 |
| Total Credits | 04 |

**Learning Outcomes:The Learner -**

- Assesses photochemical and photophysical principles.
- Identifies and characterizes transient intermediates by ultrafast modern techniques.
- Acquires the knowledge of photochemical and photophysical principles for macromolecules.
- Predicts the possibility of thermal and photochemical pericyclic reactions.
- Learns the basics of photochemical reactions of alkenes, carbonyl and aromatic compounds.

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|---|---|
| **Unit I** | **Photochemical Reactions**<br>Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. |
| **Unit II** | **Determination of Reaction Mechanism**<br>Classification, rate constants and life times of reactive energy state, determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. |
| **Unit III** | **Photochemistry of Alkenes**<br>Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.<br>**Photochemistry of Aromatic Compounds**<br>Isomerisations, additions and substitutions |
| **Unit IV** | **Photochemistry of Carbonyl Compounds**<br>Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α,β unsaturated compounds, cyclohexadienone. Intermolecular cycloaddition reactions-dimerisations and oxetane formation. |
| **Unit V** | **Miscellaneous Photochemical Reactions**.<br>Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen and its reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. |

**Books Suggested:**

1. Fundamentals of photochemistry, K.K. Rothagi-Mukheriji, Wiley-Eastern.

2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.

# M.Sc. (Chemistry) M.Ed. Semester-VI

**Organic Synthesis (MCT603A)**

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|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes:The Learner** -

- Proposes mechanistic path of organic synthesis.
- Learns retrosynthetic approach to plan organic synthesis.
- Converts different functional groups via rearrangement reactions.

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|---|---|
| **Unit I** | **Disconnection Approach**<br>An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemo selectivity, reversal of polarity, cyclisation reaction, amine synthesis. Protection of groups, chemo, region and stereo selectivity. |
| **Unit II** | **One Group C-C Disconnections**<br>Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylesnes and aliphatic Nitro compounds in organic synthesis.<br>Two Group C-C Disconnections<br>Diels- Alder Reactions, 1,3-disfunctionalised compounds, a-b- unsaturated carbonyl compounds, control in carbonyl condensation, 1, 5-difunctioalised compounds. Micheal addition and Robinson annelation. |
| **Unit III** | **Oxidation**<br>Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcholos, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate.<br>**Reduction**<br>Introduction, different reductive processes. Alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides Nitro, notros, azo and oxime groups, Hydrogenolysis. |

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| **Unit IV** | **Organometallic Reagents**<br>Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details. Group I and II metal organic compounds Li, Mg, Hg, Cd, Zn and Ce Compounds. |
| **Unit V** | Synthesis of some complex molecules:<br>Application of the above in the synthesis of following compounds:<br>Canphor, longifoline, cortisone, resprine, vitamin D, juvabion, aphidicolin and fredericamycin. |

**SUGGESTED READINGS:**


1. Designing Organic Synthesis, S. Warren. Wiley.
2. Organic Synthesis-concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O.House, W.A Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F. A Carey and R. J. Sundberg, Plenum Press.


# M.Sc. (Chemistry) M.Ed. Semester-VI

### Chemistry of Natural Products (MCT603B)

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|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes:The Learner** -

- Comprehends nomenclature of different heterocyclic compounds.
- Interprets synthesis and reactivity of fused, six membered and smaller heterocyclic compounds.
- Categorizes various natural products.

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|---|---|
| **Unit I** | Terpenoids and Carotenoids<br>Calcifications, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β- Carotene. |
| **Unit II** | Alkaloids<br>Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants, structure, |

| | |
|---|---|
| | stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+) Coniine, Nicotine, Atropine, Quinine and Morphine. |
| **Unit III** | Steroids<br>Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, Biosynthesis of steroids. |
| **Unit IV** | Plant Pigments<br>Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin Quercetin, Myrcetin, Quercetin 3-glucoside, Vitexin, Diadzein, Aureusin, Cyanidin-7 arabinoside, cyaniding, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and shikimic acid pathway.<br>Prophyrins<br>Structure and synthesis of Haemoglobin and chlorophyll. |
| **Unit V** | Prostaglandin<br>Occurrence, nomenclature, classification, biogenesis and physiological effects. Syntehsis of PGE2 and PGF2a.<br>Pyrethroids and Rotenones<br>Synthesis and reactions of Pyrethroids and Rotenones. (For structure elucidation, emphasis is to be place on the use of spectral parameters wherever possible). |

**Suggested Readings:**


1. Naturals Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.
2. Organic Chemistry: Vol.2 1L. Finar, ELBS.
3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elseveir.
5. Chemistry, Biological and Pharamacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marstone. Harwood Academic Publishers.
6. Introduction to flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Ataaur Rahman and M.L. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.

# M.Sc. (Chemistry) M.Ed. Semester-VI

**Analytical Chemistry (MCT603C)**

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|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes:The Learner -**

- Appreciates the importance of calibration of various glasswares and need of safety in the chemistry laboratory.
- Identifies errors in the experimental data and learns the techniques to minimize it.
- Acquires the knowledge of analytical chemistry behind food, water, soil and drugs.
- Feels the importance of clinical chemistry in day to day life.

| | |
|---|---|
| **Unit I** | **Introduction**<br>Role of analytical chemistry Classification of analytical methods classical and instrumental. Types of instrumental analysis. Selecting an analytical method. Neatness and cleanliness. laboratory operations and practices. Analytical balance. Techniques of weighing, errors. Volumetric glassware cleaning and calibration of glassware. Sample Volumetric glassware cleaning and Calibration of glassware. Sample preparation dissolution and decompositions. Gravimetric techniques. Selecting and handling of reagents. Laboratory notebooks. Safety in the analytical laboratory. |
| **Unit II** | **Errors and Evaluation**<br>Definition of terms in mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of error in experimental data determinate (systematic), indeterminate (or random) and gross. Sources of error and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. The uses of statistics. |
| **Unit III** | **Food analysis**<br>Moisture, ash, crude protein, fat crude fiber, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of foodstuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extraction and purification of samples- HPLC. Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products. |
| **Unit IV** | **Analysis of Water Pollution**<br>Origin of Wastewater, types, water pollutants and their effects. Sources of water pollution-domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. Objectives of analysis-parameter for analysis-colour, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different |

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| | forms of nitrogen, Heavy metal pollution-public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems. Measurements of DO, BOD, and COD. Pesticides as water pollutants and analysis. Water pollution laws and standards. |
| **Unit V** | **Analysis of soil, Fuel, Body Fluids and Drugs**<br>(a) **Analysis of Soil:** moisture pH total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.<br>**Fuel analysis**: liquid and gas. Ultimate and proximate analysis-heating values-grading of coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels-produced gas and water gas-calorific value.<br>(a) **Clinical Chemistry**: Composition of blood-collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphates. Immunoassay: principles of radio immunoassay (RIA) and applications. The blood gas analysis, trace elements in the body.<br>(b) **Drug analysis**: Narcotics and dangerous drugs. Classification of drugs. Screening by gas and thin- layer chromatography and spectrophotometric measurements. |

**Book Suggested:**


1. Analytical Chemistry, G.D. Christian, J.Wiley.
2. Fundamentals of analytical Chemistry. D.A. Skoog D.M. West and F.J. Hooler, W.B. Saunders.
3. Analytical Chemistry-Principles. J.H. Kennedy. W.B. Saunders.
4. Analytical Chemistry-Principles and Techniques. LG. Hargis. Prentice Hall.
5. Principles of Instrumental analysis D.A. Skoog and J.L. Loary, W.B. Saunders.
6. Principles of Instrumental Analysis D.A. Skoog W.B. Saunders.
7. Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
8. Environmental Solution, S.M. Khopkar, Wiley Eastern.
9. Basic Concepts of Analysis Chemistry, S.M. Khopkar, Wiley Eastern.
10. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall.


# M.Sc. (Chemistry) M.Ed. Semester-VI

**Electrochemistry (MCT603D)**

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|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes:The Learner** -

- Acquires the fundamental knowledge of electrochemical phenomenon.
- Studies the dynamics of electrochemical processes
- Investigates the electrochemical reason behind corrosion and the way to minimize it
- Applies bulk electrochemical methods for analysis.

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| **Unit I** | **1. Conversion and Storage of Electrochemical Energy Present status of energy consumption:** Pollution problem. History of fuel cells, Direct energy conversion by electrochemical means. Maximum intrinsic efficiency of an electrochemical converter. Physical interpretation of the Carnot efficiency factor in electrochemical energy converters. Power outputs.<br>Electrochemical Generators (Fuel Cells): Hydrogen oxygen cells, Hydrogen Air cell, Hydrocarbon air cell, Alkane fuel cell, Phosphoric and fuel cell, direct NaOH fuel cells, applications of fuel cells.<br>**2. Electrochemical Energy Storage :**<br>Properties of Electrochemical energy storage: Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density. Classical Batteries: (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc manganese dioxide. Modern Batteries: (i) Zinc-Air (ii) Nickel-Metal Hydride, (iii) Lithium Battery, Future Electricity stores: Storage in (1) Hydrogen, (ii) Alkali Metals, (iii) Non aqueous solutions. |
| **Unit II** | **Corrosion and Stability of Metals:**<br>Civilization and Surface mechanism of the corrosion of the metals; Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diaphragmsl; uses and abuses, Corrosion current and corrosion potential - Evans diagrams. Measurement of corrosion rate : (10 Weight Loss method, (ii) Electrochemical Method.<br>**Inhibiting Corrosion:**<br>Cathodic and Anodic Protection. (i) Inhibition by addition of substrates to the electrolyte environment, (ii) by charging the corroding method from external source, anodic Protection, Organic inhibitors, The fuller Story Green inhibitors.<br>**Passivation:**<br>Structure of Passivation films, Mechanism of Passivation, Spontaneous Passivation Nature's method for stabilizing surfaces. |
| **Unit III** | **Bioelectrochemistry**<br>Bioelectrodics, Membrane Potentials, Simplistic theory, Modern theory, Electrical conductance in biological organism: Electronic, Protonic electrochemical mechanism of nervous systems, enzymesas electrodes.<br>**Kinetic of Electrode Process:**<br>Essentials of Electrode reaction. Current Density, over potential, Tafel Equation, Butler Volmer equation. Standard rate constant (KO) and Transfer coefficient (a), Exchange Current.<br>**Irreversible Electrode processes:**<br>Criteria of irreversibility, information from irreversible wave |
| **Unit IV** | **Methods of determining kinetic parameters for quasi-reversible and irreversible waves:**<br>Koutecky's methods, Meits Israel Method, Gellings method Electrocatalysis**:** |

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|---|---|
| | Chemical catalysts and Electrochemical catalysts with special reference to purostates, porphyrin oxides of rare earths. Electrocatalysis in simple redox reactions, in reaction. involving adsorbed species. Influence of various parameters. |
| **Unit V** | **Potential Sweep Method:**<br>Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications. Diagnostic criteria of cycli voltammetry. Controlled current microelectrode techniques : comparison with controlled potentials methods, chronopotentiometry, theory ad applications.<br>**Bulk Electrolysis Methods**<br>Controlled potential coulometry, Controlled Coulometry, Electroorganic synthesis and its important applications. Stripping analysis: anodic and Cathodic modes, Pre electrolysis and Stripping steps, applications of Stripping Analysis. |

**SUGGESTED READINGS:**


1. Modern Electrochemistry Vol. I, Ila, Vol. IIB J'OM Bockris and A.K.N. Reddy, Plenum Publication, New York.
2. Polarographic Techniques by L. Meites, Interscience.
3. "Fuel Cells: Thjeir electrochemistry". McGraw Hill Book Company, New York.
4. Mom Polarographic Methods by A.M. Bond, Marcell Dekker.
5. Polarography and allied techniques by K. Zutshi, New age International publicatin. New Delhi.
6. "Electroaalytical Chemistry by Basil H. Vessor & Galen W.; Wiley Interscience.
7. Electroanalytical Chemistry by Basil H. Vessor & alen w.; Wiley Interscience.
8. Topics in pure and Applied Chemistry, Ed. S. K. Rangrajan, SAEST Publication, Karaikudi (India**)**


# M.Sc. (Chemistry) M.Ed. Semester-VI

**Medicinal chemistry (MCT603E)**

| | |
|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes:The Learner -**

- Defines and classifies drugs with examples and their structures
- Explains the Drugs used for various infectious diseases caused by pathogens
- Describes the structure and activity relation of important class of drugs
- Studies the details ofdrug action in the human body.
- Investigates the side effects of various types of drugs and the ways to minimize it.

| | |
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| **Unit I** | **Structure and activity**<br>Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combination |

| | |
|---|---|
| | synthesis in drug discovery. Factors affecting bioactivity. QSAR-Free-Wilson analysis, Hansch analysis, relationship between Free-Wilson analysis and Hansch analysis. |
| **Unit II** | **Pharmacodynamics**<br>Introduction, elementary treatment of enzymes stimulation, enzyme inhibition, sulfonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry. |
| **Unit III** | **Antibiotics and antibacterials**<br>Introduction, Antibiotic β-Lactam type - Penicillins, Cephalosporins, Antitubercular, Streptomycin, Broad spectrum antibiotics. Tetracyclines, Anticancer – Dactinomycin (Actinomycin D) |
| **Unit IV** | **Antifungal**<br>Polyenes, Antibacterial - Ciprofloxacin, Norfloxacin, Antiviral - Acyclovir.<br>**Antimalarials:** Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine |
| **Unit V** | **Non-steroidal Anti-inflammatory Drugs**<br>Diclofenac Sodium, Ibuprofen and Nefopam<br>**Antihistaminic and antiasthmatic agents:** Terfenadine, Cinnarizine, Salbutamol and Beclomethasonedipropionate. |

**Book Suggested:**


1. Introduction to medicinal chemistry, A. Gringuage,Wiley-VCH.
2. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical chemistry,Ed Robert F Dorge.
3. An introduction to Drug Design, S.S Pandeya and J.R. Dimmock,New Age International.
4. Burger's Medicinal Chemistry and Drug Discovery,Vol-I(Chapter-9 and Chapter-14), Ed.M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological basis of Therapeutics, McGraw-Hill.
6. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.
7. Strategies for Organic Drug synthesis and Design, D. Lednicer , John Wiley.
8. Principles of Medicinal Chemistry W.O. Foye.
9. Medicinal Chemistry: The Role of organic chemist in Drug Research, S.M. Roberts and B.J. Pricer.


# M.Sc. (Chemistry) M.Ed. Semester-VI

**Industrial Chemistry (Pesticides and Glass Industries) (MCT603F)**

| | |
|---|---|
| Max. Marks | 35 |
| Min Pass Marks | 14 |
| Teaching hours | 30 |
| Total Credits | 02 |

**Learning Outcomes: The Learner -**

- Classifies different types of cleansing agent.
- Understands the manufacturing process of fertilizers.
- Acquires the knowledge of different type of cements and its manufacturing process.

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|---|---|
| **Unit I** | **Cleansing Agents**<br>Cleansing Agents: Toilet and washing soaps; preparation and uses, synthetic detergents; alkyl sulfonates, fatty alcohot surfaces, ethanolamines, non-ionic detergents. |
| **Unit II** | **Fertizilizers and Inorganic Materials:**<br>Fertilizers: Fertilizers Industries in India, Manufacture of Ammonium salts, Urea, Nitrates, Phosphates and Supephosphates, Nitrogen fixation.<br>**Gases:** Types, their composition and properties testing glass. Manufacture of Glass Fibers. Optical Glass, Coloured Glasses, Lead Glass and Neutron absorbing Glass.<br>**Ceramics**: Important clays and feldspar. Glazing and vitrification, Glass ceramics |
| **Unit III** | **Cement:** Types and their manufacture, setting process.<br>**Ferrous Industry:** Manufacture of steel and other important alloys.<br>**Silicon:** Pre Silicon, Electronics Industry. |
| **Unit IV** | **Pesticies and Food additives**<br>Pesticies and food additives: Classification, important categories of insecticides, fungicides, herbicides and rodenticies; mode of action. |
| **Unit V** | **Chemistry and synthesis of common pesticides**: Such and tabum, sarin, Daygon, DDYP paraquat. |

# M.Sc. (Chemistry) M.Ed. Semester-VI

**Practical-I Physical Chemistry (MCP604)**

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|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Teaching hours | 6-8 hrs |
| Total Credits | 01 |

| | |
|---|---|
| Group A | 8 |
| Group B | 7 |
| Record | 5 |
| Viva Voce | 5 |
| Total | 25 |

**Group A**

**Spectroscopy**

i. Determination of $_{P}Ka$ of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.

ii.Determination of stoichiometry and stability constant of Ferricisothiocyanate complex ions in solution.

iii. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.

**Thermodynamics**

i. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.

ii. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intramolecular interactions (benzoic acid in water and in DMSO water mixture and calculate the partial molar heat of solution.)

**Group B**

**Chemical Kinetics**

i. Determination of rate constant and formation constant of an intermediate complex in the reaction of Ce (IV) and Hypo phosphorous acid at ambient temperature.

ii. Determination of energy and enthalpy of activation in the reaction of $KMnO_4$ and benzyl alcohol in acid medium.

iii. Determination of energy of activation and entropy of activation from a single kinetic run.

iv. Kinetics of an enzyme catalyzed reaction.

**Polarography**

i. Identification and estimation of metal ions such as $Cd^{+2}$, $Pb^{+2}$, $Zn^{+2}$, and $Ni^{+2}$ etc. polarographically.

ii. Study of a metal ligand complex polarographically (using Lingane's Method).

**Books Suggested:**

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill

# M.Sc. (Chemistry) M.Ed. Semester-VI

## Chemistry Project (MCP605)

| | |
|---|---|
| Max. Marks | 25 |
| Min Pass Marks | 10 |
| Teaching hours | 6-8 hrs |
| Total Credits | 01 |

**Title** As **Project (Chemistry):** decided by faculty members.

## GE – I: Generic Elective (Any one)

| | **External** | **Internal** |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Periods per week | 04 | |
| Total Credits | 04 | |

1. Indian Values, Culture and Heritage
2. Vocational Opportunities, Start-Up and Entrepreneurship
3. Programme and Institutional Assessment
4. Physical Education,Yoga and Wellness

# Three-Year Integrated M.Sc. (Mathematics) M.Ed. Programme

## (A) Course Structure with Credits

### 1.1 M.Sc. (Mathematics) M.Ed. First Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| **1** | MM101 | Advanced Abstract Algebra | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MM102 | Real Analysis -I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MM103 | Complex Analysis-I | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MM104 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME101 | Educational Studies (CS-I) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME102 | Philosophical Perspectives of Education (CS-II) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME103 | Teacher Education-I (CS - III) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME104 | Self-Development (P - I) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T–** Theory**, P–** Practical and **CS-** Core Subject

### 1.2 M.Sc. (Mathematics) M.Ed. Second Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| **1** | MM201 | Functional Analysis | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MM202 | Real Analysis -II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MM203 | Complex Analysis-II | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MM204 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME201 | Psychology of Learning and Development (CS - IV) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME202 | Curriculum Studies (CS - V) | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **7** | ME203 | Sociology of Education (CS - VI) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME204 | Academic Writing (P - II) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T–** Theory, **P–** Practical and **CS-** Core Subject

### 1.3 M.Sc. (Mathematics) M.Ed. Third Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| **1** | MM301 | Topology-1 | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MM302 | Differential Geometry | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MM303* | Optional (Mathematics) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MM304 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME301 | Cross Curricular Pedagogical Approaches (CS -VII) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME302 | Teacher Education-II (CS - VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME303* | TS–I Thematic Specialization I (Any one)TS1.1/TS2.1/TS3.1/TS4.1 /TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME304 | Internship-I-Internship in Teacher Education (P – III) | P | 2 | 60 | 50 | - | 50 |
| | | **Total** | | **28** | **480** | **240** | **460** | **700** |

**T–**Theory **P**– Practical **CS-**Core Subject **TS-**Thematic Specialization Course **GE-**Generic Elective Course

**Optional MM303*: Mathematics**

| Paper Code | Name of Paper |
|---|---|
| MM303(a) | Graph Theory |
| MM303(b) | Mathematical Modeling |
| MM303(c) | Advanced Probability Theory |
| MM303(d) | Tensor and Riemann Geometry |

**Optional ME303*: Thematic Specialization I**

| Paper Code | Name of Paper |
|---|---|

| | |
|---|---|
| ME303(a) | **TS1.1 -** Educational Management, Administration and Leadership |
| ME303(b) | **TS2.1-** Curriculum Theory Planning and Development |
| ME303(c) | **TS3.1-** Foundations of Educational Technology |
| ME303(d) | **TS4.1 -** Understanding and development of Equitable and Inclusive Education |
| ME303(e) | **TS5.1–** Guidance and Counselling in School |

### 1.4 M.Sc. (Mathematics) M.Ed. Fourth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MM401 | Topology -II | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MM402 | Advanced Operations Research | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MM403 | Fuzzy sets and their applications | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MM404 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| 5 | ME401 | Historical, Political and Economic Perspectives of Education (CS - IX) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME402 | Research Methodology -I (CS - X) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME403* | TS II- Thematic Specialization II (Any one: TS1.2/TS2.2/TS3.2/TS4.2/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | ME404 | Dissertation-1: Research in Education (Planning) (P- IV) | P | 1 | 30 | 25 | - | 25 |
| 9 | ME405 | Internship II - Thematic Specialisation (P – V) | P | 2 | 60 | 50 | - | 50 |
| **Total** | | | | **29** | **510** | **265** | **460** | **725** |

**Optional ME403*: Thematic Specialization II**

| Paper Code | Name of Paper |
|---|---|
| ME403(a) | TS1.2–Educational Planning |
| ME403(b) | TS2.2–Learning and Pedagogy of School Subjects |
| ME403(c) | TS3.2–ICT in Education |
| ME403(d) | TS4.2–Addressing the diverse needs in Inclusive setting |
| ME403(e) | TS5.2 – Assessment and Appraisal in Guidance and Counselling |

### 1.5 M.Sc. (Mathematics) M.Ed. Fifth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | Assessment Scheme |
|---|---|---|---|---|

| | | | T/P | Credit | Hours | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | MM501 | Advance Numerical Analysis | T | 4 | 60 | 30 | 70 | 10 |
| 2 | MM502 | Mathematical Statistics | T | 4 | 60 | 30 | 70 | 10 |
| 3 | MM503* | Optional (Mathematics) | T | 4 | 60 | 30 | 70 | 10 |
| 4 | MM504 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| 5 | ME501 | Research Methodology -II(CS - XI) | T | 4 | 60 | 30 | 70 | 10 |
| 6 | ME502 | Indigenous Knowledge System (CS – XII) | T | 4 | 60 | 30 | 70 | 10 |
| 7 | ME503* | TS – III Thematic Specialization III(Any one: TS1.3/TS2.3/TS3.3/TS4.3/TS5.3 ) | T | 4 | 60 | 30 | 70 | 10 |
| 8 | ME504 | Dissertation-2: Research in Education(Execution)(P–VI) | P | 1 | 30 | 25 | - | 25 |
| **Total** | | | | **27** | **450** | **21** | **46** | **67** |

**Optional MM503*: Mathematics**

| Paper Code | Name of Paper |
|---|---|
| MM503(a) | Advanced Discrete Mathematics |
| MM503(b) | Number Theory |
| MM503(c) | Module Theory |
| MM503(d) | Integral Transforms |

**Optional ME503*: Thematic Specialization III**

| Paper Code | Name of Paper |
|---|---|
| ME503(a) | **TS1.3 –**Educational Leadership and Supervision |
| ME503(b) | **TS2.3 –** Learners' Assessment |
| ME503(c) | **TS3.3 –** ICT Integration in Education |
| ME503(d) | **TS4.3 –** Concern, Challenges and Issues in Inclusive Education |

| | |
|---|---|
| ME503(e) | **TS5.3 –** Career Development |

### 1.6 M.Sc. (Mathematics) M.Ed. Sixth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MM601 | Differential and Integral Equations | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MM602 | Special Functions | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MM603 | Dissertation/Project in Mathematics | T/P | 4 | 60 | 30 | 70 | 100 |
| 4 | MM604 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| 5 | ME601 | Education for Sustainable Development (CS -XIII) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME602* | Generic Elective course (GE) (any one of the following)(GE-I/GE-II/GE-III/GE-IV) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME603 | Application of ICT in Education (P – VII) | P | 2 | 60 | 50 | | 50 |
| 8 | ME604 | Dissertation-3: Research in Education (Report Submission) (P-VIII) | P | 4 | 60 | 50 | 50 | 100 |
| **Total** | | | | 28 | 480 | 260 | 440 | 700 |

**Optional ME602*: Generic Elective course (GE)**

| Paper Code | Name of Paper |
|---|---|
| ME602(a) | GE-I Indian Values, Culture and Heritage |
| ME602(b) | GE-II Vocational Opportunities, Start-Up and Entrepreneurship |
| ME602(c) | GE-III Programme and Institutional Assessment |
| ME602(d) | GE-IV Physical Education, Yoga, and Wellness |

## Credit and Hours Distribution for M.Sc (Mathematics) M.Ed.

| S. No. | Semester | M.Sc. | | | M.Ed. | | |
|---|---|---|---|---|---|---|---|
| | | Credits | Hours | Marks | Credits | Hours | Marks |
| **1.** | I | 14 | 240 | 350 | 14 | 240 | 350 |
| **2.** | II | 14 | 240 | 350 | 14 | 240 | 350 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **3.** | III | 14 | 240 | 350 | 14 | 240 | 350 |
| **4.** | IV | 14 | 240 | 350 | 15 | 270 | 375 |
| **5.** | V | 14 | 240 | 350 | 13 | 210 | 325 |
| **6.** | VI | 14 | 240 | 350 | 14 | 240 | 350 |
| **Grand Total** | | **84** | **1440** | **2100** | **84** | **1440** | **2100** |

## (B) Syllabus with Credit Based Choice System (CBCS)

### 1.1 M.Sc. (Mathematics) M.Ed. First Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| **1** | MM101 | Advanced Abstract Algebra | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MM102 | Real Analysis -I | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MM103 | Complex Analysis-I | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MM104 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME101 | Educational Studies (CS-I) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME102 | Philosophical Perspectives of Education (CS-II) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME103 | Teacher Education-I (CS - III) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME104 | Self-Development (P - I) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T – Theory and P – Practical**

# Paper MM101: Advance Abstract Algebra

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Advance Abstract Algebra with new ideas.
- solve problems in the subject of Advance Abstract Algebra.
- enhance confidence level to teach the same subject
- increase their capacity to develop logics.
- generalize some important theorems of Advance Abstract Algebra.

| | |
|---|---|
| **Unit-I** | 1.1 Normal andSubnormal series of groups, Composition series<br>1.2 Jordan-Holder series<br>1.3 Solvable & Nilpotent groups. |
| **Unit-II** | 2.1 Extension fields,<br>2.2 Algebraic and transcendental extensions,<br>2.3 Splitting fields. , Algebraically closed fields,<br>2.4 Roots of polynomials. |
| **Unit-III** | 3.1 Contruction with Straightedge and Compass,<br>3.2 Constructible numbers,<br>3.3 Irrationality of $\pi$. Impossibility of trisection of $60°$ angle. |
| **Unit-IV** | 4.1 Separable and inseparable extension,<br>4.2 Perfect fields,<br>4.3 Finite fields. |
| **Unit-V** | 5.1 Group of Automorphisms of extension,<br>5.2 Galois extension,<br>5.3 Fundamental theorem of Galois theory Solution of polynomial equations by radicals,<br>5.4 Insolubility of general equation of degree 5 by radicals. |

**Text books:**


(1) John B. Fraleigh. A First Course in Abstract Algebra, Narosa Publishing House.
(2) I.N. Herstein, Topics in Algebra, Wiley Eastern, New Delhi.
(3) I.N. Herstein, Abstract Algebra, Macmillan Publishing Company New York
(4) P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Cambridge University press.


**Reference books:**

(1) N. Jacobson, Basic Algebra, Vol. I, II & VIII, Hindustan Publishing Company.
(2) S. Lang, Algebra, Addison- Wesley.
(3) I.S. Luther and I.B.S. Passi Algebra vol-1,2,3 Narosa company.
(4) V.Sahaiand V. Bisht, Algebra, Narosa Publishing House.
(5) Saunders Mac Lane and Garrett Birkhoff

## Paper MM102: Real Analysis-I

| | External | Internal |
|---|---|---|

| | | |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Real Analysis with new ideas.
- increase their capacity to develop logics of Real Analysis.
- solve problems in the subject of Real Analysis.
- enhance confidencelevel to teach the same subject
- generalize some important theorems of Real Analysis.

| | |
|---|---|
| **Unit-I** | 1.1 Countable and uncountable sets,<br>1.2 Construction of integers using Peano's axioms,<br>1.3 Construction of real numbers using Dedekind's cut. |
| **Unit II** | 2.1 Definition and existence of Riemann- Stieltjes integral and its properties,<br>2.2 Fundamental theorem of Calculus,<br>2.3 Integration of vector- valued functions,<br>2.4 Rectifiable curves. |
| **Unit-III** | 3.1 Sequences and series of functions,<br>3.2 Point wise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Drichlet's tests for uniform convergence , uniform convergence and continuity,<br>3.3 Uniform convergence and Riemann-Stieltjes integration,<br>3.4 Uniform convergence and differentiation, Weirstrass approximation theorem. |
| **Unit-IV** | 4.1 Functions of several variables,<br>4.2 Derivative as a linear transformation, Derivatives in an open subset of $R^n$ ,Chain rule, directional derivative,<br>4.3 Partial derivatives, interchange of order of differentiation, differentiation, Inverse function theorem,<br>4.4 Functions of bounded variation. |
| **Unit-V** | 5.1 Power series, uniqueness theorem for power series, Abel's and Tauber's<br>5.2 theorems, Implicit function theorem, Jacobians. |

**Text books:**

(1) Walter Rudin, Principles of Mathematical Analysis, McGraw Hill.
(2) S.C.Malik, Savita Arora Mathematical Analysis, New Age International publishers.
(3) H.L. Royden & P. M. Fitzpatrick, Real Analysis, Pearson (Fourth Edition).
(4) J.N. Sharma and A. R. Vasishtha , Real Analysis, Krishna Prakashan.

**Reference books:**

(1) T.M. Apostal, Mathematical Analysis Narosa.
(2) Introduction to Real Analysis, Robert G. Bartle, Donald R. Sherbert, John Wiley & Sons.

# Paper MM103: Complex Analysis-I

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Complex Analysis with new ideas.
- increase their capacity to develop logics of Complex Analysis.
- solve problems in the subject of Complex Analysis.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Complex Analysis.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Complex numbers and their Geometric representation, Modulus and Argument o complex numbers, Stereographic projection, |
| | 1.2 | Continuity and differentiability of complex functions, Analytic functions, Cauchy Riemann equations, Harmonic functions, |
| | 1.3 | Multi valued function, Branches of many valued functions with special reference to arg z , log z and z3, |
| | 1.4 | Sequences, Series, Sequence and series of functions, power series, elementary transcendental function. |
| **Unit-II** | 2.1 | Complex line integral, Winding number, Cauchy – Goursat theorem, Cauchy integral formula, |
| | 2.2 | Morera's theorem, Cauchy's inequality, Liouville's theorem, The fundamental theorem of algebra, Taylor's theorem. |
| **Unit-III** | 3.1 | Laurent series, Singularities. Meromorphic functions, Open mapping theorem, argument principle, |
| | 3.2 | The maximum modulus principle, Schwartz lemma, Rouche's theorem, Inverse function theorem. |
| **Unit-IV** | 4.1 | Residues, Cauchy's residue theorem, Evaluation of integrals. |
| **Unit-V** | 5.1 | Conformal mapping, Definitions and examples of conformal mappings, Sufficient and necessary condition, Some elementary transformation, |
| | 5.2 | Bilinear transformations, their properties and classification, cross ratio. |

**Text books:**

(1) J.B. Convey, Functions of one complex variable, Springer-verlag.
(2) J. N. Sharma, Function of a complex variable, Krishna Prakashan Media (P) Ltd.
(3) S. Ponnuswamy, Foundations of complex analysis, Narosa Publishing House.

**Reference books:**

1.21 L.V. Ahlfors, Complex analysis, McGraw Hill.

# Paper MM104: Mathematics Practical

| | External | Internal |
|---|---|---|
| Max. Marks (50) | 40 | 10 |
| Min Pass Marks | 16 | 4 |
| Periods Per week | 04 | |
| Total Credits | 02 | |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- verify content and concept of Mathematics papers MM101, MM102 and MM103 by using Mathematical software or computer programming language.
- connect basic concepts of Mathematics papers MM101, MM102 and MM103 content with new ideas.
- increase their skillsof analysisand problem solving using Mathematical software or computer programming language.
- visualize some important theorems and concepts of the Mathematics papers MM101, MM102 and MM103 using Mathematical software or computer programming language.
- demonstrate the concepts of Mathematics papers MM101, MM102 and MM103 through seminar etc.
- understand applications of Mathematics papers MM101, MM102 and MM103.
- use various application of Mathematics papers MM101, MM102 and MM103 with daily life problem.

**Activities:**

- Activity oriented problem solving/Experiments using Mathematical software or computer programming language based on the content studied in Mathematics papers MM101, MM102 and MM103.
- Mathematics seminar.

**1.2 M.Sc. (Mathematics) M.Ed. Second Semester**

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| **1** | MM201 | Functional Analysis | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MM202 | Real Analysis -II | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MM203 | Complex Analysis-II | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MM204 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME201 | Psychology of Learning and Development (CS - IV) | T | 4 | 60 | 30 | 70 | 100 |
| **6** | ME202 | Curriculum Studies (CS - V) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME203 | Sociology of Education (CS - VI) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME204 | Academic Writing (P - II) | P | 2 | 60 | 50 | | 50 |
| **Total** | | | | **28** | **480** | **240** | **460** | **700** |

**T – Theory and P – Practical**

# Paper MM201: Functional Analysis

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Functional Analysis with new ideas.
- increased their capacity to develop logics of Functional Analysis.
- solve problems in the subject of Functional Analysis.
- develop confidence level to teach the same subject.
- generalize some important theorems of Functional Analysis

| | |
|---|---|
| **Unit-I** | 1.1 Normed linear spaces, Properties of normed linear spaces, quotient space of normed linear spaces, Normed linear subspace, Banach Spaces and examples. Riesz lemma, equivalent norms,<br>1.2 Basic properties of finite dimensional normed linear spaces. |
| **Unit-II** | 2.1 Bounded linear transformation, bounded linear functional,<br>2.2 Zorn's Lemma, Hahn-Banach Theorem for real linear spaces, Hahn-Banachtheore for complex linear space and normed linear spaces.<br>2.3 Open mapping theorem, closed graph theorem. |
| **Unit-III** | 3.1 Category theorem- Baire's Category theorem,<br>3.2 Uniform boundedness theorem and some of its application, strong and wea convergence in normed spaces,<br>3.3 Convergence of sequences of operators and functionals, contraction theorem. |
| **Unit-IV** | 4.1 Inner product space and Hilbert space, Schwarz inequality, orthonormal sets,<br>4.2 complete orthonormal sets, Bessel's Inequality,<br>Orthogonal complements, Riesz representation theorem, parseval's identit projection theorem. |
| **Unit-V** | 5.1 Bounded linear operator on Hilbert space,<br>5.2 The conjugate space H*, Adjoint of an operator on a Hilbert space, Reflexivity Hilbert space,<br>5.3 Self adjoint operators, positive, projection, normal and Unitory operators. |

**Text books:**

1) E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons, New York 1978.
2) G.F. Simmons, Introduction to Topology & Modern Analysis McGraw Hill, New York.

**Reference books:**

1) B. Choudhary and Sudarshan Nanda, Functional Analysis with applications, Wiley Eastern Ltd.

# Paper MM202: Real Analysis – II

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Real Analysis with new ideas.
- increase their capacity to develop logics of Real Analysis.
- solve problems in the subject of Real Analysis.
- enhance confidence level to teach the same subject
- generalize some important theorems of Real Analysis.

| | |
|---|---|
| **Unit-I** | 1.1 Lebesgue Measurable Sets,<br>1.2 Inner Measure, Outer Measure, σ-Algebra of Lebesgue Measurable sets, Borel Sets, Borel σ- Algebra,<br>1.3 Outer and Inner Approximation of Lebesgue Measurable Sets, A non-measurable set Cantor's Set. |
| **Unit -II** | 2.1 Lebesgue Measurable functions, Borel Measurable function, Sums, Products and Compositions of Measurable function,<br>2.2 Point wise and Uniform Convergence of Measurable functions,<br>2.3 Simple function, Simple Approximation theorem. |
| **Unit-III** | 3.1 Riemann integration, Lebesgue integration of a bounded measurable function,<br>3.2 Bounded convergence theorem,<br>3.3 Integration of Non-negative functions, Fatou's Lemma, monotone convergence theorem,<br>3.4 The General integral, Lebesgue convergence theorem, Convergence in Measure. |
| **Unit-IV** | 4.1 Differentiation and Integration, The Four derivatives,<br>4.2 Functions of Bounded variation, Lebesgue Differentiation Theorem,<br>4.3 Convex functions, Jensen's inequality. |
| **Unit-V** | 5.1 The $L^p$-spaces, Holder and Minkowski inequalities,<br>5.2 Completeness of $L^p$,<br>5.3 Convergence in measure, uniform convergence and almost uniform convergence. |

**Text books:**

(1) Walter Rudin, Principles of Mathematical Analysis, McGraw Hill.
(2) H.L. Royden, Real Analysis, Macmillan (Third Edition) .

**Reference books:**

(1) T.M. Apostal, Mathematical Analysis Narosa.

# Paper MM203: Complex Analysis – II

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Complex Analysis with new ideas.
- increase their capacity to develop logics of Complex Analysis.
- solve problems in the subject of Complex Analysis.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Complex Analysis

| | |
|---|---|
| **Unit-I** | 1.1 Weierstrass factorization theorem,<br>1.2 Gamma function and its properties,<br>1.3 Riemann Zeta function,<br>1.4 Riemann's functional equation,<br>1.5 Runge's theorem. |
| **Unit-II** | 2.1 Mittag-Leffler‟s theorem,<br>2.2 Analytic continuation, Uniqueness of direct analytic continuation Uniqueness of analytic continuation along a curve,<br>2.3 Power series method of analytic continuation. |
| **Unit-III** | 3.1 Schwartz reflection principle,<br>3.2 Monodromy theorem and its consequences,<br>3.3 Harmonic function on a disc,<br>3.4 Harnax inequality and theorem,<br>3.5 Dirichlet problem,<br>3.6 Green‟s function. |
| **Unit-IV** | 4.1 Cannonical products,<br>4.2 Jenson's formula, Hadamard's three circles theorem,<br>4.3 Order of an entire function,<br>4.4 Exponent of convergence, Borel's theorem,<br>4.5 Hadamard's factorization theorem. |
| **Unit-V** | 5.1 The range of an analytic function,<br>5.2 Bloch's theorem,<br>5.3 The little Picard theorem, Schottky's theorem,<br>5.4 Montel Caratheodary and great Picard theorem, Univalent function, Bieberbach<br>5.5 conjecture and the ¼ - theorem(statement only). |

**Text books:**

(1) J.B. Convey, Functions of one complex variable, Springer-verlag.

(2) S. Ponnuswamy, Foundations of complex analysis, Narosa Publishing House.

**Reference books:**

(1) L.V. Ahlfors, Complex analysis, McGraw Hill.

## Paper MM204: Mathematics Practical

| | External | Internal |
|---|---|---|
| Max. Marks (50) | 40 | 10 |
| Min Pass Marks | 16 | 4 |
| Periods Per week | 04 | |
| Total Credits | 02 | |

**Learning Outcomes:**

The learner-

- verify content and concept of Mathematics papers MM201, MM202 and MM203 by using Mathematical software or computer programming language.
- connect basic concepts of Mathematics papers MM201, MM202 and MM203 content with new ideas.
- increase their skills of analysis and problem solving using Mathematical software or computer programming language.
- visualize some important theorems and concepts of the Mathematics papers MM201, MM202 and MM203 using Mathematical software or computer programming language.
- demonstrate the concepts of Mathematics papers MM201, MM202 and MM203 through seminar etc.
- understandapplications of Mathematics papers MM201, MM202 and MM203
- use various application of Mathematics papers MM201, MM202 and MM203 with daily life problem.

**Activities:**

- Activity oriented problem solving/Experiments using Mathematical software or computer programming language based on the content studied in Mathematics papers MM201, MM202 and MM203.
- Mathematics seminar.

### 1.3 M.Sc. (Mathematics) M.Ed. Third Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| **1** | MM301 | Topology-1 | T | 4 | 60 | 30 | 70 | 100 |
| **2** | MM302 | Differential Geometry | T | 4 | 60 | 30 | 70 | 100 |
| **3** | MM303* | Optional (Mathematics) | T | 4 | 60 | 30 | 70 | 100 |
| **4** | MM304 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| **5** | ME301 | Cross Curricular Pedagogical Approaches (CS -VII) | T | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **6** | ME302 | Teacher Education-II (CS - VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME303* | TS–I Thematic Specialization I (Any one) TS1.1/TS2.1/TS3.1/TS4.1/TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME304 | Internship-I-Internship in Teacher Education (P – III) | P | 2 | 60 | 50 | - | 50 |
| | | **Total** | | **28** | **480** | **240** | **460** | **700** |

**T–**Theory **P** – Practical **CS-**Core Subject **TS-** Thematic Specialization Course **GE-** Generic Elective Course

# Paper MM301: Topology-I

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Topology with new ideas.
- increase their capacity to develop logics of Topology.
- solve problems in the subject of Topology.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Topology

| | |
|---|---|
| **Unit-I** | 1.1 Countable and uncountable sets, Infinite sets and the Axiom of Choice, Cardinal numbers and its arithmetic,<br>1.2 Schroeder-Bernstein theorem, statements of Cantor's theorem and the Continuum hypothesis,<br>1.3 Zorn's lemma, well- ordering theorem. |
| **Unit-II** | 2.1 Definition and examples of topological spaces, Closed sets. Closure, Dense subsets, Neighbourhoods, interior, exterior, boundary, accumulation points and derived sets,<br>2.2 Bases and sub-bases, Subspaces and relative topology. |
| **Unit-III** | 3.1 Alternate methods of defining a topology in terms of Kuratowski Closure Operator and Neighbourhood Systems,<br>3.2 Continuous functions and homeomorphism. |
| **Unit-IV** | 4.1 First and Second Countable spaces, Lindelof's theorems,<br>4.2 Separable spaces, Second Countability and Separability. |

| | |
|---|---|
| **Unit-V** | 5.1 Path-connectedness, connected spaces. Connectedness on Real line,<br>5.2 Components, Locally connected spaces. |

**Text Books:**


(1) J.R. Munkers, Topology-A first course, Prentice-Hall of India.

(2) G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill.

(3) K.D. Joshi: Introduction to General Topology, Wiley Eastern. Books prescribed in unified syllabus.


# Paper MM302: Differential Geometry

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Differential Geometry with new ideas.
- increase their capacity to develop logics of Differential Geometry.
- solve problems in the subject of Differential Geometry.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Differential Geometry.

| | |
|---|---|
| **Unit-I** | 1.1 Curves in $R^2$ and $R^3$, Basic Definitions and Examples,<br>1.2 Arc Length, Curvature and the Frenet-Serret Apparatus. |
| **Unit-II** | 2.1 The Fundamental Existence and Uniqueness theorem for Curves,<br>2.2 Non-Unit Speed Curves,<br>2.3 Surfaces in $R^3$: Basic Definitions and Examples. |
| **Unit-III** | 3.1 The First Fundamental Form, Arc length of curves on surfaces,<br>3.2 Normal curvature, Geodesic curvature, Gauss and Weingarten Formulas,<br>3.3 Geodesics, Parallel Vector Fields along a Curve and Parallelism. |

| | |
|---|---|
| **Unit-IV** | 4.1 The Second Fundamental Form and the Weingarten Map,<br>4.2 Principal, Gaussian and Mean curvatures,<br>4.3 Isometry of surfaces, Gauss's Theorem Egregium. |
| **Unit-V** | 5.1 The Fundamental Theorem of Surfaces,<br>5.2 Surfaces of Constant Gaussian Curvature,<br>5.3 Exponential map, Gauss Lemma, Geodesic Coordinates,<br>5.4 The Gauss-Bonnet formula and the Gauss-Bonnet theorem(statement only). |

**Text books:**


(1) M. P. Do Carmo, Differential geometry of curves and surfaces, Prentice Hall 1976.
(2) A. Gray, Differential Geometry of Curves and Surfaces, CRC Press, 1998.
(3) John A. Thorpe, Elementary Topics in Differential Geometry, Springer, 1979.
(4) S.C. Mittal, D. C. Agarwal, Differential Geometry, Krishna Prakashan Mandir , Meerut


**Reference books:**


(1) B. O. 'Neill, Elementary Differential Geometry, Elsevier 2006.
(2) A. Pressley, Elementary Differential Geometry, Springer 2010.


# Optional Subject: Mathematics MM303*
# Paper MM303 (a): Graph Theory

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Graph Theory with new ideas.
- increase their capacity to develop logics of Graph Theory.
- solve problems in the subject of Graph Theory.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Graph Theory.
- apply principles and concepts of graph theory in practical situations.
- apply graph theory based tools in solving practical problems.

| | |
|---|---|
| **Unit I** | 1.1 Vertices, Lines in a graph, Degree of a Vertex, Adjacent and Incident Lines, Loop Graph,<br>1.2 Trivial Graph, Multigraph, Pseudo Graph, Directed Graph, Oriented Graph, Isomorphism of Graphs, Subgraphs, Supergraph, Spanning Subgraph, Maximal Sub<br>1.3 Triangle of a Graph. |

| | | |
|---|---|---|
| **Unit II** | 2.1 | Walk, Trial, Cycle and Path of a Graph, Connectedness of a Graph, Components of Graph, |
| | 2.2 | Girth and Circumference of a Graph, Geodesic of a Graph, Diameter of a Graph, Complement of a Graph, |
| | 2.3 | Bipartite Graph, Intersection of Graphs, Operations on Graphs (Union, Join, Produc Composition). Eulerian and Hamiltonian Graphs, Travelling Salesman Proble |
| | 2.4 | |
| **Unit III** | 3.1 | Cut Points, Bridges and Blocks of a Graph, |
| | 3.2 | Trees and their Characterization, Centres and Centroids in a Tree, Independent Cycl and Cocycles, |
| | 3.3 | Spanning Trees, Fundamental Circuits and Matroids. |
| **Unit IV** | 4.1 | Connectivity and Line Connectivity, n-Connected Graph, Partitions of a Graph, Line Graphs, Characterization of a Line Graph, Line Graphs and Transversability. |
| | 4.2 | |
| **Unit V** | 5.1 | 1-Factorization, 2-Factorization of a Graph, Complete Graph, |
| | 5.2 | Coverings and Independence, Critical Points and Lines, |
| | 5.3 | Planar Graph, Detection of Planarity, Kurtowski's Line Graphs, |
| | 5.4 | Matrix representation of graphs- Incidence matrix, Cut set matrix, Path Matrix, Circ Matrix and Adjacency matrix. |

**Text books:**

(1) F. Harary, Graph Theory, Narosa Publishing House.

**Reference books:**

(1) Joan M. Aldous & Robin J. Wilson, Graphs and Applications. An Introductory Approach Springer.

(2) Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall

# Paper MM303 (b): Mathematical Modelling

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Mathematical Modelling with new ideas.
- increase their capacity to develop logics of Mathematical Modelling.
- solve problems in the subject of Mathematical Modelling.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Mathematical Modelling.

| | |
|---|---|
| **Unit-I** | 1.1 Mathematical Modelling, Need, Techniques, Classifications, Characteristics an Limitations of Mathematical models, Some simple illustrations,<br>1.2 Modelling process, Elementary Mathematical models. |
| **Unit-II** | 2.1 Mathematical Modelling through Ordinary differential equations of first order<br>2.2 Linear growth and decay models, Nonlinear growth and decay models. |
| **Unit-III** | 3.1 Mathematical Modelling through systems of ordinary differential equations of fir order,<br>3.2 Mathematical Modelling in population dynamics,<br>3.3 Mathematical Modelling of epidemics,<br>3.4 Mathematical Modelling in economics and finance. |
| **Unit-IV** | 4.1 Mathematical Modelling through difference equations, Some simple models, Bas theory of linear difference equations with constant coefficients,<br>Mathematical Modelling through difference equations in economics and Financ<br>4.2 Mathematical Modelling through difference equations in population dynamic. |
| **Unit-V** | 5.1 Single species population model: The exponential model, Logistic model, Harvestin model and their critical values. |

**Text books:**


(1) J.N. Kapur, Mathematical Modelling, New Age Intern. Pub.
(2) J.N. Kapur, Mathematical Models in Biology and Medicine, East-West Press.
(3) Fred Brauer and Carlos Castillo-Chavez, Mathematical Models in Population Biology and Epidemiology, Springer.
(4) Frank R. Giordano, William Price Fox, Maurice D. Weir, A First Course in Mathematical Modelling, 4th Ed., Charlie Van Wagner.
(5) Walter J. Meyer, Concept of Mathematical Modelling, McGraw-Hill.


# Paper MM303 (c): Advanced Probability Theory

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Advanced Probability Theorywith new ideas.
- increase their capacity to develop logics of Advanced Probability Theory.
- solve problems in the subject of Advanced Probability Theory.

- enhance confidence level to teach the same subject.
- generalize some important theorems of Probabilistic concept.

| | |
|---|---|
| **Unit I** | 1.1 Notation of probability, Random experiment, Sample space, axiom of probability, elementary properties of probability, equally likely outcomes, conditional probability,<br>1.2 Bayes theorem, Independence, Geometric Probability. |
| **Unit II** | 2.1 Random variables: Concept, Cumulative distribution function, discrete and continuous random variables,<br>2.2 Expectations, mean, variance and moment generating function. |
| **Unit III** | 3.1 Discrete random variable,<br>3.2 Bernoulli random variable,<br>3.3 Binomial random variable,<br>3.4 Geometric random variable,<br>3.5 Poisson random variable, |
| **Unit IV** | 4.1 Continuous random variable, Uniform random variable<br>4.2 Exponential random variable, Gamma random variable,<br>4.3 Normal random variable,<br>4.4 Bivariate random variable, Joint distribution,<br>4.5 Joint and conditional distribution, the correlation coefficient. |
| **Unit V** | 5.1 Probability inequalities (Tche by shef, Markov, Jensen),<br>5.2 Characteristic functions. Modes of convergence,<br>5.3 Weak and strong laws of large numbers. |

**Text books:**

(1) R.V. Hogg and A.T. Craig: Introduction to Mathematical Statistics.
(2) S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics.

## Paper MM303 (d): Tensor and Riemannian geometry

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Tensor and Riemannian Geometry with new ideas.
- increase their capacity to develop logics of Tensor and Riemannian Geometry.

- solve problems in the subject of Tensor and Riemannian Geometry.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Tensor and Riemannian Geometry.

| | |
|---|---|
| **Unit I** | 1.1 Space of n-dimension, Subspace, Curve, Summation convention,<br>1.2 Kronecker delta, Transformation of Coordinates, Summation of convention, Indicial (or range) convention,<br>1.3 Dunny suffix, Contravariant and Covariant vectors (Tensor of first order), Tensor of second order (or rank two),<br>1.4 Tensor of higher rank (or higher orders), Invariant of Scalar. |
| **Unit II** | 2.1 Riemannian metric, Magnitude of a Vectors, Length of a Curve, Unit Tangent Vector, Associated Vectors,<br>2.2 Angle between two vectors, Conjugate of Reciprocal Symmetric Tensor, Law of Covariant differentiation of Tensor, Divergence of a Tensor, Curl of a Tensor. |
| **Unit III** | 3.1 Ricci's Theorem, Curvature Tensor or Riemannian Christoffel Tensor,<br>3.2 Ricci Identity, Bianchi's Identity, Ricci's Tensor,<br>3.3 Riemannian Christoffel's Tensor of first kind or Associative Curvature tensor or Covariant Curvature tensor. |
| **Unit IV** | 4.1 Riemannian manifold or Riemannian space,<br>4.2 Curvature of a curve, Derived vector,<br>4.3 Geodesics and related theorems, Geodesic mapping, Gradient,<br>4.4 Weyl's Curvature tensor or Projective Curvature Tensor, Geodesic Coordinate. |
| **Unit V** | 5.1 Riemannian Coordinates, Riemannian Curvature,<br>5.2 Einstein space, Flate space, Schur's theorem, Weyl's Tensor,<br>5.3 Fundamental theorem of Riemannian geometry. |

**Text books:**

(1) R.S. Mishra, A course in Tensors with Applications to Riemannian geometry, Pothishala Pvt.Ltd., Allahabad, 1965.

**Reference books:**

(1) C.E.Weatherburn, An Introduction to Tensor Calculus and Riemannian Geometry, CambridgeUniversity Press, London, 1942 and Radha Publishing House Calcutta, Indian Edition, 1995.

# Paper MM304: Mathematics Practical

| | External | Internal |
|---|---|---|
| Max. Marks (50) | 40 | 10 |
| Min Pass Marks | 16 | 4 |
| Periods Per week | 04 | |
| Total Credits | 02 | |

**Learning Outcomes:**

The learner-

- verify content and concept of Mathematics papers MM301, MM302 and MM303*(optional) by using Mathematical software or computer programming language.
- connect basic concepts of Mathematics papers MM301, MM302 and MM303*(optional)

content with new ideas.

- increase their skills of analysis and problem solving using Mathematical software or computer programming language.
- visualize some important theorems and concepts of the Mathematics papers MM301, MM302 and MM303*(optional) using Mathematical software or computer programming language.
- demonstrate the concepts of Mathematics papers MM301, MM302 and MM303*(optional) through seminar etc.
- understand applications of Mathematics papers MM301, MM302 and MM303*(optional).
- use various application of Mathematics papers MM301, MM302 and MM303*(optional) with daily life problem.

**Activities:**

- Activity oriented problem solving / Experiments using Mathematical software or computer programming language based on the content studied in Mathematics papers MM301 ,MM302 and MM303*(optional) .
- Mathematics seminar.

**1.4 M.Sc. (Mathematics) M.Ed. Fourth Semester**

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MM401 | Topology -II | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MM402 | Advanced Operations Research | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MM403 | Fuzzy sets and their applications | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MM404 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| 5 | ME401 | Historical, Political and Economic Perspectives of Education (CS - IX) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME402 | Research Methodology -I (CS - X) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME403* | TS II- Thematic Specialization II (Any one: TS1.2/TS2.2/TS3.2/TS4.2/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | ME404 | Dissertation-1: Research in Education (Planning) (P- IV) | P | 1 | 30 | 25 | - | 25 |
| 9 | ME405 | Internship II - Thematic Specialisation (P – V) | P | 2 | 60 | 50 | - | 50 |
| Total | | | | **29** | **510** | **265** | **460** | **725** |

# Paper MM401: Topology-II

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Topologywith new ideas.
- increase their capacity to develop logics of Topology.
- solve problems in the subject of Topology.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Topological space.

| | |
|---|---|
| **Unit-I** | 1.1 Separation Axioms, $T_0$, $T_1$, $T_2$ ,$T_3$, $T_4$ -spaces and their Characterizations and basic properties,<br>1.2 Urysohn‟s lemma,<br>1.3 Tietze Extension Theorem. |
| **Unit-II** | 2.1 Compactness, Continuous functions and compact sets, Basic properties compactness, Compactness and finite intersection property,<br>2.2 Sequentially and countably compact sets, Local compactness. |
| **Unit-III** | 3.1 Tychonoff product topology in terms of standard sub-base and its characterization Projection maps.<br>3.2 Separation axioms and product spaces, Connectedness and product spaces,<br>3.3 Compactness and product spaces (Tychonoff‟s theorem), Countability and produ spaces. |
| **Unit-IV** | 4.1 Net and Filters, Topology and convergence of nets, Hausdorffness and net Compactness and nets,<br>4.2 Filters and their convergence, Canonical way of converting nets to filters and vic versa,<br>4.3 Ultrafilters and Compactness. |
| **Unit-V** | 5.1 Homotopy of paths,<br>5.2 The Fundamental group, Covering spaces,<br>5.3 The Fundamental Group of the circle and the Fundamental Theorem of Algebra. |

**Text books:**

(1) James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd. New Delhi.
(2) G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company.
(3) K.D. Joshi, Introduction to general topology Wiley Eastern Ltd.

# Paper MM402: Advanced Operations Research

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Advanced Operations Researchwith new ideas.
- increase their capacity to develop logics of Advanced Operations Research.
- solve problems in the subject of Advanced Operations Research.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Advanced Operations Research.

| | |
|---|---|
| **Unit I** | 1.1 Game theory: Two-Person Zero Sum Games,<br>1.2 Maximin-Minimax Principle,<br>1.3 Games Without Saddle Points-Mixed Strategies,<br>1.4 Graphic Solution of 2×n and m×2 Games, General Solution of m×n Rectangular Gam Linear Programming Model. |
| **Unit II** | 2.1 Inventory Control-Types of Inventories, Inventory Control Problem,<br>2.2 Concept of Economic Order Quantity (EOQ)- Fundamental Problem of EOQ with sev protection runs of equal length. |
| **Unit III** | 3.1 Queuing Theory: Queuing System and its elements,<br>3.2 Queuing Models,<br>3.3 Poisson Queuing Systems, Non-Poisson Queuing Systems. |
| **Unit IV** | 4.1 Simulation: Simulation Models,<br>4.2 Monte Carlo Simulation,<br>4.3 Simulation of Inventory Problems,<br>4.4 Generation of Random Numbers,<br>4.5 Simulation of Queuing Systems. |
| **Unit V** | 5.1 Network Analysis,<br>5.2 Constraints in Networks,<br>5.3 Construction of Network,<br>5.4 Critical Path Method (CPM), PERT, PERT Calculation,<br>5.5 Dijkstra's Shortest Path Algorithm,<br>5.6 Minimum Cost Flow Problems, Trans-shipment Problem. |

**Text books:**

(1) Kanti Swarup, P.K. Gupta and Manmohan, Operations Research,Sultan Chand & Sos,New De lhi.

**Reference books:**

(1) S.D. Sharma, Operation Research.
(2) F.S. Hiller and G.J. Lieberman, Industrial Engineering Series,1995.
(3) G. Hadley, Linear programming, Narosa Publishing House 1995.
(4) G. Hadley, Linear and dynamic programming, Addison- WesleyReading mass.
(5) H.A. Taha, Operations Research – An Introduction MacmillanPublishing.
(6) Prem Kumar Gupta and D.S. Hira, Operations Research, anIntroduction S. Chand & C ompany Ltd. New Delhi.
(7) N.S. Kambo, Mathematical Programming Techniques, AffiliatedEast West Pvt. New Delhi, Madras.

# Paper MM403: Fuzzy Sets and Their Applications

| | External | Internal |
|---|---|---|

| | | |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Fuzzy Sets and Their Applications with new ideas.
- increase their capacity to develop logics of Fuzzy Sets and Their Applications.
- solve problems in the subject of Fuzzy Sets and Their Applications.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Fuzzy Sets and Their Applications.

| | | |
|---|---|---|
| **Unit I** | 1.1 | Fuzzy Sets-Basic definitions. $\alpha$-level sets. Convex fuzzy sets, |
| | 1.2 | Basic operations on fuzzy sets, Types of fuzzy sets, |
| | 1.3 | Cartesian products, Algebraic products, Bounded sum and difference, t-norms and conorms. |
| **Unit II** | 2.1 | The Extension Principle-The Zadeh's extension principle, |
| | 2.2 | Image and inverse image of fuzzy sets. Fuzzy numbers, Elements of fuzzy arithme Fuzzy, relations on fuzzy sets, Composition of fuzzy relations. |
| | 2.3 | |
| **Unit III** | 3.1 | Min-Max composition and its properties. |
| | 3.2 | Fuzzy equivalence relations. Fuzzy compatibility relations. |
| | 3.3 | Fuzzy relation equations. The role of fuzzy relation equation. |
| | 3.4 | Fuzzy graphs. |
| | 3.5 | Fuzzy similarity relation. |
| **Unit IV** | 4.1 | Possibility Theory-Fuzzy measures, |
| | 4.2 | Evidence theory. Necessity measure, |
| | 4.3 | Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory, |
| | 4.4 | Fuzzy Logic-An overview of classical logic, Multivalued logics. Fuzzy proposition Fuzzy quantifiers. |
| **Unit V** | 5.1 | Linguistic variables and hedges. Inference from conditional fuzzy propositions, the compositional rule of inference, |
| | 5.2 | Approximate Reasoning-An overview of fuzzy expert system. Fuzzy implications a their selection, |
| | 5.3 | Multi-conditional approximate reasoning. |

**References books:**


(1) H.J. Zimmermann. Fuzzy set theory and its Applications, Allied Publishers Ltd., New Deihi, 1991.

(2) G.J. Klir and B. Yuan-Fuzzy sets and fuzzy logic, Prentice-Hall of India, New Delhi, 1995.


## Paper MM404: Mathematics Practical

| | External | Internal |
|---|---|---|
| Max. Marks (50) | 40 | 10 |
| Min Pass Marks | 16 | 04 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Learning Outcomes:**

The learner-

- verify content and concept of Mathematics papers MM401, MM402 and MM403 by using Mathematical software or computer programming language.
- connect basic concepts of Mathematics papers MM401, MM402 and MM403 content with new ideas.
- increase their skills of analysis and problem solving using Mathematical software or computer programming language.
- visualize some important theorems and concepts of the Mathematics papers MM401, MM402 and MM403 using Mathematical software or computer programming language.
- demonstrate the concepts of Mathematics papers MM401, MM402 and MM403 through seminar etc.
- understandapplications of Mathematics papers MM401, MM402 and MM403
- use various application of Mathematics papers MM401, MM402 and MM403 with daily life problem.

**Activities:**

- Activity oriented problem solving / Experiments using Mathematical software or computer programming language based on the content studied in Mathematics papers MM401, MM402 and MM403.
- Mathematics seminar.

### 1.5 M.Sc. (Mathematics) M.Ed. Fifth Semester

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MM501 | Advance Numerical Analysis | T | 4 | 60 | 30 | 70 | 10 |
| 2 | MM502 | Mathematical Statistics | T | 4 | 60 | 30 | 70 | 10 |
| 3 | MM503 * | Optional (Mathematics) | T | 4 | 60 | 30 | 70 | 10 |
| 4 | MM504 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| 5 | ME501 | Research Methodology -II(CS - XI) | T | 4 | 60 | 30 | 70 | 10 |
| 6 | ME502 | Indigenous Knowledge System (CS – XII) | T | 4 | 60 | 30 | 70 | 10 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | ME503* | TS – III Thematic Specialization III(Any one: TS1.3/TS2.3/TS3.3/TS4.3/TS5.2 ) | T | 4 | 60 | 30 | 70 | 10 |
| 8 | ME504 | Dissertation-2: Research in Education (Execution) (P – VI) | P | 1 | 30 | 25 | - | 25 |
| **Total** | | | | **27** | **450** | **21** | **46** | **67** |

**Optional MM503*(Mathematics)**

| Paper Code | Name of Paper |
|---|---|
| MM503(a) | Advanced Discrete Mathematics |
| MM503(b) | Number Theory |
| MM503(c) | Module Theory |
| MM503(d) | Integral Transforms |

**Optional ME503*: Thematic Specialization**

| Paper Code | Name of Paper |
|---|---|
| ME503(a) | **TS1.3 –**Educational Leadership and Supervision |
| ME503(b) | **TS2.3 –** Learners' Assessment |
| ME503(c) | **TS3.3 –** ICT Integration in Education |
| ME503(d) | **TS4.3 –** Concern, Challenges and Issues in Inclusive Education |
| ME503(e) | **TS5.3 –** Career Development |

# Paper MM501: Advance Numerical Analysis

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Advance Numerical Analysis with new ideas.
- increase their capacity to develop logics of Advance Numerical Analysis.
- solve problems in the subject of Advance Numerical Analysis.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Advance Numerical Analysis.

| | |
|---|---|
| **Unit I** | 1.1 Interpolation, Hermite interpolation.<br>1.2 Piecewise and spline interpolation, Bivariate interpolation approximation least squar approximation.<br>1.3 Uniform approximation, rational approximation. Choice of the method. |
| **Unit II** | 2.1 System of linear algebraic equations and Eigen value problems,<br>2.2 Direct method, Iteration methods, Eigen values and Eigen Vectors,<br>2.3 Bounds on Eigen values, Jacobi Givens Household's symmetric matrices.<br>2.4 Rutishauser method for arbitrary matrices, Power method, inverse power methods. |
| **Unit III** | 3.1 Differentiation, Optimum choice of step-length,<br>3.2 Extrapolation methods. Partial Differentiation. |
| **Unit IV** | 4.1 Integration : Methods based on undetermined coefficients,<br>4.2 Composite integration methods Romberg and Double integration. |
| **Unit V** | 5.1 Ordinary differential equations initial value problems. Introduction, Differen equations, numerical and single step methods, stability analysis of numeric methods, Stability Analysis of Single step Methods.<br>5.2 Multistep methods, Predicator Corrector methods. Stability analysis of multist methods, stiff system.<br>5.3 Ordinary differential equations Initial value Problem method (Shooting method) |

**Text book:**

(1) Numerical methods for scientific and engineering computation.M.K. Jain, S.R.K. Iyengar, R.K. Jain.

**Reference books:**

(1) S.S. Sastry: Introductory Methods of Numerical Analysis

# Paper MM502: Mathematical Statistics

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Mathematical Statistics with new ideas.
- increase their capacity to develop logics of Mathematical Statistics.
- solve problems in the subject of Mathematical Statistics.
- enhance confidence level to teach the same subject.
- visualize the available data in the statistical form.

| | | |
|---|---|---|
| **Unit I** | 1.1 | Frequency distribution, measures of location, dispersion and skewness. |
| | 1.2 | Moments and Cumulate, Moment generating function. |
| | 1.3 | Simple Correlation coefficient, Multiple and Partial Correlation. |
| | 1.4 | Linear and Multiple Regression, and their application, Intra class correlation, Correlation ratio. |
| **Unit II** | 2.1 | Testing of hypothesis, Level of significance, degrees of freedom, |
| | 2.2 | Central and Non-central chi- square, t, z and F- distributions, their properties and related tests. |
| **Unit III** | 3.1 | Definition of probability, Bayes' theorem, Basic distribution function probability m function, |
| | 3.2 | Probability density function, joint, marginal and conditional p.m.f, |
| | 3.3 | Random Variables and its mathematical expectations, conditional Expectation, Expectation of sum and multiplication of random variables, |
| | 3.4 | Variance of sum and multiplication of random variables. |
| **Unit IV** | 4.1 | Standard Discrete Distributions- Bernoulli, Binomial, Poisson, Geometric, Hyper geometric and Multinomial distribution. |
| | 4.2 | Limiting form of Binomial and Poisson distributions |
| **Unit V** | 5.1 | Standard continuous distributions-Uniform, Exponential, Normal, Beta, Gamma an Cauchy distributions. |
| | 5.2 | Order Statistics-Introduction and its distributions and properties. Joint & Marginal distributions of Order-Statistics. |

**References books:**


(1) Dudewicz, E.J. and Mishra, S.N.(1988) : Modern Mathematical Statistics, Wiley, Int'I Student's Edition.

(2) Rohatgi, V.K. (1984): An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

(3) Rao, C.R. (1973) : Linear Statistical Inference and its Applications, 2/e, Wiley Eastern.

(4) Weather,Burn,C.E. : A first Course in Mathematical Statistics.

(5) Keany,J.F. and Keeping,E.S. : Mathematics of Statistics Pt. I and II

(6) Kendall,M.G. and stuart A : Advanced Theory of Statistics.
(7) Mood,gybrill and Boes : Introduction to theory of Statistics
(8) Hogs and Craig : Mathematical Statistics
(9) Goon,gupta and Dasgupta : Fundamental of Mathematical statistics Vol.I
(10) D N Elhance, Practical problems in statistics kitab mahal Allahabad 1979

# Optional Subject: Mathematics MM503*
# Paper MM 503(a): Advanced Discrete Mathematics

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Advanced Discrete Mathematics with new ideas.
- increase their capacity to develop logics of Advanced Discrete Mathematics.
- solve problems in the subject of Advanced Discrete Mathematics.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Advanced Discrete Mathematics.

| | |
|---|---|
| **Unit I** | 1.1 Computability and Formal languages- Languages, Phrase structure grammars,<br>1.2 Derivation, Sentential forms, Language generated by grammar. Regular grammar,<br>1.3 1.1 Context-free and context sensitive grammars. |
| **Unit II** | 2.1 Lattices- Lattices as partially ordered sets and their properties,<br>2.2 Lattices as Algebraic systems, sublattices, Bounded lattices, Distributive Lattices, Complemented lattices.<br>2.3 Boolean Algebra- Boolean Algebras as lattices, various Boolean identities. Joint<br>2.4 irreducible elements, minterms, maxterms, minterm Boolean forms, Canonical forms, minimization of Boolean functions.<br>2.5 Applications of Boolean Algebra to switching theory (Using AND, OR, & NOT gates) the Karnaugh method. |
| **Unit III** | 3.1 Discrete Numeric functions, Asymptotic Behavior of Numeric functions,<br>3.2 Generating functions. Recurrence Relations- Linear Recurrence Relations with constant coefficients,<br>3.3 Homogeneous solutions, particulars solutions, Total Solutions. |
| **Unit IV** | 4.1 Finite State Automata, Diagram & Language determined by an Automaton,<br>4.2 Finite State Acceptors, Deterministic and Non-deterministic Finite Automata. Finite State Machines and their transition tables & diagrams. Equivalent machines. |
| **Unit V** | 5.1 Reduced Machines, Kleen's theorem (Statement only) Pumping lemma,<br>5.2 Moore and Mealy Machines, Turning Machines, Regular Expressions and corresponding regular languages (Def. only) |

**Text books:**

(1) J.P. Tremblay & R. Manohar, Discrete Mathematical structures, McGraw Hill.

(2) N. Deo. : Graph theory with applications prentice hall.

**Reference books:**

(1) C.L. Liu: Elements of Discrete Mathematics McGraw Hill.

(2) Semyour Lipschutz/More lipson: Discrete Mathematics, McGraw Hill.

# Paper MM 503(b): Number Theory

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |

Note: Two questions will be set from each unit with internal choice.

| | |
|---|---|
| **Unit-I** | 1.1 Division algorithm,<br>1.2 Linear Congruence and their properties.<br>1.3 G.C.D. and Euclidean Algorithm,<br>1.4 The Diophantine equation ax+by = c,<br>1.5 Chinese remainder theorem.<br>1.6 Primes and factorization and co-prime,<br>1.7 Fundamental theorem of arithmetics. |
| **Unit-II** | 2.1 Fermat's theorem,<br>2.2 Euler theorem and Wilson's theorem,<br>2.3 Fermat factorization theorem,<br>2.4 Number theoretic function: Sum of Factors Function $\sigma(n)$,<br>2.5 Möbius function, Greatest Integer function.<br>2.6 Euler $\varphi$ function and its properties, Euler theorem,<br>2.7 Multiplicative function. Mobius inversion formula. An Application to Calendar. |
| **Unit-III** | 3.1 The order of integer modulo n,<br>3.2 Primitive-roots for primes Composite number having primitive roots<br>3.3 Quadratic Residues, Legendre's Symbol,<br>3.4 Euler Criterion, Gauss's lemma,<br>3.5 Law of Quadratic reciprocity and its application. |

| | |
|---|---|
| **Unit-IV** | 4.1 Numbers of special form: Perfect numbers,<br>4.2 Mersenne primes, Amicable Numbers and Fermat numbers.<br>4.3 Primitive Pythagorean Triples and their specials forms (with corresponding theorem),<br>4.4 Theorem linking in radius of Pythagorean Triangles and their properties.<br>The Diphantine equations $x^4 + y^4 = z^2$, $x^4 - y^4 = z^2$ and their impossibility.<br>4.5 Expressing numbers as the sum of two squares,<br>Expressing numbers as the sum of three squares( the proof of sufficiency<br>4.6 condition not included),<br>4.7 Euler's lemma on sum of two and four squares. Lagrange's theorem of sum of four squares. |
| **Unit-V** | 5.1 Triangular numbers,<br>5.2 Lucas numbers and their properties,<br>5.3 Fibonacci and their properties, continued fraction(both finite and infinite),<br>5.4 Pells equation,<br>5.5 Farey's sequence and their properties. |

**Text books:**

(1) David M. Burton: Elementary Number theory, Wm C.Brown Publishers.
(2) Hans Rademacher: Lectures on Elementary Number Theory, Blaisdell Publishing Company

# Paper MM 503(c): Module Theory

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Module Theory with new ideas.
- increase their capacity to develop logics of Module Theory.
- solve problems in the subject of Module Theory.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Module Theory.

| | |
|---|---|
| **Unit I** | 1.1 Modules over a ring, Endomorphism ring of an abelian group, R-Module structure o<br>abelian group, M as a ring homomorphism from R to $End_Z$, (M), Sub modules,<br>Direct summands, Homomorphism, Factor modules,<br>1.2 Statements of Correspondence theorem and Isomorphism theorems, $Hom_R$ (M, N) a<br>1.3 abelian group and $Hom_R$(M, M) as a ring. |
| **Unit II** | 2.1 Free modules, Homomorphism extension property, equivalent characterization as a d<br>sum of copies of the underlying ring, existence of a basis of a vector space,<br>Split exact sequences and their characterizations, Left exactness of Hom sequences<br>2.2 counter-examples for non-right exactness,<br>Projective modules, Injective modules, Baer's characterization, Divisible groups,<br>2.3 |
| **Unit III** | 3.1 Factorization theory in commutative domains, Prime and irreducible elements, G.C<br>Euclidean domains, Maximal and prime ideals, Principal ideal domains, |

| | |
|---|---|
| | 3.2 Divisor chain condition, Unique factorization domains, Chinese remainder theorem rings and PID's,<br>3.3 Polynomial rings over domains, Unique factorization in polynomial rings over UFD's |
| **Unit IV** | 4.1 Sub-modules of finitely generated free modules over a PID, Torsion sub-module, Tor and torsion-free modules, Direct decomposition into T(M) and a free modul primary components, Decomposition of p-primary finitely generated tor modules,<br>4.2 Elementary divisors and their uniqueness, Decomposition into invariant factors uniqueness, Direct sum decomposition of finite abelian groups into cyclic groups their enumeration. |
| **Unit V** | 5.1 Reduction of matrices over polynomial rings over a field,Similarity of matrices and l module structure,<br>5.2 Rational canonical form of matrices, Elementary Jordan matrices, Reduction to Jo canonical form,<br>5.3 Diagonalizable and nilpotent parts of a linear operator, Jordon-Chevalley Theorem. |

**Text books:**


(1) F. W. Anderson and K. R. Fuller, Rings and Categories of Modules, Springer, N.Y.,1 974.
(2) I. A. Adamson, an Introduction to Field Theory. Oliver & Boyd, Edinburgh, 1964.
(3) N. S. Gopalakrishnan, University Algebra, Wiley Eastern Ltd., New Delhi, 1986.


**Reference books:**


(1) T. W. Hungerford, Algebra, Springer (India) Pvt. Ltd., New Delhi, 2004.
(2) P. Ribenboim, Rings and Modules, Wiley Interscience, N.Y., 1969.


# Paper MM 503(d): Integral Transforms

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Integral Transforms with new ideas.
- increase their capacity to develop logics of Integral Transforms.
- solve problems in the subject of Integral Transforms.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Integral Transforms.

| | |
|---|---|
| **Unit I** | 1.1 Laplace Transform, Application to Differential Equations, Application to Integral equations. Solution of simulates differential equations.<br>1.2 Laplace Equation in two dimensions, Wave Equation in one dimension Application wave equation. |
| **Unit II** | 2.1 Application of Laplace Transform to electrical circuits, Application to Beams.<br>2.2 Heat conduction equation in one dimension, Application to heat conduction equatio |

| | | |
|---|---|---|
| **Unit III** | 3.1 | Fourier Transform, |
| | 3.2 | Infinite Fourier transform, |
| | 3.3 | Complex Fourier transforms. |
| **Unit IV** | 4.1 | Finite Fourier Transform and Fourier Integral. |
| | 4.2 | Convolution theorem, Perseval's Identity for Fourier series, Parseval's Identity for Fourier transform. |
| | 4.3 | Application for Fourier Transform to Boundary value problems. |
| **Unit V** | 5.1 | Introduction to Hankel and Mellin Transforms, |
| | 5.2 | Fourier Series and Boundary value problems. |

**Text books:**

(1) Integral Transforms by Goyal and Gupta
(2) Integral Transform by Sneddon.

# Paper MM504: Mathematics Practical

| | External | Internal |
|---|---|---|
| Max. Marks (50) | 40 | 10 |
| Min Pass Marks | 16 | 04 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

**Note:** Two questions will be set from each unit with internal choice.
**Learning Outcomes:**

The learner-

- verify content and concept of Mathematics papers MM501, MM502 and MM503*(optional) by using Mathematical software or computer programming language.
- connect basic concepts of Mathematics papers MM501, MM502 and MM503*(optional) content with new ideas.
- increase their skills of analysis and problem solving using Mathematical software or computer programming language.
- visualize some important theorems and concepts of the Mathematics papers MM501, MM502 and MM503*(optional) using Mathematical software or computer programming language.
- demonstrate the concepts of Mathematics papers MM501, MM502 and MM503*(optional) through seminar etc.
- understandapplications of Mathematics papers MM501, MM502 and MM503*(optional)

- use various application of Mathematics papers MM501, MM502 and MM503*(optional) with daily life problem.

**Activities:**

- Activity oriented problem solving/Experiments using Mathematical software or computer programming language based on the content studied in semester V Mathematics papers MM501, MM502 and MM503*(optional).
- Mathematics seminar.

**1.6 M.Sc. (Mathematics) M.Ed. Sixth Semester**

| S. No. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MM601 | Differential and Integral Equations | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MM602 | Special functions | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MM603 | Dissertation/Project in Mathematics | T/P | 4 | 60 | 30 | 70 | 100 |
| 4 | MM604 | Mathematics Practical | P | 2 | 60 | 10 | 40 | 50 |
| 5 | ME601 | Education for Sustainable Development (CS -XIII) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME602* | Generic Elective course (GE) (any one of the following)(GE-I/GE-II/GE-III/GE-IV) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME603 | Application of ICT in Education (P – VII) | P | 2 | 60 | 50 | | 50 |
| 8 | ME604 | Dissertation-3: Research in Education (Report Submission) (P-VIII) | P | 4 | 60 | 50 | 50 | 100 |
| | | Total | | 28 | 480 | 260 | 440 | 700 |

# Paper MM601: Differential and Integral Equations

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |

| | |
|---|---|
| Periods Per week | 04 |
| Total Credits | 04 |

**Note:** Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of Differential and Integral Equations with new ideas.
- increase their capacity to develop logics of Differential and Integral Equations.
- solve problems in the subject of Differential and Integral Equations.
- enhance confidence level to teach the same subject.
- generalize some important theorems of Differential and Integral Equations.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Laplace's Equation-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods. |
| | 1.2 | Heat Equation-Fundamental Solution, Mean Value Formula, Properties of Solutions Energy Methods. |
| | 1.3 | Wave Equation-Solution by Spherical Means, Non-homogeneous Equations, Energ Methods. |
| **Unit-II** | 2.1 | Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necess and sufficient conditions for extrema. |
| | 2.2 | Variational methods for boundary value problems in ordinary and partial differentia equations |
| **Unit-III** | 3.1 | Classification of Linear integral Equations, solution of an integral equation, Fredho integral equation, Volterra integral equation, |
| | 3.2 | Converting ODE to Integral equation, converting IVP to Volterra Integral Equation Method of converting a boundary value problem into a Fredholm integral equation |
| | 3.3 | Classification of nonlinear integral equations, Singular Integral equations, Abel's problem, the generalized Abel's Integral Equation. |
| **Unit-IV** | 4.1 | Fredholm Integral equations, the Adomian decomposition method, |
| | 4.2 | The Variational Iteration method, the direct computation method, the successive approximations method. |
| **Unit-V** | 5.1 | Eigen values and Eigen functions. |
| | 5.2 | Fredholm Integral equations of second kind with Separable Kernels. Iterated kernel Resolvent kernels |
| | 5.3 | Volterra integral equation of the second kind, Fredholm alternative theorem, Fredholm integral equation of first kind,Volterra integral equation of first kin applications of integral equations and green's functions to ordinary differenti equations |

**Reference books:**


(1) Integral equations; (Vol. 4) (Translation), S.G. Mikhlin, Pergamon Press London.
(2) Integral equations- A short course, L. G. chambers International Suggested Books Compan East kilbridge, Scotland.
(3) A course of higher Mathematics, Vol.IV, (Translation); V. I. Smirnov, Pergmon Press, Oxford,(chapter I: .Integral equations, chapter IV: Boundary value Problems).
(4) Integral equations & Applications, C. Corduneanu, Cambridge University Press, Cambridge.
(5) Lectures on Differential & Integral equations; Vol. X, Kosaku Yosida, Innterscience Publishers London1960.
(6) Integral Equations and Boundary Value Problems:, M.D. Raisinghania, S.Chand Publications, New Delhi. E book links: National Digital Library


## Paper MM602: Special Functions

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

Note: Two questions will be set from each unit with internal choice.

**Learning Outcomes:**

The learner-

- connect basic concepts of SpecialFunctions with new ideas.
- increase their capacity to develop logics of SpecialFunctions.
- solve problems in the subject of SpecialFunctions.
- enhance confidence level to teach the same subject.
- generalize some important theorems of SpecialFunctions.

| | | |
|---|---|---|
| **Unit I** | 1.1 | Definition of Hermite polynomials $H_n(x)$, Pure recurrence relations, Differential recurrence relations, |
| | 1.2 | Rodrigue's formula. Other generating functions, |
| | 1.3 | Orthogonality, Expansion of polynomials, more generating functions. |
| **Unit II** | 2.1 | Laguerre Polynomials : The Laguerre Polynomials $L_n(x)$, Generating functions, |
| | 2.2 | Pure recurrence relations, Differential recurrence relation, |
| | 2.3 | Rodrigue's formula, Other generating functions, |
| **Unit III** | 3.1 | Definition of Jacobi polynomials $P_n^{(a,b)}(x)$, Pure recurrence relations, Differe recurrence relations, |
| | 3.2 | Rodrigue's formula. Other generating functions, |
| | 3.3 | Orthogonality, Expansion of polynomials, more generating functions. |
| **Unit IV** | 4.1 | Hyper geometric function and function ${}_2F_1(a,b;c;z)$. |
| | 4.2 | A simple integral form valuation of ${}_2F_1(a,b;c;z)$. Contiguous function relations, |
| | 4.3 | Hyper geometric differential equation and its solutions, ${}_2F_1(a,b;c;z)$ as function of its parameters. |
| **Unit V** | 5.1 | Generalized Hyper geometric function. Confluent hyper geometric function and its properties. |
| | 5.2 | Elementary series manipulations, Simple transformation, Relations between functions z and l-z. |

**Text books:-**


(1) Rainville, E.D., Special Functions, the Macmillan Co., New York 1971.

(2) Srivastava, H.M., Gupta K.C. and Goyal, S.P. ; The H-Functions of one and two variables with applications, South Asian Publication, New Delhi.

(3) Saran N., Sharma S.D. and Trivedi- Special Functions with application, Pragati Prakashan 1986.

(4) Saxena V.P., I-Function, Anamaya- New Delhi, 2008.


**Reference books:-**


(1) Lebdev, N.N., Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New Jersey, USA 1995.

(2) Whittaker, E.T. and Watson, G.N., A course of Modern Analysis Cambridge University Press, London, 1963

# Paper MM603: Dissertation/Project in Mathematics

| | External | Internal |
|---|---|---|
| Max. Marks (100) | 70 | 30 |
| Min Pass Marks | 28 | 12 |
| Periods Per week | 04 | |
| Total Credits | 04 | |

The dissertation presents a major piece of guided independent research on a topic agreed between the student and their supervisor. It typically involves a literature review and an appropriate form of critical analysis of sources of primary and /or secondary data; it may involve field and/or laboratory work. The dissertation must show evidence of wide reading and understanding, of critical analysis and/or appropriate use of advanced research techniques. The students must attend relevant seminars, present at least one seminar, and comply with any other prescribed conditions.

**Learning Outcomes**:
The learner-

- critical investigate and evaluate research topic/problem related to Mathematics.
- systematically identify relevant theory and apply concept with appropriate techniques and evidence, related to Mathematics and draw the conclusions.
- systematically discover and critical review of appropriate and relevant information sources.
- communicate research concepts and contexts clearly and effectively both in writing and orally

**Dissertation activities in Mathematics:**

Students must submit a report/synopsis/thesis of dissertation work on the topic of their study comprising of -

a. an introduction on the topic along with literature survey and justification for the Selection of the topic.
b. methodology
c. results and discussion
d. summary and conclusion along with the references.
e. each student has to give a midterm presentation of his or her work
f. preparation and presentation of paper in seminar.
g. submit final report for evaluation and conduct the viva

# Paper MM604: Mathematics Practical

| | External | Internal |
|---|---|---|
| Max. Marks (50) | 40 | 10 |
| Min Pass Marks | 16 | 4 |
| Periods Per week | 04 | |
| Total Credits | 02 | |

**Learning Outcomes:**

The learner-

- verify content and concept of Mathematics papers MM601 and MM602 by using Mathematical software or computer programming language.
- connect basic concepts of Mathematics papers MM601 and MM602 content with new ideas.
- increase their skills of analysis and problem solving using Mathematical software or computer programming language.
- visualize some important theorems and concepts of the Mathematics papers MM601, and MM602 using Mathematical software or computer programming language.
- demonstrate the concepts of Mathematics papers MM601 and MM602 through seminar etc.
- understand applications of Mathematics papers MM601 and MM602.
- use various application of Mathematics papers MM601 and MM602 with daily life problem.

**Activities:**

- Activity oriented problem solving / Experiments using Mathematical software or computer programming language based on the content studied in Mathematics papers MM601 andMM602.
- Mathematics seminar.

# Three-Year Integrated M.Sc. (Zoology) M.Ed. Programme

# Three-Year Integrated M.Sc. (Zoology) M.Ed. Programme

## (A) Course Structure with Credits

### 1.1 M.Sc. (Zoology) M.Ed. I Semester

| S. | Paper Code | Subject Name | T/P | Credit | Hours | Internal | External | Tot |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | MZ101 | Biosystematics, Taxonomy and Evolution | **T** | 4 | 60 | 30 | 70 | 10 |
| 2 | MZ102 | Classification, Structure and Function of Invertebrates | **T** | 4 | 60 | 30 | 70 | 10 |
| 3 | MZ103 | Developmental Biology and Gamete Differentiation | **T** | 4 | 60 | 30 | 70 | 10 |
| 4 | MZ104 | Zoology Practical | **P** | 2 | 60 | 15 | 35 | 50 |
| 5 | ME101 | Educational Studies (CS-I) | T | 4 | 60 | 30 | 70 | 10 |
| 6 | ME102 | Philosophical Perspectives of Education (CS-II) | T | 4 | 60 | 30 | 70 | 10 |
| 7 | ME103 | Teacher Education-I (CS - III) | T | 4 | 60 | 30 | 70 | 10 |
| 8 | ME104 | Self-Development (P - I) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **245** | **455** | **70** |

T – Theory and P – Practical

**1.2 M.Sc. (Zoology) M.Ed. II Semester**

| **S.** | **Paper Code** | **Subject Name** | **T/P** | **Credit** | **Hours** | **Internal** | **External** | **Tot** |
|---|---|---|---|---|---|---|---|---|
| 1 | MZ201 | Classification and Comparative Anatomy of Vertebrates | T | 4 | 60 | 30 | 70 | 10 |
| 2 | MZ202 | Animal Physiology and Endocrinology | T | 4 | 60 | 30 | 70 | 10 |
| 3 | MZ203 | Immunology | T | 4 | 60 | 30 | 70 | 10 |
| 4 | MZ204 | Zoology Practical | P | 2 | 60 | 15 | 35 | 50 |
| 5 | ME201 | Psychology of Learning and Development (CS – IV) | T | 4 | 60 | 30 | 70 | 10 |
| 6 | ME202 | Curriculum Studies (CS - V) | T | 4 | 60 | 30 | 70 | 10 |
| 7 | ME203 | Sociology of Education (CS - VI) | T | 4 | 60 | 30 | 70 | 10 |
| 8 | ME204 | Academic Writing (P - II) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **245** | **455** | **70** |

**1.3 M.Sc. (Zoology) M.Ed. III Semester**

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MZ301 | Biomolecules & Structural Biology | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ302 | Cell Biology | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ303 | Genetics | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ304 | Zoology Practical | P | 2 | 60 | 15 | 35 | 50 |
| 5 | ME301 | Cross Curricular Pedagogical Approaches (CS - VII) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME302 | Teacher Education-II (CS - VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME303* | TS–I Thematic Specialization I (Any one) TS1.1/TS2.1/TS3.1/ TS4.1/TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME304 | Internship –I (P-III) (Teacher Education) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **245** | **455** | **700** |

T – Theory and P – Practical

**Thematic Specialization:**

**TS1.1 -** Educational Management, Administration and Leadership

**TS2.1-** Curriculum Theory Planning and Development

**TS3.1-** Foundations of Educational Technology

**TS4.1 -** Understanding and development of Equitable and Inclusive Education

**TS5.1–** Guidance and Counselling in School

**1.4 M.Sc. (Zoology) M.Ed. IV Semester**

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Tota |
| 1 | MZ401 | Molecular Biology | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ402 | Genetic Engineering | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ403 | Tools and Techniques in Biology | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ404 | Zoology Practical | P | 2 | 60 | 15 | 35 | 50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | ME401 | Historical, Political and Economic Perspectives of Education (CS - IX) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME402 | Research Methodology -I (CS - X) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME403* | TS II- Thematic Specialization II (Any one: TS1.2/TS2.2/TS3.2/TS4.2/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | ME404 | Dissertation-1: Research in Education (Planning) (P- IV) | P | 1 | 60 | 25 | | 50 |
| 9 | ME405* | Internship II - Thematic Specialisation (P – V) | P | 2 | 30 | 50 | | 50 |
| | | Total | | 29 | 510 | 270 | 455 | 750 |

**Optional ME403***

**Thematic Specialization**

**TS1.2–**Educational Planning
**TS2.2–**Learning and Pedagogy of School Subjects
**TS3.2–**ICT in Education
**TS4.2–**Addressing the diverse needs in Inclusive setting
**TS5.2 –** Assessment and Appraisal in Guidance and Counselling

**1.5 M.Sc. (Zoology) M.Ed. V Semester**

| S. No. | Paper Code | Subject Name | T/ | Cred | Hou | Internal | External | Tot |
|---|---|---|---|---|---|---|---|---|
| 1 | MZ501 | Computational Biology, Biostatistics, Quantitative Biology, Bioinformatics, Biosafety & Bioethics, and IPR | **T** | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ502 | Applied Zoology | **T** | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ503 | Optional Papers Zoology Group 1 (Entomology I/ Ichthyology I/ Limnology I/ Aquaculture I) | **T** | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ504 | Zoology Practical | **P** | 2 | 60 | 15 | 35 | 50 |
| 5 | ME501 | Research Methodology -II(CS - XI) | **T** | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6 | ME502 | Indigenous Knowledge System (CS – XII) | **T** | 4 | 60 | 30 | 70 | 100 |
| 7 | ME503 | TS – III Thematic Specialization III(Any one: TS1.3/TS2.3/TS3.3/TS4.3/TS5.2) | **T** | 4 | 60 | 30 | 70 | 100 |
| 8 | ME504 | Dissertation-2: Research in Education (Execution) (P – VI) | **P** | 1 | 30 | 25 | | 25 |
| | **Total** | | | **27** | **450** | **220** | **455** | **675** |

**Thematic Specialization:**

**TS1.3 –**Educational Leadership and Supervision

**TS2.3 –** Learners' Assessment

**TS3.3 –** ICT Integration in Education

**TS4.3 –** Concern, Challenges and Issues in Inclusive Education

**TS5.3 –** Career Developme

**Optional MZ503:**

| **Optional (MZ503)** | **Name of Paper** |
|---|---|
| MZ503(a) | Entomology I |
| MZ503(b) | Ichthyology I |
| MZ503(c) | Limnology and Fish Productivity I |
| MZ503(d) | Aquaculture I |

**1.6 M.Sc. (Zoology) M.Ed. VI Semester**

| **S.** | **Paper Code** | **Subject Name** | **T/P** | **Credit** | **Hours** | **Internal** | **External** | **Tota** |
|---|---|---|---|---|---|---|---|---|
| **1** | MZ601 | Ecology and Environment | **T** | 4 | 60 | 30 | 70 | 100 |
| **2** | MZ602 | Animal Behaviour, Biodiversity and Wildlife Conservation. | **T** | 4 | 60 | 30 | 70 | 100 |
| **3** | MZ603 | Optional Papers Zoology Group 2 (Entomology/ Ichthyology/ Limnology/ Aquaculture) | **T** | 4 | 60 | 30 | 70 | 100 |
| **4** | MZ604 | Zoology Practical | **P** | 1 | 30 | 5 | 20 | 25 |
| **5** | MZ605 | Project Zoology | **P** | 1 | 30 | 5 | 20 | 25 |
| **6** | ME601 | Education for Sustainable Development (CS -XIII) | **T** | 4 | 60 | 30 | 70 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **7** | ME602 | Generic Elective course (GE) (any one of the following)<br>I. Indian Values, Culture and Heritage<br>II. Vocational Opp.<br>III. Programme and Institutional Assessment<br>IV. Physical Education, Yoga, and Wellness | **T** | 4 | 60 | 30 | 70 | 100 |
| **8** | ME603 | Application of ICT in Education (P – VII) | **P** | 2 | 60 | 50 | | 50 |
| **9** | ME604 | Dissertation-3: Research in Education (Report Submission) (P-VIII) | **P** | 4 | 60 | 50 | 50 | 100 |
| | **Total** | | | **28** | **480** | **260** | **440** | **700** |

**Optional MZ603:**

| **Optional (MZ603)** | **Name of Paper** |
|---|---|
| MZ603(a) | Entomology II |
| MZ603(b) | Ichthyology II |
| MZ603(c) | Limnology and Fish Productivity II |
| MZ603(d) | Aquaculture II |

## (B) Syllabus with Credit Based Choice System (CBCS)

### 1.3 M.Sc. (Zoology) M.Ed. I Semester

| S. | Paper Code | Subject Name | T/P | Credit | Hours | Internal | External | Tot |
|---|---|---|---|---|---|---|---|---|
| 1 | MZ101 | Biosystematics, Taxonomy and Evolution | **T** | 4 | 60 | 30 | 70 | 10 |
| 2 | MZ102 | Classification, Structure and Function of Invertebrates | **T** | 4 | 60 | 30 | 70 | 10 |
| 3 | MZ103 | Developmental Biology and Gamete Differentiation | **T** | 4 | 60 | 30 | 70 | 10 |
| 4 | MZ104 | Zoology Practical | **P** | 2 | 60 | 15 | 35 | 50 |
| 5 | ME101 | Educational Studies (CS-I) | T | 4 | 60 | 30 | 70 | 10 |
| 6 | ME102 | Philosophical Perspectives of Education (CS-II) | T | 4 | 60 | 30 | 70 | 10 |
| 7 | ME103 | Teacher Education-I (CS - III) | T | 4 | 60 | 30 | 70 | 10 |
| 8 | ME104 | Self-Development (P - I) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **245** | **455** | **70** |

T – Theory and P – Practical

**M.Sc. Zoology M.Ed. I Semester**

**Paper MZ101: Biosystematics, Taxonomy and Evolution**

| | |
|---|---|
| Contact Periods/week | |
| Maximum Marks | |
| Min. pass marks | |
| External | |
| Internal | |

**Learning Outcome:**

Students will be able to:

- Describe history of life and development of evolutionary thought, mechanism by which evolution occurs, role of extinction in evolution.
- Identify animals and will be able to describe their identifying characters.
- Explain history of life on earth, and phylogenetic relationships between organisms.
- Evaluate animals according to the level of organization, body plan, symmetry, germ layers, coelom development etc.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Palaeontology and Evolutionary History: The evolutionary time scale, periods and Epoch, major events in the evolutionary time scale, Origins of unicellular and multicellular organisms. |
| | 1.2 | Definition and basic concepts of Biosystematics, Taxonomy and Classification – History of Classification |
| | 1.3 | Trends in Biosystematics: Chemotaxonomy, Cytotaxonomy and Molecular Taxonomy, Dimensions of Speciation and Taxonomic Characters |
| | 1.4 | Species Concepts: Species Category, Different Species Concepts, Sub Species and Other Infra-Specific Categories, Theories of Biological Classification: Hierarchy of Categories. |
| **Unit-II** | 2.1 | Origin of Reproductive Isolation, Biological Mechanism of Genetic Incompatibility. |
| | 2.2 | Taxonomic Procedures: Taxonomic Collections, Preservation, Curetting, Process of Identification. |
| | 2.3 | |

| | | |
|---|---|---|
| | | International Code of Zoological Nomenclature (ICZN): Operative Principles, Interpretation and Application of Important Rules: Formation of Scientific Names of various taxa. |
| **Unit-III** | 3.1<br>3.2<br>3.3<br>3.4 | Taxonomic categories.<br>Evaluation of Biodiversity Indices.<br>Evaluation of Dominance Index.<br>Similarity and Dissimilarity Index. |
| **Unit-IV** | 4.1<br>4.2<br><br><br><br><br><br><br>4.3 | Concepts of Evolution and Theories of Organic Evolution.<br>Neo Darwinism and Population Genetics:<br>A. Hardy-Weinberg law of Genetic Equilibrium<br>B. A detailed account of destabilizing forces:<br>i. Natural Selection<br>ii. Mutation<br>iii. Genetic Drift<br>iv. Migration<br>v. Meiotic Drive<br>Molecular Evolution<br>A. Gene Evolution, Evolution of Gene Families.<br>B. Molecular divergence and molecular clocks, molecular tools in Phylogeny, Classification and Identification. |
| **Unit-V** | 5.1<br>5.2<br>5.3<br>5.4<br><br>5.5 | Major trends in the origin of Higher Categories (Primary evolutionary pattern).<br>Phylogenetic- Gradualism and Punctuated Equilibrium.<br>Micro and Macro Evolution.<br>Molecular population Genetics: Pattern of changes in nucleotide and amino acid sequence.<br>Phylogenetic, gradualism and punctuated equilibrium and Biological concepts of Species, Modes of Speciation (Allopatry, Parapatry, and Sympatry). |

**Suggested Readings:**


1. M. Koto-The. Biology of Biodiversity-Springer.
2. E.O. Wilson-Biodiversity-Academic Press Washington.
3. G.G.-Simpson-Principle of Animal Taxonomy- Oxford IBH Publication Company.
4. E. Mayer-Elements of Taxonomy.
5. Dobzansky - Biosystematics.
6. Dallela and Sharma - Animal Taxonomy and Museology.
7. Dobzhansky - The Genetic and Origin of Species. Columbia University Press.
8. Futuyama D.I. - Evolutionary Biology - INC Publishers Dunderland.
9. Jha A.P - Genes and Evolution- John Publication, New Delhi.
10. Parker, T.J. Haswell W.A., Textbook of zoology, Macmillan co., London.

**M.Sc. Zoology M.Ed. I Semester**

**Paper MZ102: Classification, Structure and Function of Non-Chordata**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcome:**

Students will be able to:

- Gain knowledge of the animal world that surrounds us, identify the invertebrates and vertebrates and classify them up to the order level.
- Classify non-chordates, their structure and organization.
- Develop an understanding of the Excretory and Nervous system of the invertebrates.

| | | |
|---|---|---|
| **Unit-I** | | **Classification of Non-Chordates** |
| | 1.1 | Classification of Non – Chordata. |
| **Unit-II** | | **Organization, Locomotion, and Nutrition in Invertebrates** |
| | 2.1 | Origin of Metazoan. |
| | 2.2 | Organization of Coelom: Acoelomates, Psuedocoelomates, and Coelomates |
| | 2.3 | Locomotion in Protozoan, Coelenterate, Annelida and Echinodermata |
| | 2.4 | Nutrition and Digestion- Patterns of feeding and digestion in lower Metazoa,Mollusca, and Echinodermata, filter feeding in Polychaeta. |
| **Unit-III** | | **Excretion** |
| | 3.1 | Excretion in Lower Invertebrates (Protozoa to Nematoda). |
| | 3.2 | Excretion in Higher Invertebrates (Mollusca to Echinodermata). |
| | 3.3 | Mechanism of Osmoregulation. |
| | 3.4 | Respiration - Organs of Respiration: Gills, Lungs and Tracheae, Respiratory Pigments, Mechanism of Respiration. |
| **Unit-IV** | | **Nervous System** |
| | 4.1 | Primitive Nervous Systems- Coelenterata and Echinodermata. |
| | 4.2 | Advanced Nervous System in Annelida, Arthropoda (Crustacea and Insects) and Mollusca (Cephalopoda). |
| **Unit-V** | | **Larval Forms in Invertebrates** |
| | 5.1 | |

| | | |
|---|---|---|
| | 5.2 | Larval Forms and their Evolutionary significance: Helminthes, Mollusca, Echinodermata.<br>Structure, Life History, and Affinities of the Minor Phyla Rotifera, Entoprocta, Ectoprocta. |

**Suggested Readings:**


1. Hyman, L.H., The invertebrates, Nol. I. Protozoa through Ctenophora, McGraw Hill Co., New York.
2. Barrington, E.J.W., Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G., Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, L.H., The Invertebrates. Vol. 2. McGraw Hill Co., New York.
5. Hyman, L.H., The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
6. Barnes, R.D., Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel-Hunter, W.D. A biology of higher Invertbrates, the Macmillan Co. Ltd., London.
8. Hyman, L.H., The Invertebrates smaller coelomate groups, Vol. V.Mc. Graw Hill Co., New York.
9. Read, C.P., Animal Parasitism. Parasitism. Prentice Hall Inc., New Jersey.
10. Sedgwick, A.A., Student Text book of Zoology. Vol. I, II and III. Central Book Depot, Allahabad.
11. Parker, T.J. Haswell W.A., Text book of zoology, Macmillan co., London.

**M.Sc. Zoology M.Ed. I Semester**

**Paper MZ103: Developmental Biology and Gamete Differentiation**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcome:**

Students will be able to:

- Understand the developmental processes of vertebrates and invertebrates.
- Cognizant of the general patterns and sequential developmental stages of animal and fertilization processes and differentiation.
- Connect the basics concepts physiology and endocrinology of animals.
- Generalize some important terms of germ cell and migration.

| | | |
|---|---|---|
| **Unit-I** | | **Gamete Biology** |
| | 1.1 | Comparative accounts of Differentiation of Gonads in Mammals and Invertebrates. |
| | 1.2 | Germ Cell Determination and Germ Cell Migration. |
| | 1.3 | Spermatogenesis: Morphological basis in Rodents and any Invertebrates |
| | 1.4 | Biochemistry of Semen: Semen composition and formation, assessment of Sper Function. |
| | 1.5 | Ovarian Follicular Growth and Differentiation: Morphology and Endocrinology |
| **Unit-II** | | **Pre-Fertilization and Post-Fertilization Events** |
| | 2.1 | Fertilization: Pre-fertilization events, Biochemistry of fertilization, post-fertilizatio Events. |
| | 2.2 | Biology of Sex Differentiation in the animals. |
| | 2.3 | Multiple ovulation and Embryo transfer technology: In Vitro Oocyte Maturation, Superovulation. |
| **Unit-III** | | **Hormonal Regulation and Teratology** |
| | 3.1 | Hormonal regulation of Ovulation, Pregnancy, and Parturition. |
| | 3.2 | Hormonal regulation of Development of Mammary glands and lactation. |
| | 3.3 | Endocrinology and Physiology of Placenta. |
| | 3.4 | Cryopreservation of Gametes and Embryo. |
| | 3.5 | Teratological effects of Xenobiotics on Gametes. |
| **Unit-IV** | | **Differentiation** |
| | 4.1 | Cell Commitment, aggregation and Differentiation in *Dictyostelium;* axes an pattern formation in Drosophila, Amphibia and Chick, Organogenesis Vulv formation in *Caenorhabditis elegans*, eye lens induction, Limb development an |

| | | |
|---|---|---|
| | | regeneration in vertebrates; differentiation of neurons, post-embryon development- larval formation, metamorphosis. |
| | 4.2 | Melanogenesis. |
| **Unit-V** | | **Development** |
| | 5.1 | Induction competence, Morphogenetic gradients, cell fate and cell lineages, Genomi Equivalence and the cytoplasmic determinants, Imprinting, mutants and Transgenics in Analysis of development. |
| | 5.2 | Maternal effect genes, segmentation genes. |
| | 5.3 | Cell Diversification in early Amphibian Embryo, Totipotency, and Pluripotency. |
| | 5.4 | Embryonic Stem cells, renewal by Stem cells, Epidermis. |
| | 5.5 | Connective tissue cell family. |
| | 5.6 | Hematopoietic Stem cells: Blood cell formation and Stem cell disorders. |

**Suggested Readings:**


1. Long J.A., Evan H.M. 1922: The oestrous cycle in the Rat and its associated phenomenon.
2. Nalbandou. A.C., Reproductive physiology.
3. Prakash, A.S., 1965-66 Marshall's, Physiology Reproduction (3 Vol.).
4. Gilbert, S.F., Developmental Biology, Sinauer Associated Inc. Massachusetts.
5. Ethan Bier, The cold Spring. The cold spring Harbor laboratory Press, New York.
6. Balinsky, B.I., Introduction to Embryology sanders, Philadelphia.
7. Berril, N.J. and Karp. G., Development Biology. McGraw Hill New York.
8. Davidson, E.H., Gene Activity During Early Development. Academic Press, New York.

**M.Sc. Zoology M.Ed. I Semester**

**Paper MZ104: Zoology Practical**

| | |
|---|---|
| Maximum Marks | 50 |
| Min. pass marks | |
| External | 35 |
| Internal | 15 |

**Learning Outcome:**

- After conducting these laboratory exercises, the students develop the skill Of Identification, staining and study of various Developmental Stages of the animal.

Practical:

1. Spotting – Classification and Identification of various Phylum.
2. Study of museum specimens, slides relevant to the study in theory.
3. Histochemistry: Fixation, Sectioning, Embedding, Processing and Staining
4. Permanent Mounting
5. Developmental Biology

A. Study of embryological slides (Different stages of spermatogenesis and Oogenesis, developmental stages of frog and chick)
B. Study of fate maps
C. Study of egg window

**Scheme of Practical Examination**

| | | |
|---|---|---|
| 1. | Spotting | 10 |
| 2. | Mounting | 05 |
| 3. | Study of various developmental stages of the animal | 10 |
| 4. | Practical records and collection | 05 |
| 5. | Viva voce | 05 |
| **Total -** | | **35** |

## 1.2 M.Sc. (Zoology) M.Ed. II Semester

| S. No. | Paper Code | Subject Name | T/P | Credit | Hours | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | MZ201 | Classification and Comparative Anatomy of Vertebrates | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ202 | Animal Physiology and Endocrinology | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ203 | Immunology | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ204 | Zoology Practical | P | 2 | 60 | 15 | 35 | 50 |
| 5 | ME201 | Psychology of Learning and Development (CS – IV) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME202 | Curriculum Studies (CS - V) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME203 | Sociology of Education (CS - VI) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | ME204 | Academic Writing (P - II) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **245** | **455** | **700** |

**M.Sc. Zoology M.Ed. II Semester**

**Paper MZ201: Classification of Chordates, Comparative Anatomy of Vertebrates**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcome:**

Students will be able to:

- Understand the basic structure, organization of anatomical systems and their modification in the major transitions in vertebrate evolution.
- Explain the classification and phylogeny of animals.
- Enrich knowledge on comparative accounts of sense organs, ANS and CNS.

| | | |
|---|---|---|
| **Unit-I** | | **Classification of Chordates** |
| | 1.1 | Origin of Chordata: Concept of Protochordata. |
| | 1.2 | Classification of Phylum Chordata. |
| **Unit-II** | | **Integument system and Digestive system of Vertebrates** |
| | 2.1 | Development, structure and function of integument and its derivatives (Glands, Scales, feathers and hairs). |
| | 2.2 | Comparative account of Jaw Suspensorium, Girdles and Vertebral Column. |
| | 2.3 | Comparative account of Digestive System. |
| **Unit-III** | | **Heart, Blood, and Respiratory System of Vertebrates** |
| | 3.1 | Evolution of Heart. |
| | 3.2 | Evolution of Aortic Arches and Portal System. |
| | 3.3 | Blood Circulation in various Vertebrates groups. |
| | 3.4 | Respiratory System: Character of Respiratory tissue, External and Internal |

| | | |
|---|---|---|
| | | Respiration, Comparative account of Respiratory organs. |
| **Unit-IV** | | **Nervous and UrinogenitalSystem of Vertebrates** |
| | 4.1 | Comparative anatomy of Brain and Spinal Cord (CNS). |
| | 4.2 | Comparative account of Peripheral and Autonomous Nervous System. |
| | 4.3 | Evolution of Urogenital System of Vertebrates. |
| **Unit-V** | | **Sense Organs** |
| | 5.1 | Comparative account of organs of Olfactory and Tastes. |
| | 5.2 | Lateral line system of Pisces. |
| | 5.3 | Comparative account of Electro-reception, Mechanoreception, Photoreception, Phonoreception in vertebrates. |

**Suggested Readings:**


1. EJW Barrington-General & comparative Endoctrinology-Oxford, Claredon Press.
2. R.H. Williams-Text Book of Endocrinology-W.B. Saunders.
3. C.R. Martin- Endocrine Physiology-Oxford University Press.
4. Molecular CellBiology-J. Darnell, H. Lodish and D. Baltimore Scientific American Book USA
5. Molecular Biology of the cell-B. Alberts, D-Bray, J.Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Pub. New York.

**M.Sc. Zoology M.Ed. II Semester**

**Paper MZ202: Animal Physiologyand Endocrinology**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcome:**

Student will be able to:

- Understand the anatomy and physiology of the system.
- Perform, analyse and report experiments and observations in physiology.
- Understand the defence mechanism in humans.

| | | |
|---|---|---|
| **Unit-I** | | **Physiology-I** |
| | 1.1 | Physiology of Digestion; GI Hormones and Mechanism of Absorption. |
| | 1.2 | Patterns of Nitrogen excretion in different Animal groups. |
| | 1.3 | Osmoregulation in different animal groups. |
| | 1.4 | Respiratory pigments (Haemoglobin) through different Phytogenic group (Arthropoda, Mollusca etc). |
| | 1.5 | Transport of Oxygen and Carbon Dioxide in blood and body fluids. |
| | 1.6 | Regulation of Breathing (Respiratory centre). |
| **Unit-II** | | **Physiology-II** |
| | 2.1 | Composition of Blood; Blood volume regulation, blood groups. |
| | 2.2 | Haemostasis and Mechanism of Coagulation of blood. |
| | 2.3 | Nerve Physiology: Neurons and Neuronal Cells, transmission of electrical signal through nerve fibres and Synapses, Autonomic nervous system neurotransmitters |
| | 2.4 | and their Physiological functions. Physiology of muscle: Mechanism of muscle contraction. |
| **Unit-III** | | **Endocrinology** |
| | 3.1 | Structure and function of Endocrine glands: Pituitary, Pineal, Thyroid and parathyroid, Thymus, Pancreas, Adrenal, Testes and Ovary. |
| | 3.2 | Neuro-endocrine system. |
| **Unit-IV** | | **Hormones and Mechanism of Action** |
| | 4.1 | Hormones: Properties, Classification and chemical nature. |
| | 4.2 | Mechanisms of Hormone Action. |

| | | |
|---|---|---|
| | 4.3 | Hormone receptors- Signal transduction mechanisms. |
| | 4.4 | Pheromones and other Semiochemicals as means of communication among animals. |
| | 4.5 | Hormones and Reproduction<br>A. Seasonal Breeder<br>B. Continuous Breeders |
| **Unit-V** | | **Pregnancy and Parturition** |
| | 5.1 | Physiology of Pregnancy. |
| | 5.2 | Placental hormones. |
| | 5.3 | Pregnancy diagnosis tests. |
| | 5.4 | Parturition and Lactation. |
| | 5.5 | Hormones and Diseases. |

**Suggested Readings:**


1. Carter, G.S. Structure and habit in vertebrate evolution - Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates, Central Book Depot. Allahabad,
3. Kent, C.G. Comparative anatomy of vertebrates
4. Malcom Jollie, Chordata morphology. East - West Pres Pvt. Ltd., New Delhi.
5. Milton I lildergrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
7.Sedgwick, A.A. Students Text Book of Zoology, Vol. II.
8. Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia
10. Young J.Z. life of vertebrates. The oxford University Press, London
11. Parker & Haswell to III Rev. by Marshall willianslatested Macmillan Co. Itd.
12. Young J.Z. Life of mammals. The Oxford University Press, London.
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.

**M.Sc. Zoology M.Ed. II Semester**

**Paper MZ203: Immunology and vaccination**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Objectives:**

Students will be able to:

- Identify the Immune system, cellular and molecular basis of immune responsiveness.
- Emphasize the Immunity, BCR, TLRs.
- Understand the structure and function of Immune Cells.
- Identify the Immune diseases and the importance of vaccines.

| | | |
|---|---|---|
| **Unit-I** | | **Immunology-I**<br>Overview of Immune System: Components of Immune system, Principles of innate and adaptive Immunity, Antigen and Immunogenicity, Clonal selection theory, Evolution of Immune system. |
| **Unit-II** | | **Immunology-II**<br>Antigen recognition by Immune cells: Innate immunity – Pattern recognition in the Innate Immune system, TLRs and their role in Innate Immune response; Adaptive Immunity: Antibody structure, Antigen recognition by B lymphocytes; Molecular mechanism behind BCR formation; B lymphocyte development and survival. |
| **Unit-III** | 3.1<br><br>3.2 | **MHC Complex and Antigen Processing**<br>Structure and function of MHC Complex: Antigen processing cells, antigen processing and presentation to T lymphocytes, MHC restriction.<br>TCR Structure and function: T cell receptor gene rearrangement; T lymphocyte Development and survival; Antigen recognition by T-cell, signalling through TCR and T-cell activation, co-receptors and their role in T-cell functioning; Co-stimulation. |
| **Unit-IV** | 4.1<br><br><br>4.2 | **Immune Response**<br>Induced innate response to infection, innate memory, complement system, NK and NKT cell functions, Humoral immune response, Production of effector T cells, cytotoxic T cell effector mechanisms. |

| | | |
|---|---|---|
| | | Leukocyte activation and migration, cytokines, innate regulation of immune response, T cell mediated regulation of immune response, immunological tolerance; Mucosal immunity. |
| **Unit-V** | | **Health and Diseases**<br>Immunity in Health and disease: Allergy and hypersensitivity, Autoimmunity, Immunodeficiency diseases, Immunity and infection, Tumour immunology, Transplantation and Vaccines. |

**Suggested Literature:**


1. Kuby Immunology, Richard, Thomas, Barbara, Janis , W. H. Freeman and Company [Latest edition].
2. Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, Garland Science Publishing [Latest edition].
3. Essentials of Immunology, David, Brostoff and Roitt, Mosby &Elsevier Publishing[Latest edition].
4. Fundamentals of Immunology by William E. Paul, Lippincott Williams &Wilkins Publishing[Latest edition].
5. Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Elsevier Publishing [Latest edition].

**M.Sc. Zoology M.Ed. II Semester**

**Paper MZ204: Zoology Practical**

| | |
|---|---|
| Maximum Marks | 50 |
| Min. pass marks | |
| External | 35 |
| Internal | 15 |

**Learning Outcome:**

After conducting these laboratory exercises, the students will be able to:

- Develop the skills of performing physiological, chemical and immunological tests to know the actual process of life.

Practical:

1. Spotting – Classification and Identification of various Phylum
2. Study of museum specimens, slides relevant to the study in theory
3. Permanent slide preparation- Scales of Fishes
4. Comparative study of Vertebrate through Charts, Models, Permanent slides
5. Comparative study of Vertebrate Osteology
6. Identification of blood groups of human
7. Preparation of blood film & study of human blood corpuscles
8. Study of haemin crystal from human blood
9. Estimation of haemoglobin
10. Total count of RBCs and WBCs in human blood
11. Study of blood pressure
12. To perform Dot ELISA test for the detection of antigen and antibody
13. To perform sandwich ELISA Test
14. To learn the technique of Ouchterlony double diffusion. (The reaction pattern of an antigen with a set of antibodies).

**Scheme of Practical Examination**

1. Spotting
2. Mounting -
3. Haematology experiment
4. Immunology experiment
5. Practical records and collection
6. Viva voce

**Total - 35**

### 1.3 M.Sc. (Zoology) M.Ed. III Semester

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MZ301 | Biomolecules & Structural Biology | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ302 | Cell Biology | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ303 | Genetics | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ304 | Zoology Practical | P | 2 | 60 | 15 | 35 | 50 |
| 5 | ME301 | Cross Curricular Pedagogical Approaches (CS - VII) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME302 | Teacher Education-II (CS - VIII) | T | 4 | 60 | 30 | 70 | 100 |
| **7** | ME303* | TS–I Thematic Specialization I (Any one) TS1.1/TS2.1/TS3.1/ TS4.1/TS5.1) | T | 4 | 60 | 30 | 70 | 100 |
| **8** | ME304 | Internship –I (P-III) (Teacher Education) | P | 2 | 60 | 50 | | 50 |
| | | **Total** | | **28** | **480** | **245** | **455** | **700** |

T – Theory and P – Practical

**Thematic Specialization:**

**TS1.1 -** Educational Management, Administration and Leadership

**TS2.1-** Curriculum Theory Planning and Development

**TS3.1-** Foundations of Educational Technology

**TS4.1 -** Understanding and development of Equitable and Inclusive Education

**TS5.1–** Guidance and Counselling in School

**M.Sc. Zoology M.Ed. III Semester**

**Paper MZ301: Biomolecules and Structural Biology**

| | |
|---|---|
| Max. Marks (100) | 70 |
| Min Pass Marks | 40 |
| Periods Per week | 04 |
| Total Credits | 04 |

**Learning Outcomes:**

On completion of this paper, the student will be able to:

- Understand the basic principles of thermodynamics and basic chemistry.
- Understand the composition, structure, and function of biomolecules (Carbohydrates, Proteins, Nucleic Acids, Lipids, and Vitamins).
- Explain the important metabolic processes and biosynthesis of the biomolecules.
- Learn the basic concept of enzymology.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Chemical Foundation of Biology. |
| | 1.2 | pH, Pk, Acids Bases, Buffers, Weak Bonds. |
| | 1.3 | Free Energy Resonance, Isomerisation. |
| | 1.4 | Concept of Free Energy and Thermodynamic Principles in Biology. |
| | 1.5 | Energy Rich Bonds, Compound and Biological Energy Transducers. |
| **Unit-II** | 2.1 | Composition, Structure and Function of Carbohydrates. |
| | 2.2 | Composition, Structure and Function of Amino Acids and Proteins. |
| | 2.3 | Composition, Structure and Function of Nucleic Acids (DNA & RNA). |
| | 2.4 | Composition, Structure and Function of Fatty Acids & Lipids. |
| | 2.5 | Composition, Structure and Function of Vitamins |
| **Unit-III** | 3.1 | Basic Concepts of Metabolism: Coupled and Interconnecting Reactions of Metabolism, Cellular Energy Resources and ATP Synthesis. |
| | 3.2 | Glycolysis and Glycogenolysis. |
| | 3.3 | Citric Acid Cycle. |
| | 3.4 | Oxidative Phosphorylation. |
| | 3.5 | Fatty Acid Metabolism: Synthesis and Degradation of Fatty Acids. |

| | | |
|---|---|---|
| **Unit-IV** | 4.1 | Biosynthesis of Carbohydrates. |
| | 4.2 | Biosynthesis of Amino Acids and Proteins. |
| | 4.3 | Biosynthesis of Nucleotides. |
| | 4.4 | Biosynthesis of Membrane Lipids and Steroids. |
| **Unit-V** | 5.1 | Enzymes: Nomenclature, Classification, and Basics of Enzyme Kinetics. |
| | 5.2 | Mechanism of Enzyme Catalysis. |
| | 5.3 | Regulation of Enzyme Action. |
| | 5.4 | Concept of Isozymes. |

**Suggested Readings:**


1. Voet, D. and J.G. Voet. Biochemistry John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
3. Segal, I.H. Biochemical calculations John Wiley and Sons
4. Creighton, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co.
5. Freifelder, D. Essentials of Molecular Biology
6. Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of Practical Biochemistry
7. Cooper, T.G. Tools of Biochemistry
8. Hawk, Practical Physiological ChemistryGarret, R.H. and C.M. Grisham. Biochemistry. Saunders college Publishers.

# Paper MZ302: Cell Biology

| | |
|---|---|
| Max. Marks (100) | 70 |
| Min Pass Marks | 40 |
| Periods Per week | 04 |
| Total Credits | 04 |

**Learning Outcomes:**

On completion of this paper, the student will be able to:

- Understand the structure and function of the cell and its organelles.
- Comprehend the composition and function of bio-membranes and cytoskeleton.
- Explain the cell communication and cell signalling processes in detail.
- Understand the process of cell cycle, its control and regulation.
- Learn the basic concept of aging, cell-death mechanisms, and cancer biology.

| | | |
|---|---|---|
| **Unit-I** | | **Structural Organization and Function of Cell and Intracellular Organelles** |
| | 1.1 | Cell & their types. |
| | 1.2 | Mitochondria. |
| | 1.3 | Endoplasmic Reticulum. |
| | 1.4 | Ribosomes |
| | 1.5 | Golgi Bodies. |
| | 1.6 | Lysosomes, Peroxisomes, Endosome, Hydrogenosome, Centrosome. |
| | 1.7 | Nucleus. |
| **Unit-II** | | **Bio-membrane** |
| | 2.1 | Molecular Composition, Arrangement, and Functional Consequences of bio-membranes. |
| | 2.2 | Plasma Membrane. |
| | 2.3 | Transport across Cell Membrane Diffusion: Active Transport, Pumps, Uniports, Antiports, and Symports. |
| | 2.4 | Cytoskeleton: Intermediate Filaments, Microtubules, Actin Filaments, Cilia and Centrioles, Organization of the Cytoskeleton. |
| | 2.5 | Cell-Matrix Adhesion: Integrins, Collagen, and Non-Collagen Components |
| **Unit-III** | | **Cellular Signaling** |
| | 3.1 | Cell-Cell Adhesion: Calcium dependent & Calcium independent - homophilic cell-cell adhesion, Gap Junctions, and Connexins. |
| | 3.2 | Cell Surface Receptors. |
| | 3.3 | Second Messenger System. |
| | 3.4 | Signaling from Plasma Membrane to Nucleus. |
| | 3.5 | Regulation of Cell Signaling Pathways. |
| **Unit-IV** | | **Cell Division and Cell Cycle** |
| | 4.1 | Mitosis. |

| | | |
|---|---|---|
| | 4.2 | Meiosis. |
| | 4.3 | Regulation and Control of Cell Cycle. |
| **Unit-V** | | **Cell Death Mechanisms and Cancer** |
| | 5.1 | Cell Death: Apoptosis, Necrosis, Cell Aging. |
| | 5.2 | Basics of Cancer & Hallmarks of Cancer. |
| | 5.3 | Carcinogens. |
| | 5.4 | Oncogenes &Tumor-suppressor Genes. |
| | 5.5 | Prevention, Detection, and Treatment of Cancer. |

**Suggested Reading:**

1. Alberts, B., Bray, D., Lews, J., Raff, M., Roberts, K. and Watson, J. D. (2010). Molecular Biology of the Cell. Garland publishers, Oxford.
2. Celis, J. E. (2006). Cell Biology: A Laboratory Handbook, Vol 1, 2, 3. Academic Press, UK.
3. Gupta, P. K. (2008). Cytology, Genetics and Evolution. Rastogi publications, Meerut, India.
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc. New Delhi, India.

# Paper MZ303: Genetics

| | |
|---|---|
| Max. Marks (100) | 70 |
| Min Pass Marks | 40 |
| Periods Per week | 04 |
| Total Credits | 04 |

**Learning Outcomes:**

On completion of this paper, the student will be able to:

- Understand the basic principles of Mendelian Genetics and inheritance patterns.
- Explain the linkage patterns and its types, detailed pedigree analysis, and gene mapping methods.
- Comprehend the sex-determination mechanism in different organisms, dosage compensation, extra-chromosomal inheritance, and quantitative genetics in detail.
- Understand the mutations, chromosomal aberrations, genetic diseases and their causes.
- Learn the basic concept of microbial genetics and gene transfer methods.

| | | |
|---|---|---|
| **Unit-I** | | **Concept of Gene and Mendelian Principles & its Extensions** |
| | 1.1 | Dominance, Segregation, Independent Assortment. |
| | 1.2 | Concept of Gene: Allele, Multiple Alleles, Pseudoallele, Complementation Tests. |
| | 1.3 | Codominance, Incomplete Dominance, Gene Interactions, Pleiotropy. |
| | 1.4 | Genomic Imprinting, Penetrance and Expressivity, Phenocopy. |
| **Unit-II** | | **Gene Mapping Methods** |
| | 2.1 | Linkage and Crossing Over. |
| | 2.2 | Linkage Maps. |
| | 2.3 | Tetrad Analysis. |
| | 2.4 | Mapping with Molecular Markers. |
| | 2.5 | Mapping by using Somatic Cell Hybrids. |
| **Unit-III** | | **Sex Determination, Extra-Chromosomal Inheritance, and Quantitative Genetics** |
| | 3.1 | Sex Determination in Animals: Genetically, Hormonal, and Environmental controlled mechanisms. |
| | 3.2 | Basic Concept of Dosage Compensation |
| | 3.3 | Sex Linkage, Sex Limited and Sex Influenced Characters. |
| | 3.4 | Mitochondrial Gene Inheritance, Maternal Inheritance and Maternal Effect.Polygenic Inheritance |
| **Unit-IV** | | **Chromosomal Cytogenetics and Mutations** |
| | 4.1 | Structural and Numerical Alterations of Chromosomes: Deletion, Duplication, Inversion, Translocation, Ploidy and their Genetic Implications. |
| | 4.2 | Mutation: Types, Causes and Detection. |
| | 4.3 | Mutant Types – Lethal, Conditional, Biochemical, Loss of Function, Gain of Function, Germinal Vs Somatic Mutants, Insertional Mutagenesis. |
| | 4.4 | Ames Test, Replica Plating Experiment, and Complementation Test. |

| | | |
|---|---|---|
| **Unit-V** | | **Human Genetics and Microbial Genetics** |
| | 5.1 | Pedigree Analysis. |
| | 5.2 | Autosomal Inheritance, Holandric Inheritance. |
| | 5.3 | Karyotypes & Genetic Disorders. |
| | 5.4 | Methods of Genetic Transfers – Transformation, Conjugation, Transduction and Sexduction. |
| | 5.5 | Mapping Genes by Interrupted Mating, Fine Structure Analysis of Genes. |

**Suggested Reading:**


1. Anthony, J. F., Miller, J. A., Suzuki, D. T., Richard, R. C., Gilbert, W. M. (1998). An Introduction to Genetic Analysis. W.H. Freeman publication, USA.
2. Atherly, A. G., Girton, J. R., Mcdonald, J. F. (1999). The Science of Genetics. Saundern College publication.
3. Snusted, D. P., Simmons, M. J. (2010). Principles of Genetics. John Wiley & Sons, New York.
4. Gupta, P. K. (2009). Genetics. Rastogi publications, Meerut, India.
5. Gupta, P. K (2008). Cytology, Genetics and Evolution. Rastogi publications, Meerut, India.
6. Jocelyn, E. K., Elliott, S. G., Stephen, T. K. (2009). Lewin's Genes X. Jones & Bartlett Publishers, USA.
7. Schaum, W. D. (2000). Theory & problems in Genetics by Stansfield, outline series McGrahill, USA.
8. Tamarin, R. H. (1996). Principles of Genetics, McGrawhill, USA.

# Paper MZ304: Zoology Practical

| | |
|---|---|
| Max. Marks (100) | 50 |
| Min Pass Marks | |
| Periods Per week | |
| Total Credits | 02 |

**Learning Outcomes:**

After conducting these laboratory exercises, the student will be able to:

- Prepare basic chemical reagents, solutions and buffers.
- Explain the linkage patterns and its types, detailed pedigree analysis, and gene mapping methods.
- Comprehend the sex-determination mechanism in different organisms, dosage compensation, extra-chromosomal inheritance, and quantitative genetics in detail.
- Understand the mutations, chromosomal aberrations, genetic diseases and their causes.
- Learn the basic concept of microbial genetics and gene transfer methods.

Practical:

1. Preparation of Reagents, Buffers and Solutions
2. Biochemical estimation and analysis of Proteins, Lipids and Carbohydrates.
3. Problem based on genetics example: Multiple Factor Inheritances, Pedigree Analysis
4. Demonstration of chromosome polymorphism isozyme polymorphism in some insect populations.
5. Preparation of different types of chromosomes: Polytene chromosomes, Lampbrush chromosomes.
6. Cell division preparation of slide on Meiosis & Mitosis.
7. Viva-voce.
8. Practical Record.

**1.4 M.Sc. (Zoology) M.Ed. IV Semester**

| S. | Paper Code | Subject Name | Teaching-Learning | | | Assessment Scheme | | |
|---|---|---|---|---|---|---|---|---|
| | | | T/P | Credit | Hours | Internal | External | Total |
| 1 | MZ401 | Molecular Biology | T | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ402 | Genetic Engineering | T | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ403 | Tools and Techniques in Biology | T | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ404 | Zoology Practical | P | 2 | 60 | 15 | 35 | 50 |
| 5 | ME401 | Historical, Political and Economic Perspectives of Education (CS - IX) | T | 4 | 60 | 30 | 70 | 100 |
| 6 | ME402 | Research Methodology -I (CS - X) | T | 4 | 60 | 30 | 70 | 100 |
| 7 | ME403* | TS II- Thematic Specialization II (Any one: TS1.2/TS2.2/TS3.2/TS4.2/TS5.2) | T | 4 | 60 | 30 | 70 | 100 |
| 8 | ME404 | Dissertation-1: Research in Education (Planning) (P- IV) | P | 1 | 60 | 25 | | 50 |
| 9 | ME405* | Internship II - Thematic Specialisation (P – V) | P | 2 | 30 | 50 | | 50 |
| | | Total | | 29 | 510 | 270 | 455 | 750 |

**Optional ME403***

**Thematic Specialization**

**TS1.2–**Educational Planning

**TS2.2–**Learning and Pedagogy of School Subjects

**TS3.2–**ICT in Education

**TS4.2–**Addressing the diverse needs in Inclusive setting

**TS5.2 –** Assessment and Appraisal in Guidance and Counselling

## Paper MZ401: Molecular Biology

| | |
|---|---|
| Max. Marks (100) | 70 |
| Min Pass Marks | 40 |
| Periods Per week | 04 |
| Total Credits | 04 |

**Learning Outcomes:**

On completion of this paper, the student will be able to:

- Understand and explain the molecular processes of the Central Dogma i.e. DNA Replication, Transcription, and Translation in depth.
- Comprehend the regulation and control of the gene expression in prokaryotes and eukaryotes.
- Understand the mutations, chromosomal aberrations, genetic diseases and their causes.
- Learn the basic concept of the human genome including genes, their structure, gene families, and chromosomal organization.

| | | |
|---|---|---|
| **Unit-I** | | **DNA Replication, Repair, and Recombination** |
| | 1.1 | DNA Replication in Prokaryotes and Eukaryotes:Unit of Replication, Enzymes involved, Replication Origin and Replication Fork. |
| | 1.2 | Fidelity of Replication and Extrachromosomal Replicons. |
| | 1.3 | DNA Damage and Repair Mechanisms. |
| | 1.4 | Recombination: Homologous, Non-Homologous, and Site-Specific. |
| **Unit-II** | | **RNA Synthesis and Processing (Prokaryotes & Eukaryotes)** |
| | 2.1 | RNA Polymerases, Transcription Factors and Machinery, Formation of Initiation Complex, Elongation, and Termination. |
| | 2.2 | Transcription Activator and Repressor. |
| | 2.3 | Post-Transcriptional modifications in eukaryotes: Capping, Splicing, and Polyadenylation. |
| | 2.4 | RNA Editing and Transport. |
| **Unit-III** | | **Protein Synthesis and Processing in Prokaryotes and Eukaryotes** |
| | 3.1 | Genetic Code. |
| | 3.2 | Aminoacylation of tRNA, tRNA-Identity, Aminoacyl tRNA Synthetase |

| | | |
|---|---|---|
| | 3.3 | Ribosome, Formation of Initiation Complex, Initiation Factors and their Regulation, Elongation and Elongation Factors, Termination. |
| | 3.4 | Translational Proof-Reading, Translational Inhibitors, Post-TranslationalModification of Proteins. |
| **Unit-IV** | | **Control of Gene Expression at Transcription and Translation Level** |
| | 4.1 | Regulation of Prokaryotic and Eukaryotic Genes. |
| | 4.2 | Role of Chromatin in Gene Expression and Gene Silencing. |
| | 4.3 | Environmental Modulation of Gene Activity: Stress Response, Stress Genes and Stress Proteins. |
| **Unit-V** | | **Organization of Genes and Chromosomes** |
| | 5.1 | Molecular Organization of Eukaryotic Chromosomes: Structure of Nucleosome Particles, and Higher Order Compaction of Mitotic Chromosomes, Chromatin Remodelling. |
| | 5.2 | Specialized Chromosomes: Structural Organization and Functional Significance of Polytene Chromosomes &Lampbrush Chromosomes, Euchromatin & Heterochromatin. |
| | 5.3 | Transposable Genetic Elements of Prokaryotes and Eukaryotes, Gene Imitation and Molecular Mechanism of Occurrence of Mutation Repair Mechanism |
| | 5.4 | Chromosomal Organization of Genes and Non-Coding DNA, |

**Suggested Reading:**


1. Fasman, G. D. (1989). Practical Handbook of Biochemistry and Molecular Biology. CRC Press, Taylor and Francis Group, UK.
2. Gupta, P. K. (2005). Cell and Molecular Biology. Rastogi publications, Meerut, India.
3. James, D. W., Baker, T. A., Bell, S. P., Gann, A. (2009). Molecular Biology of the Gene. Benjamin Cummings, USA.
4. Jocelyn, E. K., Elliott, S. G., Stephen, T. K. (2009). Lewin's Genes X. Jones & Bartlett Publishers, USA.
5. Johnson, A., Lewis, J., Raff, M. (2007). Molecular Biology of the Cell. Garland Science, USA.
6. Lodish, H., Berk, A., Chris, A. K. and Krieger, M. (2008). Molecular Cell Biology. W.H. Freeman, USA.
7. Sambrook, J., Fritish, E. F., Maniatis, T. (2000). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.

## Paper MZ402: Genetic Engineering

| | |
|---|---|
| Max. Marks (100) | 70 |
| Min Pass Marks | 40 |
| Periods Per week | 04 |
| Total Credits | 04 |

**Learning Outcomes:**

On completion of this paper, the student will be able to:

- Comprehend the basic concept of Recombinant DNA Technology.
- Understand and explain the tools and technologies involved in Genetic Engineering.
- Understand the applications of Genetic Engineering: Transgenic Animals, Therapeutic Applications, Medicinal uses, Diagnosis of diseases, etc.
- Know about the ethical issues surrounding Genetic Engineering.

| | | |
|---|---|---|
| Unit-I | | **Molecular Techniques I** |
| | 1.1 | Introduction to the Concept of Recombinant DNA technology. |
| | 1.2 | Cloning Vectors. |
| | 1.3 | Restriction and Modifying Enzymes. |
| | 1.4 | Transformation Techniques in Animals. |
| | 1.5 | Construction and Screening of cDNA Libraries. |
| Unit-II | | **Molecular Techniques II** |
| | 2.1 | Electrophoresis: Principle and their applications. |
| | 2.2 | Southern, Northern and Western Blotting. |
| | 2.3 | Polymerase Chain Reaction. |
| | 2.4 | RFLP, RAPD and DNA Fingerprinting. |
| Unit-III | | **Genomics and Proteomics** |
| | 3.1 | Structural Genomics: Operon, Unique And Repetitive DNA, Structural Organization of Eukaryotic Genes, Interrupted Genes and Overlapping Genes and their Evolution, Human Genome Project. |
| | 3.2 | Functional Genomics: Microarrays; Maxam-Gilbert, Sanger and Next Generation Sequencing Methods; Single Nucleotide Polymorphisms (SNP)- Nature, Distribution, and Applications. |
| | 3.3 | Proteomics: basic concept, methods, and applications. |
| Unit-IV | | **Transgenic Animals and Gene Cloning** |
| | 4.1 | Transgenic Animal Technology and its applications: Production of Transgenic Animals (Nuclear Transplantation, Retroviral Method, DNA Microinjection Method). |
| | 4.2 | Gene Cloning and its applications. |
| | 4.3 | Gene Therapy. |

| | | |
|---|---|---|
| | 4.4 | Ethical Issues of Transgenic Animals. |
| Unit-V | | **Applications of Biotechnology** |
| | 5.1 | Molecular Diagnosis of Genetic Diseases (Cystic Fibrosis, Huntington's Disease, Sickle Cell Anaemia). |
| | 5.2 | Recombinant DNA in Medicines (Recombinant Insulin and Human GrowthHormone). |
| | 5.3 | Enzymes in Detergents and Leather Industries. |
| | 5.4 | Heterologous Protein Production. |
| | 5.5 | Bioremediation. |

**Suggested Readings**:


1.Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

2. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.

3. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA- genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

4. Watson, J.D., Gilman, M., Witkowski, J. and Zoller, M., (1983) Recombinant DNA. II Edition. Freeman and Co., N.Y., USA.

5. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers. 6. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California, USA.

## Paper MZ403: Tools and Techniques in Biolog

| | |
|---|---|
| Max. Marks (100) | 70 |
| Min Pass Marks | 40 |
| Periods Per week | 04 |
| Total Credits | 04 |

**Learning Outcomes:**

On completion of this paper, the student will be able to:

- Comprehend and explain the basic principle, function, and applications of all the tools and techniques that are essential part to understand the practical aspects of the theory papers.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | **Microscopy:** Principle, and Applications ofLight Contrast and Phase Contrast Microscope, Fluorescence Microscope, Electron Microscope, Confocal Microscope. |
| | 1.2 | **Analytical Instruments:** General Principle and Applications ofpH meter, Colorimeter, Spectrophotometer, Biosensors. |
| | 1.3 | **Microbiological Techniques:** Media Preparation and Sterilization, Inoculation and Growth Monitoring, Microbial Assays, Use of Fermenters. |
| **Unit-II** | 2.1 | Computer Aided Techniques for Data Presentation Data Analysis, Statistical Techniques. |
| | 2.2 | **Cryo-techniques:** Cryopreservation of Cells, Tissues, Organs, and Organisms, Cryosurgery, Cryotomy, Freeze Fracture and Freeze |
| | 2.3 | Drying. |
| | | **Separation Techniques:** Chromatography: Principle, Types and Application, Organelle Separation by Centrifugation. |
| **Unit-III** | 3.1 | Autoradiography. |
| | 3.2 | **Immunological Techniques:** Immunodiffusion, Immuno-electrophoresis, Immunodetection, Immunofluorescence, Immunoblotting. |
| | 3.3 | **Surgical techniques:** Organ ablation (eg. ovariectomy, adrenalectomy), Perfusion Techniques |
| **Unit-IV** | 4.1 | **Histological Techniques**: Principles of Tissue Fixation, Microtomy, Staining, Mounting, Histochemistry. |
| | 4.2 | **Cell Culture Techniques:** Design and Functioning of Tissue Culture Laboratory, Animal Cell and Tissue Culture Cell Culture Media (Natural and Defined), Preparation and Sterilization, Primary Cell Culture, Cell Lines, Pluripotent Stem Cells. |
| **Unit-V** | 5.1 | **Cytological Techniques:** Mitotic and Meiotic Chromosome Preparations from Insects and Vertebrates, Chromosome Banding, |
| | 5.2 | Flowcytometry. |

| | | |
|---|---|---|
| | | **Molecular Cytological Techniques:** In-situ Hybridization (Radio Labelled and Non- radio Labelled Method)**,** FISH**,** Restriction Banding. |

**Suggested Readings:**


1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical
3. Biochemistry-K, Wilson and K.H. Goulding EIBS Edn.
4. Clark &Swizer. Experimental Biochemistry. Freeman, 2000.
5. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983.
6. Boyer. Modern Experimental Biochemistry. Benjamin, 1993.
7. Freifelder. Physical Biochemistry. Freeman, 1982.
8. Wilson and Walker. Practical Biochemistry. Cambridge, 2000.
9. Cooper. The Cell-A Molecular Approach. ASM, 1997
10. John R.W. Masters. Animal Cell Culture- A practical approach. IRL Press.
11. Robert Braun. Introduction to instrumental analysis. McGraw Hill.

## Paper MZ404: Zoology Practical

| | |
|---|---|
| Max. Marks | 50 |
| Min Pass Marks | |
| Periods Per week | |
| Total Credits | 02 |

**Learning Outcomes:**

After conducting these laboratory exercises, the student will be able to:

- Demonstrate the parts and functions of laboratory instruments.
- Perform isolation of Nucleic acids (DNA: Genomic & Plasmid; RNA)
- Perform the different electrophoresis experiments.
- Learn and perform PCR & RT-PCR.
- Perform Western Blotting and check the protein expression.

Practical:

1. Demonstration and applications of the laboratory instruments:
a. Colorimeter,
b. Sectrophotometer,
c. Ultacentrifrige,
d. Microtomy,
e. Chymographic Instruments
2. Isolation of Genomic & Plasmid DNA.
3. Isolation of RNA.
4. Quantification of DNA/RNA.
5. Agarose Gel Electrophoresis.
6. SDS-and native polyacrylamide gel electrophoresis.
7. Western Blotting.
8. PCR, cDNA synthesis, and RT-PCR.
9. Viva-voce.
10. Practical Record.

**1.5 M.Sc. (Zoology) M.Ed. V Semester**

| S. No. | Paper Code | Subject Name | T/P | Credit | Hours | Internal | External | Tot |
|---|---|---|---|---|---|---|---|---|
| 1 | MZ501 | Computational Biology, Biostatistics, Quantitative Biology, Bioinformatics, Biosafety & Bioethics, and IPR | **T** | 4 | 60 | 30 | 70 | 100 |
| 2 | MZ502 | Applied Zoology | **T** | 4 | 60 | 30 | 70 | 100 |
| 3 | MZ503 | Optional Papers Zoology Group 1 (Entomology I/ Ichthyology I/ Limnology I/ Aquaculture I) | **T** | 4 | 60 | 30 | 70 | 100 |
| 4 | MZ504 | Zoology Practical | **P** | 2 | 60 | 15 | 35 | 50 |
| 5 | ME501 | Research Methodology -II(CS - XI) | **T** | 4 | 60 | 30 | 70 | 100 |
| 6 | ME502 | Indigenous Knowledge System (CS – XII) | **T** | 4 | 60 | 30 | 70 | 100 |
| 7 | ME503 | TS – III Thematic Specialization III(Any one: TS1.3/TS2.3/TS3.3/TS4.3/ TS5.2) | **T** | 4 | 60 | 30 | 70 | 100 |
| 8 | ME504 | Dissertation-2: Research in Education (Execution) (P – VI) | **P** | 1 | 30 | 25 | | 25 |
| | **Total** | | | **27** | **450** | **220** | **455** | **675** |

**Thematic Specialization:**

**TS1.3 –**Educational Leadership and Supervision

**TS2.3 –** Learners' Assessment

**TS3.3 –** ICT Integration in Education

**TS4.3 –** Concern, Challenges and Issues in Inclusive Education

**TS5.3 –** Career Development

**Paper MZ501: Bioinformatics, Biostatistics, Ethics in Biotechnology, Biosafety and IPR**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

On completion of this paper students will be able to:

- Understand protein sequence databases.
- Collect, classify, represent and interpret data through tables, charts, and diagrams.
- Find out the measure of central tendency.

| | | |
|---|---|---|
| **Unit-I** | | **Bioinformatics** |
| | 1.1 | Introduction to bioinformatics. Introduction to nucleic acid sequence databases (Genbank, EMBL, ENSEMBL, DDBJ). |
| | 1.2 | An outline of protein sequence databases (Swiss-Prot, PDB, PIR and |
| | 1.3 | PFM). |
| | | Basics of Alignment; Simple Alignment (by hand and dot-plot), Dynamic Alignment, Heuristic alignment, Global alignment (Needleman-Wunsch) and Local Alignment (Smith Waterman). BLAST and FASTA, file formats- FASTA, GCG and Multiple Sequence Alignment- ClustalW. |
| **Unit-II** | | **Biostatistics** |
| | 2.1 | Introduction to Biostatistics- population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, pie diagram, mean, median, mode, |
| | 2.2 | quartiles and percentiles, variance, standard deviation, coefficient of variation. |

| | | |
|---|---|---|
| | 2.3 | Probability and distributions- definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples- Bernoulli, binomial, Poisson and normal distributions.<br>Bivariate data- scatter plot, correlation coefficient (r), properties (without proof), interpretation of r, linear regression: Fitting of lines of regression, regression coefficient, coefficient of determination. |
| **Unit-III** | | **Ethics in Biological Sciences** |
| | 3.1 | Applications of biotechnology in society, perceptions of the consumers, government, industry and civil society. |
| | 3.2 | Biotechnology and globalization, role of international economic and regulatory regimes. |
| | 3.3 | Introduction to Bioethics: Codes of ethics in history, UN Declaration on bioethics and human rights. |
| | 3.4 | Research and regulatory ethics: Ethical practices in research, Institutional Animal Ethical Committee (IAEC), CPCSEA, misconduct, falsification, fabrication, plagiarism, conflict of interest, regulatory misconduct, implications for public trust in biotechnology. |
| **Unit-IV** | | **Biosafety** |
| | 4.1 | Introduction to Biosafety: Concepts, biosafety in the laboratory, institution and outside, regulatory regime through institutional, state and national biosafety bodies, biosafety in |
| | 4.2 | rDNA work, hospitals, fields etc.<br>International biosafety dimensions: Cartagena protocol, biological |
| | 4.3 | warfare and bioterrorism.<br>Food safety and environmental safety evaluation of genetically modified microbes, crops, animals. |
| **Unit-V** | | **Intellectual Property Rights** |
| | 5.1 | IPR: Introduction, scope, types (copyright, design, trademark, patent) and duration of protection, international harmonisation and transition from National to WTO regime, Patent Cooperation Treaty (PCT), TRIPS-plus, FTAs, current |
| | 5.2 | domestic and global scenario.<br>Patents: Patentable subject matter, procedure of patenting, products |
| | 5.3 | and processes, novelty, non-obviousness, utility, enablement, disclosure.<br>Strategic aspects of patent filing locally and abroad, patent litigation |

**Suggested Literature:**

1. Latest software and articles available on University internet sites and subscribed sites.
2. Latest e-books and the text books available in the Department and University Library.

3. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA.
4. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA. 5. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, US.
5. Encyclopedia of Bioethics
6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.
7. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
8. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed). ASM Press.
9. The law and strategy of Biotechnological patents by Sibley. Butterworth publications
10. Recent reviews/articles and websites such as WIPO.

**M.Sc. Zoology M.Ed. V Semester**

**Paper MZ502: Applied Zoology**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |

**Learning Outcomes:**

After reading this course the students will be:

- Apply biological techniques for fish culture, prawn culture, animal husbandry, poultry farming, sericulture, lac culture etc.
- Make use of tools and techniques for pest control.
- Understand the life cycle, mode of action, transmission, prevention and control of pathogens.

| | | |
|---|---|---|
| **Unit-I** | | **Insect and Pest Management** |
| | 1.1 | Bionomics of *Eariasvittella, Pectinophoragossypiella, Heliothisarmigera*. |
| | 1.2 | Pest control: Mechanical, physical, cultural; Classification of insect control with reference to chlorinated hydrocarbons, organophosphates, carbamates and synthetic pyrethroid; General aspects of Integrated Pest Management (IPM). |
| | 1.3 | Insects of Medical Importance: Medical importance and control *of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsyllacheopis.* |
| **Unit-II** | | **Animal Resource Management** |
| | 2.1 | Fish Technology: Zebrafish as a model for biotechnology; Genetic improvements in aquaculture industry; Ornamental fishes; Induced breeding and transportation of fish seed. |
| | 2.2 | Animal Husbandry: Semen collection, Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle. |
| | 2.3 | Poultry Farming: Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs. |
| **Unit-III** | | **Human Diseases** |
| | 3.1 | Human Diseases: Pandemics, Epidemics, transmission, prevention, control of diseases: Tuberculosis, amoebiasis, Dengue, Malaria, Swine flu and CoVID. |
| | 3.2 | Life history and pathogenicity of *Dracunculus, Schistosoma, Ancylostoma duodenale* and *Wuchereriabancrofti*. |
| | 3.3 | Liver cirrhosis, Alcoholic cirrhosis, Biliary cirrhosis, Haemochromatosis and Wilson's disease. |
| **Unit-IV** | | **Bioprocessing** |
| | 4.1 | Microbial fermentation and production of small and macromolecules. |
| | 4.2 | Bioresources and their uses |
| **Unit-V** | | **Apiculture, Sericulture and Lac Culture** |

| | | |
|---|---|---|
| | 5.1 | Classification, lifecycle, social organization and culture of honey bees. |
| | 5.2 | Classification, lifecycle, and culture of silkworm. |
| | 5.3 | Classification, lifecycle, and culture of lac insects. |

**Suggested Readings:**


1. Park, K. (2007). Preventive and Social Medicine. XVI Edition. B.B Publishers.
2. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.
3. Kumar and Corton. Pathological Basis of Diseases.
4. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
5. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
6. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea &Fabiger Publisher Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
7. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
8. Chaudhury, S.K. (1996) Practice of fertility Control, A Comprehensive Textbook. B.I.Churchill Livingston Pvt Ltd, India.
9. Hafez, E. S. E. and Evans, T. N. (1973). Human Reproduction: Contraception and Conception. Harper and Row, New York.
10. Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
11. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
12. Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
13. Knobil, E. & Neill, J.D. (2006) The Physiology of Reproduction, Vol. 2, Elsevier Pub.
14. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
15. Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.

**COURSE WISE SCHEME**

**M.Sc. Zoology M.Ed. V Semester**

**Paper MZ503 (a): Optional I (Entomology- Paper I)**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand the fundamental morphological characteristics of insects.
- Discuss the use of various insects as biocontrol agents.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Insect head types and their modifications as per their habit and habitat. |
| | 1.2 | Modification of mouthparts and feeding behaviour. |
| | 1.3 | Structure, types, and function of Antenna. |
| | 1.4 | Hypothetical wing venation. |
| **Unit-II** | 2.1 | Structure of cuticle and pigment. |
| | 2.2 | Sclerotization and tanning of the cuticle. |
| | 2.3 | Structure of alimentary canal and physiology of digestion. |
| | 2.4 | Malphighian tubules: anatomical organization, transport mechanism. |
| **Unit-III** | 3.1 | Structure of circulatory system. |
| | 3.2 | Cellular elements in the haemolymph. |
| | 3.3 | Cell mediated and humoral immunity. |
| | 3.4 | Structure of compound eye and physiology of vision. |
| **Unit-IV** | 4.1 | Sound production of insects. |
| | 4.2 | Structure and function of the endocrine gland. |
| | 4.3 | Pheromones. |
| | 4.4 | Embryonic membranous up to the formation of blastoderm. |
| **Unit-V** | 5.1 | Metamorphosis. |
| | 5.2 | Insecticide effects on CNS. |
| | 5.3 | Important pest of soybean. |
| | 5.4 | Modern concept of pest management. |

**Suggested Readings:**

1. The Insect: Structure and function by R.F. Chapman
2. Comparative Insect physiology, Biochemistry and Pharmacology. Vol:1-13. Edited by G.A Kerkut and L.I. Gilbert.
3. Entomophagous Insect by Clausen
4. Entomology bu Gilbert
5. Principles of Insect Physiology by Wigglesworth.

6. Fundamentals of Entomology by Elzinga
7. Handbook of Economic Entomology for South India by Ayyar.
8. Insect cytogenetics by R.E.F.Symposium.
9. Insects and plants by Sting, Lawton and southwood.
10. Insect and hygiene by Busvine.
11. Insect Physiology by Wigglesworth.
12. Insect morphology by Mat Calf and Flint
13. Applied Agricultural Entomology by Dr. Lalit Kumar Jha

**M.Sc. Zoology M.Ed. V Semester**

**Paper MZ503 (b): Optional I (Ichthyology- Paper I)**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Discuss the application and management of fish culture.
- Explain culture methods of prawn, oysters.
- Understand the practices of management of hatcheries, nurseries and ponds.

| | | |
|---|---|---|
| Unit-I | 1.1 | Collection of fish seed from natural resources. |
| | 1.2 | Dry bundh breeding of carps. |
| | 1.3 | Wet bundh breeding of carps. |
| Unit-II | 2.1 | Hypophysation. |
| | 2.2 | Breeding of Indian major carps. |
| | 2.3 | Drugs useful in induced breeding of fish. |
| Unit-III | 3.1 | Types of ponds required for fish culture farms. |
| | 3.2 | Composite fish culture. |
| Unit-IV | 4.1 | Management of hatcheries. |
| | 4.2 | Management of nurseries. |
| | 4.3 | Rearing ponds. |
| | 4.4 | Management of stocking ponds. |
| Unit-V | 5.1 | Prawn culture. |
| | 5.2 | Pearl, Oyster culture. |

**Suggested Readings:**


1. JR. Norman - The History of fishes.
2. Nagaraja Rao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. I & II.
10. Hoar and Randall - Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanharn -The Fishes.
13. G.V. Nikolsky -The ecology of Fishes,

14. Borgstram -Fish as food Vol. I & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
17. Carl E. Bond - Biology of fishes.
18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
20. S.K. Gupta -Fish and Fisheries
21. K.P. Vishwas -Fish and Fisheries.
22. Jhingaran -Fish and Fisheries.

**M.Sc. Zoology M.Ed. V Semester**

**Paper MZ503 (c): Optional I (Limnology and Fish Productivity- Paper I)**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand the ecological characteristics of lakes and rivers.
- Describe the role of light, heat, oxygen, carbon dioxide in freshwater ecosystems.
- Discuss the water quality monitoring indicators.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Basic principles of Limnology. |
| | 1.2 | Development of science Limnology |
| **Unit-II** | 2.1 | Morphometry, Origin and Classification of Lake systems of the world. |
| | 2.2 | Ecological characteristics of lakes. |
| | 2.3 | Ecological characteristics of rivers. |
| | 2.4 | Saprobic system indicator organisms. |
| **Unit-III** | 3.1 | Water quality monitoring. |
| | 3.2 | Wastewater treatment. |
| | 3.3 | Aquatic macrophytes and their control. |
| **Unit-IV** | 4.1 | Light and its relation in freshwater. |
| | 4.2 | Heat and its relation in freshwater. |
| **Unit-V** | 5.1 | Role of oxygen and carbon dioxide in freshwater. |
| | 5.2 | Role of organic and inorganic carbon in freshwater |

**Suggested Readings:**

1. E.P. Odum - Fundamental of Ecology.
2. R.G. Wetzel - Limnology.
3. P.S. Welsch - Limnology.
4. P.S. Welsch - Practical limnology.
5. R.G. Wetzel - Laboratory guide of Limnology.
6. J. Schwocrbel - Principles of Limnology,
7. K.A. Ruttner - Fundamentals of Limnology.
8. Hutchinson - A Treatise on Limnology Vol- 1 & 2.
9. V.G. Cole - Limnology. 194
10. G.A. Cole - Limnology.

11. W.T. Edmondson - Fresh water Biology.
12. R.W. Pennak - Freshwater invertebrates on N. America.
13. J.G. Needham and P.R. Needham - A Guide to freshwater invertebrates.
14. G.T. Tonapi – Freshwater animals of India.
15. S. Krishan Swamy- A Guide to the study of freshwater organism.
16. G.W. Prescott - Freshwater Algae.
17. Deshikachary- A guide for identification of Algae.
18. Published by International Biological program- I.B.P. Hand Books Nos. 1 & 2.
19. H.L. Goltermann - Chemical analysis of freshwaters.
20. K.S. Rao & Suresh Jain - Limnological methods & Principles of fish productivity.
21. O.P. Lind - Practicals Limnology.
22. H.B.N. Hynes – Biology of Running waters.
23. L. Klein - River pollution Vols. I & II.

**M.Sc. Zoology M.Ed. V Semester**

**Paper MZ503 (d): Optional I (Aquaculture-Paper I)**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand the effects of biotic and abiotic factors on rivers and lakes.
- Discuss the cultured species in the aquatic environment.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | History of Aquaculture. |
| | 1.2 | Definition, scope & importance of Aquaculture. |
| | 1.3 | Fishery resources of India in general. |
| | 1.4 | Fishery resources of Madhya Pradesh in particular. |
| **Unit-II** | 2.1 | Abiotic factors of water necessary for fish life. |
| | 2.2 | Biotic factors of water necessary for fish life. |
| | 2.3 | Ecological characteristics of lakes. |
| | 2.4 | Ecological characteristics of rivers. |
| **Unit-III** | 3.1 | General ecological characteristics of reservoirs of India. |
| | 3.2 | Fish culture: mono, poly, mixed and composite fish culture. |
| **Unit-IV** | 4.1 | Fresh water prawn culture and its prospects in India. |
| | 4.2 | Culture of mussels, clams, oysters & pearl culture. |
| **Unit-V** | 5.1 | Sewage fed fish culture, paddy cum fish culture. |
| | 5.2 | Frog culture. |

**Suggested Readings:**


1. C.B.L. Shrivastava: Fishes of India
2. Jhingaran: Fishes and Fisheries of India
3. S.S. Khanna: An Introduction to Fishes
4. R.S. Rath: Fresh Water Aquaculture
5. Gopalji Shrivastava: Fishes of U.P. & Bihar
6. H.D. Kumar: Sustainability & Management of Aquaculture & Fisheries.
7. A.J.K. Mainan: Identification of Fishes
8. R. Sanatam: A Manual of Freshwater Aquaculture.
9. S.K. Gupta: Fish & Fisheries
10. P.D. Pandey: Fish & Fisheries

11. K.P. Vishwas: Fish & Fisheries

**M.Sc. Zoology M.Ed. V Semester**

**Paper MZ504: Practical**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 50 |
| Min. pass marks | |
| External | 35 |
| Internal | 15 |

**Learning Outcomes:**

After performing these practical and laboratory exercises the students will be:

- Understand the basic bioinformatics tools.
- Describe insect pests and beneficial insects.
- Identify specimens of insects.
- Discuss management of ponds for fish culture.
- Describe the water quality testing methods.
- Identify the life cycle of some of the organisms involved in aquaculture.

**Practical based on MZ501:**

1. Introduction to nucleic acid and protein sequence databases.
2. Web– based tools for sequence searches and homology screening.
3. Annotations: ORF finder or any other suitable software.
4. Construction of phylogenetic trees for DNA and proteins.

**Practical based on MZ502:**

1. Study of damage caused by commonly occurring insect pests.
2. Study of beneficial insects, their life stages and products.

**Practical based on MZ503 (a) (Entomology-Paper I)**

1. Study of museum specimens of different orders and families of insects.

OR

**Practical based on MZ503 (b) (Ichthyology- Paper I)**

1. Study of Indian Major carps.
2. Study of management of different types of ponds: hatcheries, nurseries, stocking ponds.

OR

**Practical based on MZ503 (c) (Limnology and Fish Productivity- Paper I)**

1. Water quality testing (pH, BOD, COD).
2. Study of aquatic macrophytes.

OR

**Practical based on MZ503 (d) (Aquaculture- Paper I)**

1. Study of the life cycle of pearl oysters, prawn and frog.

**Scheme of Practical Examination:**

Exercise based on MZ501
Exercise based on MZ502
Exercise based on MZ503
Record
Viva
Collection

**1.6 M.Sc. (Zoology) M.Ed. VI Semester**

| S. No. | Paper Code | Subject Name | T/P | Credit | Hours | Internal | External | Tot |
|---|---|---|---|---|---|---|---|---|
| **1** | MZ601 | Ecology and Environment | **T** | 4 | 60 | 30 | 70 | 100 |
| **2** | MZ602 | Animal Behaviour, Biodiversity and Wildlife Conservation. | **T** | 4 | 60 | 30 | 70 | 100 |
| **3** | MZ603 | Optional Papers Zoology Group 2 (Entomology/ Ichthyology/ Limnology/ Aquaculture) | **T** | 4 | 60 | 30 | 70 | 100 |
| **4** | MZ604 | Zoology Practical | **P** | 1 | 30 | 5 | 20 | 25 |
| **5** | MZ605 | Project Zoology | **P** | 1 | 30 | 5 | 20 | 25 |
| **6** | ME601 | Education for Sustainable Development (CS - XIII) | **T** | 4 | 60 | 30 | 70 | 100 |
| **7** | ME602 | Generic Elective course (GE) (any one of the following)<br>I. Indian Values, Culture and Heritage<br>II. Vocational Opp.<br>III. Programme and Institutional Assessment<br>IV. Physical Education, Yoga, and Wellness | **T** | 4 | 60 | 30 | 70 | 100 |
| **8** | ME603 | Application of ICT in Education (P – VII) | **P** | 2 | 60 | 50 | | 50 |
| **9** | ME604 | Dissertation-3: Research in Education (Report Submission) (P-VIII) | **P** | 4 | 60 | 50 | 50 | 100 |
| | **Total** | | | **28** | **480** | **260** | **440** | **700** |

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ601: Ecology and Environment**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Exposed to the fundamental aspects of ecology.
- Understand the impact of anthropogenic activities on the environment.
- Discuss the natural resources and their conservation methods.

| | | |
|---|---|---|
| **Unit-I** | | **Concepts of Ecology** |
| | 1.1 | General principles of Environmental Biology with emphasis on ecosystems. |
| | 1.2 | Abiotic and biotic factors of ecosystems. |
| | 1.3 | Communities of the environment, their structure & significance. |
| | 1.4 | Energy flow in the environment: Ecological energetics. |
| | 1.5 | Environmental limiting factors; Inter and intra-specific relationship; Habitat and Niche, Ecological succession. |
| **Unit-II** | | **Population Ecology** |
| | 2.1 | Populations and their characters; Demography: Life tables, generation time, reproductive value; Population growth: Growth of organisms with non-overlapping generations, stochastic and time lag models of population growth, stable age distribution. |
| | 2.2 | Population regulation: Extrinsic and intrinsic mechanisms. |
| | 2.3 | |

| | | |
|---|---|---|
| | 2.4 | Adaptations: Levels of adaptations, significance of body size; Aquatic environments: Fresh water, marine, shores and estuarine environments; Eco-physiological adaptations to freshwater, marine water, terrestrial and aerial environments. |
| | 2.5 | Predator- prey relationship, predator dynamics, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time); Mutualism, evolution of plant pollinator interaction. |
| | | Concept of homeostasis; Endothermic and physiological mechanism of regulation of the body temperature; Physiological response to oxygen deficient stress, body exercise. |
| **Unit-I I I** | | **Environmental Pollutions** |
| | 3.1 | Kinds of environmental pollution and their control methods; Radioactive compounds and their impact on the environment; Vehicular exhaust pollution, causes and remedies; Noise pollution. |
| | 3.2 | Productivity, Production and analysis; Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation. |
| | 3.3 | Remote sensing - basic concepts and applications of remote sensing techniques in environmental conservation; Environmental indicators and their role in environmental balance. |
| **Unit-I V** | | **Toxicology** |
| | 4.1 | Toxicology-Basic concepts, Principles and various types of toxicological agents. |
| | 4.2 | Toxicity testing principles, hazards, risks and their control methods. |
| | 4.3 | Food toxicants and their control methods. |
| | 4.4 | Public Health Hazards due to environmental disasters. |
| **Unit-V** | | **Pesticides and occupational hazards** |
| | 5.1 | Pesticides, types, nature and their effects on the environment. |
| | 5.2 | Important heavy metals and their role in the environment. |
| | 5.3 | Agrochemical use and misuse, alternatives. |
| | 5.4 | Occupational health, hazards and their control. |

**Suggested Readings**:


1. Cherrett, J.M. Ecological Concepts. Blackwell Science Publication, Oxford, U.K.
2. Elseth, B.D. and K.M. Baumgartner, population Biology, Van Nostrand Co., New York.
3. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
4. Krebs, CJ. Ecology. Harper and Row, New York.
5. Krębs,C.J. Ecological Methodology. Harper and Row, New York.
6. Eckert, R. Animal Physiology: Mechanism and Adaptation. W.H. Freeman and Co., New York.
7. Hochachka, P.W. and G.N., Somero. Biochemical adaptation. Priceton, New Jersey.
8. Clark: Elements of Ecology
9. Odum: Fundamentals of Ecology
10. South Woods: Ecological Methods
11. Trivedi and Goel: Chemical and biological methods for water pollution studies.

**COURSE WISE SCHEME**

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ602: Animal Behaviour, Biodiversity and Wildlife Conservation**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand a broad range of behaviour mechanisms.
- Discuss the management and conservation of wildlife.
- Describe the protected areas for biodiversity conservation.
- Understand the importance of biodiversity and take steps to conserve wildlife.

| | |
|---|---|
| **Unit-I** | **Concept of Ethology**<br>1.1 Introduction: ethology as a branch of biology; Animal psychology, classification of behavioural patterns, analysis of behaviour (Ethogram).<br>1.2 Reflexes and complex behaviour; Evolution and ultimate causation: inheritance behaviour and relationships; Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual.<br>1.3 Neural and hormonal control of behaviour; genetic and environmental components in the development of behaviours.<br>1.4 Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation; Communication: chemical, visual, light and audio, evolution of language (primates).<br>1.5 Ecological aspects of behaviour: habitat selection, food selection, optimal foraging theory, anti-predator defences, aggression, homing territoriality, dispersal, host parasite relations. |
| **Unit-II** | **Adaptive Behaviour**<br>2.1 Biological rhythms: circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.<br>2.2 Learning and memory: conditioning, habituation, insight learning, association learning and reasoning. Reproductive behaviour: Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care. |

| | |
|---|---|
| | 2.3 Social behaviour: aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.<br>2.4 Thermoregulation; Homeothermic animals, poikilotherms and hibernation; Receptor physiology a comparative study: Mechanoreceptor, Photoreceptor, Phonoreceptor, Chemoreceptor, Equilibrium receptor, Bioluminescence. |
| **Unit-III** | **Wildlife and its conservation**<br>3.1 Wildlife: Values of wildlife- Positive and Negative; Our conservation ethics; Importance of conservation; Causes of depletion.<br>3.2 World conservation strategies; Habitat analysis and Evaluation and management of Wildlife; Physical Parameters: Topography, Geology, Soil and water; Biological Parameters: Food cover, forage, browse and cover estimation; Standard evaluation procedures- remote sensing and GIS.<br>3.3 Management of Habitats: Setting back succession; Grazing logging; Mechanical treatment; Advancing successional process; Cover construction; Preservation of general genetic diversity.<br>3.4 Population estimation: Population density, natality, birth rate, mortality, fertility, schedules and sex ration composition; Faecal analysis of ungulates and carnivores – Faecal samples, slide preparation, Hair identification, pug marks, and census method. |
| **Unit-IV** | **Environment Conservation Laws**<br>4.1 National Organisation: Indian board of wildlife; Bombay Natural History society; Voluntary Organization involved in wildlife conservation.<br>4.2 Wildlife Legislation- Wildlife Protection Act 1972, its amendments and implementation.<br>4.3 Management and planning of wildlife in protected areas; Estimation of carrying capacity; Eco-tourism and wildlife tourism in forests; Concept of climax persistence; Ecology of perturbation.<br>4.4 Management of excess population and translocation; Biotelemetry; Care of injured and diseased animals; Quarantine; Common diseases of wild animals. |
| **Unit-V** | **Wildlife Management**<br>5.1 Protected areas, National parks, Sanctuaries, community reserves.<br>5.2 Important features of protected areas in India.<br>5.3 Tiger conservation- Tiger reserve in MP and In India; Management challenges in Tiger reserves.<br>5.4 Rare, endangered species. Conservation strategies. |

**Suggested Reading:**

1. Eibl-Eibesfeldt, I. Ethology. The biology of Behaviour. Holt, Rineheart & Winston, New York.
2. Gould, J.L. The mechanism and Evolution of Behaviour.
3. Kerbs, J. R. and N.B. davies :Behaviourable Ecology. Blackwell, Oxford, U.K.
4. Hinde, R.A. Animnal Behaviour: A Synthesis of Ethology and Comparative Psychology. McGraw Hill, New York.

5. Alcock, J. Animal Behaviour: An Evolutionary approach. Sinauer Assoc. Sunderland, Massachsets, USA.
6. Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication. Sinauer Assoc. Sunderland, Massachsets, USA.
7. Gopal Rajesh
8. Agrawal K.C
9.. Dwivedi A.P (2008)
10. Asthana D.K: Fundamentals of wildlife management: Wildlife India: Management wildlife in India: Environment problem and solution
11. Rodgers N.A & Panwar H.S
12. Odum E.P
13. Saharia V.B: Planning of wildlife / Protected area Network in India] vol. the report, wildlife Institute of India Dehradun: Fundamentals of Ecology: Wildlife in India: Wildlife in Central India: Wildlife of India: Wildlife conservation (Natraj publishers)
14. Tiwari S.K
15. E.P Gee
16. Negi S.S

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ603 (a): Optional II (Entomology- Paper II)**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand the importance of insects and identify some of the orders of insects.
- Discuss use of insects in forensics, medical and veterinary areas.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Classification of apterygota into families. |
| | 1.2 | Classification of following insect orders: |
| | (a) | Orthoptera (b) Hemiptera (c) Diptera. |
| | 1.3 | Classification of following insect orders: |
| | (a) | Hymenoptera (b) Lepidoptera (c) Coleoptera. |
| | 1.4 | Collection and preservation of insects. |
| **Unit-II** | 2.1 | Insect pest management strategies and tools. |
| | 2.2 | Biological Control. |
| | 2.3 | Genetic Control. |
| | 2.4 | Chemical Control. |
| **Unit-III** | 3.1 | Pest of cotton. |
| | 3.2 | Pest of Sugarcane. |
| | 3.3 | Pest of Paddy. |
| | 3.4 | Pest of stored food grains. |
| | 3.5 | Pest of citrus fruits and mango. |
| | 3.6 | Pest of pulses. |
| | 3.7 | Household pest insects. |
| **Unit-IV** | 4.1 | Insects in relation to forensic sciences. |
| | 4.2 | Insect migration, population fluctuations, and factors. |
| | 4.3 | Insects of medical and veterinary importance. |
| | 4.4 | Ecological factors affecting the importance and development of insects. |
| **Unit-V** | 5.1 | Mulberry and non-mulberry sericulture. |
| | 5.2 | Apiculture. |
| | 5.3 | Lac culture. |
| | 5.4 | Insect as human food for the future. |

**Suggested Readings:**

1. The Insect: Structure and function by R.F. Chapman
2. Comparative Insect physiology, Biochemistry and Pharmacology. Vol:1-13. Edited by G.A Kerkut and L.I. Gilbert.
3. Entomophagous Insect by Clausen
4. Entomology bu Gilbert
5. Principles of Insect Physiology by Wigglesworth.
6. Fundamentals of Entomology by Elzinga
7. Hand book of economic Entomology for South India by Ayyar.
8. Insect cytogenetics by R.E.F.Symposium.
9. Insects and plants by Sting, Lawton and southwood.
10. Insect and hygiene by Busvine.
11. Insect Physiology by Wigglesworth.
12. Insect morphology by Mat Calf and Flint
13. Applied Agricultural Entomology by Dr. Lalit Kumar Jha

**COURSE WISE SCHEME**

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ603 (b): Optional II (Ichthyology- Paper II)**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand applications related to fisheries.
- Discuss the importance of fish and its by-products.

| | |
|---|---|
| **Unit-I** | 1.1 Fisheries resources of MP.<br>1.2 Riverine Fisheries. |
| **Unit-II** | 2.1 Coastal fisheries in India.<br>2.2 Offshore and deep-sea fisheries in India. |
| **Unit-III** | 3.1 Role of fisheries in rural development.<br>3.2 Sewage fed fisheries. |
| **Unit-IV** | 4.1 Methods of fish preservation.<br>4.2 Marketing of fish in India.<br>4.3 Economic importance and by product of fishes. |
| **Unit-V** | 5.1 Shark liver oil industry in India.<br>5.2 Transport of live fish and fish seed. |

**Suggested Readings:**


1. JR. Norman - The History of fishes.
2. Nagaraja Rao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. I & II.
10. Hoar and Randall - Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanharn -The Fishes.
13. G.V. Nikolsky -The ecology of Fishes,
14. Borgstram -Fish as food Vol. I & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
17. Carl E. Bond - Biology of fishes.

18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
20. S.K. Gupta -Fish and Fisheries
21. K.P. Vishwas -Fish and Fishries.
22. Jhingaran -Fish and Fishries.

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ603 (c): Optional II (Limnology and Fish Productivity- Paper II)**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be able to:

- Understand the ecological characteristics of benthic ecosystems.
- Describe the production, management, preservation and marketing of fish and its by-products.

| | | |
|---|---|---|
| **Unit-I** | 1.1 | Aspects of primary productivity in freshwater. |
| | 1.2 | Role of physicochemical characteristics in freshwater. |
| | 1.3 | Plankton and its role in freshwater. |
| **Unit-II** | 2.1 | Characteristics of Benthic biota. |
| | 2.2 | Substrate preference of Benthic biota. |
| | 2.3 | Significance of Benthic biota. |
| **Unit-III** | 3.1 | Fresh water resources in India and their quality. |
| | 3.2 | Wetland and its management. |
| **Unit-IV** | 4.1 | Fishery and management of reservoirs. |
| | 4.2 | Inland fish breeding. |
| | 4.3 | Riverine fisheries. |
| **Unit-V** | 5.1 | Fish production in ponds and its management. |
| | 5.2 | Indian cultivable fishes and their crop potential. |
| | 5.3 | Preservation processing transport and marketing fish. |

**Suggested Readings:**

1. E.P. Odum - Fundamental of Ecology.
2. R.G. Wetzel - Limnology.
3. P.S. Welsch - Limnology.
4. P.S. Welsch - Practical limnology.
5. R.G. Wetzel - Laboratory guide of Limnology.
6. J. Schwocrbel - Principles of Limnology,
7. K.A. Ruttner - Fundamentals of Limnology.
8. Hutchinson - A Treatise on Limnology Vol- 1 & 2.

9. V.G. Cole - Limnology. 194
10. G.A. Cole - Limnology.
11. W.T. Edmondson - Fresh water Biology.
12. R.W. Pennak - Freshwater invertebrates on N. America.
13. J.G. Needham and P.R. Needham - A Guide to freshwater invertebrates.
14. G.T. Tonapi – Freshwater animals of India.
15. S. Krishan Swamy- A Guide to the study of freshwater organism.
16. G.W. Prescott - Freshwater Algae.
17. Deshikachary- A guide for identification of Algae.
18. Published by International Biological program- I.B.P. Hand Books Nos. 1 & 2.
19. H.L. Goltermann - Chemical analysis of freshwaters.
20. K.S. Rao & Suresh Jain - Limnological methods & Principles of fish productivity.
21. O.P. Lind - Practicals Limnology.
22. H.B.N. Hynes – Biology of Running waters.
23. L. Klein - River pollution Vols. I & II.

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ603 (d): Optional II (Aquaculture- Paper II)**

| | |
|---|---|
| Contact Periods/week: | 04 |
| Maximum Marks | 100 |
| Min. pass marks | 40 |
| External | 70 |
| Internal | 30 |

**Learning Outcomes:**

After reading this course the students will be:

- Understand fish farm engineering.
- Discuss the diseases of cultured species.
- Describe the production, management, preservation and marketing of fish and its by-products.

| | | |
|---|---|---|
| Unit-I | 1.1 | Fish breeding in natural conditions, bundh breeding, Hypophysation & stripping. |
| | 1.2 | Transport of live fish & seed. |
| Unit-II | 2.1 | Different types of crafts used for fish catching. |
| | 2.2 | Different types of gears used for fish catching. |
| | 2.3 | Plankton- its definition, culture & identification. |
| Unit-III | 3.1 | Common weeds of fish ponds and methods of their eradication. |
| | 3.2 | Fresh water fish farm engineering: selection of site, construction of fish farm & soil chemistry. |
| | 3.3 | Designing, layout & construction of different types of fish ponds. |
| Unit-IV | 4.1 | Setting and management of freshwater aquariums. |
| | 4.2 | Preservation & processing of fish. |
| | 4.3 | By products of the fish Industry & their utility. |
| | 4.4 | Water pollution, its effects on fisheries and methods of its abatement. |
| | 4.5 | Setting and management of freshwater aquariums. |
| | 4.6 | Preservation & processing of fish. |
| | 4.7 | By products of the fish Industry & their utility. |
| | 4.8 | Water pollution, its effects on fisheries and methods of its abatement. |
| Unit-V | 5.1 | Common fish diseases & their control. |
| | 5.2 | Biochemical composition and nutritional value of fish. |
| | 5.3 | Fisheries economics and marketing. |
| | 5.4 | Fisheries management and extension. |

**Suggested Readings:**


1. C.B.L. Shrivastava: Fishes of India
2. Jhingaran: Fishes and Fisheries of India
3. S.S. Khanna: An Introduction to Fishes
4. R.S. Rath: Fresh Water Aquaculture
5. Gopalji Shrivastava: Fishes of U.P. & Bihar
6. H.D. Kumar: Sustainability & Management of Aquaculture & Fisheries.
7. A.J.K. Mainan: Identification of Fishes
8. R. Sanatam: A Manual of Freshwater Aquaculture.
9. S.K. Gupta: Fish & Fisheries
10. P.D. Pandey: Fish & Fisheries
11. K.P. Vishwas: Fish & Fisheries

**M.Sc. Zoology M.Ed. VI Semester**

**Paper MZ604: Practical**

| | |
|---|---|
| Contact Periods/week | 04 |
| Maximum Marks | 50 |
| Min. pass marks | |
| External | 35 |
| Internal | 15 |

**Learning Outcomes:**

After performing these practical/ laboratory exercises, the students will be:

- Describe the aquatic ecosystem.
- Understand the mechanism of reflexes, navigation and orientation in animals.
- Describe life cycle of honeybees and silk worms.
- Discuss the physicochemical characteristics of water.
- Identification of tools of fish catching.

**Practical based on MZ601:**

1. Study of aquarium maintenance.
2. Study of pollution.

**Practical based on MZ602:**

1. Study of reflexes.
2. Study of orientation and navigation.
3. Study of mechanoreceptor, photoreceptor, phonoreceptor, chemoreceptor, equilibrium receptors.

**Practical based on MZ603 (a) (Entomology- Paper II):**

1. Study of the life cycle of Hymenoptera.
2. Identification pests of cotton, sugarcane, etc.
3. Study of the life cycle of silk worms.

OR

**Practical based on MZ603 (b) (Ichthyology- Paper II):**

1. Study of the economic importance of fishes.

OR

**Practical based on MZ603 (c) (Limnology and Fish Productivity- Paper II):**

1. Identification of plankton: zooplankton, phytoplankton.
2. Study of physicochemical characteristics of water.

OR

**Practical based on MZ603 (d) (Aquaculture- Paper II):**

1. Identification of crafts used for fish catching.
2. Identification of gears used for fish catching.

**Scheme for Practical Examination**

Exercise based on MZ601
Exercise based on MZ602
Exercise based on MZ603
Practical record
Viva Voce
Collection

# Three- Year Post Graduated Integrated M.Sc. (Botany) M.Ed. Programme

# Three- Year Post Graduated Integrated M.Sc. (Botany) M.Ed. Programme

## A) Courses and Curriculum Struture

**Table 1: Structure of 3 Year M.Sc. M.Ed. Botany (Six Semester) programme (CBCS Scheme)**

**Semester-I**

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | Marks | |
|---|---|---|---|---|---|---|
| | | | | | Theory/Practical | |
| | | | | | Internal Th + Pr | External Pr |
| **DC 1.1** | Biology and Diversity of Bacteria and Virus | 2+1+1 | 6 | 60 | 10+ 10 | 20 |
| **DC 1.2** | Biology and Diversity of Algae | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **DC 1.3** | Fungi and Applied Mycology | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **EC 1.1** | Education as discipline | 3+1+0 | 5 | | 30 | - |
| **EC 1.2** | Advanced Educational Psychology | 3+1+0 | 5 | | 30 | - |
| **PC 1.1** | Working with community | 0+0+2 | 4 | | 50 | - |

**Semester-II**

| Course code | Course | Credits L+T+P | Contact Hours | Hours per Semester | Mark |
|---|---|---|---|---|---|
| | | | | | Theory/Pr |

| | | | per week | | Theory/Practical | |
|---|---|---|---|---|---|---|
| | | | | | Internal Th + Pr | External Pr |
| **DC 2.1** | Plant Pathology | 2+1+1 | 6 | 60 | 10+ 10 | 20 |
| **DC 2.2** | Biology and Diversity of Bryophytes and Pteridophytes | 2+1+1 | 6 | 60 | 10 + 10 | 20 |
| **DC 2.3** | Gymnosperms | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **EC 2.1** | Introduction to Educational Research | 3+1+0 | 5 | | 30 | - |
| **EC 2.2** | Curriculum Studies | 3+1+0 | 5 | | 30 | - |

**Semester III**

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | Ma | |
|---|---|---|---|---|---|---|
| | | | | | Theory/ | |
| | | | | | Internal Th + Pr | Externa |
| **DC 3.1** | Morphology and Taxonomy of Angiosperms | 2+1+1 | 6 | 60 | 60 | 10+ 10 |
| **DC 3.2** | Developmental Biology (anatomy and embryology) | 2+1+1 | 6 | 60 | 60 | 10+10 |
| **DC 3.3** | Plant Physiology and Biochemistry | 2+1+1 | 6 | 60 | 60 | 10+10 |
| **EC 3.1** | Advanced Educational Research | 3+1+0 | 5 | | | 30 |
| **EC 3.2** | Testing assessment and evaluation | 3+1+0 | 5 | | | 30 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **EE 3.1** | Any one ( Educational Management, Administration and Leadership I/Curriculum Theory Planning and Development I/ Guidance and Counselling I) | 1+1+0 | 3 | | | 15 |
| **PC 3.1** | Internship in TEI | 0+0+2 | 4 | | | 50 |

**Semester IV**

| **Course code** | **Course** | **Credits L+T+P** | **Contact Hours per week** | **Hours per Semester** | **Ma** | |
|---|---|---|---|---|---|---|
| | | | | | **Theory/I** | |
| | | | | | **Internal Th + Pr** | **Externa P** |
| **DC 4.1** | Cytology and Genetics | 2+1+1 | 6 | 60 | 10+ 10 | 20 |
| **DC 4.2** | Molecular Biology and Improvement of Plant Resources | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **DC 4.3** | Bioinformatics and Biostatistics | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **EC 4.1** | ICT in Education | 3+1+0 | 5 | | 30 | - |
| **EC 4.2** | Teacher Education | 3+1+0 | 5 | | 30 | - |
| **EE 4.1** | Any one( Educational Management, Administration and Leadership II/Curriculum Theory Planning and Development II/ Guidance and | 1+1+0 | 3 | | 15 | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Counselling II) | | | | | |
| **PC 4.1** | Internship in Educational Institutions | 0+0+2 | 4 | | 50 | - |

**Semester V**

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | M Theory | |
|---|---|---|---|---|---|---|
| | | | | | Internal Th + Pr | Exter |
| **DC 5.1** | Plant Tissue Culture and Biotechnology | 2+1+1 | 6 | | 10+ 10 | 20 |
| **DC 5.2** | Ecology and Environmental Biology | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **DE 5.1** | Any one: (Industrial microbiology/ Conservation and utilization of plant resources/ Organic farming/ Horticultural practices) | 1+1+0 | 3 | 60 | 10 | - |
| **EC 5.1** | Science Education- I | 3+1+0 | 5 | | 30 | - |
| **EE 5.1** | Any one:(Inclusive Education I/ Classroom Assessment I/ Educational Technology I) | 1+1+0 | 3 | | 15 | - |
| **EE 5.2** | Any one:(Inclusive Education II/ Classroom Assessment II/ Educational Technology II) | 1+1+0 | 3 | | 15 | - |
| **PC 5.1A (Core)** | Dissertation Botany (Proposal Development) | 0+0+2 | 4 | | 30 | 20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **PC5.1 B (Edn)** | Dissertation Education (Proposal Development) | 0+0+2 | 4 | | 30 | 20 |

**Semester VI**

| **Course code** | **Course** | **Credits L+T+P** | **Contact Hours per week** | **Hours per Semester** | **M** | |
|---|---|---|---|---|---|---|
| | | | | | **Theor** | |
| | | | | | **Internal Th + Pr** | **Exte** |
| **DC 6.1** | Instrumentation and Bioanalytical Tools | 2+1+1 | 6 | 60 | 10+ 10 | 2 |
| **DC 6.2** | Agricultural Botany | 2+1+1 | 6 | 60 | 10+10 | 2 |
| **DE 6.1** | Any one (Medicinal and Aromatic Plants/ Ethnobotany/ Aesthetic Botany/ Environmental Science) | 1+1+0 | 3 | | 10 | - |
| **EC 6.1** | Science Education- II | 3+1+0 | 5 | | 30 | - |
| **PC 6.1A (Core)** | Dissertation Botany ( Implementation and Report Submission) | 0+0+4 | 8 | | 60 | 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **PC 6.1B (Core)** | Dissertation Education ( Implementation and Report Submission) | 0+0+4 | 8 | | 60 | 4 |

**Distribution of credits Semester- Wise for M.Sc.M.Ed Botany**

| Semester | M.Sc. | | | | M.Ed. | |
|---|---|---|---|---|---|---|
| | Discipline Specific Core Course (L+T+P) | Discipline Specific Electives | Ability Enhancement Courses | Practicum/ Dissertation/ Project | Education Core | Education Electives |
| I | 6+3+3 | - | - | | | |
| II | 6+3+3 | - | - | | | |
| III | 6+3+3 | - | - | | | |
| IV | 6+3+3 | - | - | | | |
| V | 4+2+2 | 1+1+0 | - | 0+0+2 | | |
| VI | 4+2+2 | 1+1+0 | - | 0+0+4 | | |

## (B) Syllabus with Credit Based Choice System (CBCS)

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | Marks | |
|---|---|---|---|---|---|---|
| | | | | | Theory/Practical | |
| | | | | | Internal Th + Pr | External Pr |

| | | | | | | |
|---|---|---|---|---|---|---|
| **DC 1.1** | Biology and Diversity of Bacteria and Virus | 2+1+1 | 6 | 60 | 10+ 10 | 20 |
| **DC 1.2** | Biology and Diversity of Algae | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **DC 1.3** | Fungi and Applied Mycology | 2+1+1 | 6 | 60 | 10+10 | 20 |
| **EC 1.1** | Education as discipline | 3+1+0 | 5 | | 30 | - |
| **EC 1.2** | Advanced Educational Psychology | 3+1+0 | 5 | | 30 | - |
| **PC 1.1** | Working with community | 0+0+2 | 4 | | 50 | - |

## DC 1.1 Biology & Diversity of Bacteria and Virus
## Theory

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes:**
On completion of this paper students will be able to:

1. Understand the general characteristics of virus, their classification, ultra structure, isolation and purification.
2. Describe chemical nature, replication and transmission of viruses and their importance in human welfare.
3. Distinguish between archaebacteria and eubacteria and explaining their characteristics, ultrastructure, reproduction and economic importance .
4. Describe the characteristics, ultrastructure, nutrition and economic importance of cyanobacteria, actinomycetes, mycoplasma, rickettsiae and chlamydiae.
5. Explain the concept of biological warfare and importance of microbes in space science .

| | |
|---|---|
| **Unit-I** | History and development of microbiology, Bergey's manual for classification of microbes, microbial growth, Factors influencing growth of microbes |
| **Unit-II** | Viruses: History, General characteristics, Classification and ultrastructure, Isolation a Purification of viruses. Chemical nature, replication, transmission of viruses, economic importance of viruses – virions, prions, role in genetic research, plan diseases, phyto-viruses, study of COVID-19 virus responsible for pandemic. |
| **Unit-III** | Archaebacteria and Eubacteria: History, General characteristics, Bergey's classificati ultrastructure, nutrition and reproduction (transformation, conjugation and transduction) and economic importance. |
| **Unit-IV** | Cyanobacteria (Cyanophyceae) : *Oscillatoria, Rivularia, Lyngbya* , Actinomycetes, Spirochaetes, Rickettsia, Chlamydiae : General characteristics, ultrastructure, nutrition, reproduction and economic importance .<br>Mycoplasma: General account. |
| **Unit-V** | Biological warfare and use of bacteria and virus in space science, plant disease cause by viruses, bacteria and mycoplasma |

## Practical

## SUGGESTED LABORATORY EXERCISES

**After conducting the laboratory exercises, the students will be able to:**

- Develop technical skills to isolate microbes from soil, water and air and learn the various techniques for bacteria culture and staining.
- Observe and identify the members of cyan bacteria and symptomatology of some diseased specimens.

1. Morphological study of reproductive members of cyan bacteria: *Nostoc, Anabaena.*
2. Gram staining of Bacteria.
3. Isolation of microbes from soil, water and air.
4. Culture of bacteria: - Sterilization methods, preparation of media and stains.
5. Symptomatology of some diseased specimens: Angular leaf spot of cotton, Citrus canker, Bacterial blight of paddy, Tobacco mosaic, little leaf of brinjal, Mango malformation, Leaf curl of papaya.

## SUGGESTED READINGS


- Madigan, M T. Martinko, J. M and Parker Jack; I 997: Book of Biology of Microorganisms, (8th edition) Prentice Hall, N, J. U.S.A
- Mandahar, C. L.; 1978: Introduction to Plant Viruses. Chand & Co. Ltd. Delhi
- Smith G. M. Cryptogamic Botany Vol I (1st edition) ~ Tata McGraw-Hill Publishing Company Ltd. Bombay -New Delhi.
- Clifton, A; 1958: Introduction to Bacteria, McGraw- Hills Book Co. New Delhi.
- Madigan, M T. Martinko, J. M and Parker Jack; I 997: Biology of Microorganisms, (8th edition) Prentice Hall, N, J. U.S.A
- Raychoudhari, S.P. and Nariani, T.K. (1977) Virus and Mycoplasma Diseases of Plant in India, Oxford and IBH Publication Co.
- Microbiology by Pelzar.
- Cyanobacteria

## DC 1.2 Biology and Diversity of Algae

**Credits: 4** **Max Marks: 100**
**Contact hours per week: 6** **Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**LEARNING OUTCOMES**:

On completion of this paper students will be able to:

1. Differentiate between various groups of Algae based on the presence of various pigments, stored food product.
2. Partially identify various classes of Algae.
3. Comprehend the various beneficial products from Algae and their industrial production.

| | |
|---|---|
| **Unit-I** | General characteristics of Algae; Classification of Algae, diversified habitats, thallus organization, cell ultrastructure, reproduction, life cycle patterns, pigments, reserve foods, types of flagella. |
| **Unit-II** | General characteristics and life cycle of Chlorophyta - *Chlamydomonas, Pandorina, Chlorella, Hydrodictyon, Cladophora, Zygnema, Draparnaldiopsis, Bryopsis.*<br>General characteristics of Charophyta - *Chara*. |
| **Unit-III** | General characteristics and life cycle of Xanthophyta: *Botrydium, Vaucheria*.<br>General characteristics and life cycle of Bacillariophyta: Diatoms (*Pennularia*).<br>General characteristics of Euglenophyta: *Euglena* |
| **Unit-IV** | General characteristics and life cycle of Phaeophyta: *Ectocarpus, Dictyota, Laminaria, Fucus.*<br>General characteristics and life cycle of Rhodophyta: *Batrachospermum, Porphyra, Gelidium, Gigartina, Polysiphonia*. |
| **Unit-V** | Algae and human welfare: Edible Algae, Algae as bio fertilizers, phycocolloids, algal blooms and phycot |

**Practical**

**SUGGESTED LABORATORY EXERCISES**

**The students will be able to:**

- Study the morphological characteristics of different algal members belonging to different classes of Algae.
- Explain the importance of algal bio fertilizers by visiting bio fertilizer factories and agricultural labs.
- Conduct the experiment to determine COD and BOD of water sample to understand the effect of eutrophication.

1. Morphological study of representative members of Algae: *Chlamydomonas, Padorina, Chlorella, Hydrodictyon, Cladophora, Zygnema, Bryopsis, Chara, Vaucheria, Pennularia, Euglena, Ectocarpus, Dictyota, Laminaria, Fucus,Batrachospermum, Porphyra, Gelidium, Gigartina, Polysiphonia*.

2. Study of Algae as Bio fertilizers, algal bloom- visit to bio fertilizer factories and agricultural labs.

3. Study the role of Algae in Eutrophication: Determination of COD and BOD.

**SUGGESTED READINGS**


- Kumar H. D. 1988: Introduction to Psychology. Affiliated East-West Press Ltd.
- Prescott, G.W., 1969. The Algae: A review. Butler &Tanner Ltd., From & London
- Chapman & Chapman, the Algae.
- Sharma O.P., The Algae
- Gangulee, H.C. & Kar, A.K. Vol. I&II ,1989, College Botany, Books & allied (P Ltd., Calcutta
- Fritsch, F.E., Vol. I, 1965, the Structure and Reproduction of the Algae, the Syndics of Cambridge University Press.


On-line Journals available on UGC –VSAT.

## DC 1.3 Fungi and Applied Mycology

### Theory

**Credits: 4** **Max Marks: 100**
**Contact hours per week: 6** **Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**LEARNING OUTCOMES:**

On completion of this paper students will be able to:

1. Explain the general characteristics and classification of fungi and describe some genera belonging to these classes.

2. Understand the substrate relationship in fungi, reproduction, fungal diversity in different ecosystems, effect of environment on fungal growth and behavior.

3. Become familiar with the terms like heterothallism, par asexuality and importance of mycorrhiza.

4. Understand the importance of fungi in causing human diseases mainly dermatophytes and allergy causing fungi.

5. Explain the importance of fungi in producing industrial and non-industrial metabolites.

6. Relate fungi with human welfare activities like food processing, primary and secondary metabolite production, as food source and as bio control agents.

7. Distinguish between bio deterioration and biodegradation and fungal organisms involved in these two process.

| | |
|---|---|
| **Unit-I** | General characteristics, classification of fungi.<br>General characteristics of Mastigomycotina- *Saprolegnia, Peronospora*.<br>General characteristics of Zygomycotina –*Pilobolus, Rhizopus*.<br>General characteristics of Ascomycotina- *Penicillium, Aspergillus*.<br>General characteristics of Basidiomycotina- *Melampsora, Amanita*.<br>General characteristics of Deuteromycotina- *Alternaria, Curvularia*. |
| **Unit-II** | Substrate relationship in fungi, reproduction, heterothallism, parasexuality.<br>Fungal diversity in different ecosystems, effect of environment on fungal growth and behavior.<br>Mycorrhiza:<br>1. Kinds of mycorrhizae. Ectotrophic and endotrophic mycorrhizae, their morphology and anatomy. Mycorrhiza in plant growth promotion, mycorrhiza in plant disease control.<br>2. Rhizosphere and phyllosphere - General concept and importance.<br>3. Medical Mycology- Dermatophytic fungi - Knowledge of common dermatophytes and human diseases caused by fungi allergic to human beings viz. Athlete's foot (*Tinea pedis*); Aspergillosis (*Aspergillus sp*) and Mucormycosis. |
| **Unit-III** | Production of Metabolites by Fungi:<br>A) Industrial Fungal Metabolites:<br>i) Antibiotics -Penicillin, Cephalosporin, Griseofulvin, Industrial production of Penicillin.<br>ii) Enzymes - Amylase, Proteases, Lipases, Pectinases, Cellulases and Xylanases.<br>iii) Organic acids - Critic acid, Gluconic acid, Lactic acid, Kojic acid, Itaconic acid.<br>B) Non Industrial Fungal Metabolites: |

| | |
|---|---|
| | i) Phytoalexins ii) Mycotoxins. |
| **Unit-IV** | Fungi and human welfare:<br>i) Fungi in food processing: soybean products, cheese, fermented milk, other fermented foods.<br>ii) Fungal metabolites – General account of production and application: Primary metabolites (vitamins, proteins), Secondary metabolites (antibiotics, pigments, alkaloids.<br>iii) Fungi as food source - edible mushrooms, methods of their cultivation.<br>iv) Fungus as biocontrol agent. |
| **Unit-V** | Concept of Bio deterioration and Biodegradation<br>i) Bio deterioration of non-cellulosic materials (leather, plastics, hydrocarbons, pesticides)<br>ii) Bio deterioration of cellulosic materials.<br>iii) Role of microorganisms and factors affecting Biodegradation of organic wastes. |

**Practical**

**LABORATORY EXERCISES:**

**The students will be able to:**

- Understand the principles of sterilization and culture techniques of fungi.
- Conduct experiments to demonstrate the antifungal activity, toxicity, estimation of enzyme activity, sugars and proteins.
- Learn the cultivation technique of mushrooms.
- Study mycorrhiza and locally available plant crop diseases.

**List of practicals:**

1. Sterilization Processes viz. moist heat, dry heat, chemical and radiation.

2. Preparation of different cultural media for cultivation of Fungi.

3. Demonstrate antifungal activities of different antibiotics in leaf, flower and root extract.

4. Study of toxicity of fungi in relation to seed germination, and seedling abnormality.

5. Cultivation of Mushrooms.

6. Demonstration of biodegradation of organic waste.

7. Isolation of Soil fungi by soil plate (War cup) and serial dilution (Walksman) method.

8. Isolation of external and internal seed borne mycoflora by blotter and Agar Plate method.

9. Qualitative estimation of enzymes – cellulases, amylases.

10. Estimation of sugars and proteins in fungal mycelium and culture filtrate.

11. Study of mycorrhiza (VAM).

12. Study of locally available crop plant diseases caused by fungi (Five)

13. Demonstration of morphological & physiological changes in diseased plants.

14. Preparation and presentation of herbarium of pathological specimens available in the region.

15. Field visit to different localities Visit to Agriculture University, Plant Pathological research

centers and plant clinics.

**SUGGESTED READINGS:**

- Agrios, G.N. (1980) Plant Pathology, Academic Press, INC, New York.
- Ainsworth, G.C. and A.S. Sussman (eds). The Fungi, An advance Treatise Vol. I, II, III & IV Academic Press, New York.
- Alexopoulos, C.J. (1962). Introductory Mycology John Wiley Eastern Pvt. Ltd.
- Alexopoulos, C.J. and Mims C.W. (1979). Introductory Mycology 3rd Edition John Wiley and Sons, Inc. Wiley, New York.
- Alexopoulos, C.J., Mims and Blackwell (1996) 4th ed. John Wiley and Sons, Inc. Wiley, New York.
- Aneja, K.R. (1993) Experimental in Microbiology, Plant Pathology & Tissue Culture, Wiswa Prakashan, New Delhi.
- Bessey, E.A. (1950) Morphology and Taxonomy of Fungi. The Blakiston co. Philadelphia.
- Bilgrami, K.S. and H.C. Dube (1985) A text Book of Modern Plant Pathology, Vikas Publication House, New Delhi.
- Dube, R.C. and D.K. Maheshwari (1999) A Text Book of microbiology, S. Chand & Co. Ltd.
- Dube, R.C. and D.K. Maheshwari (2000) Practical Microbiology -S. Chand & Co. Ltd.
- Gupta, V.K. and M.K. Behl (1994) Indian Plant Viruses and Mycoplasma Kalyani Publishers, 1/1, Rajinder Nagar, Ludhiana.
- Jha, D.K. (1993) A Text Book of Seed Pathology, Vikas Publication House.
- Mehrotra, R.S. (1989) Plant Pathology, Tata McGraw Hill.
- Mehrotra, R.S. and K.R. Aneja (1998) An Introduction to Mycology, New Age Intermediate Press.
- Pelzer, M.J., Jr. Cahn, E.C.S. and N.R. Krieg (1993) Microbiology, Tata McGraw Hill.
- Preece and Dickeson. Ecology of leaf surface microorganism Academic Press, New York.
- Rangaswamy, G. and A. Mahadevan (1999) Diseases of Crop Plant in India, Prentice Hall of India.
- Schlegel, H.G. (1996) General Microbiology, 7th Edition, Cambridge University Press.
- Snowdon, A.L. (1991) A color Atlas of Post-harvest diseases & disorders of fruits & vegetables Vol. I & II Wolfe Scientific, London.
- Sunder Rajan, S. (2001) Tools and Techniques of Microbiology, Anmol Publ. New Delhi.
- Thind, T.S. (1998) Diseases of field crops and their management, National Agricultural Technology, Information Centre, Ludhiana.
- Vaidya, J.G. (1995) Biology of the fungi, Satyajeet Prakashan, Pune.
- Walker, J.G. (1952) Diseases of Vegetables Crops. McGraw Hill, New York.
- Walker, J.C. (1968) Plant Pathology, McGraw Hill, New York.
- Eggins, H.O.W. and Allsop (1975) The Filamentous Fungi Vol. I Industrial Mycology (Biodetoriation and Biodegradation by Fungi) Eds. J.E. Smith and D.R. Berry Edward Arnold, London.
- Emmons, C. W., C. H. Bin ford, J.P. Utz and Know Chung (1977) Medical Mycology, Lea and Febigo, Philadelphia.
- Holliday, P. Fungus disease of tropical plants (1980), Cambridge University Press, Cambridge. Mehrotra, R S. and Aneja, R S.; 1998: An Introduction to Mycology. New Age Intermediate Press.
- Rangaswamy, G. and Mahadevan, A; 1999: Diseases of Crop Plants in India (4th edition). Prentice Hall of India Ltd. New Delhi.
- Webster, J.; 1985: Introduction to Fungi Cambridge University Press. Dubey, R C. & Maheshwari, D. K.; 2005: A Text Book of Microbiology, S. Chand Publisher, New Delhi.
- Smith,. Cryptogamic Botany.

On line Journals available on UGC –VSAT. **E- content available with IGNOU/ Swyam portal**

## M.Sc. Botany M.Ed. II Semester

| Course code | Course | Credits L+T+P | Hours per Semester | Marks | | | |
|---|---|---|---|---|---|---|---|
| | | | | Practical | | | |
| | | | | Internal Th + Pr | External Pr | Theory | Total |
| **DC 2.1** | Plant Pathology | 2+1+1 | | 6 | 60 | 10+ 10 | 20 |
| **DC 2.2** | Biology and Diversity of Bryophytes and Pteridophytes | 2+1+1 | | 6 | 60 | 10 + 10 | 20 |
| **DC 2.3** | Gymnosperms | 2+1+1 | | 6 | 60 | 10+10 | 20 |
| **EC 2.1** | | 3+1+0 | | 5 | | 30 | - |
| **EC 2.2** | | 3+1+0 | | 5 | | 30 | - |
| **PC 2.1** | | 0+0+2 | | 4 | | 50 | - |

## DC 2.1 Plant Pathology

### Theory

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Course Learning Outcomes**:

After completion of this paper the students will be able to:

1. Understand the importance of plant diseases and their causes.

2. Understand the mode of infection involving the role of enzymes and toxins.

3. Understand the role of environment and host nutrition on disease development and host parasite interaction.

4. Understand molecular aspects of host pathogen interaction (PR protein, degradation of phytoalexins).

5. Explain the biochemical factors involved in disease development.

6. Explain the genetic basis of disease resistance mechanism.

7. Describe the strategies of disease management based on chemical treatments, biological control and genetic engineering.

| | |
|---|---|
| **Unit-I** | Importance and concept of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. |
| **Unit-II** | Mode of infection and role of enzymes and toxins in plant disease.<br>Growth, reproduction, survival and dispersal of important plant pathogens.<br>Role of environment and host nutrition on disease development<br>Host parasite interaction. |
| **Unit-III** | Molecular aspects of host pathogen interaction – Pathogenesis-related (PR) protein, degradation of phytoalexins.<br>Disease development: role of enzymes, toxins and growth regulators.<br>Systemic resistance mechanism, Defense strategies: Oxidative burst, Phenolics, Phytoalexins, (PR) proteins and elicitors, application of molecular biology to plant disease control – transgenic approach for crop protection.<br>Chemicals that elicit defense response to plants, symptomatology. |
| **Unit-IV** | Genetics of resistance: 'R' genes, mechanism of genetic variation in pathogens; molecular basis for resistance; marker assisted selection; genetic engineering for disease resistance. |
| **Unit-V** | Disease management strategies: Molecular approaches for the investigation of plant diseases.<br>Control mechanisms based on chemical treatments, biological control and genetic engineering. |

**Practical**

**SUGGESTED LABORATORY / FIELD EXERCISES**

**The students will be able to:**

- Develop skills to handle the equipments of plant pathology lab and learn the techniques to prepare culture media for isolation and culture of fungi and bacteria.
- Study the morphological and anatomical features of diseased plant specimens.

1. Acquaintance to plant pathology equipments.
2. Morphological and anatomical study of diseased plant specimens infected by fungi, bacteria and virus.
3. Preparation of culture media for fungi and bacteria.
4. Isolation techniques.

**SUGGESTED READINGS:**


- Agrios, N. George (2009). Plant Pathology. 5th Ed, Academic Press Publishers, U.K.
- Heitefuss, R. and Williams, P.H (1976), Physiological Plant Pathology, Springer Verlag, Berlin, New York.
- Mehrotra, R.S. and Aggarwal, A (2003), Plant Pathology, 2nd Ed, Oxford and IBH, New Delhi.
- Singh, R.S. (2002), Introduction to Principles of Plant Pathology, Oxford and IBH, New Delhi.
- Singh, D.P. and Singh A. (2007), Disease and Insect Resistance in Plants, Oxford and IBH, New Delhi.
- Upadhyay, R.K and Mukherjee, K.G (1997), Toxins in Plant Disease Development and Evolving Biotechnology, Oxford and IBH, New Delhi.

## DC 2.2 Biology and Diversity of Bryophytes and Pteridophytes

### Theory

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes**:

After completion of this paper the students will be able to:

1. Describe the general characteristics of bryophyta and pteridophyta, their classification and details of their representative genera.

2. Understand the terms telome theory, origin of sporophyte, stelar organization, homospory, heterospory and seed habits in pteridophytes and their fossil forms.

3. Appreciate the important contributions of Indian bryologists and pteridologists.

| | |
|---|---|
| **Unit-I** | General Characteristics, classification, Morphology, reproduction and life history, Origin, Evolution of sporophyte, gametophyte and Ecological and Economic importance of Bryophytes.<br>Contribution of Indian Bryologists. |
| **Unit-II** | General Characteristics of Hepaticopsida- *Pellia, Porella.*<br>General Characteristics of Anthocerotopsida- *Anthoceros, Notothylus*.<br>General Characteristics of Bryopsida-*Sphagnum, Polytrichum.* |
| **Unit-III** | General characteristics of Pteridophyta; Classification, origin of sporophyte and Telome theory, stelar organization, Homospory, Heterospory and Seed Habits, Reproduction, Morphological nature and Evolutionary significance of sporocarp.<br>Contribution of Indian Pteridologists and fossil Pteridophytes. |
| **Unit-IV** | General characteristics of Psilophyta- *Horneophyton, Asteroxylon, Psilotum*.<br>General characteristics of Lycophyta- *Lcyopodium, Lepidodendron, Isoetes*. |
| **Unit-V** | General characteristics of Sphenophyta- *Calamites, Sphenophyllum*.<br>General characteristics of Pterophyta- *Ophioglossum, Osmunda, Dryopteris/ Pteris, Salvinia, Azolla.* |

**Practical**

## SUGGESTED LABORATORY EXERCISES

**The students will be able to:**

- Learn morphological and anatomical features of representative members of Bryophyta and Pteridophyta.
- Study some fossil Pteridophytes through specimens and prepared slides.

1. Morphological & Anatomical study of representative members of the Bryophyta: *Pellia, Porella, Anthoceros, Notothylas, Sphagnum, and Polytrichum.*

2. Morphological & Anatomical study of representative members of the Pteridophyta: - *Horneophyton, Lycopodium, Psilotum, Isoetes, Ophioglossum, Osmunda, Dryopteris/ Pteris, Salvinia, Azolla.*

*3.* Study of fossil Pteridophytes.

## SUGGESTED READINGS


• Smith G. M. Cryptogamic Botany Vol II (2nd edition) ~ Tata McGraw-Hill Publishing Company Ltd. Bombay -New Delhi.

• Kashyap S. - 1972 Liverworts of Western Himalayas and Punjab. Research Publication.

• Puri P. 1980~ Bryophyta -Morphology, Growth & Differentiation. Atma Ram & Sons, Delhi.

• Chopra & Kumar- 1988: Biology of Bryophyta; Wiley Eastern Ltd.

• Ram Udar; 1970: An Introduction to Bryophyta; Shashidhar Malviya Prakashan.

• Watson; 1968: Structure and life of Bryophyta; Hutchinson & Co. Ltd.

• Campbell; 1939: The evolution of land plants; Stanford University.

• Sporne, K.R. 1991. The Morphology of Pteridophyta.

• Parihar N.S. 1996 Biology and Morphology of Pteridophytes, CentralBook Depot. Allahabad.

• Arnold C. A; An Introduction to Paleobotany; Tata Mc Graw –Hill Publishing Co. New Delhi. • Stewart, W. N. and Rathwell G. W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.

• Eames A J.; Morphology of Vascular Plants-Lower Groups. Tata Mc Graw -Hill Publishing Co. New Delhi

• Rashid A. 1999; An introduction to Pteridophytes; Vikas Publishing House Pvt. Ltd.

• Gangulee & Kar College Botany Vol II.

## DC 2.3 Gymnosperms

### Theory

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning outcomes:**

On completion of this paper, students will be able to:

1. Describe the general characteristics and classification and evolutionary tendencies of gymnosperms and their distribution in India.
2. Describe fossil and living representative members of different classes of gymnosperms.

Understand the plant fossils and the evolution process will become more easy to understand.

3. Appreciate the important contribution of some distinguished persons in the field of gymnosperms.

| | |
|---|---|
| **Unit-I** | General Characteristics and Classification of Gymnosperms, Distribution of Gymnosperms in India, Economic Importance, Evolutionary tendencies in Gymnosperms.<br>Contribution of Indian botanists to Gymnosperms. |
| **Unit-II** | Paleobotany: Fossilization, Geological Time Scale.<br>General Characteristics of Fossil Gymnosperms (Pteridospermales) – *Lagenopteris, Glossopteris, Caytonia, Pentoxylon,*. |
| **Unit-III** | General Characteristics of Cycadeoidales, Cycadales, Bennettitales, *Cycadeoidia, Williamsonia, Zamia*. |
| **Unit-IV** | General Characteristics of Ginkgoales, Cordaitales & Coniferales, *Ginkgo biloba, Cordaites, Juniperus, Cedrus, Cupressus, Araucaria, Thuja*. |
| **Unit-V** | General Characteristics of Ephedrales- *Ephedra.*<br>General Characteristics of Welwitschiales- *Welwitschia.*<br>General Characteristics of Gnetales- *Gnetum.* |

## Practical

## SUGGESTED LABORATORY EXERCISES

**The students will:**

- Study the morphological and anatomical features of representative members of gymnosperms.
- Conduct studies the monographs of some members of gymnosperms.
- Study the morphological and anatomical features of representative members of fossil gymnosperms.

1. Morphological and anatomical study of specimens included in the theory.

2. Monographic study of following: - *Cycas, Ginkgo, Cedrus, Araucaria, Taxus, Ephedra* and *Gnetum*.

3. Study of important fossil gymnosperm from permanent slides and specimens.

## SUGGESTED READINGS


- Bhatnagar, S.P. and Moitra, A; 1996: Gymnosperms. New Age International Pvt. Ltd., New Delhi.
- Spome K R; 1991: The Morphology of Gymnosperms; Hutchinson Univ. Library; London.
- Foster A S. & Gifford E. M; Comparative morphology of vascular Plants; Vakils, Feffer, & Simons Private Ltd. Bombay.
- Chamberlain; Gymnosperms -Structure & Evolution; CBS Publishers & Distributors Delhi.
- Shukla A C. & Mishra S. P.; Essentials of Paleobotany; Vikas Publishing House Pvt. Ltd. Delhi Bombay-Bangalore-Calcutta-Kanpur.
- Vashishta – Gymnosperms.
- Sharma, O.P. – Gymnosperms.

## M.Sc. Botany M.Ed. III Semester

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Practical | | | |
| | | | | | Internal Th + Pr | External Pr | Theory | Tota |
| **DC 3.1** | Morphology and Taxonomy of Angiosperms | 2+1+1 | 6 | 60 | 10+ 10 | 20 | 60 | 100 |
| **DC 3.2** | Developmental Biology (anatomy and embryology) | 2+1+1 | 6 | 60 | 10+10 | 20 | 60 | 100 |
| **DC 3.3** | Plant Physiology and Biochemistry | 2+1+1 | 6 | 60 | 10+10 | 20 | 60 | 100 |
| **EC 3.1** | | 3+1+0 | 5 | | 30 | - | 70 | 100 |
| **EC 3.2** | | 3+1+0 | 5 | | 30 | - | 70 | 100 |
| **EE 3.1** | | 1+1+0 | 3 | | 15 | - | 35 | 50 |
| **PC 3.1** | | 0+0+2 | 4 | | 50 | - | - | 50 |

**DC 3.1 Morphology and taxonomy of Angiosperms**

**Theory**

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning outcomes:**

On completion of this paper, students will be able to:

1. Study in detail the morphological features of flowers and its parts.
2. Understand the species concept, taxonomic hierarchy, International Code of Botanical Nomenclature and taxonomic evidences.
3. Study the phenetic and phylogenetic systems of classification of angiosperms and their merits and demerits.
4. Study in detail the characteristics of some families of dicots and monocots.

| | |
|---|---|
| **Unit-I** | Morphology of flower, morphology of stamens and carpels, morphology of ovary and its types, placentation: their origin and types, morphology, types and dispersal of fruits and seeds. |
| **Unit-II** | The species concept Taxonomic hierarchy, International Code of Botanical Nomenclature, Taxonomic evidences (morphology, anatomy, palynology, embryology, cytology, phytochemistry).<br>Taxonomic tools (Herbarium/ Digital Herbarium, Botanical garden, Taxonomic keys, Taxonomic literature, floras.) Histological, biochemical, cytological, phytochemical, serological, and molecular technique. |
| **Unit-III** | Systems of Angiosperm classification: Outline of classification of angiosperms, Hutchinson, Cronquist, Bentham and Hooker and basic concept of APG systems (Angiosperm Phylogeny Group system), merits and demerits of systems of classification<br>Phenetic versus phylogenetic system. |
| **Unit-IV** | Families of Dicotyledons: Magnoliaceae, Annonaceae, Papaveraceae Capparidaceae, Portulaceae, Oxalidaceae, Meliaceae, Rosaceae, Cucurbitaceae, Cactaceae, Rubiaceae, Gentianaceae, Bignoniaceae,Verbenaceae, Nyctaginaceae, Urticaceae, Moraceae. |

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| **Unit-V** | Families of Monocotyledons: Orchidaceae, Iridaceae, Amaryllidaceae , Musaceae, Commelinaceae, Arecaceae, Typhaceae, Cyperaceae, Poaceae.<br>General characteristics and phylogeny of Ranales, Amentiferae, Tubiflorales, Santales, Centrospermales and Hellobiales. |

**Practical**

**SUGGESTED LABORATORY EXERCISES**:

The students will be able to:

- Compare the structures of stamens and carpels of various species including placentation.
- Learn the use of identification keys at generic and at family level.
- Learn the technique of herbarium preparation.
- Describe in taxonomic terms the locally available plant species of both monocot and dicot families.

**List of practicals:**

1. Study of stamens and carpels in various species.
2. Different kinds of placentation.
3. Description of various species of a genus, preparation of identification Keys at generic level and at family level.
4. Demonstration for herbarium preparation.
5. Study of locally available plants of Dicot Families: Magnoliaceae, Annonaceae, Papaveraceae Capparidaceae, Portulaceae, Oxalidaceae, Meliaceae, Rosaceae, Cucurbitaceae, Cactaceae, Rubiaceae, Gentianaceae, Bignoniaceae, Verbenaceae, Nyctaginaceae, Urticaceae, Moraceae.
6. Study of locally available plants of Monocot Families: Orchidaceae, Iridaceae, Amaryllidaceae, Musaceae, Commelinaceae, Arecaceae, Typhaceae, Cyperaceae, Poaceae, Ranales, Amentiferae, Tubiflorales, Santales, Centrospermales and Hellobiales.

**SUGGESTED READING**:


- Heywood V. H & Moore D.M, CW Tent, 1984: Concept in Plant Taxonomy Academic Press.
- Eames, AL.; 1961; Morphology of Angiosperms, McGraw Hill, New York.
- Lawrence, G.H.M,1951: Taxonomy of Vascular Plants Macmillan, New York
- Naik V.N,1984: Taxonomy of Angiosperms. Tata McGraw Pub Co. Ltd New Delhi.

**DC 3.2 Developmental Biology (Anatomy and Embryology)**

**Theory**

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Course Learning Outcomes:**

After completion of this paper the students will be able to:

1. Study tissue systems and different types of meristems in the organization of plant body.
2. Study the secondary growth in stem and anomalous secondary growth in stem of some plants.
3. Explain the origin, development, differentiation, arrangement, diversity, venation, modification and anatomy of leaves.
4. Describe the differentiation of floral organs.
5. Explain the structures of reproductive organs and process of reproduction in angiosperms.

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| **Unit-I** | Organization of the higher plant body: shoot and reproductive meristem, Tissue system, Shoot apical meristem (SAM), Root apical meristem (RAM), Lateral meristem. Control of tissue differentiation especially xylem and phloem, Lateral root and root hair. |
| **Unit-II** | Secondary growth in stem, primary and secondary anomalous structure of stem.<br>Origin, development, differentiation, arrangement, diversity, venatian, modification and anatomy of leaves. |
| **Unit-III** | Flower development, floral organ differentiation, homeotic mutants in *Arabidiopsis* and *Antirrhinum*.<br>Androecium, Microsporangium, Microsporogenesis, role of tapetum, Male gametophytes and their development, Pollen storage, Pollen allergy and Pollen embryos, Palenology, Male sterility. |
| **Unit-IV** | Gynoecium: structure of Megasporangium, Ovule development, Types, Megasporogenesis, organization of Embryo sacs.<br>Pollination Mechanisms and vectors, Self-incompatibility. |

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| **Unit-V** | Double fertilization: Endosperm development, embryogenesis, storage proteins of endosperms and embryo.<br>Fruit growth: biochemistry and molecular biology of fruit maturation, parthenocarpy.<br>Seed growth and their dispersal, Polyembryony, apogamy and apomixis. |

**Practical**

**SUGGESTED LABORATORY / FIELD EXERCISES**

**The students will:**

- Undertake the cytohistological and anatomical studies of shoot apical meristem.
- Compare the phyllotaxy of various plant species.
- Compare trichomes, glands and pollen morphology of certain species.
- Explain the different stages of reproduction in angiosperms (microsporogenesis and game to genesis etc.) with the help of permanent slides.

**List of practicals:**

1. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double strained permanent slides of suitable plant such as *Coleus*, Tobacco.
2. Study of shoot apices in a monocotyledon in both TS and LS to show the origin and arrangement of leaf Primordia.
3. Study of phyllotaxy of various plant species.

4. Anatomy of leaf of locally available plants.
5. Study of trichomes and glands in few species *Oscimum sp, Azadirechta indica , Plumbago sp, Eucalyptus* sp, citrus sp, *Tridax* sp etc.
6. Study of morphology of pollen grains of different species.
7. Study of pollen germinations and test for pollen viability using stains.
8. Study of microsporogenesis and gametogenesis in section of Anthers.
9. Pollen pistil interaction, self-incompatibility, In- vitro pollination.
10. Study of monosporic, bisporic and tetra sporic type of embryo sac.
11. Suitable seeds and polyembryony in Citrus, Jamun, etc. by dissection.

**SUGGESTED READINGS**


- Bhojwani, S.S, Bhatnagar S.P.2000. The Embryology of Angiosperms (4th revised and enlarged edition) Vikas Publishing House, New Delhi.
- Burgess.J.1985.An introduction to Plant Cell Development Cambridge University Press, Cambridge.
- Fahn, A 1 982.Plant Anatomy. (3rd edition) Pergamon Press, Oxford.
- Fosket, D.E.1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
- Howell, S.H.1998. Molecular Genetics of Plant Development, Cambridge University Press, Cambridge.
- Leins P, Tucker, S.C and Endress, P.K.1988.Aspects of Floral Development. J. Cramer, Germany.
- Lyndon, R.F.1990.Plant Development. The Cellular Basis. Unin Hyman. London.
- Murphy, T. M. and Thompson, W. E. 1988 Molecular Plant Development. Prentice Hall, New Jersey.
- Proctor, M. and Yeo, P.1973.The Pollination of Flowers. William Collins Sons, London.
- Raghvan, V .1997. Molecula r Embryology of Flowering Plants. Cambridge University Press, Cambridge.
- Raghvan, V. 1999. Development Biology of Flowering Plants. Springer-verla


## DC 3.3 Plant Physiology and Biochemistry

### Theory

**Credits: 4**
**Contact hours per week: 6**

**Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes:**

After completion of this paper the students will be able to:

1. Explain the different aspects of enzymes and mechanism of their action.
2. Learn in detail the basic principles of photochemistry and different steps and variations in photosynthesis and its ecological importance.
3. Explain the different aspects of respiratory metabolism in plants.
4. Explain the structure and role of biomolecules involved in plant metabolism.
5. Understand the mechanism of action of different growth regulators and their role in different phenomenon of plant growth.
6. Understand the concepts of stress physiology.

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| **Unit-I** | Plant water relation, Absorption, Transpiration, Nitrogen metabolism (Root microbe interaction), Membrane Transport, Phloem Transport, Role of cyclic nucleotides.<br>Fundamentals of Enzymology: Nomenclature and classification of enzymes, Michaelis - Menten equation and Kinetics of enzymatic catalysis, mechanism of action of enzyme, inhibition of enzymes, Regulation of enzyme activity. |
| **Unit-II** | Photochemistry and Photosynthesis: Principles of light absorption, pigments, light harvesting complex, excitation energy transfer, electron transports, proton electrochemical potential, photosynthetic quantum yield and energy conversion efficiency.<br>Photorespiration and its significance, Calvin cycle, C-4 cycle, CAM pathway.<br>Respiration: Overview of plant respiration, Glycolysis, TCA cycle, Electron Transport, oxidative pentose phosphate pathway, Structure, function & synthesis of ATP, Glyoxylate cycle and alternative oxidases system. |
| **Unit-III** | Structure, classification and function of proteins, carbohydrates, biosynthesis of sucrose and starch.<br>Structure and function of Lipids, Fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids and oxidation of lipids,<br>Nitrogen metabolism: nitrogen fixation, nitrate and ammonium assimilation, amino acid biosynthesis. |
| **Unit-IV** | Plant growth regulators: Biosynthesis, Physiological effects and mechanism of action of plant growth hormones, phytochromes, cryptochromes and phototrophins, signal transduction.<br>The flowering process: Photoperiodism, Vernalisation and its significance, biological clock and its regulation, floral induction and development. |
| **Unit-V** | Stress physiology: Plant response to biotic and abiotic stress, water deficit and drought resistance, salinity stress and resistance, concept of freezing, heat stress and oxidative stress. |

**Practical**

**SUGGESTED LABORATORY EXERCISES**:

The students will:

- Develop the skills to use colorimeter and spectrophotometer and other equipments in plant physiology.
- Conduct the experiments to elucidate plant physiological processes (photosynthesis, respiration and enzyme studies).
- Separate the isoenzymes of some enzymes with the help of polyacrylamide gel electrophoresis.

List of practicals:

1. Principles of Colorimetry and Spectrophotometry.
2. Determine rate of respiration in germinating seeds/young buds by Ganong's respirometer.
3. Determine rate of respiration in terms of oxygen utilized by plant material by volume method/ weight method.
4. Determine effect of light intensity / wave length on rate of photosynthesis.
5. Determine effect of CO2 concentration on rate of photosynthesis.
6. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids by spectrophotometer.

7. To determine the chlorophyll-a / chlorophyll- b ratio in C3 and C4 plants by spectrophotometer.
8. Biochemistry of carbohydrates and lipids.
9. Effect of enzyme concentration on enzyme activity e.g. catalase, amylase, acid phosphatase, nitrate reductase.
10. Effect of substrate concentration on enzyme activity e.g. catalase, amylase.
11. Separation of isoenzymes of esterase, Peroxidases by polyacrylamide gel electrophoresis.

**SUGGESTED READINGS:**


- Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
- Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer - Verlag, New York. USA.
- Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
- Salisbury FB and Ross CW 1991 Plant Physiology IV edition Woodsworth Publishing co. California USA.
- Taiz l and Ziegler E. 1998 Pant Physiology II Edition. Sinauer Associates Inc. Publisher MS.
- Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
- Buchanan, B.B. Gruissem, W. and Jones R.L. 2000. Biochemistry and molecular Biology of plants. American Society of Plants Physiologist, Maryland USA.

Albert L. Lehninger, David L. Nelson, and Michael M. Cox Principles of Biochemistry.

**M.Sc. Botany M.Ed. IV Semester**

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Practical | | | |
| | | | | | Internal Th + Pr | External Pr | Theory | Tota |
| **DC 4.1** | Cytology and Genetics | 2+1+1 | 6 | 60 | 10+ 10 | 20 | 60 | 100 |
| **DC 4.2** | Molecular Biology and Improvement of Plant Resources | 2+1+1 | 6 | 60 | 10+10 | 20 | 60 | 100 |
| **DC 4.3** | Bioinformatics and Biostatistics | 2+1+1 | 6 | 60 | 10+10 | 20 | 60 | 100 |
| **EC 4.1** | | 3+1+0 | 5 | | 30 | - | 70 | 100 |
| **EC 4.2** | | 3+1+0 | 5 | | 30 | - | 70 | 100 |
| **EE 4.1** | | 1+1+0 | 3 | | 15 | - | 35 | 50 |

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|---|---|---|---|---|---|---|---|---|
| **PC 4.1** | | 0+0+2 | 4 | | 50 | - | - | 50 |

**DC 4.1 Cytology and genetics**

**Theory**

**Credits: 4**
**Contact hours per week: 6** **Max Marks: 100**
**Theory: 60**

**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes:**

After completion of this paper the students will be able to:

1. Understand structure, assembly and packaging of DNA and repetitive DNA.
2. Explain nuclear content, C value paradox and different types of genes (split genes, overlapping genes) along with specialized types of chromosome.
3. Understand the methods of staining and visualizing the chromosomes to get a better view of their structure and banding patterns.
4. Develop insights about cytogenetics and breeding behaviour of haploids and their uses in plant breeding.
5. Understand the concept of inbreeding and heterosis and non-conventional methods of crop improvement.
6. Construct genetic and cytological maps by using techniques like FISH and GISH.

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| **Unit-I** | Chromatin organization: Chromosome structure and packaging of DNA, Nucleosome-assembly and de assembly, histones: Euchromatin and heterochromatin. |

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| **Unit-II** | Structure and Function of Nucleus, structure and forms of DNA, C value paradox, Cot curve, DNA content and adaptability, repetitive DNA, split genes, overlapping genes, karyotype, idiogram, banding patterns, types and uses of chromosome bandings, special types of chromosomes. |
| **Unit-III** | Cell division,Chromosomal Aberrations (Structural and numerical changes), Mendelian inheritance, Cytoplasmic inheritance, Gene interaction and polygenic inheritance, Linkage and Crossing over. |
| **Unit-IV** | Cytogenetics of haploids: Haploidy/monoploidy.<br>Oncogene, Apoptosis, innate and adaptive immune system.<br>Antisense technology, biochemistry and applications of ribozyme technology. |
| **Unit-V** | Chromosome mapping: Cytological and genetic maps, interference and coincidence, deletion and aneuploidy mapping, Fluorescent in situ hybridization (FISH), Genomic in situ hybridization (GISH). |

**Practical**

**SUGGESTED LABORATORY EXERCISES:**

**The students will be able to:**

- Learn the techniques of isolation of DNA and RNA and their quantification by spectrophotometric methods.
- Learn the working of electron microscopes (SEM and TEM).
- Use the technique of isolation of mitochondria and activity of its marker enzyme succinate dehydrogenase.
- Use different techniques(SDS-PAGE) of isolation of chloroplast and separation of its two subunits.
- Understand the concepts of mitosis and meiosis using onion tip cells and Tradeschantia.
- Determine the mitotic index and demonstrate the abnormalities in meiosis.
- Prepare karyotype and ideogram and calculate Nucleo Cytoplasmic Index of onion/garlic root tip with the help of micrometric method.

**List of practicals:**

1. Isolation of plant DNA and its quantification by a spectrophotometric method.
2. Isolation of RNA and quantification by a spectrophotometric method.
3. Demonstration of SEM and TEM.
4. Isolation of Mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
5. Isolation of chloroplasts and SDS-PAGE. Profile of proteins to demarcate the two submits of Rubisco.
6. Demonstration of Mitosis.
7. To determine Mitotic Index in onion root tip cells.
8. Demonstration of Meiosis (normal) in *Tradeshcantia*.
9. Demonstration of abnormal meiosis.
10. Demonstration of special types of chromosomes.
11. Preparation of karyotype and Idiogram.
12. Problem solving related to genetics.
13. Calculation of Nucleo Cytoplasmic Index of onion/garlic root tip with the help of micrometric method.
14. Prepare cot curve.

Refer the following Review Journals: -

1. Annual Review of plant physiology and Molecular Biology.
2. Current Advances in Plant Sciences.
3. Nature Reviews: Molecular and Cell Biology.

**SUGGESTED READINGS**:


- Lewin, B. 2000, Genes VIL Oxford University Press, New York.
- Alberts, B., Bray, D., Lewis, J., Ratf, M., Roberts, K., and Watson, J.D. Molecular Biology of the Cell. Garland Publishing: Inc., New York.
- Wolfe, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
- Rost, T. et: al. 1998.PIant Biology, Wadsworth Publishing Co., California, U.S.A.
- Krishanmurthy K V. 2000 Methods in Cell Wall Cytochemistry, CRC Press, Boca Raton, Florida U.S.A.
- Buchanan, B.B. Groissem, W. and Jones, RL. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
- De, D.N. 2000: Plant Cell Vacuoles: An Introduction. CSIRO Publication, ColliJ18W~ Australia.

**DC 4.2 Molecular Biology and Improvement of Plant Resources**

**Theory**

**Credits: 4**

**Contact hours per week: 6** **Max Marks: 100**

**Theory: 60**

**Practical (External): 20**

**Internal (Th+Pr): 20 (10+10)**

**Learning outcomes:**

After completion of this paper, students will be able to:

1. Understand the causes of DNA mutation and repair, restriction mapping and multigene families.
2. Comprehend gene structure and expression along with the detailed analysis of genetics of bacteria and virus.
3. Learn the steps involved in RNA synthesis and processing and structural features of genomic components (protein and RNA coding gene, promoter).
4. Understand the mobile genetic elements and their role in creating novel species, protein profiling and post translaitonal modifications of proteins.
5. Understand the concept and techniques of in-situ hybridization and genetic basics of cancer and immune system in plants.

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| **Unit-I** | Nuclear DNA content, DNA replication mechanisms in prokaryotes and eukaryotes, DNA mutation and repair, Restriction mapping, Multigene families and their evolution. |
| **Unit-II** | Gene structure and expression, Gene fine structure, cis and trans test of recombination, introns and exons, their significance, prokaryotic and eukaryotic transcription. |
| **Unit-III** | RNA synthesis and processing- adding, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.<br>Genetic code, Protein synthesis in prokaryotes and eukaryotes.<br>Regulation of gene expression in Prokaryotes and Eukaryotes (lac, trp operon).<br>Bacterial genetics (conjugation, transduction and transformation). |
| **Unit-IV** | Mobile genetic elements: insertion elements, transposons<br>Microarrays, protein profiling and its significance.<br>Post translation modification of protein, protein sorting.<br>Targeting of protein to organelles. |
| **Unit-V** | Plant breeding and heterosis: Genetic basis of inbreeding depression and heterosis, manifestations and exploitation of hybrid vigour, non- conventional methods of crop improvement. |

**Practical**

**SUGGESTED LABORATORY EXERCISES**

- **The students will:**
- Learn the techniques of DNA and RNA quantification and estimation.
- Understand the restriction digestion of DNA by performing agarose gel electrophoresis and Etbr staining.
- Perform immunological techniques like ELISA, Western blotting etc.
- Perform isolation of chloroplast and separation of its subunits.

**List of practicals:**

1. Isolation of DNA & its quantification by a spectrophotometric method.
2. Restriction digestion of plant DNA, its separation by Agarose gel electrophoresis and visualization by ethidium bromide staining.
3. Isolation of RNA and quantification by a spectrophotometric method.
4. Separation of RNA by Agarose gel electrophoresis and visualization by Et. Br. staining.
5. Immunological techniques: Ouchterlony method, ELISA & western blotting.
6. Isolation of chloroplasts and SDS-PAGE. profile of proteins to demarcate the two subunits of Rubisco.

**SUGGESTED READINGS**:


- Alberts, B. Bray, D. Lewis, J. Raff: M. Roberts, K. and Watson, J. D. 1989 Molecular Biology of the Cell (2nd edition). Garland Publishing Inc., New York. U. S. A.
- Karp, G. 1999 Cells and Molecular Biology: Concepts and Experiments John Wiley & Sons, Inc. U. S.A
- Malacinski, G. M. and Freifelder, D. 1998. Essentials of Molecular Biology (3M edition). Jones and Barlett Publishers, Inc. London.
- Wolfe, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, J.D. 1999.Molecular Biology of the Cell. Garland Publishing: Inc., New York.
- Rost, T. et al. 1 998.Plant Biology, Wadsworth Publishing Co. California, U.S.A
- Krishanmurthy K. V. 2000 Methods in Cell Wall Cytochemistry, CRC Press, Boca Raton, Florida U.S.A
- Buchanan, B.B. Gruissem, W. and Jones, RL. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA
- De, D.N. 2000 Plant Cell Vacuoles: An Introduction, CSIRO Publication, Collingwood, Australia.
- Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA
- Lodish H. Bert, A. zipursky, S.L. Matsudaira, P. Baltimore, D. and Darnell, J. 2000.Molecular Cell Biology, W.H. Freeman and Co., New York, U.S.A
- Twyman, R. M. 2003. Advanced Molecular Biology. Viva Books Private Ltd. New Delhi. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley &, Sons, Inc., New York, USA.
- Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer - Verlag, New York. USA.
- Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
- Salisbury FB and Ross CW 1991 Plant Physiology IV edition Woodsworth Publishing co. California USA.
- Taiz l and Ziegler E1998 Pant Physiology II Edition. Sinauer Associates Inc. Publisher MS.
- Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
- Buchanan, B.B. Gruissem, W. and Jones R.L. 2000. Biochemistry and molecular Biology of plants. American Society of Plants Physiologist, Maryland USA.

## DC 4.3 Bioinformatics and Biostatistics

### Theory

**Credits: 4**
**Contact hours per week: 6** **Max Marks: 100**
**Theory: 60**

**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes**:

After completion of this paper, the students will be able to:

1. Understand role, scope and applications of bioinformatics and different types of databases and online tools related to biological and specialized data.
2. Comprehend sequencing by making use of different methods of alignment and the concepts of scoring matrix and phylogenetic analysis.

3. Understand the concept of structural bioinformatics of proteins by using models of molecular visualization and molecular modeling.
4. Develop necessary skills of data representation, classification, tabulation and graphical representation.
5. Learn the basics of data interpretation and distribution by using different tools. Understand the concepts of correlation and regression, skewness, standard deviation, variance, different tests of significance along with probability distribution.

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| **Unit-I** | **Introduction to bioinformatics:** Definition, role, scope, limitations and applications of bioinformatics, Introduction to biological databases –nucleotide databases- GenBank, EMBL, DDBJ, Protein sequence databases- PIR, PROSITE, Pfam, Structural databases- PDB, CATH, SCOP, Specialized databases- REBASE, ENZYME and KEGG. Sequence files format-FASTA, GENBANK, CLUSTALW, PHYLIP, PDB. |
| **Unit-II** | **Sequence analysis:** Introduction, methods (HMM & ANN) and significance. Sequence Comparison- Pair wise alignment and significance.<br>Methods of alignment- Dot matrix, Dynamic Programming (Needleman-Wunsch and Smith-Waterman algorithm), Homology sequence searching- FASTA and BLAST.<br>Concept of Scoring matrix (PAM and BLOSUM) and Gap penalty Multiple Sequence Alignment- methods, tools (ClustalW) and application.<br>Phylogenetic Analysis- Introduction and importance, Phylogenetic tree, methods of Phylogenetic analysis and tools (PHYLIP and MEGA). |
| **Unit-III** | **Structural Bioinformatics:** Introduction and Importance, Coordinate systems, Molecular visualization models and tools – RASWIN, spdbv, ChemSketch.<br>Protein structure prediction- secondary structure prediction, tertiary structure prediction. Molecular modeling- structure models, Molecule designing and geometry optimization, Molecular docking- concepts and methods, drug discovery approaches and QSAR modeling. |
| **Unit-IV** | **Data and Data Representation:** Introduction to statistics. Data - definition, collection of data, sampling. Types of classification. Tabulation - Types of Tables, format, sorting. Frequency distribution, cumulative frequency distribution. Representation of Data - Graphical representation. I D Diagrammatic representation. Representation of frequency distribution - Histogram, Frequency polygon, frequency curve, Ogive. |
| **Unit-V** | **Data Interpretation:** Arithmetic Mean, Median, Mode. Geometric Mean. Harmonic Mean. Partition Values - Quartiles, Deciles, Percentiles. Measures of Dispersion - Range. Mean Deviation, Standard Deviation, Variance, Coefficient of Variation. Basic concepts of Skewness and Kurtosis, Correlation and Regression. Test of Significance - T-Test. F-Test. Chi square test, ANOVA.<br>Probability - Terms and Concepts, Theorems (Addition, Multiplication and compound) Distribution - Binomial. Poisson. Normal. |

## Practical

**SUGGESTED LABORATORY EXERCISES:**

**The students will learn to:**

- Perform DNA sequencing and gene identification by collecting biological data using online tools.
- Perform and study sequence alignment and retrieve data available from NCBI website.
- Develop the skills to locate gene(s) on chromosomes for a given disease/disorder.
- Perform the exercises related to biostatistics like measurement of central tendencies, dispersion, cluster analysis, dendogram making and tests analysis.

**List of practical's:**

1. To work out the DNA sequence from the given autoradiogram and identify the gene using online tools.
2. To search literature database of different organisms.
3. To search the genes in the Genebank.
4. To use the various tools to retrieve information available from NCBI
5. To locate gene(s) on chromosomes for a given disease/disorder.

6. To study biological databases and data retrieval-

a) Nucleotide Databases: GenBank, EMBL, DDBJ

b) Protein Databases: SWISSPROT, PIR

c) Others: KEGG

7. To perform Homology Sequence alignment –

a) FASTA

b) BLAST

8. To perform Multiple sequence alignment- CLUSTAL W

9. To study Molecular Visualization by RasMol, spdvb.

10. To study Phylogenetic analysis- MEGA, PHYLIP.

11. Protein secondary structure prediction.

12. To draw and visualize drug molecule through chemsketch.

13. Collection of biological data and tabulation.

14. Data collection and preparation of a frequency distribution table.

15. Graphical representation of collected data.

16. Measurement of central tendencies

a. Mean

b. Median

c. Mode

17. Measures of dispersion-

a) Range

b) Mean deviation

c) Standard deviation

d) Variance

18. Cluster analysis and dendogram making

19. T-test

20. Chi – Square test

21. Correlation and regression analysis

22. ANOVA

**SUGGESTED READINGS**:

1. Attwood TK and Parry-Smith DJ (2004) Introduction to Bioinformatics, Pearson Education (Singapore) Pvt. Ltd.

2. David Edwards (Ed.) (2007) Plant Bioinformatics: Methods and Protocols, Humana Press, New Jersey, USA.

3. Kulas JT (2008) SPSS Essential: Managing and Analyzing Social Science Data. John Wiley & Sons, New York.

4. Pagano M, Gauvreau K (2007) Principles of Biostatistics. Thomson India Edition, New Delhi.

5. Randal Schwartz, Tom Phoenix and Brian d Foy (2005) Learning Perl (4th edition), O'Reilly & Associates, ISBN: 0-596-10105-8.

6. Rex A. Dwyer (2004) Genomic Perl: From Bioinformatics Basics to Working Code, Cambridge University Press, 1st South Asian Edition.

7. Rosenkrantz WA (2009) Introduction to Probability and Statistics for Science, Engineering and Finance. CRC Press, Boca Raton.

**M.Sc. Botany M.Ed. V Semester**

| Course code | Course | Credits L+T+P | Contact Hours per week | Hours per Semester | Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Practical | | | |
| | | | | | Internal Th+Pr | External Pr | Theory | Total |
| **DC 5.1** | Plant Tissue Culture and Biotechnology | 2+1+1 | 6 | 60 | 10+ 10 | 20 | 60 | 100 |
| **DC 5.2** | Ecology and Environmental Biology | 2+1+1 | 6 | 60 | 10+10 | 20 | 60 | 100 |
| **DE 5.1** | Any one: (Industrial microbiology/ Conservation and utilization of plant resources/ Organic | 1+1+0 | 3 | | 10 | - | 40 | 50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | farming/ Horticultural practices) | | | | | | | |
| **EC 5.1** | | 3+1+0 | 5 | | 30 | - | 70 | 100 |
| **EE 5.1** | | 1+1+0 | 3 | | 15 | - | 35 | 50 |
| **EE 5.2** | | 1+1+0 | 3 | | 15 | - | 35 | 50 |
| **PC 5.1A (Core)** | Dissertation Botany (Proposal Development) | 0+0+2 | 4 | | 30 | 20 | - | 50 |
| **PC5.1 B (Edn)** | | 0+0+2 | 4 | | 30 | 20 | - | 50 |

## DC 5.1 Plant Tissue Culture and Biotechnology

### Theory

**Credits: 4**
**Contact hours per week: 6** **Max Marks: 100**
**Theory: 60**

**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning outcomes:**

After completion of this paper, the students will be able to:

1. Learn the basic concepts, tools and techniques of plant tissue culture using different types of explants and setting up of culture lab.
2. Learn the techniques of isolation of protoplasts and culture and applications of plant tissue culture.
3. Explain the details of recombinant DNA technology and its applications in genetic manipulation of plants.
4. Learn genomics and proteomics using high throughput sequencing and other related technologies.
5. Apply different techniques of biotechnology to various fields related to human welfare like agriculture, industries, health care etc.
6. Relate the applications of biotechnology to human ethics and Intellectual Property Rights.

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| **Unit-I** | Plant cell and tissue culture: General introduction, history, scope, concept of cellular differentiation and Totipotency.<br>Establishment of lab: aseptic technique and sterilization. Different types and preparation of tissue culture media.<br>Micropropagation techniques : meristem culture, haploid production through anther, microspore and ovary culture, embryo culture, callus mediated organogenesis, somatic embryogenesis. |
| **Unit-II** | Somatic Hybridization, Protoplast isolation, Fusion and culture, Somatic cell genetics, application of tissue culture, Artificial seed, Somaclonal variation. Production of Secondary metabolites, cryopreservation, and germplasm storage. |
| **Unit-III** | Recombinant DNA technology: gene cloning, principle and technique, construction of genomic and c-DNA library, Vector, Plasmid, DNA synthesis.<br>Genetic manipulation of plants- Direct DNA transfer in plant cells.<br>Gene transfer in plants through vectors – Selectable markers, reporter genes and promoters, Genetic markers, Gene therapy.<br>*Agrobacterium tumefaciens* mediated transformation.<br>GM crops: Resistance to herbicide, insect resistance, nematode resistance, virus resistance, Bt genes, non Bt like Protease inhibitors, Amylase inhibitor.<br>Advantages of genetically modified crops for resistance against biotic/abiotic stress and nutritional quality RNA silencing in Tomato and Soybean, Plant as a bioreactor, fermentation technology. |
| **Unit-IV** | Genomics and proteomics, molecular markers, Artificial chromosomes, High through put sequencing, genome projects, protein profiling and its significance Polymerase Chain Reaction (PCR), DNA fingerprinting. |
| **Unit-V** | Biotechnology Principles and Application of biotechnology in agriculture, horticulture, forestry, food, and industries, health care and immunology, environment biotechnology, and ethics.<br>Intellectual Property Rights (IPR- Copyright, Design, Trademark and Patents). Process of filing Patents. |

**Practical**

**SUGGESTED LABORATORY EXERCISE: -**

**The students will learn to:**

- Prepare different culture media and sterilization techniques.
- Develop plants through tissue culture using different types of explants.
- Conduct experiments related to bacterial growth, fermentation techniques, use of plant growth regulators and nitrogen fixers.
- Prepare artificial seeds.

**List of practicals:**

1. Sterilization techniques: Sterilization of medium and explants.
2. Preparation of culture medium.
3. To demonstrate growth characteristics of *E. coli* using plating method.
4. To demonstrate growth characteristics of *E. coli* by turbidometric method.
5. To study the effect of antibiotics on growth of microorganism.
6. To study fermentation techniques.
7. Study of nitrogen fixer & its applications.
8. To prepare tissue culture lab.
9. Study effect of plant growth hormones (PGR) on tissue culture.
10. To perform the techniques of micro propagation/ somatic embryogenesis /and androgenesis.
11. To perform the techniques of organogenesis.
12. Raising of callus by isolation of an explants on MS medium.
13. Preparation of artificial seeds.

**SUGGESTED READING:**


- Butenko, R.G. 2000 Plant Cell Culture. University Press of pacific.
- Collin, H.A. and Edwards, s. 1998 Plant Cell culture. Bios scientific publishers Oxford. UK.
- Callow, J.A. Ford-Lloyd, B.V. and Newbury, H.J.1997 Biotechnology and plant genetic Resources, Conservation and Use.CAB, International Oxon, UK.
- Dixon, R.A. 1987 Plant Cell Culture; a Practical Approach. IRL press, Oxford. George, E.F.1993 Plant Propagation by Tissue culture part- 1&2 Exegenetics Ltd Edington. UK.
- Glick, B.R. and Thompson, J.E. 1993 methods in Plant Molecular Biology and Biotechnology Grc Press Boca Raton. Florida.
- Primrose, S.B. 1995 Principles of Genome Analysis, Blackwell Science ltd., Oxf


## DC 5.2 Plant Ecology and Environmental Biology

### Theory

**Credits: 4**
**Contact hours per week: 6** **Max Marks: 100**
**Theory: 60**
**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes:**

After completion of this paper the students will be able to

- Understand the structural and functional aspects of ecosystem.
- Learn the concepts of community ecology.
- Learn about the environmental issues and their remediation.
- Explain the biotechnological applications to solve the environmental issues.
- Classify the different types of climates of India and the world.

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| **Unit-I** | Introduction: Ecosystem components -abiotic and biotic factors, Population Ecology, Inter and intra specific competition and self-regulation.<br>Ecological energetics, energy flow pathways, Ecological efficiencies, consumption, assimilation and production at trophic level, Primary production measurement methods, limiting factors, litter fall and decomposition, Recycling pathway relation between energy flow and nutrient cycling. |
| **Unit-II** | Community organization: Concepts of community and continuum, analysis of community (analytical and synthetic characters), Concept of ecological niche, Ecads and Ecotypes, Biome & Biosphere.<br>Ecosystem development and stability: Temporal changes (cyclic and non-cyclic), Succession processes & types, Mechanism of succession, facilitation, tolerance and inhibition models, Concept of climax, persistence, Ecological stability concept (resilience and resistance), Ecosystem restoration. |
| **Unit-III** | Global distribution and Classification of climate (Koppen's classification); Climatic types and their distribution. Climate of India: Climatic Factors (Light, Temperature, Water), Soil types of India. |
| **Unit-IV** | Environmental Issues – Pollution, Global warming and climate change, Greenhouse effect; consequences; responsible factors.<br>Loss of Biodiversity.<br>Waste management (Biomedical, Industrial and Hazardous waste), Bio magnification.<br>Indian Environmental Laws and Policies;<br>Environmental priorities in India and sustainable development,<br>Environmental Impact Assessment,<br>Environmental management, Man and Biosphere Programme (MAB). |
| **Unit-V** | Environmental Biotechnology: Need and scope, Biofuel (Jatropha), Bioplastics, Biogum, Biopesticides and Integrated Pest Management, Biomining, Bioleaching, Bioremediation, Biodegradation of Xenobiotic compounds (PCP, 2,4-D, 4CB).<br>Waste water treatment.<br>Toxicology: Radiation toxicants - Kinds, sources & biological effects. Chemical toxicants - Sources & biological effects of Mercury, Lead, Chlorine, DDT, Fluorine, Arsenic & Pesticides. Bioremediation. |

**Practical**

**SUGGESTED LABORATORY EXERCISES:**

**The students will learn to:**

- Compare the diversity of different vegetations by determining diversity Index or community coefficient.
- Conduct experiment to determine gross and net phytoplankton productivity, seed reproductive capacity and calculation of basal area of tree species found locally.
- Estimate the level of pollution in a water sample by determining its DO content.
- Handle the different apparatuses related to plant ecological study.
- Analyze physical and chemical properties of soil and mark different biomes of the world on a map.

**List of practicals:**

1. To determine diversity Index or community coefficient for two different vegetation / protected and unprotected grassland.
2. To determine gross and net phytoplankton productivity by light and dark bottle method.
3. To calculate Basal area of tree species found locally.
4. To find out reproductive capacity of the seeds.
5. To determine dust deposition on leaves of polluted and non-polluted area.
6. To estimate the dissolved oxygen (DO) content in entrophic and oligotrophic water sample by azide modification of Winkler's method.
7. Physical and Chemical analysis of soil.
8. To study- Hygrometer, Minimum Maximum Thermometer, sling Psychrometer, Saci disc, pH meter, Spectrophotometer, Soxhlet apparatus, Kjehldal's apparatus.
9. Mapping of Biomes on world map.

**SUGGESTED READINGS:**


- Smith. R.L. 1996. Ecology and Field Biology. Harper Collins. New York.
- Muller- Dombois and D. Ellenberg. H.1974. Aims and Methods 01 Vegetation Ecology, Wiley, New York.
- Begon. M. Harper, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science. Cambridge.
- Ludwig. J. and Reynolds. J.F. 1988. Statistical Ecology. John Wiley & Sons.
- Odum. E.P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.
- Barbour, M.G., Burk, J.H. and Pitts, W.O. 1987. Terrestrial Plant Ecology. Cummings Publication Company, California.
- Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
- Chapman, J.L. and Reiss, M.J. 1988. Ecology: Principles and Applications. Cambridge University Press, Cambridge, U.K.
- Moldan, B. and Billharz, S. 1997. Sustainability Indicators. John Wiley & Sons, New York.
- Treshow. M. 1985. Air Pollution and Plant Life. Wiley Interscience.
- Heywood, V.H. and Watson. R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.
- Mason, C.F. 1991. Biology of Freshwater Pollution. Longman. 'Hill. M.K. 1997. Understanding Environmental Pollution. Cambridge University Press.
- Brady, N.C. 1990. The Nature and Properties of Soils. MacMillan.

## DE 5.1 Industrial microbiology

### Theory

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes**:

After completion of this paper the students will be able to:

1. Understand the concepts of general microbiology, agricultural microbiology and environmental microbiology, food and industrial microbiology.
2. Comprehend the basics related to biodegradation of pesticides, toxic chemicals, xenobiotic compounds, agricultural residues.
3. Explain the existence of microbes in extreme environments.
4. Learn the usage of microbes in bioleaching, recombinant-DNA technology and medicine making.

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| **Unit-I** | General Microbiology: Diversity of the microbial world – Microbial taxonomy and phylogeny; Microbial nutrition, growth and metabolism;<br>Genetics of bacteria and viruses. |
| **Unit-II** | Agricultural Microbiology: Agriculturally important microorganisms; Biological nitrogen fixation; Mycorrhizae, microbial mineralization, Biocontrol of plant diseases, Plant growth promoting rhizobacteria (PGPR). |

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| **Unit-III** | Environmental Microbiology: Microbes and quality of environment; Distribution and implications of microbes in air – bio-aerosols, microbial flora of water, water pollution, drinking water and domestic waste treatment systems; Microbial pesticides. |
| **Unit-IV** | Biodegradation: microbial degradation of pesticides and toxic chemicals, Biodegradation of xenobiotic compounds, biodegradation of the agricultural residues, bioremediation of contaminated soils and water.<br>Microbes in nanotechnology, biosensors; Microbes in extreme environments. |
| **Unit-V** | Food and Industrial Microbiology: Recent developments in food and industrial microbiology – Fermentation, fermented foods, fermenter design and growth processes, food spoilage, methods of food preservation.<br>Microbes in recovery of metal (bioleaching) and oil, Recombinant-DNA technology; Cell and enzyme immobilization, microbial enzymes of industrial interest.<br>Novel medicines from microbes. |

**Practical**

SUGGESTED LABORATORY EXERCISES:

**The students will learn to:**

- Perform experiments of microbiology related to selection, isolation and screening of microorganisms.
- Conduct laboratory study of techniques for production of organic acids, solvents, amino acids etc.

List of practicals-

1. Isolation of microorganisms- Selection of culture media, Isolation of colony, screening.
2. Growth pattern in shake culture and fermenter, Utilization of carbohydrate/production of biomass, Control of parameters: nutrition, agitation, aeration, temperature, oxygen.
3. Biomass production of baker's yeast and Bacillus thuringiensis.
4. Utilization of cellulose/methanol for biomass production-*Trichoderma reesei/ Candida utilis, Methylobacterium.*
5. Production of:

i. Organic acids - Citric acid (*Aspergillus niger*), Gluconic acid (*A. niger)*, lactic acid (*A. oryzae*) and Acetic acid (*Acetobacter)*.

ii. Amino Acids-Glutamic acid (Coryebacterium).

iii. Solvents - Alcohol (*Saccharomyces cerevisiae*).

iv. Vitamins and Hormones- Riboflavin (*Ashbya gossypii*), Gibberellin (*Gibberella fujikuroi*) and Ergosterol (*Cleviceps tropicalis*).

v. Enzymes- Amylase (*S. occidentalis, B. megaterium*) diastase (*A. oryzae*), pectinase (*A. aureus*).

SUGGESTED READINGS:


- Blake, T. 1997. Fungal biotechnology. Chapman and Hall. London.
- Bulock, J. and Kristiansen, B. 1987. Basic Biotechnology. Academic Press, New York.
- Casida, Jr. L.E. 1968. Industrial Microbiology. New Age International (P) Ltd Publishers, New Delhi.

- Crueger, W. and Crueger, A 2000. Biotechnology: A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi.
- Peppler, H.J. 1997. Microbial Technology. Robert E. Krieger Publishing Company. New York.
- Prescott, C.S and Duim. G.C. 1959. Industrial Microbiology. McGraw-Hill Book Company, New York.
- Reed, G. 1987 Prescott and Dunn's Industrial Microbiology. CBS Publishers and Distributors, New Delhi.
- Riviere. J. 1975. Industrial Applications of Microbiology. John Wile & sons, New York. CBCS BOTANY-Ordinance-14 69.
- Smith, J.E., Berry, D.R., and Kristiansen, B. 1983. Filamentous Fungi Vol. IV, Fungal Technology, Edward Arnold, London.
- Stanbury, P.F., Whitaker, A. and Hall, S.J. 1995. Principles of Fermentation Technology, Pregemen Press, Oxford.

## DE 5.1 Conservation and Utilization of Plant Resources

### Theory

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Course Learning Outcomes:**

After completion of this course the students will be able to:

- Understand the different strategies for conservation of plant resources.
- Learn different techniques of extraction of herbal products.
- Describe various techniques of gardening practices, mushroom and spirulina cultivation and hydroponics.
- Explain the concept and scope of entrepreneurship and its application in areas pertaining to utilization of plant products.

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| **Unit-I** | Strategies for conservation of resources: Social forestry, Principle of conservation, In situ conservation (Sanctuaries, National Parks, Biosphere reserves for wild life conservation), Ex situ conservation (Botanical Garden, Field gene bank, Seed bank, in vitro repositories, Cryo banks). |
| **Unit-II** | Green herbal techniques:<br>Plant based products: Techniques for extraction/preparation of various dyes, cosmetics, perfumes (essential oils), sweeteners (Stewia etc.), herbal medicine, nutraceuticals.<br>Cultivation of common medicinal herbs: *Aloe vera, Curcuma longa, Zingier officinalis, Withania somnifera, Chlorophytum borivilianum* |
| **Unit-III** | Gardening and Post harvesting techniques:<br>Gardening -History, types of gardens, landscape gardening, major gardens of the world.<br>Floriculture -General introduction, nursery management, methods of propagation (Bonsai, cutting, grafting, budding) poly house and green house, commercial floriculture.<br>Silviculture- Introduction, Agro-forestry, avenue trees, ornamental shrubs and trees cultivation. |

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| | Kitchen gardening- Spinach, tomato, brinjal, coriander, drumstick, lady's finger, chilly, curry leaf, methi and other spices etc. |
| **Unit-IV** | Technique of: Mushroom culture, Spirulina cultivation, compost, vermi composting, bio- fertilizer production, hydroponics, techniques to increase shelf-life of ornamental plants |
| **Unit-V** | Entrepreneurship in Botany:<br>Concept, definition, structure and theories of entrepreneurship; Types of start-ups; Types of entrepreneurship, Entrepreneurship of NTFP (collection/Production, value addition, marketing strategies).<br>Biodiesel/bio-ethanol plant production, Trichoderma production for control of soil borne fungi, honey production, Plant enzyme production. |

## Practical

**SUGGESTED PRACTICAL EXERCISES:**

**The students will learn to:**

- Enlist plants of medicinal importance.
- Appreciate the various strategies undertaken to conserve plant resources.
- Apply the knowledge of the extraction techniques of various plant based products.
- Develop the understanding of different entrepreneurial aspects of botany.

List of practicals:

1. Study of locally available plants used for dyes, perfumes, cosmetics production.
2. Plants used in kitchen gardening: spinach, tomato, brinjal, coriander, drumstick, lady's finger, chilly, curry leaf, methi and other spices economic importance.
3. Medicinal herbs: - morphology and importance of *Aloe vera, Curcuma longa, Zingier officinalis, Withania somnifera, Chlorophytum borivilianum.*
4. Fire wood and timber yielding plants and Non wood forest products (NWFPs).
5. Morphology and Anatomy of plants used in biodiesel/bio-ethanol plant production.
6. Prepare an inventory of medicinal plants, of your area giving their scientific and local name their important uses appropriate illustrations.
7. Study of live or herbarium specimens or other visual materials to become familiar with these resource.
8. Mapping of natural resources (water and forest) of M.P.
9. Visit to apiculture center.
10. Introduction to mushrooms fungi – nutritional value, edible and poisonous types, edible mushrooms, Pleurotus, Volvariella and Agaricus, medicinal value of mushrooms, cultivation techniques, harvesting, packing and storage.
11. Study of live or herbarium specimens or other visual materials to become familiar with these resource:

- The student should be taken to one of the following:

1. Protected areas (biosphere reserve- Pachmarhi, national park or a sanctuary).
2. A wet land.
3. Botanical survey of India (BSI).
4. CSIR Laboratory doing research on plants and their utilization.
5. Botanical Gardens or Museum.
6. FRI Forest Research Centre, Dehradun.

Note – The students are expected to prepare a brief illustrated narrative of the field survey and scientific visits. After evaluation the grades awarded to students by teachers and should be added to the final assessment of practical examination.

**SUGGESTED READING:**

- Burch JG 1086. Entrepreneurship. Wiley, USA.
- Des R. 2013 Floriculture at glance. Kalyani Publ., New Delhi.
- Desai V 1994.Forest management in India- Issues and Problems. Himalaya Publ. House, New Delhi.
- Grewal HS and Singh P 2014.Landscape designing and ornamental plants. Kalyani Publ., New Delhi.
- Gupta CB and Srinivasan NP 2001.Entrepreneurship in India. S. Chand and Sons, New Delhi.
- Hartman HT, Kester DE, Davies FT(Jr) and Geneva RL 2002. Plant Propagation- Principles and Practices 6e. Prentice-Hall India, New Delhi.
- Holt DH 1998. Entrepreneurship- New venture creation. Prentice-Hall of India, New Delhi.
- Kas J. 1989. Entrepreneurship: Creativity and Organization. Prentice Hall Englewood Cliffs, New Jersey.
- Kochhar SL 1998. Economic Botany in tropics 2e. Macmillan India Ltd., New Delhi.
- Nandan H 2011.Fundamentals of Entrepreneurship 2e. PHI Learning Pvt. Ltd., New Delhi.
- Randhawa GS and Mukhopadhyay A 1986.Floriculture in India. Allied Publ., New Delhi.
- Sabnis SD and Daniel M 1990.A phytochemical approach to economic botany. Kalyani Publ., New Delhi.
- Sagwal SS 2010.A textbook of silviculture. Kalyani Publ., New Delhi.
- Sharma OP 1996 Hill's Economic Botany. TMH Publ. Co. Ltd., New Delhi.
- Singh B. 2012. Horticulture at glance. Kalyani Publ., New Delhi.
- Singh BD 2013.Plant Biotechnology. Kalyani Publ., New Delhi.
- Swaminathan MS and Kochhar SL 2003.Groves of Beauty and Plenty- An atlas of major flowering trees in India. Macmillan India Ltd. New Delhi.


## DE 5.1 Organic Farming

### Theory

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes:**

After completion of this paper, the students will be able to:

- Understand the concepts of organic cultivation, organic farming system and the recent developments in the field of organic farming.
- Develop insights about Effective Microorganisms (EM) technology, indigenous practices of organic farming, composting, mulching, soil fertility management, biological control of pests and diseases and Good Agriculture Practices (GAP).
- Explain the practices of biological intensive nutrient management.
- Explain the importance of Medicinal and Aromatic Plants (MAPs), greenhouse, polyhouse technologies.
- Relate themselves with the various certification procedures, quality considerations, labeling and accreditation processes.

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| **Unit-I** | Organic Cultivation – definition, synonyms and misnomers, principles, methods, merits and demerits.<br>Organic farming systems, components of organic farming systems, different organic inputs and their role in organic production, role of biofertilizers, biodynamics and the recent developments. |
| **Unit-II** | Effective Microorganisms (EM) technology and its impact in organic cultivation, indigenous practices of organic farming, FYM, composting, mulching, sustainable soil fertility management, weed management practices in organic farming, biological/natural control of pests and diseases, organic cultivation in quality improvement.<br>Good Agriculture Practices (GAP) - Principles and management., organic production and export, post-harvest management of organic produce. |
| **Unit-III** | Biological intensive nutrient management: Biological intensive nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues. |
| **Unit-IV** | Importance and scope of protected cultivation of MAPs; principles used in protected cultivation, energy management, low cost structures; training methods; engineering aspects.<br>Greenhouse – World scenario, Indian situation: present and future, Environmental factors and their effects on plant growth.<br>Polyhouse, Shade-net house, Polytunnel and Polypit. |
| **Unit-V** | Organic certification, Constraints in certification, Quality considerations, labeling and accreditation processes, marketing, exports.<br>IFOAM and global scenario of organic movement. |

## Practical

**SUGGESTED LABORATORY EXERCISES**:

The students will learn to:

- Perform various exercises related to preparation of compost, vermicompost, biocompost, biofertilizer, green manure etc.

List of practicals:

1. Method of preparation of compost, vermicomposting, biocomposting, biofertilizers, soil solarization, bio pesticides, green manuring, mycorrhizae and their application in organic crop.
2. Weed management in organic cultivation.
3. Visit to organic fields and marketing centers.

**SUGGESTED READINGS:**


1. Organic Farming-Theory and Practise by Palaniappan & Annadurai, Scientific Publ. (2008).
2. Green House Operation and Management by Pant V. Nelson, Bali Publ. (1991).
3. Management of Horticultural Crops. Parts I, II, by T. Pradeepkumar, B. Suma, Jyothibhaskar & K.N. Satheesan, New India Publ. Agency (2007).
4. Organic Farming by N. Lampkin & Ipswich, Farming Press, London (1990).
5. The Economics of Organic Farming – An International Perspective by N.H. Lampkin & S. Padel, CABI (1992).
6. Basics of Horticulture by K.V. Peter (Ed.) New India Publ. Agency, New Delhi (2008).
7. Soil Microorganism and Plant Growth by S. Rao, Oxford & IBH (1977).
8. Green House Engineering by R.A. Aldrich & J.W. Bartok, NRAES, Riley, Robb Hall, Cornell University, Ithaca, New York-21 (1994)


## DE 5.1 Horticultural practices

### Theory

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes:**

After completion of this paper, the students will be able to:

- Understand the status, exports, classification, economic importance, culture and nutritive value of horti crops.
- Learn the principles of nursery and orchard management along with planning, layout and planting and and vegetable garden.
- Learn the production and management practices of fruit, vegetable and floriculture crops, fruit crops al factors influencing the fruitfulness and unfruitfulness.
- Explain the growth, development, photosynthetic productivity, canopy development of different hortic crops.
- Comprehend the physiological basis of training and pruning techniques.

| | |
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| **Unit-I** | Horticultural crops: classification, status, exports and agro-climatic zones.<br>Classification of horticultural crops, economic importance and their culture and nutritive value, area and production, fruit and vegetable zones of India and of different states, exports and imports. |
| **Unit-II** | Nursery and orchard management: Nursery management practices, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of gardens , principles and planning and layout, management of orchards, planting systems and planting densities. |
| **Unit-III** | Production technology: Production practices for fruit, vegetable and floriculture, crops, nursery techniques and their management.<br>Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management, weed management, fertility management, cropping systems, intercropping, multi-tier cropping, mulching, bearing habits in fruits, factors influencing the fruitfulness and unfruitfulness.<br>Rejuvenation of old orchards, top working and frame working. |
| **Unit-IV** | Growth and development: definitions, components, photosynthetic productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, growth analysis in horticultural crops. |
| **Unit-V** | Training and Pruning: physiological basis of training and pruning, source and sink relationship, translocation of assimilates. |

**Practical**

**SUGGESTED LABORATORY EXERCISES:**

**The students will learn to:**

- Develop a practical understanding of garden, orchard and nursery planning and management.
- Perform experiments related to estimation of photosynthetic potential of horticultural crops, leaf area index and induction of rooting in cuttings, ripening of fruits and control of flower and fruit drop.
- Demonstrate seed viability by tetrazolium test, seed germination and breaking seed dormancy with chemicals and growth regulators.

1. Features of orchard, planning and layout of orchard, tools and implements, layout of nutrition garden, preparation of nursery beds for sowing of vegetable seeds, digging of pits for fruit plants, digging of pits, planting systems, training and pruning of orchard trees.
2. Preparation of fertilizer mixtures and field application, preparation and application of growth regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits and vegetables, assessment of bearing habits, maturity standards and harvesting, grading, packaging and storage.
3. Estimation of photosynthetic potential of horticultural crops, leaf area index, growth analysis parameters including harvest index, bioassay of plant hormones, preparations of hormonal solution and induction of rooting in cuttings, ripening of fruits and control of flower and fruit drop.
4. Important physiological disorders and their remedial measures in fruits and vegetables, seed viability by tetrazolium test, seed germination and breaking seed dormancy with chemicals and growth regulators.

**M.Sc. Botany M.Ed. VI Semester**

| **ourse code** | **Course** | **Credits L+T +P** | **Contact Hours per week** | **Hours per Semester** | **Marks** | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Practical** | | | |
| | | | | | **Internal Th + Pr** | **External Pr** | **Theory** | **Total** |
| **6.1** | Instrumentation and Bioanalytical Tools | 2+1+1 | 6 | 60 | 10+ 10 | 20 | 60 | 100 |
| **6.2** | Agricultural Botany | 2+1+1 | 6 | 60 | 10+10 | 20 | 60 | 100 |

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|---|---|---|---|---|---|---|---|---|
| **6.1** | Any one (Medicinal and Aromatic Plants/ Ethnobotany / Aesthetic Botany/ Environmental Science) | 1+1+0 | 3 | | 10 | - | 40 | 50 |
| **6.1** | | 3+1+0 | 5 | | 30 | - | 70 | 100 |
| **6.1A (Core)** | Dissertation Botany ( Implementation and Report Submission) | 0+0+4 | 8 | | 60 | 40 | - | 100 |
| **6.1B (Core)** | | 0+0+4 | 8 | | 60 | 40 | - | 100 |

## DC 6.1 Instrumentation and Bioanalytical tools

### Theory

**Credits: 4**
**Contact hours per week: 6** **Max Marks: 100**
**Theory: 60**

**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**Learning Outcomes**:

After completion of this paper, the students will be able to:

- Understand the working of different types of microscopes and other lab instruments.

- Learn the principles underlying the working of different instruments and chromatography and electrophoresis techniques.
- Learn the concepts of biosensors and nanotechnology.
- Learn the extraction and importance of different phytochemicals and other plant based products like dyes, nutraceuticals, fibres, perfumes etc.

| | |
|---|---|
| **Unit-I** | Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM).<br>pH meter, absorption and emission spectroscopy, Laminar Air Flow, Autoclave. |
| **Unit-II** | Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles. |
| **Unit-III** | Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC. |
| **Unit-IV** | Introduction to electrophoresis: Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Northern, Southern and Western blotting.<br>DNA Profiling and DNA amplification – PCR techniques.<br>Introduction to Biosensors and Nanotechnology and their applications. |
| **Unit-V** | Tools and techniques in phytochemistry: Classification of secondary metabolites accumulated by the plants; extraction of phytochemicals.<br>Plant based products: Techniques for extraction/preparation of various dyes, perfumes (essential oils), sweeteners (Stewia etc.), herbal medicine, nutraceuticals.<br>Processing of fibre: Coir, Jute, banana, cotton, silk cotton etc. |

**Practical**

**SUGGESTED PRACTICAL EXERCISES**:

The students will learn to:

- Handle different instruments in the botany lab used for various studies.
- Perform various extraction and processessing techniques of plant products.
- Identify and utilize plants for day to day usage like cle

1. Working principle and Practical based on pH meter, Electrophoresis, Spectrophotometer, Centrifuge etc.
2. Extraction technique of essential oils by soxhlet method.
3. Methods of processing of crude plants and their storage.

4. Traditional method of beautification of skin and their application-

• Cleansing- Aloverea, Papaya, Lemon etc.

• Nutritive- Ashwagandha, Ginseng, Nagarmotha etc

• Bleaching- Amba haldi, Raktachuran, kachur, suganthi etc

• Anti-wrinkle- Manjistha, papaya, suganthi, Grith kumari etc

5. Hair care- amla, shikakai, Aritha, Nagarmotha etc.
6. Aromatherapy by –Chameli, Rose, Eucalyptus, Tulsi etc.
7. Enlist herbal pesticides and herbicides.
8. Techniques of vermiculture, Mushroom culture, nursery management.
9. Herbal dyes and their uses.

**SUGGESTED READING**:


- Biotechnology- R.C. Dubey
- Biotechnology by B. D Singh
- Biostatistics and Computer Application- Dr. R Goswami
- Mushroom Cultivation-
- Vermiculture-
- Floriculture-
- Aromatherapy -a Complete Guide to the Healing Art- Kathi Kerthi and Mendy Green
- Essential oils for Radiant Health- Susanne Fischer Rizzi 1998
- Beauty through Herbs- Dr. Urjita Jain, Institute of Herbal Science, Mumbai,1997
- Text book of Cosmetology-Harry Cosmetic Science and technology-Sagarin C.B.
- The Skin care Book: Simple Herbal Recipes-Kathryn wartrochi, Ist Edition 1996, Paper Gooseberry Hill Publication.
- Natural organic Hair & Skin care: Including A to Z Guide to natural & Synthetic Chemicals in cosmetics-ISBN-1990, Aubrey Hampton organic press
- Instrumentation-
- Wealth of India-CSIR New Delhi Publication
- Entrepreneurial Development concept and practices-Dilip Sarwate, Everest Himalaya Publication
- Entrepreneurial Development –S.S. Khan, S Chand Publication
- Entrepreneurial Development in India- Dr. C. B. Gupta & Dr. N. P. Shrinivasan, S Chand Publication ,4th Edition.

## DC 6.2 Agricultural Botany

### Theory

**Credits: 4**
**Contact hours per week: 6** **Max Marks: 100**
**Theory: 60**

**Practical (External): 20**
**Internal (Th+Pr): 20 (10+10)**

**LEARNING OUTCOMES:**

After completion of this paper, the students will be able to:

1. Understand the meaning of terms agriculture, domestication and selection.
2. Explain the concepts of organic farming, genetically modified organisms and their implications.
3. Comprehend various ecological problems and their solutions.
4. Relate the interdependence of farming system and biodiversity.
5. Learn competitions that prevail in farm ecosystem, phytoallelopathy, persistence of herbicides in soil and pest control measures.

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| **Unit-I** | Agroecology – definitions of terms, scope of the discipline, approaches and viewpoints, domestication, selection and protection of crop plants and farm animals, wild relatives of the crops, ecological experimentation in agriculture. |

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| | Climate change and its effects on Agriculture. |
| **Unit-II** | Organic farming- principles and concept of organic farming, important steps and methods, genetically modified organisms and their implications, climate change – agriculture and adaptation mechanisms, Organic production requirement, permitted and restricted inputs in organic farming, Vermicomposting.<br>Apiculture – Scope and importance of beekeeping.<br>Sericulture – silk worms kinds and their hosts, Mulberry silkworm, Uses of silk and by-products, Economics of silk production. Lac cultivation, food plants, pruning, inoculation, cropping. |
| **Unit-III** | Ecological problems of crop cultivation and solutions – Classification of crop plants – Cereal, pulses, cash crops and oilseeds, vegetables, flowers, pollution, leakage and erosion, land development, diseases, weeds and pests, chemical, biological and ecological control, ecological footprints. |
| **Unit-IV** | Farming systems and biodiversity – biodiversity in farming systems, landscape fragmentation, relationships and interdependence of biodiversity within farming systems.<br>Case studies of farming systems of India. |
| **Unit-V** | Crop-weed interference; competition for light, water, nutrient and space.<br>Phyto- allelopathy- Role in crop-weed interaction.<br>Herbicides, their classification and general mode of action.<br>Degradation and persistence of herbicides in soil.<br>Pest control. |

**Practical**

**SUGGESTED PRACTICAL EXERCIES:**

**The students will be learn to:**

- Apply and combine theoretical knowledge with hands on training of various agricultural practices to get a better understanding of farming and crop cultivation.

**List of practicals:**

1. Identification of crops, seeds, fertilizers, pesticides and tillage implements.
2. Effect of sowing depth on germination and seedling vigour.
3. Methods of fertilizer application.
4. Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population.
5. Study of soil profile in field.
6. Study of soil sampling tools, collection of representative soil sample, its processing and storage.
7. Study of soil forming rocks and minerals.
8. Determination of soil density, moisture content and porosity.
9. Studies of capillary rise phenomenon of water in soil column and water movement in soil.
10. Determination of soil pH and electrical conductivity.
11. Estimation of organic matter content of soil.
12. Collection and processing of soils.
13. Crop planning, raising field crops in multiple cropping systems.

14. Seed, treatment, nursery raising, sowing, nutrient, water and weed, insect and pest control management.
15. Identification of weeds in crops, Methods of herbicide application, Numerical exercises on herbicide requirement, Measurement of field capacity.
16. Morphological evaluation of germplasm, collection and identification of wild relatives for fruit crops, vegetable crops, flower crops, spices, plantation crops, medicinal and aromatic plants, preparation of herbariums.
17. Photo album/digital photo album preparation of important horticultural plants.
18. Use of descriptors, monographs in hort crops.
19. Visit to the nearest germplasm centre, herbal garden, biodiversity park and botanical gardens.
20. Beekeeping–Bees classification–Hives – Social organization–extraction of honey and other products. Experiments on grainage, mulberry silkworm rearing and silk technology. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniques for mass multiplication of natural enemies.
21. Raising of vegetable crops organically through nutrient, diseases and pest management; vermicomposting; vegetable and ornamental nursery raising; macro quality analysis, grading, packaging, postharvest management.

SUGGESTED READINGS:


1. Gliessman, S.R. 2015. Agroecology: The Ecology of Sustainable Food Systems. CRC Press. ISBN 978 14398956 10; 978 1439895764, 371 pages.
2. Altieri, M.A. 2018. Agroecology: The Science of Sustainable Agriculture. Second Edition. CRC press. ISBN 0429975090, 400 Pages.
3. Gliessman, S.R. 2014. Field and Laboratory Investigations in Agroecology. Third Edition. CRC Press. ISBN 1498728499. 241 pages. Department of Botany, University of Delhi.
4. Wojtkowski, P.A. 2006. Introduction to Agroecology: Principles and Practices. Food Products Press. ISBN-10 1-56022-317-0. 407 pages.
5. Alagh, Y.K. 2013. The Future of Indian Agriculture. ISBN 8123767366, ISBN 978 8123767369. 220 pages.
6. Mazoyer, M. & Roudart, L. (Translated by Membrez, J.H.). 2014. A History of World Agriculture: From the Neolithic Age to the Current Crisis. Monthly Review Press, New York.
7. Singh, C., & Singh, R. (1983). Modern techniques of raising field crops. Oxford and IBH publishing.
8. Bendre A & Kumar A. 1999. Textbook of Practical Botany. Vol. 2, 7th Ed., Rastogi Publications.
9. Husain Majid. 2013. Environment and Ecology: Biodiversity, Climate Change and Disaster Management. online book.
10. A.K. Dahama. 2007. Organic farming for sustainable agriculture. Agrobios (India), Jodhpur.
11. Mishra, R.C. and Rajesh Gar. 2002. Prospective in Indian Apiculture. Agrobios, Jodhpur.

## DE 6.1 Medicinal and aromatic plants

### Theory

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes:**

After completion of this paper, the students will be able to:

- Understand the history, importance and diversity of Medicinal and Aromaitc Plants.
- Learn the objectives of National Medicinal Plant Board and State Medicinal Plant Boards.
- Learn the systematics, geographical distribution and uses of important medicinal plants.
- Appreciate the historic background and uses of aromatic plants in making cosmetic products, perfumes etc.
- Learn the taxonomic descriptions and uses of important aromatic plants and aromatic spices.

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| **Unit-I** | MAPs: definition, history, importance and future prospects.<br>MAPs as industrial crops - constraints and remedial measures.<br>Medicinal plant diversity & local healthcare.<br>Medicinal plant conservation – issues and approaches, medicinal plant conservation areas (MPCA)<br>Non-timber forest products (NTFP), Good Agriculture Practices (GAP). Indian Himalayan region (IHR). |
| **Unit-II** | Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions.<br>Other organizational initiatives for promotion of MAPs at National and International levels.<br>Demand and supply of medicinal plants.<br>Herbal industries. |
| **Unit-III** | Important medicinal plants of India with their systematics, geographical distribution and uses: *Adhatoda vasica, Abrus precatorius ,Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona* |
| **Unit-IV** | Introduction and historical background of aromatic plants.<br>Aromatic and cosmetic products.<br>Raw material for perfumes etc.<br>Cosmetic Industries.<br>Major, minor and less known aromatic plants of India. |
| **Unit-V** | Taxonomic descriptions and uses of important aromatic plants – citronella, davana, damask rose, geranium, khus grass, large cardamom, lavender, lemon grass, mentha, holy basil, patchouli, rosemary, eucalyptus, thyme, marjoram and oreganum. |

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| | Aromatic spices - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curryleaf and saffron |

**Practical**

**SUGGESTED LABORATORY EXERCISES:**

**The students will be able to learn:**

1. Field surveys for familiarization with local plants.
2. Collection of specimens.
3. Description based on field characters, identification, preparation of herbarium specimens.
4. Field visits.

**SUGGESTED READINGS:**


1. Medicinal Plants of Uttarakhand by C.P. Kala (2010).
2. Indian Medicinal Plants by P.C. Trivedi (2009).
3. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
4. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
5. Handbook of MAPs by S.K. Bhattacharjee (2009)

**Theory**

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes-**

On the completion of the course, the students will be able to understand –

1. Understand the history, scope, view and different fields pertaining to ethnobotany.
2. Learn various medicinal systems prevalent in Indian medicines like Ayurvedic, Unani, Homoeopathic and Allopathic systems.
3. Learn the ethnobotanical importance of major plants.
4. Understand the detailed study of the common plants and their parts used in the treatment of diseases.

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| **Unit-I** | Definition and scope of Ethnobotany<br>Historical review and outline idea of archaeoethnobotany.<br>Ethnoecology, Ethnomedicines, Ethnonarcotics, Ethnopharmacology, Ethnotaxonomy, Ethnocosmetics, Ethnolinguistics, Ethnoorthopaedics, Ethnopaediatrics, Ethnomusicology, Ethnotoxicology. |
| **Unit-II** | Preservation of Genetic diversity, plants used in various systems of medicines, Ayurvedic, Unani, Homoeopathic and Allopathic systems.<br>Plants used by villagers and tribal people.<br>Role of ethnobotany in the development of Society. |
| **Unit-III** | Ethnobotanical importance of : *Aconitum napellus, Allium cepa, Mentha arvensis, Allium sativum, Nux-vomica, Aloe vera, Ocimum sanctum, Atropa belladona, Azadirchta indica, Piper nigrum, Butea monospera, Pterocarpus marsupium, Terminalia bellerica, Terminalia arjuna, Terminalia chebula , Eugenia aromatica, Eugenia jambolana, Hollarrhena antidysenterica, Withania somnifera, Lawsonia inermis*. |
| **Unit-IV** | Ethnobotanical importance of: *Cassia fistula, Cannabis sativa, Ricinus communis, Emblica officinalis, Santalum album.*<br>Plants in mythology, Taboos and Totems in relation to plants, folklore and folk tales, Wild life protection by tribal, plants domestication by the tribals.<br>Plants in similes and metaphors. |
| **Unit-V** | Detailed study of the common plants and their parts used in the treatment of following diseases: Expulsion of worms, Skin diseases, Bronchial inflammation and Asthma, Tuberculosis, Urino - genital problems, Amoebic dysentery, Malaria, Rheumatism, Leprosy, Jaundice, Heart diseases, Piles, Leukoderma. |

**Practical**

**SUGGESTED PRACTICAL EXERCISES:**

The students will be able to learn:

- Laboratory exercises corresponding to theory courses.

List of practicals-

1. Be familiar with the preparation of herbarium specimens of ethnobotanical plant species mentioned in the theory part.

2. Identification and collection of ethnobotanically important plants.
3. Certain herbal drugs made by single or double herbal compound, mixtures.
4. Collection and study of germplasm (seeds) and prepare a seed-bank medicinal & ethnobotanically important plants.
5. Preparation of an herbarium, medicinal parts of plants. (Leaf, stem, bark, root-powder, decoction, Bark powder also.)
6. Detailed study of certain diseases and collect plants which are used in treating these diseases like - Skin diseases – Expulsion of worms, Bronchial inflammation and asthma, Tuberculosis, urogenital problems, amoebic dysentery, malaria, rheumatism, leprosy, Jaundice, Hear diseases, piles and Leukoderma.
7. Collection of locally available plants their parts which are credible to medicinal purposes.

SUGGESTED READINGS:


- Cotton, C.M. 1996. Ethnobotany- Principles and applications, John Wiley & Sons, NY.
- Jain, S. K. &Mudgal V. 1999. A hand book of Ethnobotany. Bishan Singh &Mahendra pal Singh, Dehradun.
- Jain, S. K. & Rao R. R. 1976. Field and Herbarium methods. Todays & tomorrow Pub., New Delhi.
- Jain, S. K. &Shrivastava S. 1999. Dictionary of Ethnobotany- Veterinary Plants of India Deep Pub, New Delhi.
- Jain, S. K. 1987. Manual of Ethnobotany. Scientific Pub, Jodhpur.
- Jain, S. K. 1991. Dictionary of Indian Folk Medicine and Ethnobotany. Deep Pub, New Delhi.
- Jain, S. K. 1997. Contribution to Indian Ethnobotany -III Ed. Scientific Pub, Jodhpur.
- Jain, S. K. 2001. Bibliography of Indian Ethnobotany. Scientific Pub, Jodhpur.
- Jain, S. K. 1989. Methods and approaches in Ethnobotany. Society of Ethnobotany, Lucknow.
- Martin J. 1995. Ethnobotany. Chapman & Hall, London.
- Sakalani A. & Jain S. K. 1994. Cross Cultural Ethnobotany of N-E India. Deep Pub, New Delhi.
- Varghese E. 1996. Applied Ethnobotany- A case study of among the Kharia of Central India. Deep Pub, New Delhi.

## DE 6.1 Aesthetic botany

**Theory**

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes**:

After completion of this paper, the students will be able to:

- Learn the various phytogeographical regions and climate and vegetation of the world.
- Develop the insights of gardening, floriculture and landscaping in a better way.
- Explain and practice various methods of propagation of ornamental plants.

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| **Unit-I** | Phytogeography: Climate and Vegetation of the world.<br>Floristic regions of the world, Phytogeographical regions of India; Endemism; Concept of hotspots, hot spots of India and the world. |

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| | Forest types of India. |
| **Unit-II** | Gardening: Garden Design: Scope and objectives of gardening; Style of gardens (Formal, Informal); Types of gardens (English, Mughal and Japanese)<br>Components of garden.<br>Planning of outdoor gardens- Small, Residential, Larger Home Garden, Roof Garden, Terrace Garden, Industrial garden, Housing complex, Indoor gardening.<br>Cut flowers: harvesting techniques, post-harvest handling, Methods of delaying flower opening.<br>Garden Features and Ornamentation: Water, Garden pool, Stream, Waterfall, Fountain, Rocks, Roads, Walks, Pavements and Steps, Walls fences and Gates, Hedges, Edges, Arches, Statues, Towers. |
| **Unit-III** | Floriculture: Nursery production and management: Scope, Site, Soil, Environment, Layout, Manure, Fertilizers, Maintenance, Garden tools, Culture and Garden calendar, Types, Nursery beds, weed management. |
| **Unit-IV** | Landscaping:<br>Landscape Design: Definition, objectives and scope, Landscape elements of construction and designing of Residential, Commercial, Bungalow, Public area, Hotel, Educational Institute and religious places.<br>Palms and Cycas: Characteristics, propagation, culture, pest and disease,<br>importance and uses, genera and species of palms and Cycads.<br>Bamboo and conifers: Genera, species and varieties.<br>Lawns & Grasses: Planting methods, maintenance, pest management<br>Ornamental succulents, Cacti. |
| **Unit-V** | Propagation of ornamental plants by seeds, bulbs, layering, cuttings, grafting, budding & tissue culture.<br>Ornamental ferns and their propagation; ornamental and avenue trees, herbaceous perennials, Annuals & Biennials: Important genera and species, their importance in garden designs.<br>Polyhouse technology: Scope and objectives of floriculture. |

**Practical**

SUGGESTED PRACTICAL EXERCISES:

The students will be able to learn:

- The various practical aspects of gardening and landscaping.

1. Map different phytogeographical regions of India.
2. Propagation practices in chrysanthemum, sowing of seeds and raising of seedlings of annuals.
3. Propagation by cutting, layering, budding and grafting.
4. Training and pruning of roses.
5. Use of chemicals and other compounds for prolonging the vase life of cut flowers.
6. Drying and preservation of flowers.
7. Flower arrangement practices

SUGGESTED READINGS:


- Randhawa GS and Mukhopadhyay A. 2004.Floriculture in India Allied Publishers Pvt. Limited.
- Swarup Vishnu. 2003. Garden Flowers. National Book Trust
- Hartmann HT, Kester DE, Davies FT and Geneva RL. 2002. Plant Propagation – Principles and

- Practices. Prentice Hall India Ltd.
- Royal Horticultural Society's Encyclopedia of Gardening.


## DE 6.1 Environmental Science

### Theory

**Credits: 4** **Max Marks: 50**

**Theory: 40**

**Contact hours per week: 3** **Practical (Internal): 10**

**Learning Outcomes:**

After completion of this paper, the students will be able to:

1. Understand the classification and distribution of climate and soil types in India.
2. Learn different problems of global concern like global warming, greenhouse effect and the factors responsible for causing them.
3. Understand the details, need and scope of toxicology.
4. Comprehend the importance and guiding principles of Indian Environmental Laws.
5. Understand importance of Environmental Education and Organization.

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| **Unit-I** | Global distribution and Classification of climate (Koppen's classification); Climatic types and their distribution. Climate of India : Climatic Factors (Light, Temperature, Water) Soil types of India and Soil type of World. |

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| **Unit-II** | Global warming and climate change: Greenhouse effect; consequences; responsible factors. Environmental Impact Assessment. Environmental management. |
| **Unit-III** | Toxicology: Radiation toxicants - Kinds, sources & biological effects. Chemical toxicants - Sources & biological effects of Mercury, Lead, Chlorine, DDT, Fluorine, Arsenic & Pesticides.<br>Bioremediation : Need , scope & technology. |
| **Unit-IV** | Environmental Laws : Goal, objectives and guiding principles of Environmental Laws; Indian Environmental Laws; National Environmental Policies ; Environmental priorities in India and sustainable development. |
| **Unit-V** | Environmental Education and Organization : Goal, objectives and guiding principles of Environmental Education ; Environmental Education in educational Institutes; Environmental organizations and agencies; Man and Biosphere Programme (MAB). |

**Practical**

**SUGGESTED PRACTICAL EXERCISES**:

The students will be able to :

- Perform exercises related to bio management of waste, physiochemical properties of water, soil analysis and pollution and pollution monitoring.

**1. Non-conventional Bio-management of waste-**

1. Planning of Root Zone treatment.
2. Vermicomposting.

2.**Sampling for physico-chemical properties of water:**

1. To measure temperature by thermometer.

2. To measure pH by pH meter/pH indicator.

3. To determine turbidity 2by turbidometer.

4. To determine light intensity by photometer.

5. To determine DO (dissolved oxygen) in eutrophic & oligotrophic water.

6. To determine BOD (biological oxygen demand) of pond water.

7. Determination of chloride/fluoride/nitrate/phosphate/hardness.

3. **Sampling for soil analysis**-

1. To determine Nitrate, Phosphate, Carbonate, Potassium.

2. To determine water holding capacity of soil.

3. To determine organic matter content of soil.

4. To determine bulk density and porosity of soil.

4.**Exercises based on pollution**-

- To study the foliar injuries of plants which are exposed to SO2.
- To determine dust deposition on leaves of polluted and non-polluted areas.
- To determine pH of plants growing in under polluted and non-polluted areas.
- To study environmental impact of a given developmental activity using checklist as AIE method.
- Study of Toxicants- Mercury, Lead, Chlorine, DDT, Fluorine, Arsenic & Pesticides.
- Study of Bioremediation.
- Study of bio indicators.

**SUGGESTED READINGS**:


- Smith. R.L. 1996. Ecology and Field Biology. Harper Collins. New York.
- Muller-Dombois D. and Ellenberg. H.1974. Aims and Methods 01 Vegetation Ecology, Wiley, New York
- Begon. M. Harper, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science. Cambridge.
- Ludwig. J. and Reynolds. J.F. 1988. Statistical Ecology. John Wiley & Sons.
- Odum, E.P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.
- Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.
- Barbour, M.G., Burk, J.H. and Pitts, W.O. 1987. Terrestrial Plant Ecology. Cummings Publication Company, California.
- Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
- Chapman, J.L. and Reiss, M.J. 1988. Ecology: Principles and Applications. Cambridge University Press, Cambridge, U.K.
- Moldan, B. and Billharz, S. 1997. Sustainability Indicators. John Wiley & Sons, New York.
- Treshow. M. 1985. Air Pollution and Plant Life. Wiley Interscience.
- Heywood, V.H. and Watson. R.T. 1995. Global Biodiversity Assessment. Cambridge University Press. 36
- Mason, C.F. 1991. Biology of Freshwater Pollution. Longman. 'Hill. M.K. 1997. Understanding Environmental Pollution. Cambridge University Press.
- Brady, N.C. 1990. The Nature and Properties of Soils. MacMillan.
- Mason, C.F. 1991. Biology of Freshwater Pollution. Longman. '
- Hill. M.K. 1997. Understanding Environmental Pollution. Cambridge University Press.
- Kothari, A 1997. Understanding Biodiversity: Life ‘Sustainability and Equity’. Orient Longman.
- Kohli, R., Arya, K.S., Singh, P.H. and Dhillon, H.S. 1994. Tree Directory of Chandigarh. Lovedale Educational, New Delhi.
- Nair, M.N.B. et. al (Eds) 1998. Sustainable Management of Non-wood Forest Products. Faculty of Forestry, Universiti Putra Malaysia. 434004 PM Serdong, Selangor, Malaysia. • Rodgers, N.A. and Panwar, H.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report. Wildlife Institute of India, Dehradun. • Walter, K.S. and Gillett, H.J. 1998. 1997 IUCN Red List of Threatened Plants. IUCN, the World Conservation Union. IUCN, Gland, Switzerland, and Cambridge.

# COURSE SYLLABUS OF M.Sc. M.Ed.

## Semester - I

**EC1.1: Educational Studies**

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning outcomes:**

On completion of the course, the prospective teacher educators will be able to develop understanding about:

- changing meaning and nature of education,
- education as a disciplinary knowledge,
- context of education,
- alternative theories of education and
- radical educationists and their works.

**Unit I Education: Changing Meaning, and Nature**

i. Concept of Education :Normative and Non-normative concept
ii. Education as an evolving concept in response to changing social needs, demands and normative commitments;
iii. Aims of education in the context of emerging aspirations and political ideology
iv. Dualities in educational practice: Their role in learning /education: philosophical understanding

- Hereditary and Environment (bio-genic and socio-genic)
- Freedom and discipline/Authority
- Teaching and learning
- Teacher and learner
- Given and evolving
- Innate and acquired
- Content and pedagogy
- Theory and practice
- Learning and assessment

**Unit II Education as Disciplinary Knowledge**

- Nature and multi-facetedness of education

- Disciplinary nature of education
- Interdisciplinary and multi- disciplinary nature of education
- Education as humane discipline
- Relationship with other disciplines such as Philosophy, Sociology, Economics, Political Science, Psychology, Biology, Genetics and Anthropology.

**Unit III Context of Education**

- **Education as an Act and Process:** Constituents/ Determinants
- **Normative Context:** Constitutional commitments and Aspirations of the people (How the normative commitment and aspirations of the people shape the educational practices);
- **Socio –cultural Context:** How it shapes the classroom processes and relations (Classroom debates need to focus on to understand how social and cultural capital students carry into classroom condition their participation and learning).
- **Politico- economic Context:** How it creates conditions for equal opportunities for learning (Classroom debates and processes needs to be situated in the context of Liberalization, Privatization, Marketization and Globalization to develop critical understanding and proper perspective).
- **Psychological context of Education:** How psychological attributes one possesses which facilitate in one's own learning. (Motivation, Aspiration, Attitudes towards learning and education).

**Unit IV Alternatives Educational Theories**

- Idealistic Theory of Education: Plato's The Republic, Selected Upanishad discourses,
- Naturalistic Theory of Education: Rousseau's Emile. Tagore and Gijubhai'sDiwaswapna.
- Pragmatic theory of Education: Dewey's My pedagogic Creed / Democracy and Education

**Unit V Radical Educationists and their works: A critical understanding**

- Sri AurobindoGhosh: The Integral Yoga

- J.Krishna Murthy: Freedom from Known
- Paulo Freire: Pedagogy of the Oppressed
- Ivan Illich: De- Schooling Society

**Modes of Transaction:**

- Initiation of the dialogue by the Most Knowledgeable Other (MKO);
- Library readings;
- Observational studies and activities;
- Presentations by students on selected themes- individually and collectively.
- Documenting the dialogues.

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Undertake a survey of selected parents and community members and collect and map out their views on aims of education.
- Visit different kinds of schools and find out the socio- economic and cultural context (s) of schools.
- Make an analysis of how these different contexts of school provide differential opportunities and how those opportunities condition their achievement?

**Suggested Readings:**


- Deng, Z. (2003). School Subjects and Academic Disciplines. In A. Luke, A. Woods, & K. Weir (Eds) Curriculum, Syllabus design and equity: A Primer and model. Routledge.
- Freire, Paulo, (1970). Pedagogy of the Oppressed, The Continuum International Publishing Group, New York.
- Goodson, I.F. & Marsh, C. J.(2005). Studying School Subjects: A Guide. Routledge.
- Hollis, Martin. (2000). The Philosophy of Social Science: An Introduction. Cambridge University Press.
- Hudson, D. (1987). Science Curriculum Change in Victorian England: A case study of the science of common things. In I. Goodson (Ed.,) International Perspectives in curriculum history. Croom Helm.
- Illich Ivan (2012). De-Schooling Society. Morion Boyars, London
- Kumar Krishna. (2004). What is worth Teaching? (3rd edition). Orient Blackswan.
- Montuschi, E. (2003). Objects of Social Science. London: Continuum Press.
- Nagel, Ernest. (1979). The Structure of Science: Problems in the Logic of Scientific Explanation. Routledge, London.
- NCERT. (2005). National Curriculum Framework, NCERT. New Delhi.
- https://ncert.nic.in/pdf/nc-framework/nf2005-english.pdf
- NCERT. (2005). Position Paper on Curriculum, Syllabus, and Textbooks, NCERT. New Delhi.https://ncert.nic.in/pdf/focus-group/cst_final.pdf

- Pathak Avjit (2009). Education and Moral Quest. Aakar Books, New Delhi. (2007). Social Implications of Schooling: Knowledge, Pedagogy and Consciousness. Rainbow Publishers, New Delhi
- Teacher Education and Classroom Practice in India: A Critique and Propositions: http://episteme4.hbcse.tifr.res.in/review-volume/9-batra
- A Critique of Methodological Dualism in Education https://pdfs.semanticscholar.org/2fd6/5155a225e6ecf5e6156da95d68a4862f019d.pdf
- The Impact Of Dualism In Education On Sustainable Development Through TVET http://eprints.utm.my/id/eprint/14968/1/JOE-1-2011-004.pdf
- DISCIPLINARY KNOWLEDGE AND SCHOOL EDUCATION https://egyankosh.ac.in/bitstream/123456789/46618/1/Unit-3.pdf
- Understanding Disciplines and School Subjects https://mangaloreuniversity.ac.in/sites/default/files/2019/Course-5%20English%20Version.pdf
- RADICAL DEMOCRATIC EDUCATION https://www.ssc.wisc.edu/~wright/ASA/Fielding%20and%20Moss%20Real%20Utopia%20Proposal%20--%20democratic%20education%20.pdf
- Alternative Theories, Pedagogy and Education for Fostering Creativity in a Diverse Global World https://www.researchgate.net/publication/306138556_Alternative_Theories_Pedagogy_and_Education_for_Fostering_Creativity_in_a_Diverse_Global_World
- Alternatives in education https://egyankosh.ac.in/bitstream/123456789/8328/1/Unit-18.pdf

## EC1.2: Advanced Educational Psychology

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- describe multiple dimensions of learner's development and its implications for learning.
- Reflect on the process of learning from the point of view of different theoretical perspectives and the need to adapt appropriate approach.
- Define the learner in terms of diversities and its implications on learning.
- describe the factors affecting learner's environment and assessment.
- discuss the strategies for effective management of learning.
- conceptualize a framework for understanding and evaluating teaching-learning situation.
- Conceptualizethe needs of the learners and the process of learning.

### Unit I Learner Development and Implication for Learning

- Human Development: Meaning and understanding various stages of development of the Learner – childhood stage to late adolescence stage,
- Factors influencing development of the Learner: Role of Heredity and Environment (Family; Community, Neighbourhood, Peer group and School; Media; and Culture)
- Critical review of theoretical perspectives on different dimensions of development of Learner in relation to existing school practices: Physical, Cognitive (Piaget, Bruner); Language (Vygotsky, Chomsky, Labov); Psycho-Social (Erickson); Moral (Kohlberg); and Spiritual

### Unit II Understanding the Process of Learning

- Learning – Meaning and Types of learning
- Cognition in Learning: Cognitive processes: sensation, perception, attention, memory, development of concepts, logical reasoning, critical thinking, and problem solving.
- Various theoretical perspectives on human learning: Behavourist(Thorndike, Pavlov, Skinner), Humanist (Maslow, Carl Rogers), Cognitivist (Gagne, Ausubel, Bruner, Piaget), Constructivist (Piaget, Vygotsky), Social (Bandura), Gestalt Insightful theory.

**Unit III Learner Engagement in the Process of Knowledge Construction**

- Forms of learner‘s engagement: observation, demonstration, exploration, collaboration, experimentation, modeling, contextualisation, analysing, discovering, multiple interpretations and critical reflection (based on action, observation, selected reading, discussion etc.).
- Role of motivation in learning: Meaning of motivation, various approaches to motivation (humanistic approach; cognitive approach, attribution theory-Weiner); Achievement motivation; Strategies for motivating learner - Intrinsic and extrinsic motivation.

**Unit IV Understanding diversity in learning**

- Conceptual framework of understanding dimensions of differences in individual learners (with reference to individual attributes and socio cultural contexts)
- Approaches to Intelligence from Unitary to Multiple: concept of social intelligence, Multiple intelligence, emotional intelligence, spiritual intelligence, Theories of intelligence: Gardner, Assessment of intelligence, Metacognition.
- Mental health and Hygiene.
- Personality: Definitions and theories (Freud, Carl Rogers, Gordon Allport)
- Differences in learners based on predominant learning styles’ and Preferences
- Understanding differences based on cognitive abilities in children: such as giftedness, creativity, learning disability, low intellectual functioning (slow learner), and under achievement.
- Understanding Learners with difficulties with reference to Right to Persons with Disabilities (2016)
- Strategies to deal with diversity among learners

**Unit V Creating Learning Environment and Management of Learning**

- Identifying learning needs through continuous and functional assessment during teaching learning process, self-assessment and feedback, teacher observation and their reflective discussion in a group
- Creating congenial learning environment: physical, psychological (social and emotional), and academic to make inclusive classroom
- Duration and scheduling of instructional time as per the needs of learners
- Use of Educational Technology and learning resources for effective management of learning in different subject areas.
- Guidance and counselling: concept, scope and importance

**Practicum:**

- Lab work: Related to Psychological Practical

**Modes of Transaction**

- Lecture-cum- Discussion
- Individual and Group assignment through self study in the library and presentation in a seminar
- Observation of learning situation in schools and out of the schools
- Preparing reflective dairies/journals
- Interpretation, Analysis and Reflection on observation in a group
- Interaction and discussion with classroom teachers and peer group
- Observation followed by reflective discussion in a group
- Library study
- Project work

**Sessional work:**

Prospective teacher educators are expected to take any two from the following:

- Conducting case study on one student who has difficulties in learning at elementary stage.
- Reading Gardener's theory of multiple intelligence: implications for understanding differences in individual learners.
- Engaging learner in the process of knowledge construction and observe how they use their out-of-the-school experience and local knowledge. Prepare report and discuss in group presentation.
- Identification of group learning and self learning strategies following constructivist approach and their field testing.
- Identification of learning difficulties of the student in any subject area through administration of diagnostic test and development of remedial instruction.
- Identification of strategies for motivating the learner in study of a subject and practicing in school.
- Analysis of a case of adolescent learner with maladjusted/deviant behaviour.
- Preparation of learner's profile based on cognitive and non-cognitive characteristics in order to depict individual differences at elementary or secondary stage.
- Analysis of learning situations and presentation before a group followed by discussion.
- Critical analysis of learning situation in schools and out of the schools/ preparing reflective dairies, interpretation, analysis, reflection.

**Suggested Readings:**


- Aggarwal, J.C. (2009). Child Development and the Process of Learning, Shipra Publication, Delhi.
- Agochiya, Devendra (2010). Life Competencies for Adolescents-Training Manual for Facilitators, Teachers and Parents, Sage Publications Pvt. Limited, New Delhi.
- Aleinkov, A.G. (1999). Human Creativity. Encyclopedia of Creativity, Vol. I London: Academic Press.
- Ambron, S.R. (1981). Child development, Holt, Rinehart and Winston, New York.

- Anderson, J.R.(1983). The Architecture of Cognition. Cambridge, MA. Harvard University Press.
- Anita, Woolfolk (2004). Educational Psychology, Pearson Education, New Delhi.
- Bichard, M.H. (1992). Scaffolding and Self-scaffolding: Central Aspects of Development . In L.T.
- Winegar, J. Valsiner (edn.) Children's Development within Social Contexts: Research and Methodology. Erlbaum.
- Bichkard, M.H. (2000). Motivation and Emotion: An Interactive Process Model. In R.D. Ellis, N. Newton (Edn). The Caldron of Consciousness. Pp.161-178. J. Benjamins.
- Bickhard , M.H. (1978). The nature of Developmental stages, Human Development 21, pp. 217-233.
- Bickhard, M.H., Campbell, R.L. (1996) topologies of Learning and development. New Ideas in Psychology. 14(2), 111-156.
- Bonder, G.M. (1986). Constructivism: A Theory of Knowledge. Journal of Chemical Education.
- Bower, G.H. and Hillgard, E.R. (1981) Theories of learning. Prentice Hall, Inc. Englewood Cliffs, New Jersey.
- Bruner, J. S. (1990). Acts of Meaning, M. A. Harvard University Press, Cambridge.
- Bruner, R. F. (1978). Psychology applied to teaching, Boston: Houghton Miffin 19.
- Chaube, S. P. (2007). Developmental Psychology, Neelkamal Publications Pvt. Limited, Hyderabad.
- Dandapani, S. (2001). Advanced Educational Psychology, (2nd Edition), Anmol Publications Pvt. Limited, New Delhi.
- Daniels, Harry (Ed.) (2007). Cambridge Companion to Vygotsky, Cambridge University Press, New Delhi.
- Dececo, J.P. (1977). The Psychology of Learning and Instruction, Prentice Hall, Delhi.
- Eason, M.E. (1972). Psychological Foundation of Education, N.Y. Holt, Rinehart and Winston, Inc.
- Gardner, H. (1983). Frames of Mind: The Theory of Multiple Intelligences, Basic Books, Newyork.
- Gisatnti, M. L., & Howard, E. Gruber (1999). (Eds.). Creativity in the Moral Domain, Encyclopedia of Creativity, Vol. 1, Academic Press, London.
- Grammage, P. (1990). Teacher and Pupil : Some Socio- Psychological Principles and Applications (3rd Edition), Pressman Little, Brown Higher Education, Illinois: Scott.
- Guilford, J. P. (1967). Nature of Human Intelligence, McGraw Hill: Newyork.
- Hergenhahn, B. R. &Methew, H. Olsen (2007). Theories of Learning: An Introduction(7th Edition), Prentice Hall of India.
- Labov, W. (1969). The Logic of non-standard English. Reprinted in 1972; Language in Education: A Source Book, Routledge and Kegan Paul/ Open University Press, London and Boston.
- Laura, E. Berk (2005). Child Develoipment, 6th Edition, Pearson Prentice Hall, New Delhi.
- Mangal, S. K. (2012). Advanced Educational Psychology, 2nd Edition, PH1 Learning Pvt Limited, New Delhi.
- NCERT (2005). National Curriculum Framework for School Education, New Delhi.
- Newell, A. & Simon, H. A. (1972). Human Problem Solving. Englewood Cliffs, NJ: Prentice Hall.
- Papalia, D. E.; olds, S. W., &Feldmen, R. D. (2004). Human Development, 9th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
- Passer, M.W. & Smith, R.E.(2007). Psychology: The Science of Mind and Behaviour, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
- Piaget, J.(1999). Judgment and reasoning in the child. London: Routledge.
- Pintrich, P.R. and Schunk, D.H. (1996). Motivation in education: theory, research and applications. Englewood Cliffs, N.J. Merill.
- Santrock, John.W. (2006). Educational Psychology, Tata McGraw Hill Publishing Company Limited, New Delhi.
- Schneider, F.W., Gruman, J.A. & Coutts, L.M.(Eds.) (2012). Applied Social Psychology –Understanding and Addressing Social and Practical Problems, Second Edition, Sage Publications Pvt. Limited, New Delhi.
- Segal J.W. Chipman, S.F. & Glaser, R. (1985). Thinking and learning skills: Relating Instruction to Basic Research. (Vol.I) Hillsdale, NJ: Erlbaum.
- Sherfield, R.M., Montgomery, R.J., & Moody, P.G. (Eds.) (2009). Cornerstone Developing Soft Skills, Fourth Edition, Pearson Education.
- Slater, M. A., & Quinn, P. C. (Eds.) (2012). Developmental Psychology-Revisiting the Classic Studies, Sage Publications Pvt. Limited, New Delhi.

- Smith, Peter, K.; Cowie, Helen, & Blades, Mark (1998). Understanding Children's Development, III Edition, Blackwell Publications Ltd, 10 UK.
- Srivastava, G.N.P. (2002). Siksha Manovigyan NaveenVicharDharaein, Concept Publishing Company, New Delhi.
- Synder, C. R. & Shane, J. Lopez. (2007). Positive Psychology, Sage Publications, U. K.
- Venkatesan, S. (2004). Children with Develeopmental Disabilities- A Training Guide For Parents, Teachers and Caregivers, Sage Publications Pvt. Limited, New Delhi.
- Vygotsky, L. (1986). Thiught and Language (A. Kazulin, Trans), Cambridge, M. A..: MIT Press.
- Whitebread, David (2012). Developmental Psychology & Early Childhood Education, Sage Publications Pvt. Limited, New Delhi.


## AE1.1: Education for Global Citizenship

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

### Learning Outcomes

After the completion of the course the prospective teacher educators will be able to:

- explain the concept of global citizenship
- describe the need and importance of global citizenship
- identify the issues and challenges of global citizenship
- develop a broad understanding of barriers and bridges to global citizenship
- describe the relationship between human and peace with global citizenship

- acquire competencies as teacher for understanding human rights and global citizenship

**Unit 1 Understanding Citizenship**

- Citizenship: definition and concept
- Global citizenship in India: meaning, characteristics, ethics and importance
- From National to global citizenship
- Learning objectives of global citizenship education
- Self-assessment activities for global citizenship
- Analysis of self as a global citizen
- Challenges to global citizenship: the challenges of being informed in the face of print media and social media influence
- Concerns for global citizenship: social divisions of gender, region, race, religion, ethnicity, culture, nation and state.
- The challenge of redefining previous notions of nation and state to recognize diversity and multiculturalism.

**Unit 2 Citizenship and Contemporary Concerns**

- Roleofmediain global citizenship - printmedia andelectronicmedia
- Understanding global citizenship education:
  - Education for a culture of peace
  - Education for attaining equity and equality in educational opportunities
  - Education for attaining sustainable development goals
  - Education for promoting inclusive education
  - Education for respect for multiculturalism
  - Education for attaining gender equality
  - Education for attaining social justice
  - Education about human rights

**Unit 3 Global Citizenship and Education**

- Mapping Science textbooks and exemplars from science and embedding GCED in Science
- Mapping GCED themes in NCERT Science text books at secondary stage
- Pedagogical principles of global citizenship education
- Role of education in global citizenship - need of an interdisciplinary approach
- Teaching for global citizenship - observation, group discussion, dramatization, cooperative learning,play-based and project-based learning, field trips, community-based learning, culturally responsivepractices
- Classroomsfor global citizenship – virtualtoursandvirtuallabs, teachingwithecologicalfootprints, theatrepedagogy, game-based pedagogy, etc.
- Possibilitiesofprofessionaldevelopmentofin-serviceteachersfor global citizenship

***Modesof Transaction:***

- FieldsVisits
- Surveys
- GroupDiscussion
- Debates
- Lectures
- VideoTalks
- Movies
- Documentaries

***SessionalWork:***

Thelearner's areexpected to takeanytwo from thefollowing:

- Tosuggeststrategies/solutionsforconcerningglobal citizenshipissues
- Reviewofabookon global citizenshipissues andconcerns
- Prepareasurveyreport on attitude towards global citizenship
- "Beyond the Classroom" Activity: Education about global citizenship happens in a variety of contexts, inside and outside the classroom, on campus and in the wider community. This assignment asks to take learners in a public event relevant to this subject (speaker, panel discussion, presentation, film screening, song review, news review, analysis of radio talk, etc.)

***SuggestedReadings:***


- Bamshad, M. J., & Olson, S. E. (2003). Does race exist? *Scientific American,* 289, 78-85.
- Basiago, A. D. (1995). Methods of defining 'sustainability', Sustainable Development, 3: 109-119.
- Gardner, S. (2009). The 2009 Dalton Camp Lecture in Journalism. Broadcast by CBC Radio Best of Ideas, Thursday November 26th 2009. Available online at: http://castroller.com/podcasts/Ideas/1386039-The 2009 Dalton Camp Lecture in Journalism.
- Hardin, G. (1968). The Tragedy of the Commons. *Science, 162,* 1243-1248. Available at: http://dieoff.org/page95.htm
- Heater, Derek. (2002). World citizenship: cosmopolitan thinking and its opponents. New York: Continuum. (Chapter 3: Identity and Morality)
- Inglis, C. (1995). Multiculturalism: New Policy Responses to Diversity. Management of Social Transformations (MOST) - UNESCO. Policy Paper No. 4. Available online at: http://www.unesco.org/most/pp4.htm
- Kornelsen, Lloyd. (2014). Stories of transformation: Memories of a global citizenship practicum. The International Center for Innovation in Education: Ulm, Germany. (Chapter 2: Global Citizenship: What is it?)
- Krotoski, A. (2010). Virtual Revolution: The Great Levelling. BBC World Service. (Audio lecture, 20 minutes). Available online at: http://www.bbc.co.uk/worldservice/programmes/2010/03/100311_virtual_revolution_how_and_when.shtml

- Malalai, Joya. (2009). A Woman Among Warlords: The Extraordinary Story of an Afghan Who Dared to Raise Her Voice. Toronto: Scribner
- Norman, W., &Kymlicka, W. (2003). Citizenship. In A Companion to Applied Ethics, edited by R. G. Frey & C. H. Wellman. Oxford: Blackwell Publishing Ltd.
- Nussbaum, M. (1994). Patriotism and Cosmopolitanism. The Boston Review. Available online at: http://www.soci.niu.edu/~phildept/Kapitan/nussbaum1.html
- Parekh, B. (2003). Cosmopolitanism and Global Citizenship. *Review of International Studies, 29*, 3-17.
- Prins, B., &Slijper, B. (2002) Multicultural Society under Attack. Introduction. *Journal of International Migration and Integration, 3*(3&4), 313-328.
- Robinson, J. (2004). Squaring the circle? Some thoughts on the idea of sustainable development. Ecological Economics, 48: 369-384.
- The United Nations Universal Declaration of Human Rights. (1948). Available online at: http://www0.un.org/events/humanrights/2007/index.shtml
- Westheimer, J., &Kahne, J. (2004). Educating the "Good" Citizen: Political Choices and Pedagogical Goals. *Political Science & Politics, 38*(2). Available at: http://www.democraticdialogue.com/DDpdfs/WestheimerKahnePS.pdf
- Worth, J. (2010). Taking on Tarmageddon. *New Internationalist*, 431. http://www.newint.org/features/2010/04/01/keynote-tar-sands/


## AE1.1: Indian Constitution and Child Rights

**Credits: 2**



**Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On the course, the prospective teacher educators will be able to develop understanding about:

- explain meaning and natureof constitution
- gain insight and reflect on the concept of rights
- analyze the realtionship between the education and children
- reflect on the contemporary issues and relate to changes occuring in society and education
- analyze education of children in various context in different context in society

**Unit I** **Understanding India: Indian Constitution: Concern for New Social Order**

- Constitution and Preamble: National Ideals Democracy, Equality, Liberty, Secularism, and Social Justice.
- Constitutional provisions on education that reflect these ideals: Implicit concerns and Issues-India as a Society: Socio-economic, cultural, linguistic and regional framework
- India as an evolving Nation state: Vision, Nature and Salient Features Democratic polity, Federal structure.
- Implications to Educational arrangements and responsibility
- India as Developing Economy: Salient features and contradictions Development and Displacement, Development and environmental degradation, Growing incomes and widening inequalities
- Facets/sectors of Indian economy: Agriculture, Industrial and Service
- India as Knowledge economy-Implications to education

**Unit II** **Child Rights and Constitutional Provisions**

- International Child Rights and Conventions-1989
- Constitutional Provisions of child rights
- Constitutional Journey of Right to Education
- RTE Act 2009 Salient Features
- Deprived Childhood
- Rights of Under privileged children:
  - Girl child
  - Differently abled children
  - Transgender
  - Children of prostitute
  - Children from slum area
  - Children in conflict zone
- Child labour and Schooling: Alternative School nature

**Unit III** **Education as Fundamental Right**

- Practices of Indian Schooling
- Child Rights: International Covenants and Indian Constitutional Provisions
- Rights of Girl Child
- Education as a Fundamental Right of Children
- Universalisation of School Education
- Equalization of Educational Opportunities
- Problematization of Indian schooling in understanding the apparent contradictions/Paradoxes of universality and equality: Private-public schools Urban–rural schools Centre-state schools Many other forms of in-equalities in Indian Schooling
- Schooling and Access: Physical, Epistemological, and Cultural Access
- Issue of enrollment, retention and success: Sociological analysis.

**Modes of Transaction:**

- Reflective talk
- Dailogue
- Library Readings
- Observation and activities
- Lecture-cum discussions.
- Analysis of education data
- Observational studies.
- Conventions on Human Right and Child Rights.
- Extended reading of certain required portions from Indian constitution and UNO

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- To situate and understand contradictions/paradoxes of economy a Case study/project work on children in various context:
  - Adolescent learner in maladjusted / deviant context
  - Living in urban slums
  - Growing up as girl
  - Growing up in dalit household
  - slum areas
  - Conflict Zones
  - Transgender community
- Critical study of alternative schooling in the light of education as a fundamental right of every child
- Debate may be organized on the contemporary issues in relation to children

**Suggested Readings:**

- Pathak,V. (2004). *Social Implications of Schooling: Knowledge, Pedagogy and Consciousness*, Rainbow Publishers, New Delhi.
- Baxi, U.(1995). *The Human Rights Education: The promise of the Third Millennium*, New Delhi.
- Dube, S.C. (2005). *Indian Society*. National Book Trust of India, New Delhi.
- Kumar, K. (1991). *The Political Agenda of Education; A Study of Colonialist and Nationalist Ideas.* Sage Publication, New Delhi.
- Levin, L. (1998). *Human Rights-Questions and Answers*, New Delhi.
- Naik, J.P. (1975). *Equality, Quality and Quantity: The Elusive Triangle in Indian Education,* Allied Publishers, Bombay.
- Nehru, J.(1989). *The Discovery of India*, Oxford University Press: New Delhi.
- PROBE Team. (1999). Public Report on Basic Education in India, New Delhi: Oxford University Press.
- Sharma, S.K. (1998). *Children and The Human Rights*. New Delhi.
- Tawney, R.H. (1964). *Equality*. London:Unwin Book

## PC1.1:WorkingwithCommunity

**Credits: 2** **Max Marks: 50**

**Contact Hours: 1 per week +One Week Field Work** **Internal: 50**

***LearningOutcomes:***

Afterthecompletion ofthiscourse, thelearnershall:

- Acquainthimself/herself withthefactorsworkingwithin thesociety, communityi.e.knowledgeof social realities that havebearingonschool and education.
- Arousehis/herinterestintheprocesses ofsocialandeconomicreconstructionofthecommunity.
- Developawareness on theeducationaland social issues andneeds of thecommunity
- Identifyandplanforusingcommunityresources,bothmaterialandhuman,forenrichingthequalityof school education
- Gatherintimateknowledgeofthestructureandfunctioningoftheinstitutions/organizationsandtheirsphere of activity.
- explore the scope of collaboration of local institutions/organizations with the developmentalandacademicactivities (bothcurricular andother curricularactivitiesoftheschools.
- Developatentativeplanofactionwiththelocalinstitutions/agencies/socialgroupsfortheircollaborationwi th schoolactivities

***InteractionStrategies***

- The students (prospective teacher-educators) shall spend a week at a stretch in the identifiedvillages/communitiesand/or in locations decided bythe institute/department.
- Forinteractionwithcommunity discussion,Rally,Competitions(Debates)PostersandBanner displays Working in community setting, Mass movement, *Nukkad*Performances,Localactiongroupformation,surveys,interviews,actionresearch,casestudy,disse minationofsuccessstoriesetc**.**maybe employedformoremeaningful interaction.
- For discourse with other related agencies observation, Interview, Individual and GroupDiscussion,CaseStudy,Video recordingwill beadopted.

**Semester 2**

**EC2.1: Introduction to Educational Research**

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain the concept, characteristics, process, perspective and types of educational research,
- classify methods educational research,
- select and formulate research problem,
- prepare a draft proposal for research problem,
- select appropriate sampling techniques,
- describe different tools and techniques of collecting data and
- apply statistical techniques for data analysis

**Unit I** **Research in Education: Conceptual Framework**

- Educational research: Concept, nature and scope
- Paradigms of educational research: Positivist, Interpretative
- Research as a process
- Classification of research based on purpose (basic, applied and action), design (experimental and survey) and nature of data (quantitative and qualitative)

**Unit II** **Planning for Research**

- Identification, selection and formulation of a research problem
- Sources of research problem-experiences, theory, review of research
- Variables of research-Constructs, concepts, Meaning, Nature and types
- Delimitation and scopeof research problem
- Formulation of objectives/Research Questions
- Meaning and types of Hypotheses
- Preparation of Research proposal

**Unit III** **Sampling Design**

- Concept of Population and Sample
- Concept of Sampling unit, representativeness of sample, sampling frame
- Sampling methods: meaning, nature, conditions and applicability of Probability Sampling (Simple Random Sampling, Stratified Random Sampling, Systematic Sampling, Multi-Stage Sampling) and non-Probability Sampling (Cluster sampling,

incidental sampling, Purposive Sampling and Judgmental sampling, Snowball sampling, etc.,)

**Unit IV Tools and Techniques of Data Collection**

- Characteristics of a Good Research Tool, Checklist, Interview, Questionnaire, Psychological Tests, Achievement Tests and Diagnostic Tests, Focus Group Discussion, Observation, Field Notes, Transcriptions, Recording (Audio-Video), Anecdotal Records, Portfolios, Dialogue, Discourse and Documents.
- Reliability: Meaning, types, and procedure of establishing reliability; Validity: Meaning and approaches.
- Tool development, Item Analysis, Difficulty Value of test item, Discriminative Index and Facility value; finalization of items (standardization of various tools), Item Response Theory (IRT).

**Unit V Data Analysis and Interpretation**

- Understanding the data in terms of scales of measurement
- Processing data in tabular and graphical representation (Bar diagram, Line diagram, Histogram, Frequency curve, Frequency polygon, Ogive and Box plot)
- Statistics and Parameters: Descriptive, Inferential, Parametric and non-parametric, Sampling error
- Normal Probability curve: Characteristics and Application

**Mode of Transaction:**

Lecture Cum Discussion, Brain storming, Group presentation, Presentations, Panel Discussion, Seminar Presentations, research proposal presentation

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Development of the research proposal on an identified research problem
- Identification of variables in the research study and classification of them based on the types and levels of measurement
- Planning of a study and research design by keeping the objectives and research questions/hypothesis of the research study
- Identity appropriate tool for a given problem
- Select an appropriate sample for a given research problem based on stratified random sampling
- Presentation of Research synopsis

**Suggested readings:**


- Best J.W.(1986). Research in education, New Delhi: Prentice Hall of India Pvt.Ltd.

- Cohen. L., Lawrence, M. and Keith, M.(2007)0. Research Methods in Education. Routledge London
- Creswelll, John.W(2007). Qualitative Inquiry and Research Design: Choosing Among Five Approaches, New Delhi: SAGE Publications
- Elliott, ane(2005) Narrative in Social Research: Qualitative and Quantitative Approaches. SAGE Publications
- Good Carter, V Methodology of Educational research, New York: Appleton Century Crafts
- Gupta Santosh (1983). Research Methodology and Statistical Techniques . New Delhi: Dee and Deep Publishers.
- Kerlinger, F.N.(1973). Foundation of Behavioral Research. New York: Holt, Rinehart and Winston
- Kaul Lokesh,(1997). Methodology of educational research. New Delhi: Vikas Publications
- Mertens, D.M.(1998). Research methods in Education and Psychology. New Delhi: SAGE Publications
- Scott, David & Usher Robin(1996). Understanding Educationall Research. Routledge; London and New York
- Sharma, Bharati. (2004). Methodology of Educational Research. New Delhi: Vohra Publishers and Distributors
- Sharma, S.R.( 2003). Problems of Educational Research. New Delhi: Anmol Publication Pvt. Ltd.
- Sindhu, K .S.( 1987). Methodology of Research in Education. New Delhi: Sterling Publication Pvt. Ltd.
- Srivastav, G.N.P (1994). Advanced Research Methodology. New Delhi: Radha Publication
- Stake, Robert.E.(1995). The Art of case study research. SAGE Publications
- Tuckman, B.W.(1969). An introduction to educational research. New York: The MacMilan Company.
- Travers, Robert.M.W.(1978). An introduction to educational research.(4th edition). London: The MacMilan Company.
- Van, Dalen,B. And Meyer, William.J.(1979). Understanding educational research: An introduction. New York: McGraw Hills Co.
- Wiersma, W.(2000). Research Methds in Education.(7th edition) Alllyn&Bacon.Willis,, Jerry. W. (2007). Foundations of Qulaitative Research: Interpretive and Critical Approach. SAGE Publications.
- Garrett, H.E. (2005). Statistics in Psychology and Education. Paragon International Publications. New Delhi.
- Gage, N.L. (1963). Handbook of research on teaching. Rand McNally & Co. Chicago
- कोठरी, सी. आर. (२०१८). शोधपद्धति. न्यूएजइंटरनेशनलपब्लिकेशनलिमटेड, नईदिल्ली
- शर्मा, जी. ए. एवंशर्मा, वाई.के. (२०१७). रिसर्चमेथोडोलॉजी. यूनिवर्सिटीबुकहाउस, जयपुर

## EC2.2: Curriculum Studies

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain the meaning, nature and determinants of curriculum
- compare the various types of curriculum
- reflect on the bases of curriculum development
- explain various approaches and models of curriculum development
- identify the guiding principles of selection and organization of learning experiences
- describe the process of curriculum evaluation

**Unit I** **Concept, Bases and determinants of curriculum**

- Stages and strategies of curriculum development
- Meaning and nature of curriculum
- Perspectives on Curriculum, Traditionalists; Conceptual- Empiricists; Reconceptualists, and Constructivists.
- Basesof Curriculum: Philosophical, Psychological, Sociological and Economic
- Determinantsof Curriculum Development: National policy; Learner's needs and characteristics; & Educational Objectives, methods, Assessment and Evaluation.
- Curriculum and Curriculum framework: difference

**Unit II** **Curriculum Planning & Development**

- Curriculum Planning and Development as a continuous and cyclic process.
- Approaches to curriculum development: Administrative approach, Grass root approach, Systems approach.
- Models of Curriculum Development: Tylers-1949 model; Hilda Taba 1962 model; Nicholls and Nicholls-1972 model; Willes and Bondi-1989 model; Skill Development model.
- Models of curriculum Design: Traditional and contemporary Models (Academic/ Discipline model, Competency bases model, social functions/ activities model {social reconstructions}, Individual needs & Interest Model, Outcome based Integrative Model, Intervention Model, CIPP Model.
- Development of textual and learning material; planning, process of development, involvement of various stakeholders etc.
- Role of central and state level statutory bodies in curriculum development : Central and State Boards, UGC and NCTE

**Unit III Implementation of Curriculum in School**

- School as site for curriculum implementation: Creating context for curriculum transaction; Availability of infrastructure; curricular resources (textbook, teacher's handbook, library, laboratory, school playground, neighborhood etc.)
- Teacher's Role in Curriculum construction, Curriculum Transaction (Cooperative leaning approach and collaborative learning approach) and researching in curriculum.
- Use of ICT in curriculum transaction.
- Role of external agencies in providing curriculum and pedagogical supports to teachers within schools-local, regional, national.

**Unit IV Selection and Organization of learning experiences**

- Principles and criteria for creating learning experiences: Cognitive, Critical perspectives applicability, Utility, objectivity and scope for inclusiveness.
- Designing integrated and interdisciplinary learning experiences.
- Integration of learning experience to work experience, sensitivity to gender parity, peace oriented values, health and needs of children with disabilities, arts and India's heritage of crafts.

- Infusion of environment related knowledge and concerns in all subjects and levels.
- Learning to draw upon resources other than text books including local history and geography.

**Unit V Curriculum Evaluation**

- Curriculum Evaluation: Planning and Evaluation of curriculum Material.
- Models of curriculum evaluation: Tyler model, Screven model, Kirkpatrick model.
- Utilizing evaluation result for curriculum improvement.
- Situation analysis using survey and interview.
- Issues in Curriculum evaluation.
- Curriculum change: Meaning and Types
- Factors affecting curriculum change.
- Approaches to curriculum change.

**Modes of Transaction:**

- Lecture-cum-discussion
- Individual and group assignment through self-study in the library and presentation in a seminar
- Demonstration
- Interpretation, analysis and reflection on observation in a group
- Library study
- Project work/Assignment
- Workshop
- Group Discussion
- Small Survey

**Sessional Activities:**

Prospective teacher educators are expected to take any two from the following:

- Detailed study of National Curriculum Framework of School Education, India (1975 onwards) followed by seminar presentation.
- Preparation and presentation of papers on Comparative study and analysis of curricular frameworks of other countries – US, UK and Australia (Eg; Nuffield, BSCS, PSCS, NSES with respect to their priorities, concerns and goals towards school education).
- Preparation and presentation of paper on Curriculum framework of different states of the country.

**Suggested Readings:**


- Aggarwal, Deepak (2007): Curriculum development: Concept, Methods and Techniques. New Delhi. Book Enclave.
- Arora, G.L. (1984): Reflections on Curriculum. NCERT.
- Bob Moon and Patricia Murphy (Ed) (1999). Curriculum in Context. Paul Chapman Publishing, London.
- Butchvarov, P. (1970). The Concept of Knowledge, Evanston, Illinois: North Western University Press.
- Chomsky, N. (1986). Knowledge of Language, Prager, New York.
- Datta, D.M. (1972). Six ways of knowing. Calcutta University Press, Calcutta.
- G.W. Ford and LarencePungo. (1964). The structure of knowledge and the curriculum. Rand McNally & Company, Chicago.
- Panda, S.K., and Panda, N. (2020). Curriculum Development. Shipra Publications, Delhi.
- Talla, Mrunalini (2012). Curriculum Development. Pearson India Education Services, Cheenai.
- NCERT (2005). Curriculum, Syllabus and Textbooks. NCERT, New Delhi.
- NCF 21 position parents NCFs and XXI National Focus Group Position Papers https://ncert.nic.in/focus-group.php?ln=
- Learning outcomes https://ncert.nic.in/learning-outcome.php
- National policy of education
- https://en.wikipedia.org/wiki/National_Policy_on_Education#:~:text=The%20policy%20covers%20elementary%20education,Minister%20Narendra%20Modi%20in%202020 and https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- Shodhganga: a reservoir of Indian theses https://shodhganga.inflibnet.ac.in/
- National digital library https://ndl.iitkgp.ac.in/
- Digi libraries https://digilibraries.com/
- For B.Ed textbooks by NCERT.: https://ncert.nic.in/desm/b-ed-textbooks.php?ln=
- https://ncert.nic.in/desm/b-ed-textbooks.php?ln=hi

- एन.सी. ई.आर. टी (२००६) एजुकेशनऑफ़चिल्ड्रनविथस्पेशलनीड्स. राष्ट्रीयफोकससमूहकाआधारपत्र. एन.सी. ई.आर. टी. नईदिल्लीhttps://ncert.nic.in/pdf/focus-group/special_ed_final1.pdf

- एन.सी. ई.आर. टी (२००९). पाठचर्याबदलावकेलिएव्यवस्थागतसुधारराष्ट्रीयफोकससमूहकाआधारपत्र. एन.सी. ई.आर. टी. नईदिल्ली

- https://ncert.nic.in/pdf/h_focus_group/Pathyacharya%20Badlao.pdf


**AE2.1: Indian Values, Culture and Heritage**

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

## Learning Outcomes:

On completion of the course, the prospective teacher educators will be able to:

- explain Indian value system,
- describe Indian culture and its relationship with education,
- explain the concept and place of value education in school curriculum,
- describe salient features of various Indian heritage and their educational implications,
- recognize the need for preservation and promotion of Indian values, culture and heritage.

**UNIT I** **Indian Value System**

- Indian value system- social, economic, political and moral aspects.
- Relevance of Indian values in global context - self control, universal brotherhood (*VasudhaivaKutumbakam*)
- Indian constitutional/National values– democracy, socialism, secularism, equality, justice, liberty, freedom and fraternity
- Professional values- knowledge thirst, sincerity in profession, regularity, punctuality and faith
- Social values- pity and probity, self control and emotional intelligence, Religious values- tolerance, wisdom and character
- Aesthetic values- love and appreciation of literature and fine arts and respect for the same
- National integration and international understanding, impact of global developments on ethics and values.

**UNIT II** **Value Education**

- Need and importance of value education, concept of human values, types of values, components of value education
- Personal development: self-analysis and introspection
- Sensitization towards gender equality, physically and intellectually challenged. Respect to- age, experience, maturity, family members, neighbours and co-workers
- Models of Value development: value-Imbibing through value analysis and inquiry for social action
- Direct and indirect approach to value education through stories and motivational life histories
- Integrated Concurrent Approach(ICA) through holistic learning and application

**UNIT III Indian Culture and Education**

- Concept of culture in India, Characteristics of Indian culture, dynamic nature of culture
- Evolution of culture, Salient features of Indian culture- spirituality, universality, unity in diversity, scientific outlook, theory of karma, love of nature, reverence of women, value based society, towards synthesis of cultures
- significance of Geography on Indian culture, society in India through ages
- Ancient period- Varna and Jaati, Family and marriage in India, Position of women in ancient India
- Contemporary Period- Caste system and Communalism.

**UNIT IV Indian Heritage and Education**

- Indian Art and Architecture- Gandhara School and Mathura school of Art, Hindu temple architecture, Buddhist, medieval and colonial Architecture
- Indian painting Tradition, Indian classical music: Hindustani and Carnatic. Dances of India: Various dance forms. Indian languages and literature- Sanskrit literature, the Vedas, the Brahmanas, Upnishad and Sutras
- Evolution of script and languages, rise of modern theatre and Indian cinema Epics- Ramayana, Mahabharata and Puranas

**UNIT V Preservation and promotion of Indian Values**

- Mapping of Indian values, culture and heritage, educational activities and programmes,
- Teacher and Classroom practices, Proactive strategies
- Teacher Development and Orientation; Home, School and Community Partnership and Evaluation system

**Modes of Transaction:**

- lecture cum discussion,
- brain-storming,
- group discussion,
- case studies,
- group and individual field based project
- assignments followed by seminar presentation,
- workshop on field based topics of study,
- panel discussion,
- survey,
- ICT labwork,
- role play,
- field visits and

- narration etc.

**Sessional Work:**

Prospective Teacher educators are expected to take any two from the following:

- Prepare a reflective report of different values mentioned in Indian history
- Conduct a survey on perception of values in local area
- Prepare an article on development of a language and integration of values
- Prepare a lesson plan on value education.

**Suggested Readings:**


- Blanchard, Justine L. "Indian Wedding Tradition Guide." - *Indian Wedding Customs*. The Knot. Web. 29 Apr. 2012. <http://indian.weddings.com/articles/6-indian-wedding-traditions.aspx>.
- "Census of India - India at a Glance : Religious Compositions." *Census of India Website : Office of the Registrar General & Census Commissioner, India*. Government of India. Web. 22 Apr. 2012.
- "Family Life in India." *All About Family Life In India*. Web. 30 Apr. 2012. <http://web.mac.com/oscartavernini/India_Profile/Family_Life.html>.
- "Gender Inequality." *Gender Inequality*. Azad India Foundation. Web. 29 Apr. 2012. <http://www.azadindia.org/social-issues/GenderInequality.html>.
- Gupte, Kamakshi. "Indian Culture." *Culture of India*. Indian Child. Web. 22 Apr. 2012. <http://www.indianchild.com/culture%20_1.htm>.
- "India Education." *Education in India*. Educational Institutions Resource Bank. Web. 30 Apr. 2012. <http://www.indiaedu.com/education-india/>.
- "India - Language, Culture, Customs and Etiquette." *Professional Translation Services*. Kwintessential. Web. 23 Apr. 2012. http://www.kwintessential.co.uk/resources/global-etiquette/india-country-profile.html
- Khan, Saeed. "There's No National Language in India: Gujarat High Court." *The Times Of India*. Bennett, Coleman & Co. Ltd, 25 Jan. 2010. Web. 22 Apr. 2012. <http://articles.timesofindia.indiatimes.com/2010-01-25/india/28148512_1_national-language-official-language-hindi>.
- Patel, Reena, and Mary Jane C. Parmentier. "The Persistence of Traditional Gender Roles in the Information Technology Sector: A Study of Female Engineers in India."*Information Technologies and International Development* 2.3 (2005): 29-46.*Research Article*. Information Technologies and International Development, 2005. Web. 20 Apr. 2012. <http://itidjournal.org/itid/article/viewFile/203/73>.
- Indian Value Systemhttps://sites.google.com/site/welcometoindianculture/home/ethnicity/indian-values-and-beliefs
- INDIAN CULTURE AND HUMAN VALUES https://egyankosh.ac.in/bitstream/123456789/8857/1/Unit-1.pdf
- INDIAN CULTURE AND HERITAGE by Dr. Binod Bihari Satpathyhttps://ddceutkal.ac.in/Syllabus/MA_history/paper-8-N.pdf
- Understanding Culture drishtiias.com/images/pdf/secondary%20indian%20culture%20and%20heritage.pdf

## AE2.1: Physical Education, Yoga and Wellness

**Credits: 2** **Maximum: 50**

**Contact Hours per week: 3** **External Marks: 35**

**Internal Marks: 15** **Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- Define the concept of physical education and yoga
- Describe the concept of health, food and nutrition
- Explain the concept of physical fitness
- Perform the physical fitness activities
- Describe the sports management and its related schemes

**UNIT I** **Concept of Physical Education and Yoga**

- Meaning, Definition and scope of Physical education
- Wellness: Meaning and Scope (Physical, Intellectual, Emotional, Spiritual and Social)
- Different schools of Yoga (Bhakti, Karma, Gyaan, Tantra )
- AstangaYoga (Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana, Samadhi)

**UNIT II** **Health, Food and Nutrition**

- Concept and Meaning of Health and health Education (WHO)
- Hygiene (Personal and environmental)
- Food, Nutrition and Balanced Diet
- Nutritional Deficiency
- Concept of Body Mass Index (BMI) and its importance

**UNIT III** **Physical fitness**

- Physical and Motor Fitness (Strength, Speed, Endurance, Flexibility, Agility, Co – ordination)
- Warming up (General and specific),Cooling down exercise

- Basic fundamental Movements (Walking, Running, Jumping and throwing)
- Evaluation of Physical Fitness (AAPHERD, Youth fitness test)
- Sports injuries and their First Aid
- Body posture (Kyphosis and Lordosis) and Postural deformities and it's Rehabilitation

**UNIT IV Sports management**

- Management of Playgrounds, Equipmentand Sports Facilities
- Tournament (Intramural and Extramural, League and Knock out tournament)
- Overview of Anti-doping (WADA, NADA)
- Moral values and Fair play
- National Games, Olympic Games, Asian Games, Commonwealth Games

**UNIT V Government schemes and Awards in India**

- Sports Authority of India(SAI), Sports Hostels,
- National AYUSH Mission, State and National Policies for games and sports, National Sports Talent Contest (NSTC), Army Boys Sports Company Scheme (ABSC), Special Area Games (SAG) Scheme, Centre of Excellence (COX) Scheme, COME and PLAY Scheme
- Concept of Khelo India and fit India movements
- Different sports awards in India
- National institutes for games and sports

**Modes of Transaction:**

- Lecture-cum discussion
- Individual and group assignment through self-study in the library and presentation in a seminar
- Demonstration
- Interpretation and analysis on observation in a group
- Library study
- Project work/Assignment
- Group discussion

**Sessional Work:**

Prospective Teacher Educators are expected to take any two from the following:

- Demonstration of Fundamental Skills and Rules and regulations of Games and Sports
- Indigenous Sports – Kabaddi ,Kho-Kho Mallakhamb, KushtiAkhada, Thang-Ta, Kalaripayattu, Archery, Lagori&Langdi, Tug of War, Hekko, GilliDanda
- Racket Games –Badminton , Lawn Tennis , Table Tennis
- Team Games – Volleyball , Football , Basketball , Cricket
- Individual Sports – Track and Field Athletics , Weight lifting , Power Lifting
- Conduct a survey of food intake of local area
- Prepare a diet chart
- Observe the local games and report
- Prepare a BMI Chart of students

**Suggested Readings:**


- George T. Stafford, Physical conditioning Exercise for sports and Healthful living New York: Ronald Press Company, 1942.
- David A. Armbruster and Leslie W. Irwin, Basic skills in sports for men and women, St. Louis-The C. V. Mosby Company, 1958.
- Encyclopedia of Sports and Games, Goel, G. and R. G. Goel (2003). Vikas Publishing House, New Delhi
- L. Walling, Sanfernando, Gene A. Logan, Figure improvement and body conditioning through exercise, U.S.A: Ronald Press Company, 1964
- John Kieren and Arthur Deley: The story of the Olympic game Philadelphia New York: J. B. Lippincott Company.
- Thomas S. Yakic, Fundamentals of recreation, New York and Evanston: diamond press and company, 1963.
- John R. Taris, Every sportsman's cook book by, New York: The Micmillian Company, 1962.
- Shri Ananda, The complete boons of yoga, New Delhi: Ryan printing press, 1984.
- K. S. Joshi, Yoga and Nature cure theraphy, New Delhi: Sherling publishers limited, 1991.

## PC2.1: INTERNSHIP IN SCHOOL

**Credits:2** **Maximum: 50**

**Contact Hours per week: 4** **Internal: 50**

The M.Ed. students will be actively participating in B.Ed. school internship programme (they will be observing/cooperating B.Ed. internees).

## SEMESTER III

### EC3.1: Advanced Educational Research

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- identify a topic of qualitative research
- select an appropriate design with respect to identified research problem
- analyse qualitative data in educational research
- develop and standardize a research tool
- testing of hypotheses by using different inferential techniques
- develop a research report, abstracts and research paper

**UNIT I** **Methods and Design of Research**

- Descriptive Methods: Survey, Correlation Studies, Cross-sectional, Longitudinal, Historical
- Experimental Design: True experimental (Single group pre-test, post-test design; Two group experimental-Control group design; Solomon four-group

design, Rotational group design; Factorial design), Quasi experimental designs

- Internal and External validity of the research design
- Mixed Method Design: Types, Steps, Strengths & Limitations

**UNIT II Qualitative Research**

- Meaning, Nature, Characteristics, Scope and Relevance
- Types of Qualitative Research: Naturalistic Enquiry, Hermeneutics, Phenomenology, Grounded Theory, Ethnography, and Case Study
- Recording of Qualitative Data
- Analysis of Qualitative data using Qualitative Techniques
- Qualitative data analysis using Computer Software(Ultavista, N etc)

**UNIT III Scales of Measurement and Inferential Statistics**

- Scales of measurement: Nominal, ordinal, interval, and ratio
- Transformation of scores: Standard Scores, Derived Scores
- Concepts of sampling Distribution of Statistics
- Standard Error as an index of sampling error
- Correlation, Product Moment Correlation; Rank Correlation; Concept of Multiple and Partial Correlation and Linear Regression (Bivariate Only)
- Testing of Hypothesis: Concept of One-tailed and two-tailed tests; Type one and type two errors; Testing the significance of the Difference between Means, Variances, Correlations and Proportions.
- Analysis of Variance and Co-variance: Concept, Assumptions, Principles and Uses
- Fiduciary Limits (Descriptive Data Analysis)

**UNIT IV Non-parametric statistics**

- Use of non-parametric tests and rationale for distribution free data: chi square test, median test, sign test, Mann Whitney U test, Wilcoxon Test, Kruskal-Wallis test, Kolmogorov Smirnov test, Shapiro wilk test
- Friedman's test
- Quantitative data analysis using computer software (MS Excel, SPSS, etc.)

**UNIT V Report Writing**

- Report Writing: Chapterization and Presentation (Language style, headings and sub headings), quotations, tables and figures, footnotes, bibliography/

references, pagenation, typing and font, format of report, APA Reference style

- Ethical considerations in quantitative and qualitative research: accuracy, readability, confidentiality, transparency, honesty, originality, protecting authenticity and plagiarism

**Modes of Transaction:**

Lecture Cum Discussion, Brainstorming, Group presentation, Presentations, Panel Discussion, Seminar Presentations, research exercise.

**Sessional Activities:**

Prospective teacher educators are expected to take any two from the following:

- Preparing a research design for a study by considering the Objectives and the research tools
- Preparation try out and standardization of the research tool
- Critical analysis of research paper for qualitative research
- A critical assessment of the statistical techniques used in research reports and hypotheses.
- Selection and description of appropriate statistical techniques for answering a research question or testing a given hypothesis
- Analysis of the data using any one computer based statistical package .

**Suggested Readings:**


- Edwards, A.L. (1973) Statistical methods for Behavioral Sciences, New York: Holt Rinehart and Winston
- Ferguson, G.( 1981). A statistical analysis in psychology and education, New York: McGraw Hill
- Garret, H.E. (1967). Statistics in psychology and education. Bombay Vakils
- Grbich, Carol(2006) Qualitative Data Analysis: An introduction. SAGE Publication.
- Guilford, J.P. and B. Fruchter.(1987). Fundamental Statistics in education and psychology. Tokyo:McGraw Hills(Student-sixth edition)
- Levin,J. (1977). Elementary Statistics in Social Research. New York: Harpper and Row Publishers
- LitchmanMarilyn(2006). Qualitative research in education-A user Gide. SAGE Publication
- Popham and Sirohic (1993). Educational Statistics- Use and interpretations, New York: Harper and Row
- Quinn,MCNemar . (1969). Psychological Studies, New York: Wiley and Sons.
- मंगल, एस. के. एवंमंगल, एस. (२०१४). व्यावहारिकविज्ञानोमेंअनुसन्धानविधियाँ, प्रेंटिसहॉलइंडियालर्निंगप्राइवेटलिमटेड. नईदिल्ली
- कपिल, एच. के. (२०१६).सांख्यिकीकेमूलतत्त्व. अग्रवालपब्लिकेशन.आगरा


## EC3.2: Understanding and Development of Equitable and Inclusive Education

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain the concept and meaning of inclusive education and different perspectives of inclusive education.
- aware about the legislations and policies for inclusive educations.
- develop critical understanding of the recommendations of various commissions, policies, schemes and committees towards teacher preparation in inclusive education.
- discuss the nature of difficulties encounter and prepare conducive teaching learning environment in inclusive schools.
- identify the global and national commitments towards the education of learners with diverse needs.
- performs how to seek parental, community and NGOs support for utilizing available resources for education in inclusive settings.

**UNIT I** **Introduction to Inclusive Education**

- Concept of Inclusive Education
- Need and Importance of Inclusive Education
- Scope of Inclusive Education
- Target Groups (Diverse Learners, including marginalized groups & learners with disabilities)
- Segregation to Inclusion, Education for All movement

**UNIT II** **Different Perspectives of Inclusive Education**

- Historical and Political Economic perspective of Inclusive Education
- Philosophical perspective of Inclusive Education
- Psychological perspective of Inclusive Education
- Sociological perspective of Inclusive Education
- Concept of Impairment, Disability & Handicap
- Classification of Disabilities based on ICF Model
- Readiness of School & Models of Inclusion, Prevalence, Types, Characteristics
- Educational needs of Diverse learners' Intellectual, Physical & Multiple Disabilities

- Causes & Prevention of Disabilities

**UNIT III Initiatives taken in the direction of Inclusive education**

- At International level: The Universal Declaration of Human Rights (1948), The UN Convention on the Rights of the Child (CRC), International Year / decade of the Disabled Persons (IYDP, 1981), The World Declaration on Education for All and its Framework for Action to meet Basic Learning Needs, (1990), Salamanca Statement and Framework for action on Special Needs Education UNESCO 1994
- At National level: The Indian Education Commission (1964-66), National Policy on Education 1986 (POA, 1992), NEP (2020), Rehabilitation Council of India Act, 1992, The National Trust for the Welfare of Persons with Autism, Cerebral Palsy, Mental Retardation and Multiple Disabilities Act 1999, Sarva Shiksha Abhiyan, RMSA, Samagra Shiksha Abhiyan, RTE-2009 and its amendments, RPWD Act (2016).

**UNIT IV Creating and Sustaining Inclusive Practices**

- Index of Inclusion- culture, policy, and practice
- Factors for Successful Inclusion
- Preparation for Inclusive Education
- Barrier in Inclusive Education
- Building learning friendly classrooms
- Role of teachers, parents and other community members for supporting inclusion of children with diverse needs

**UNIT V Supportive Services for Inclusion**

- Concept, importance and types of supportive services (medical, rehabilitative and educational)
- Early identification and available referral services for support.
- Role of teacher educators in utilizing support services for inclusion (academic supports, resource room support, support of special schools and special teachers, family and community participation, guidance and counselling, NGO collaboration), evaluation methods, techniques & tools
- Research Trends of Inclusive education in India
- Current Status & Ethical Issues of Inclusive Education

**Mode of Transaction:**

- Lecture cum Discussion,
- Group work,
- ICT- Power Point Presentation,
- Use of internet etc.
- field visit to get first-hand experience on inclusive practices,
- Library readings and
- project works.

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Preparation of status report education of learners with diverse needs.
- Evaluation of text books from the perspective of learners with diverse needs.
- Field visit to school/ institutions promoting inclusive practices and discussion with teachers and observation and analysis of teaching learning practices.
- Critical review of policy, practice, and panel discussion by a group of students.
- Critical analysis of NCF-2005 / NCFTE- 2009 for planning quality teacher preparation programme with respect to Inclusive Education.
- Conduct a survey on the type of supportive service needed for inclusion of children with any disability of your choice and share the findings in the class.
- Visit to Special/ integrated/ inclusive classrooms and prepare a comprehensive report
- Visit to a NGO working in the education of LwDNs and prepare a comprehensive report on their contribution and activities.

**Suggested Readings:**


- Ainscow, M. & Booth, T. (2002). Index for Inclusion: Developing Learning and Participating in schools, Bristol: CSIE.
- Ainscow, M., Dyson, A., & Booth, T. (2006). Improving Schools, Developing Inclusion, London: Routledge.
- Ainscow, M. (1999). Unerstanding the Development of Inclusive Schools, London: Falmer Press.
- Booth, T., Nes, K., &Stromstab, M. (2003). Developing Inclusive Teacher Education, London: Routledge Falmer.
- Clough, P., & Corbet, J. (2002). Theories of Inclusive Education A students' Guide, London: Paul Chapman Publishing Ltd.
- Cohen, L., Manion, L., & Morrison, K. (2002). Research Methods in Education, London. Routledge.

- Coleman, M., & Briggs, A. (2002). Research Methods in Educational Leadership and Management, London: Paul Chapman Publishing Ltd.
- Collard, J., & Reynolds, C. (eds) (2005). Leadership, Gender and Culture in Education, Maidenhead: Open University Press.
- Diener, L., & Penny (2010). Inclusive Early Childhood Education 5th Ed. Wadsworth Cengag learning Belmont, CAUSA.
- Gunter, H. (2006). Educational Leadership and Diversity, Educational Management, Administration and Leadership, Special Edition: Diversity.
- Hegarty, S., &Mithu Alur (2002). Education and Children with Special Educational Needs- Segregation to Inclusion, New Delhi: Sage Publication India Pvt. Ltd.
- IEDSS 2009 MHRD, New Delhi.
- Index of Inclusion (2014) NCERT, New Delhi.
- Jangira, N. K., & Ahuja, A. (2002). Effective Teacher Training: Cooperative Learning Based Approach: National Publishing House 23 Daryaganj, New Delhi.
- Jangira, N. K., & Mani, M.N.G. (1990). Integrated Education for Visually Handicap, Gurgaon, Old Subjimandi, Academic Press.
- Jha, M. (2002). Inclusive Education for All: Schools without Walls, Heinemann Educational Publishers, Multivista Global Ltd, Chennai.
- Julka, A. (2006). Inclusive Children and youth with disabilities in Education-a guide for Practitioners NCERT, New Delhi.
- Karantha, P. and Rozario, J. (2003). Learning Disabilities in India, New Delhi: Sage Publications India Pvt. Ltd.
- Loreman, Tin, Deppeler, J., & Harvey, D. (2005). Inclusive Education a Practical Guide to Supporting Diversity in the class, London: Routledge Falmer.
- LowenFeld, B. (1973). (Ed) The Visually Handicapped Child in the School, New York: Jhon Day.
- Mittler, P. (2000). Working Towards Inclusive Education: Social Contexts, London: David Fulton.
- National Policy of Education (1986) (revised 1992).
- Nielson, L. B. (1998). The Exceptional Child in a regular classroom- an Educator Guide Corwin Press Inc. Sage Publication Company, California.
- Orlich, D.C., Harder, R.J., Callahan, R.C., Trevisan, M. S., & Brown, A.H. (2004). Teaching Strategies- A Guide to Effective Instruction (7th edition) New York: Houghton Miffin Company.
- Rao, Indumati et. al. (2011). Moving away from Label, Banglore CBR NETWORK (South Asia).
- Rehabilitation Council of India Act 1992.

- Rehabilitation Council of India Act 2005 Annual Report.
- Right to Education Act 2005.
- RMSA (2009) for detail www.rmsa.nic.in.
- SSA (2002) for detail www.ssa.nic.in
- Stubbs, S. (2002). Inclusive Education Where There Are Few Resources, Oslo, Norway: The Atlas Allince.
- Swarup, S. (2007). Inclusive Education, Sixth Survey of Educational Research, New Delhi: NCERT.
- Thomas, G., & Vaughan, M. (2004). Inclusive Education: Readings and Reflections, Maidenhead; Open University Press.
- Tilstone, C., Florian, L., & Rose, R. (Eds.) (1998). Promoting Inclusive Practice, London: Roultedge.
- UNICEF (2003). Examples of Inclusive Education.
- World Bank (2003). Inclusive Education: Achieving Education for all including those with Disabilities and Special Educational Needs.
- York-Brar, J., Sommers, W. A. et al. (2001). Reflecting Practice to improve school, Corwin Press Inc. A Sage Publication Com[pany, California.
- Ysseldyke, J.E., &Algozzine, B.(1998). Special Education A Practical Approach for Teachers, New Delhi: Kanishka Publishers Distributors.
- RPWD Act, 2016

## EE3.1: Educational Management, Administration and Leadership - I

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain about nature and scope of educational management.
- discuss perspective and structure of educational administartion
- critically examine the various styles of educational leadership and the issues related.
- analyze the challenges and opportunities emerging in the leadership

**UNIT I Meaning, Scope and Process of Educational Management**

- Meaning, nature and scope and theories of educational management
- Principle, function and importance of educational management
- Theories of educational management
- Evolution of the educational management, management as a system, management as process, management as bureaucracy, delegation of authority, control,
- Human relations to management, communication, direction, coordination and unity of command.
- Change Management: meaning, need for planned change, three step model of change (unfreezing, moving, refreezing), Japanese, models of change: just in time, poka yoke, cost of quality: appraisal cost, failure cost and preventable costs, cost benefit analysis, cost specific analysis

**UNIT II Meaning, Scope and Process of Educational Administration**

- Meaning, nature and scope of educational administration.
- Principles, functions and importance of educational administration
- Theories of educational administration.
- Institutional building
- Process of educational administration: purposing, planning, organizing, operating (direction, coordination and control) and evaluating.
- Differentiating (a) educational organization; (b) educational administration (c) educational management.
- Nature and characteristics of educational organization
- Stages to educational administration – centralized vs decentralized
- Educational administration in India, U.K., U.S.A., and U.S.S.R.

**UNIT III Understanding Educational Leadership**

- Meaning and nature of leadership, approaches to leadership
- Theories of leadership
- Leadership traits: responsible, self-disciplined, innovative, imaginative, good at organization, correct in judgment, visionary etc. transformational, transactional, value based, cultural, psychodynamic and charismatic.
- Measurement of leadership.

- Educational administration leadership skills:
  (a) decision making (b) planning (c) co-ordinating
  (d) communicating (e) evaluating (f) feed back.

- Behavioural patterns of educational leadership:
  (a) aloofness (b) production emphasis (c) thrust
  (d) consideration (e) human relationship.

- Styles of educational leadership.
  (a) autocratic (b) laissez-faire (c) democratic

- Models of leadership (blake and manton's managerial grid, fiedler'scontingencymodel , tri-dimensional model, hersey and blanchard's model, leader-member exchange theory)

**Modes of Transaction:**

- Lecture Cum Discussion,
- Brain-Storming,
- Group Discussion,
- Case Studies,
- Group and Individual Field Based Project
- Assignments Followed By Seminar Presentation,
- Workshop on Field Based Topics of Study,
- Panel Discussion,
- Survey,
- ICT Labwork,
- Role Play,
- Field Visits and
- Narration

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- A study of the functioning and contribution towards school development /SMC/PTA/MTA (Any one).
- Preparing a report on review of research articles related to the contemporary issues in administration and management in education
- Explore the community resources a school is utilizing for various purposes.
- On the basis of your experience an interaction in the School/teacher training institution.
- Critically analyze the plan and implementation in any government school under Samagra Shiksha
- Preparing a report on review of research articles related to the contemporary issues in leadership in education

**Suggested Readings:**

• Adolph and Turner Harold, E. Supervision for change & Innovation.
Houghton Miffin Company.
• Bhatnagar and Verma. Educational Supervision. Meerut: International

Pub. House.
• Bhatnagar, R.P. and Agrawal, V (2006) Educational Administration Supervision, Planning and Financing. R.Lall Book Depot, Meerut.
• Campbell R. F. and Gagg R. T.AdministrativeBehavioral in Education, Harper Brothers, New York, 1957.
• Gregory Moorhead & Ricky W. Griffin. n. Mumbai: Jaico Pub. House.
• Griffiths, Daniel E: Human relations in school administration appleton century croft, New York, 1956.
• James M. Liphem : Leadership and administrative in Behavioral Science and administration edited by Daniel E. Griffiths, Chicago, Uni. of Chicago Press, 1964.
• James M. Huges, Human Relations in Educational Organization, Harper and Brothers, New York, 1957.
• Morphel, E. L. R. L. Jones and others: Educational Leadership Prentice Hall, 1959.
• Ronald C. Doll Leadership to improve schools Charles A JOnes Publishing Co., Washington, 1970.
• Robert G. Oweus: Organizational Behavior, Prentice Hall. Inc. Englewood Clifs, 1970.
• S. N. Mukerji: Administration of Education, Planning and Finance, Baroda, Acharya Book Dept, 1970.
• V. Anderson and DaniesDavies: Patterns of Educational Leadership, Prentice Hall, 1956.
• Waber, Clarence A. Fundamentals of Educational Leadership. New York: Exposition Press.

**EE3.1: Educational Technology - I**

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain the nature and scope of educational technology and various forms of technology
- describe the systems approach to Education and communication theories and modes of communication
- define the instructional design and modes of development of self-learning material
- apply and develop the basic skills in the production of different types of instructional material and ability for critical appraisal of the audio-visual media
- demonstrate and exhibits the recent innovations and future perspectives of Education Technology
- appreciate the role of internet as a learning resource and multimedia in education and its production process

**UNIT I Educational Technology: Meaning, Nature and Scope**

- Historical Perspective of Educational Technology
- Meaning and Scope of Educational Technology
- The nature of Educational Technology: Evolution of the concept of Educational Technology, The existing position and latest concept
- Forms of Educational Technology: Teaching Technology, Instructional Technology, Behavioural Technology, Instructional Design Technology
- Educational Technology as Systems Approach

- Major Institutions of Educational Technology in India and their role: CIET, AVRC, EMRC, MCRC, IGNOU, SIET, Consortium for Educational Communication (CEC)-UGC

**UNIT II** **Instructional Strategies**

- Models of Teaching
  - Meaning, definitions and characteristics
  - Types (Families) of Teaching Models: Information Processing Model, Social Interaction Model, Personal Development Model, Behaviour Modification Model
- Designing Instructional System
- Formulation of Instructional Objectives
- Task Analysis
- Overview of Models of Instructional Design- ADDIE Model, ASSURE model
- Dick and carry Instructional Design Model, Gagme's Nine Events of Instruction and five E's of constructivism, Nine Elements of Constructivist Instructivist Design.
- Designing of Instructional Strategies: Concept Mapping, Lecture, Team Teaching, Cooperative Learning, Discussion, Panel Discussion, Seminars, Tutorials
- Programmed Instruction
  - Concept and Types: Linear or Extrinsic Programming, Branching or Intrinsic Programming
  - Development of Programmed Instructional Material: Linear and Branching Model, Teaching Machines, Computer Assisted Instruction

**UNIT III** **Understanding Multimedia**

- Multimedia: Need and Importance
- Multimedia instructional design: planning, process, content structure and sequence, media specification
- Multimedia and learning theory, multimedia in teaching and learning, and multimedia distribution system
- E-content: Design and development, Learning objects and their characteristics, Standards and specifications, Advantages of learning objects
- Using and contributing in Online Resources
  - http://nroer.gov.in/
  - http://slideshare.net/

- https://www.scribd.com/
- https://www.youtube.com/

**UNIT IV Internet as a Learning Resource**

- Internet Terminology: WWW, Browsers, Search Engines, etc.
- Internet: Needed Hardware and Software, Types of networking
- Browsing the internet, Locating internet resources - navigating, searching, selecting, evaluating, saving and bookmarking
- Email, Newsgroups and mailing lists, discussion forums, Social Networking Sites
- Some exemplar websites: Lesson plans for classrooms, Help from experts, Contents in curricular subjects, Educational projects, Simulation of experiments, Milestones on any topic, Online courses/banking, miscellaneous
- Computer Security: hacking, virus, spy ware, misuse, abuse, antivirus, firewall, and safe practices

**UNIT V Technology Integration: Policies, Promises, Challenges and Trends**

- **Policies**
- International Scenario- UNESCO transforming Education: The power of ICT Policies, ICT policies and Practices- Case Studies from European and Asian Countries
- National Scenario- MHRD‘s National Policy on ICT, ICT in CABE Report, National Curriculum Framework-2005 and ICT, National knowledge Network
- Global ICT Policies and Strategies and Indian Perspective
- **Promising Trends**
- Increased online access and connectivity
- Mobile access- ubiquitous computing
- Free and Open Source Software (FOSS)
- Convergence of Hardware and software
- Technological sophistication and affordability
- Digital assistive technology
- **Challenges**
- Equity issues and the digital divide
- Social, ethical, and security issues
- Limitations of technology integration: A critical look at the impact of technology integration
- Technology dependence and learner autonomy

- Capacity Building of Teachers and other Stakeholders
- Availability of Digital Resources
- Development and Sharing of Digital Resources
- Policy Coherence in the Application of ICT for Education Financing and Sustainability

- **Current and Future Trends**
- Emerging role for augmented and virtual reality in education
- Learning analytics and education
- Personalised learning spaces
- Digital badging and games
- BYOD and digital citizenship
- 3D printing and its educational application

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Seminar presentation on approaches to education technology.
- Seminar presentation on Evolution of Education Media
- Locating internal resources, navigating, searching, selecting, saving and evaluating (use standard internet evaluation criteria)
- Evaluating multimedia CD ROMs using standard criteria and study the multimedia evaluation reports available at www.teem.org,uk/
- Developing a multimedia e-content for an educational topic using any authoring tool.
- Critical study of ICT related policies.

**Suggested Readings:**


- Alessi, Stephen. M. & Trollop, Stanley. R., (2001) Multimedia for Learning (3rd Edition), Pearson Allyn& Bacon, ISBN 0-205-27691-1.
- Anderson, T. (2003). Models of interaction in distance education: Recent development and research questions. In Michael G. Moore and William G. Anderson, (eds.) Handbook of Distance Education Mahwah: Eribaum, ISBN 0805839240.
- Crumlish Christian (1999), The internet No experience required, BPB Publications: New Delhi.
- Evant, M: The International Encyclopedia of Educational Technology.
- Lee, William W., Dianna, L. Owens (2001), Multimedia based Instructional design: Computer Based Training, Jossey-Bass.
- Mangal S K, Mangal Uma (2009), Essentials of Educational Technology, PHI Learning Pvt. Ltd.
- Reiser Robert A. and John V. Dempsey (eds). (2006). Trends and issues in Instructional Design and Technology, 2nd edition, Prentice Hall. ISBN: 0131708058.
- Wilson, Brent, G. (1997). Thoughts On Theory In Educational Technology, Educational, January/February 1997 (pp. 22-27).

## EE3.1: Inclusive Education – I

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- Examine issues of identity and diversity in society in general and education in particular
- Appreciate the need for promoting inclusive practice and the roles and the responsibilities of all concerned personnel
- Develop an understanding of the needs and magnitude of the challenges faced by learners with diverse needs
- Develop an understanding of the educational needs of children from the socially disadvantaged background
- Develop an understanding about the characteristics and nurturance of creativity and giftedness
- Develop an understanding about universal design for learning approach and technology

**UNIT I Conceptual Framework**

- Diversity and Inclusion
- Whole school scenario with reference to diversity
- Diversity in the classroom – socio-cultural differences, gender, language, ability
- Learning styles in a classroom
- Social and academic inclusion of learners with diverse needs in classrooms

**UNIT II Educational Needs of the Deprived Children from the Socially Disadvantaged/Deprived Background**

- Socially disadvantaged section in India – the scheduled castes, scheduled tribes; economically disadvantaged group, educationally backward minorities, children from rural areas and urban slum, geographically isolated/hilly terrains, social and emotional problems, children with special health problems and children belonging to other marginalized groups.
- Provision in the Constitution for social group, equity and education of socially disadvantaged groups.

**UNIT III Educational Needs of Children with Sensory Impairments**

- Hearing Impairment: nature and needs, types, identification, implications on development, educational provisions
- Visual Impairment: nature and needs, types, identification, implications on development, educational provisions
- Deaf Blindness: nature and needs, types, identification, implications on development, educational provisions
- As per RPWD Categories of different kinds of disabilities: nature and needs

**UNIT IV Educational Needs of Children with Intellectual Impairments and Developmental Disabilities**

- Intellectual Impairment: degree of impairment, identification, implications on development, educational provisions
- Learning Disability: types, identification, implications on development, educational provisions
- Cerebral Palsy: degree of impairment, identification, implications on development, educational provisions
- Autism: spectrum disorders, identification, implications on development, educational provisions
- Multiple Disability: identification, implications on development, educational provisions
- Difference between intellectual impairment and mental illness
- Creativity: characteristics and nurturance, areas of giftedness and talent academic, music, sports, art, theatre – educational provisions and implications for inclusion
- Mention 21 disabilities as per RPWD

**UNIT V Teaching in Inclusive Setting**

- Teaching in today's inclusive classrooms: A Universal Design for Learning Approach
- Collaboration and cooperation tools for teaching all learners
- Designing learning that works for all students
- Creating literacy rich environment for all learners
- UDL principle, design and implications differentiated instruction

- Contribution of educational thinkers at the National and International levels towards the conceptualization of inclusive education
- Adaptations in instructional objectives, curricular activities for meeting diverse needs of learners
- Role of technology for meeting educational needs of all learners.

**Modes of Transaction:**

- Lecture-cum-discussion
- Group work
- Using ICT
- Field visit to get first-hand experience on inclusive practices
- Library studies
- Project work/Assignment

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- The students will undertake any one of the following activities
- Analysis of policy document (National and International) related to diversity
- Survey the locality for early identification and intervention
- Review of literature related to education of children with diverse needs presentation of reports in a seminar
- Observation of inclusive teaching strategies and discussion
- Planning and conducting multi-level teaching/ use of Universal Design for Learning Approach in the DMS (2 classes)/ or any other school
- Observation of learning styles in a classroom
- Visit to a special school observation of students and study aids and equipments available
- Any other as per the local availability

**Suggested Readings:**


- Gunter, H. (2006). Educational leadership and diversity? Educational Management, Administration and Leadership. Special Edition Diversity.
- Jangira, N.K., & Mani, M.N.G. (1990). Integrated Education for Visually Handicapped. Gurgaon, Old Sabjimandi, Academic Press.
- Jha, M. (2002). Inclusive Education for All: Schools Without Walls. Heinemann Educational Publishers, Multivista Global Ltd, Chennai.

- Loreman, T., &Deppler, J., & Harvey, D. (2005). Inclusive Education - A practical guide to supporting diversity in the class. London: RoutledgeFalmer.
- Lowenfeld, B. (1973) (Ed). The Visually Handicapped Child in School. New York: Jhon Day.
- Nielsen, L.B. (1998). The exceptional child in a regular classroom – An educator' guide. Corwin Press Inc. A Sage Publication Company, California.
- Rao, et al. (2011). Moving away from label. Bangalore CBR Network (South Asia).
- Thomas, G., & Vaughan, M. (2004). Inclusive Education: Reading and Reflections. Maidenhead: Open University Press.
- Tilstone, C., Florian, L., & Rose, R. (Eds.) (1998). Promoting Inclusive Practice. London: Routledge.
- UNICEF (2003). Examples of inclusive education.
- York-Brar, J., Sommers, W.A. et al. (2001). Reflecting practice to improve school. Corwin Press Inc. A Sage Publication Company, California.
- Ysseldyke, J.E., &Algozzine, B. (1998). Special Education: A practical approach for teachers. New Delhi: Kanishka Publishers Distributors.


## EE3.1: Guidance and Counselling - I

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- Describe the meaning, nature and scope of guidance and counselling
- Appreciate the need for guidance and counselling in school
- Develop acquaintance with different techniques of group guidance
- Recognize the role of guidance in attaining the goals of education

- explain the essential services involved in the guidance programme and carry out different guidance and counselling activities
- Develop awareness of the constitution of the school guidance committee, its roles and functions
- define the concept and process of counselling in group situation
- exhibit the acquainted with the skills of an effective counselor and various approaches and techniques of counselling

**UNIT I Guidance, Education and Curriculum**

- Guidance: need, scope and types; techniques of group guidance
- Relation of guidance with education; integration of guidance and curriculum: need and importance
- Role of teachers and other personnels' in guidance programme
- Types of guidance services
- School Guidance: a collaborative effort of school and community; School guidance committee: constitution roles and functions
- Planning and organization of guidance programme in school; Setting up of 'Guidance cell in school'

**UNIT II Understanding Counselling and Counselling Process**

- Meaning, nature, types, scope and principles of counselling, place of counselling in the total guidance programme
- Goals of Counselling: resolution of problems, modification of behaviour promotion of mental health
- Issues, concerns and problems of childhood and adolescence stage: identification of cases for Counselling
- Nature and importance of Counselling relationship
- Stages of counselling process

**UNIT III Counselling: Approaches, Theories, Skills and Techniques**

- Major counselling approaches and theories; and Counseling techniques
- Basic counselling skills-Application of skills for building a positive classroom climate to enhance learning
- Various counselling interventions: behavioral, cognitive and transactional
- Peer counselling: concept and relevance to the school situation
- Family counselling

- Role of teacher as a counselor and the professional ethics

**UNIT IV Diversity in Individuals and Role of Guidance & Counselling**

- Understanding diversity among individuals: Intellectually gifted and creative students, and intellectually challenged students
- Physically-challenged students-role of guidance and counselling
- Socio-cultural diversity: socially disadvantaged students
- Guidance for students with learning disability-meaning and types of learning disabilities; guidance for students with learning disabilities
- Crisis counselling: Counselling for prevention of child abuse, substance abuse, suicide, HIV/AIDS awareness

**UNIT V Guidance for Promoting Psychological Well-being of Students**

- Guidance for human development and adjustment
- Adaptive and non-adaptive behaviours: nature and causes
- School discipline and guidance: violence, bullying, truancy, dropout, students with behaviuoral problems, delinquent behaviour etc.
- Stress: nature, causes and consequences; types of coping skills and developing coping skills
- Promoting psychological well-being and peace through school based guidance programmes
- Alternative therapies: Yoga, Meditation, Reiki, Pranic Healing, Expressive therapies

**Modes of Transaction**

- Lecturer-cum-discussion
- Individual and group assignment through self-study in the library and presentation in a seminar
- Interpretation, analysis and reflection on observation in a group
- Library study
- Project work/assignment
- Workshop
- Group discussion
- Case study
- Small survey

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Conduct a survey of the problems that are most prevalent in schools, which need immediate attention of a guidance counsellor and prepare a brief report.
- Identify a topic for class talk and prepare a detailed outline of the class talk.
- Prepare a list of resources required for setting up a guidance-oriented curriculum.
- Identify personal-social cases for group counselling and prepare counselling plan.
- Explore the possibilities for peer counselling; identify students as peer counsellors and preparing them for peer counselling in the school
- Interact with the counsellor with regard to the process of counselling, nature of problems of the students/clients and write a report.

**Suggested Readings:**


- Bhatnagar, Asha & Gupta, Nirmala (Eds) (1999). Guidance and Counselling, Vol. I: A Theoretical Perspective, New Delhi: Vikas.
- Bhatnagar, Asha & Gupta, Nirmala (Eds) (1999). Guidance and Counselling, Vol. II: A Practical Approach, New Delhi: Vikas.
- Gibson, R. L. & Mitchell, M. H. (1986). Introduction to Guidance. New York: McMillan
- Glickman, C. & Wolfgang, C. (1981). Solving Discipline Problems: Strategies for Classroom Teachers. Boston: Allyn and Bacon.
- Gibson, R. L. & Mitchell, M. H. (1986). Introduction to Guidance. New York: McMillian
- Mathewson, R. H. (1962). Guidance Policy and Practice, 3rd Ed. New York: Harper and row.
- NCERT (2008) Module-1: Introduction to Guidance
- NCERT (2008) Module-8: Guidance in Action
- NCERT (2008) Module-2: Counselling Process and Strategies
- NCERT (2008) Module-9: Special Concern in Counselling
- NCERT (2008) Module-3: Guidance for Human Development and Adjustment
- NCERT (2008) Module-10: Developing Mental Health and Coping Skills
- Pietrofesa, J. J.; Bernstein, B.; & Stanford, S. (1980). Guidance: An Introduction. Chicago: Rand McNally.
- Saraswat, R. K. & Gaur, J. S. (1994). Manual for Guidance Counsellors. New Delhi, NCERT.
- Corey, G. (1986). Theory and Practice of Counselling and Psychotherapy, 3rd Ed. Belment: Calif-Brooks Cole.
- Cormier, L. & Hackney, H. (1987). The Professional Counsellor Englewood Cliffs, New Jersey: Prentice Hall.
- Dave, Indu (1984). The Basic Essentials of Counselling. New Delhi: Sterling Pvt. Ltd.
- Egan, Gerard (1994). The Skilled Helper. 5th Ed. California: Brookes Cole Publishing Co.
- Gazda George R. M. (1989). Group Counselling: A Developmental Approach. London: Allyn Bacon.
- Gladding, Samuel, T. (1996). Counselling: A Comprehensive Profession. New Delhi: Prentice Hall Inc of India Pvt. Ltd.
- Mallon, Brenda (1987). An Introduction to Counselling Skills for Special Educational Needs-Participants Manual. Manchester: Manchester University Press, UK.
- Nugent, Frank A. (1990). An Introduction to the Profession of Counselling. Columbus: Merrill publishing Co.
- Rao, S. N. (1981). Counselling Psychology. New Delhi: Tata McGraw Hill.

## SE3.1:SelfDevelopment

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 4** **Internal: 50**

**LearningOutcomes:**

Oncompletionofthiscoursethelearnershall

- enablethestudents,understandthatthe−developmentofselfisaresourcetoexercise theirprofessionalism,
- make them realize that one is responsible as a person and as a teacher for the integrateddevelopment of oneself and the learners: physical, cognitive, social, emotional, aesthetic,moral,and spiritual developments,
- helpthemdevelopsensitivitytowardssocial-culturaldiversitiescrucialinmakingteaching–learningenvironment conductive/congenialto thelearner and
- demonstrate sensitivity with respect to gender biases and other social disparities in theclassroom,andpracticeinclusivenessintheclassroom.Tohelptheminachievingmentaland physical well-being.

**Theme1 Indian Value System**

- Indian value system- social, economic, political and moral aspects.
- Relevance of Indian values in global context - self control, universal brotherhood (*VasudhaivaKutumbakam*)
- Indian constitutional/National values– democracy, socialism, secularism, equality, justice, liberty, freedom and fraternity
- Professional values- knowledge thirst, sincerity in profession, regularity, punctuality and faith
- Social values- pity and probity, self control and emotional intelligence, Religious values- tolerance, wisdom and character
- Aesthetic values- love and appreciation of literature and fine arts and respect for the same
- National integration and international understanding, impact of global developments on ethics and values.

**Theme 2 Self-Management in Stressful/Emotional (sad as well happy)/ConflictingSituations**

**Objective**

Objective of this activity is to make student recognize the affective resources of self-understanding to be understood both as assets such as feelings of love, joy, appreciation,affection, happiness, and threats or limiting factors such as emotions like fear, anger,jealousyetc. intheirprofessionalism.

**Activities**

Following exercises may be organized in the workshop for inner observation for self- knowingwhilein stress or in emotions andto develop skills of self-management

- Identificationofanyoneoftheabovesituations**(stressful/emotional-sadas wellhappy/conflicting)** by the students, reflect on it and share with the group on how itwasmanaged/resolved

This activity will help students learn about various ways of managing/ resolving criticalsituations in life. Thefocusmaybethe school context.

**Theme3 Developing‘Self‘asProfessional(TeacherEducator)**

Self - Critical awareness about one‘s abilities and assets in different contexts of professionallife and limitations in terms of knowledge, attitudes, skills and values which may be

reviewedordevelopedwhileteachingdifferentsubjects(Science,SocialScience,Mathematics,Languagesetc.)or while dealingwithothercurricularcomponentsorclassroom situations.

**Objective**

The objective of this activity is to develop awareness among students in following aspects of theirprofessionalendeavors

- Adequacy of subject matter knowledge, professional skills, andeffectivecommunicationtothestudents.
- One‘sattitudestowardsstudents,teaching,teachingmaterial,interestinteachingsubject and one‘s aptitude in developing interest in learning among students and intappingtheirabilities to realizethe values identified inthesubject matter.
- Suitability of one‘s role being performed contextually to enrich learners‘ capabilitiesandguidingthem for self-actualization while interacting.
- Involvement in teamwork with colleagues, head of the institution, parents of learnersandmanagementforholisticdevelopment of the learners.

**Activity:Self-ReflectionandDocumentation**

Thestudents will be asked to

- interactwithan eminent educationist/socialactivistandprepareawriteup.
- readabiography/autobiographyofaneminenteducationistandpreparea writeup. On thebasisoftheabovethe students will-
- Identify the characteristics, values, attitudes of the teacher and reflect upon self withrespectto the same.
- Prioritiesthecharacteristics, values,attitudesofaneffectiveteacherandwilltrytodevelopthrough practice in reallifesituationtobecomeaprofessional.
- Reflectuponselfanddocumenttheexperiences.

**EvaluationofSelf-Development**During transaction of this course through workshop mode, student teachers will be asked todevelop**Portfolio**withdocuments. Studentsarerequiredto submit Portfolioin the prescribed

formatwith all evidences.

Note: The **Portfolio** will be assessed by concerned faculty members to award

final marks.Rubrics will be developed with the help of faculty and students. The students and peers mayalsoevaluatePortfolio.

- DocumentationoftheCriticalthinkingpractices;Creativethinkingpractices ;Decisionmakingpractices; and Problem solvingpractices
- Documentation of their reflection on feelings and attitude change on the observationsduringvisitstotheslums/migrantgroups/institutionorNGO‘s workingwithdisadvantagedgroups of children. Teamwork donebythemoutof empathy.
- Documentation of stressed or emotionally loaded situations where in self-observationhelpedtobuild resilience.
- Documentationoftherealitiesfeltduring_naturewalks‘and_nature‘observations.
- Documentationofthedifficultiesfacedinmaintaining_letcome‘and_letgo ‘attitudeandthe abilitytoexperiencethe spells of silenceand its outcomes.
- Identificationanddocumentationofone‘sassetsandlimitationsaswel lasone‘sopportunitiesanddifficulties in theparticipated context.
- Documentation of the ways of dealing with conflicts in inter-personal relations atvariedcontexts.
- Documentationoftheeffectivecommunicationskillswithenrichedunders tandinginrelationto students,their parents, colleagues,authoritiesandoutsiders.
- Documentationofparticipationwhereinhabitualthoughts, attitudesandactionsweredealtto be freeof them togiveplaceforrightthinkingandrighteous living.
- Documentation of critical understanding of the biographies of the great thinkersandeducationists.
- Documentationoftherichcontributionsofthegreatpeople.

**Modesof Transaction:**

Workshopand GroupDiscussion

**SuggestedReadings:**

- Agochiya,Devendra(2010).LifeCompetenciesforAdolescents-TrainingManualforFacilitators,Teachersand Parents,SagePublicationsPvt. Limited,New Delhi
- Dalal,A.S.(ed)(2001).AGreaterPsychology – AnIntroductiontothePsychologicalThoughtsof Sri Aurobindo. Puducherry, SriAurobindo Ashram Pub.
- Delors,J.(1996).LearningtheTreasurewithin–TwentyFirstCenturyEducation.UNESCOEducation Commission Report.
- Krishnamurti,J.(1998).OnSelf-knowledge.Chennai,KrishnamurtiFoundationIndia.
- Krishnamurti,J.(2000).EducationandSignificanceofLife.Chennai,KrishnamurtiFoundationIndia.
- Palmer,J.A.(ed)(2001).Fiftymodernthinkersofeducation,RoutledgePublishers,UKSchneider,F.W.,Gruman, J.A.&Coutts,L.M. (Eds.)(2012).Applied SocialPsychology-
- UnderstandingandAddressingSocialandPracticalProblems,SecondEdition,SagePublicationsPvt. Limited, New Delhi
- Sherfield,R.M.;Montgomery,R.J.;&Moody,P.G.(Eds.) (2009).Cornerstone-Developing SoftSkills,FourthEdition,PearsonEducation
- SwamiVivekananda (1988).SelectionsfromthecompleteworksofSwamiVivekananda.
- Mayavathi,AdvaitaAshrama.
- UNICEF(2006).LifeSkillsModules-AdolescenceEducationProgram.UNICEFHouse,NewDelhi.
- Venkateshamurthy,C.G.&GovindaRao,A.V.(2005).LifeSkillsEducationTrainingPackage.R.I.E., Mysore.

## SE3.1:AcademicWriting

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 4** **Internal: 50**

**LearningOutcomes:**

Oncompletionofthecourse, the learnerwillbeableto:

- facilitatelearnerstounderstanddifferenttypesofwritingandwritingstyles,
- enablethelearnerstowritereports,
- engagelearnerswithjournalisticwriting,
- developcreativewritingskillsamongstlearnersand
- enablelearnerstohandleprofessionalwriting.

**Theme1 Typesofwritingandwritingstyles:**

- Orientationabouttypesandstyles(Narrative,descriptive,persuasive,academic,creative, reflectivejournal).
- Reports:Samplereportsofseminars,projectsreports,researchreports,institutionalreport s,fieldvisit reports should beshown to students. Thisshouldbefollowedbyadiscussion.
- Suggestedtasks---writingreports.

**Theme2 JournalisticWritingandExpositoryWriting:**

- Samplesofbookreviews,filmreviews,editorials,articlesand filmstrips(asperrequirement)can be provided to learners. Discussion can be encouraged amongst learners to understandfeaturesofjournalisticwriting.
- Suggestedtasks---writingbookreviews, filmreviews,editorials, articlesand filmstrips.

**Theme3 CreativeWriting:**

- Learners should be provided exposure to some literary works like poems, stories,

travelogue,dairy and children‘s literature. They can discuss on what makes literary works creative and alsoappreciateaesthetics in literarypieces.

- SuggestedTasks--- writingpoems,stories,travelogue,dairyandwritingforchildren.

**Theme4 ProfessionalWriting**

- Samplesoftheletters,memos,officialminutes, CV,Officialfilesfornotinganddraftingshouldbeshown to learners.Letthem discuss and understandtheformatandcontent.

- SuggestedTasks--- writingletters,resume,note, memosandofficialminutes.

**Theme5 ResearchWriting**

- Conceptual and Theortical articles, Research articles, Research reviews, Book reviews, Abstractanalysis/reviews, Textbook analysis,content analysis, Trendanalysis

**Modesof Transaction:**

- Different theoretical aspects of writing skills will be taught through presentation cum discussionmode. Practical exposure will be given to trainees by reviewing different journals and books forgainingskills andcompetencies in writingresearch projects/reportsandarticles.

**ModesofAssessment**

- Assessment can be continuous and comprehensive, i.e. in each workshop tasks suggested can beusedforthis purpose.

**SuggestedReadings:**


- McCarter,SamandNormanwhitby.ImproveyourIELTSwritingskills,McMillan.NewDelhi,2009.
- Gangal,J.K.DevelopingwritingskillsinEnglish.PHIlearningprivateLtd,NewDelhi,2011.
- Taylor,Shirley.CommunicationforBusiness.Pearson.Delhi,2005.
- Brown,Kristineand SusanHood. Academicencounters.CambridgeUniversityPress, 2002.
- Murrey,R.(2004).WritingforAcademicJournals.Maidenhead:OpenUniversityPress.

## PC3.1: Internship in TEI

**Credits: 2** **Max Marks: 50**

**Two Weeks Attachment** **Internal: 50**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- Plan and implement learning experiences on a unit.
- Assess students' performance
- Prepare profile of an Institution
- observe and get acquainted to different activities of a school teacher
- Perform different activities as a school teacher

**Organization**

The internship will be organized in two phases in a pre-service teacher education institution and in an in-service teacher education setting. Necessary orientation to the students of this programme and mentor teacher educators from the respective institutions of teacher education will be provided before organizing the internship.

**Activities**

**Task Set 1: Pre-service Teacher Education (2 weeks)**

- Under the guidance of a mentor teacher educator, undertake planning and implementation of learning experiences on a Unit from the prescribed course in the pre-service teacher education curriculum.
- Plan assessment criteria/tools and evaluate the performance of student teachers on the Unit transacted.
- Based on the acquaintance with various activities, infrastructure and resources of the teacher education institution, prepare an institutional profile with reflections on the experiences gained

**Task Set 2: In-service Teacher Education (1 week )**

- Undertake assessment of training need through an interview with practicing teachers
- Observe and analyze an in-service teacher education programme
- Review the TLM developed *I* the report of an in-service teacher education

**Evaluation and Scheme of Assessment**

Evaluation of performance during internship in teacher education will be done on the basis of assessment by institute supervisors and mentor teacher educators, and records/reports submitted by the students.

## Semester 4

**EC4.1: ICT in Education**

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal Practicum: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- Distinguish between related hardware and software and their uses in educational context
- Know about ICT in general and ICT in education in particular
- Appreciate need, issues and challenges related to ICT in education
- Understand the role of ICT in education in decision making
- Understand the issues related to integration of technology in Inclusive Education
- Know about assistive technology and its worldwide uses in Inclusive Education

**UNIT I** **ICT in Education: Essentials**

- The need for ICT: Literacy Redefined, Implications for Education, Lifelong Learning, 21st Century Skills
- Information and Communication Technology (ICT)
  - Purpose, terminologies and definitions
  - Stages of development
  - Characteristics of Digital Natives
- Integrating ICT as tool in education-
  - Accessible Education
  - Improved quality of education
  - Efficient management tool

**UNIT II** **Role of ICT in Education**

- ICT for Professional Development of Teachers
- ICT for Open and Distance Learning
- ICT Enabled Teaching Learning Processes
- ICT for evaluation specially for continuous and comprehensive evaluation
- ICT for Management and Administration of Education System

- ICT for Skill Development
- ICT for Children with special needs

**UNIT III Technologies in ICT**

- Technologies
  - Radio: Cost-effective mass communication
    - Mainstream and distance education
    - Radio Strategies for use: Fly-away radio stations, Radio in a (Bigger) box, Using local radio stations
    - Examples in Indian context
  - Television
    - Benefits of television for learning
    - Divergent television
    - Examples in Indian context
  - Assistive and Adaptive learning technologies
  - Audio Cassettes, iPods, Podcasting and Video
  - Computer Technologies
    - Computers in schools
    - Computer outside school
  - Application of Computers in Education CAI, CAL, CBT, CML
  - Internet-dependent Technologies
    - Pros and Cons of internet use
    - Online education
    - Web 2.0: Online chat, Content Management System, Online Forum, Simulation, Weblog, WebQuest, Wikis
  - Open Educational Resources (OER) (Creative Common, Massive Open Online Courses: Concept and Applications)
  - Wireless Technology and Satellite based technologies
  - ICT initiatives in India- CIET, IGNOU, SIET, UGC-CEC, EDUSAT

**UNIT IV E-learning**

- Concept, Attributes/Features of E-learning
- Types/categories of e-learning
- E-Learning Technologies
- Pedagogical Approaches to E-Learning

- Tools for Offering E-Learning
  - Web Servers, LMS (Learning Management System), LCMS (Learning Content Management System), KMS (Knowledge Management System),
  - Collaboration Authoring Tools (eXe-Learning, Xerte), Media Server
- Tools for Creating E-Learning Contents-
  - Course Authoring Tools (Web CT, Moodle), Course Lab – for creating high quality interactive e-learning content, eXe – to design, develop and publish web based learning and teaching materials
  - Website Authoring Tools, Texting and Assessment tools
  - Screen casting tools (camtasia) for creating screen casting presentations
  - Animation -2d animation (Pencil, Tupi)
  - Graphic editing
    - Timeline (timeline) for creating time lines
    - Picture/photographs (GIMP/Mypaint)
    - Concept map ( freemind, Cmap, VUE)
  - E-book tools (sigil, calibre) for creating and editing e-books
  - Measuring quality of System: information System service, user satisfaction and Net Benefits (D & M in Success Model, 2003)
- E-learning Platforms
  - https://www.coursera.org
  - https://www.wiziq.com/

**UNIT V E-Learning Trends**

- Personalized and Co-operative E-Learning
- Social and Collaborative E-Learning
- Gamification and Video E-Learning
- Micro Learning
- Mobile Learning
- Blended Learning
- Research trends in E-Learning

**Modes of transaction:**

- Lecture-cum discussion
- Individual and group assignment through self-study in the library and presentation in a seminar
- Demonstration
- interpretation, analysis and reflection on observation in a group
- Role play

- Library study
- Project work/Assignment
- Workshop
- Group discussion
- Small Survey

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Practice in installing various system and application software.
- Using word processor, spreadsheet and presentation software to produce various teaching learning resources.
- Comparative study of ICT syllabus of school education and teacher education of various organizations.
- Developing and electronic assessment portfolio
- Developing and electronic teaching portfolio
- Evaluating multimedia CD ROMs using standard criteria and study the multimedia evaluation reports available at www.team .org.uk/
- A study of EDUSAT and teleconferencing/
- Creating an account in Wikipedia/wikieducator/wikispaces and adding/editing content.
- Creating an account in teacher tube/slide share and sharing your video/Power Point. View in www. blogger.com, www.wordpress .com
- Developing an educational blog in www.blogger .com www.wordpress.com
- Downloading, installing and using free and open source antivirus programmes.
- A study of status of technology integration in teacher education institutions.
- Critical review of UNESCO ICT Competency Standards for Teachers-2008

**Suggested Readings:**


- Ahalpara, D. P. and others (2001), "Introduction to Computers-Std. 9" Gujarat State Board of School Textbooks, Gandhinagar.
- Ahalpara, D. P. and others (2001), "Introduction to Computers-Std, 10" Gujarat State Board of School Textbooks, Gandhinagar.
- Aptech Limited (1999), MS-Office 97, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Bartee, Thomas C. (1983)." Digital Computer Fundamentals", McGraw-Hill International Book Company.
- Bharihok Deepak (2000), Fundamentals of Information Technology Pentagon Press, New Delhi
- CIStems School of Computing (2000) Jaipur "Internet: An Introduction", Tata McGraw –Hill Publishing Company Limited, New Delhi.
- Denis, Kim, Sen and Morin (2000), "Information Technology-The breaking Wave", Tata McGraw –Hill Publishing Company Limited, New Delhi.
- Jain Amit; Sharma Samrat; &BenarjiSaurab (2002), Microsoft Word for Beginners, NISCOM, CSIR, New Delhi
- Jain Amit; Sharma Samrat; &BenarjiSaurab (2002), Microsoft Excel for Beginners, NISCOM, CSIR, New Delhi
- Jain Amit; Sharma Samrat; &BenarjiSaurab (2002), Microsoft Power Point, NISCOM, CSIR, New Delhi
- James, K. L. (2003) The Internet: A User's Guide, Pentice Hall of India Pvt. Ltd., New Delhi
- Meredith Marilyn and Rustkosky Nita (2000), "Advanced Microsoft Office-2000", BPB Publication, New Delhi.
- Madaan, Gupta and Arya. "The Illustrated Computer Dictionary", Dreamland Publication, New Delhi.
- Malik Utpal et al. (2001), Learning with Computer level-III, NCERT, New Delhi

- Meredith Marilyn and Baber Roberta (1998), "Computers in Your Future", Prentice-Hall of India Pvt. Ltd., New Delhi.
- Roblyer, M. D. (2006), Integrating Educational Technology into Teaching, Upper Saddle River, NJ: Pearson, Education Inc.
- Sandars, Donald, H (1998), Computer Today, McGraw Hill Book Company, New Delhi
- Sarkar S K & Gupta, A K (1998), Elements of Computer Science, S Chand & Company, New Delhi
- Saxena Sanjay (2000), A First Course in Computers, Vikas Publishing House Pvt. Ltd., New Delhi
- Sememov, Alexy (2000) Information and Communication Technologies in Schools, A handbook for Teachers, UNESCO
- Singh, V. P. and Singh Meeanakshi (1999), "Computer-Terms and Definitions", Asian Publishers, New Dehli.
- Sitaram, B. R. and others (2001), "Introduction to Computer-Std. 8", Gujarat State board of School Textbooks, Gandhinagar.
- Tehenbaum, Andrews (1995), Computer Networks, Prentice-Hall of India Pvt. Ltd., New Delhi.
- Tehenbaum, Andrews (2003), Modern Operating System, Prentice-Hall of India Pvt. Ltd., New Delhi.
- UNESCO's set of seven CDs with special reference to UNESCO Bangkok E-Learning Series on Information and Communication Technology (ICT) in Education, ISBN: 978-92-9223-259-7, URL: http://www, unsecobkk.org/education/ict/
- CD on ICT and Curriculum, CIET, NCERT production.


## EC4.2: Teacher Education

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- gain insight and reflect on the concept of teaching and the status of teaching as a profession,
- examine the nature of teacher education,
- appreciate the historical development of teacher education in India,
- assess the relevance of the present teacher education Curriculum and
- reflect on various issues and concerns related to teacher education
- describe the perspectives of teacher education
- classify the structure and management of teacher education
- explain the quality assurance in teacher education
- review researches in teacher education

- identify problems and issues in teacher education

**UNIT I Teachers and Teaching Profession**

- Concept and nature of teaching
- Teachers in India: The changing profile; changing roles and responsibilities of teachers and its demands on teacher education
- Teaching as a profession: characteristics of a profession; professional ethics for teachers; teacher autonomy and accountability
- History of teacher education in India: trends, developments and forces that shaped teacher education.
- Reports of International and National Commissions on education with reference to teacher education (Learning the treasure within and National Knowledge Commission)

**UNIT II Preparation of School Teachers**

- Teacher education institutions: RIEs, University departments of Education, NTTIs, DIETs, CTEs and IASEs.
- Organization & Models of In-service Teacher Education.
- Models and outcomes of pre-service teacher education :

**Face to Face Mode:** elementary level - 1 year model; 2 years model; 4 year integrated model secondary level -; one year model; two year model;

**Distance Mode:** One-year model; 2 years model.

- Preparation of teacher for senior secondary level, vocational stream and for inclusive settings.
- Concept, Need, Purpose & Scope of In-Service Teacher Education.

**UNIT III Curriculum Organization and Continuing Professional Development of Teachers**

- Vision in Curriculum Documents at various levels.
- Teacher education curriculum: overview of curriculum frameworks for teacher education (1978, 1988, 1998, 2006 and NCFTE 2009, 2014) and vision of NCERT & NCTE towards teacher education.
- Concept and importance of Professional Development

- Approaches of Professional Development: in-service education; self-study; participation in seminars; workshops, panel discussion, Symposium; organization of study groups and study circles
- INSET and Extension education: concept and methodology, training need assessment strategies; formulation of programme proposal, development of content for training modules, organization of training; preparation of Self-Learning Material (SLM), monitoring, evaluation and impact assessment.

**UNIT IV Perspectives of Teacher Education**

- Teacher Development: concept, factors influencing teacher development – personal and contextual.
- Teacher Expertise – Berliner‘s stages of development of a teacher.
- Preparation of teachers for various disciplines i.e. art, craft, music, and physical education - existing programmes and practices
- Structure of teacher education system in India - its merits and limitations.
- Review of Recommendations of various committees andcommissions, regulatory bodies related to teacher education; Kothari Commission, Justice Verma Committee, NPE 1986, POA 1992, NCFTE 2009, NCTE Regulation 2014. ( NCTE,2009 to be included)
- Universalization of secondary education and its implication for teacher education at secondary level (Samagra Shiksha)

**UNIT V Quality Assurance in Teacher Education**

- Meaning of quality assurance and its indicators in teacher education; TQM
- Competency based performance and commitment oriented teacher education.
- Teacher appraisal and accountability.
- Role of different agencies in quality assurance of teacher development: DIETs, SCERT,CTE, IASE, NCERT, NIEPA, UGC
- Assessment of Quality of teacher education programme/ institutes NCTE, NAAC
- In-service Teacher Education at District, State & National Levels (CSSA, RMSA, SCERT, NCTE & UGC)
- Issues related to enhancing teacher competence, commitment and teacher performance.

- Code of conduct and professional ethics for teachers
- Reforms in teacher education recommended in NEP 2020

**Modes of Transaction:**

- Lecture cum discussion,
- Brainstorming,
- Group Discussion,
- Presentation,
- Panel Discussion,
- Seminar Presentation

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Relevance of Teacher Education Curriculum
- Writing review of at least one book related to Teacher Education
- Critical Study of Curriculum Frameworks- 1978, 1988, 1998, 2006
- Preparation of Training Plan for INSET giving the rationale, target group, costing of resources and phases of training
- Book Review (at least one book on Teacher Education)
- Analysis of written supervisory remarks by Peers and Supervisor
- Construction of tools for identification of Training Needs
- Preparation of Self learning Material for D.Ed/B.Ed students on identified topic
- Appraisal of norms/ standards of teacher education developed by NCTE
- Study of Reports of various committees and commission with reference to Professional Development of Teachers
- Select any one current practice in teacher education and trace the background of its formulation as a policy e.g. Internship in teaching
- A Critical Appraisal of researches in areas of Teacher Education
- Critical Review of atleast one Training Material/Package developed by the national/state/district level training institute
- Review on Unplanned growth of teacher education instititutions
- Discussion on the recommendations of NEP 2020

**Suggested Readings:**


- Arora, G.L. (2005). Teachers and Teaching: Need for New Perspectives. Ravi Book, Delhi
- Canon, L. &Monin, L. (1978). A Guide to Teaching Fanciness. London: Mtehner& Co. Ltd.
- Cohen, L., Minion, L. & Morrison, K. (2004). A Guide to Teaching practice (5th ed.). Routledge Falmer, London and New York
- Coomb, A.W.et al. (1974). The Profession Education of Teachers: A Humanistic Approach to Teacher Training, Boston: Allyaon&Becon Inc.
- Digi libraries https://digilibraries.com/
- Flanders, N.A. (1970). Analysing Purching Behaviours. Massachusetts: Addison Wesley Publishing Co Reading.

- For B.Ed textbooks by NCERT.: https://ncert.nic.in/desm/b-ed-textbooks.php?ln=
- Gage, N.L. (1963). Handbook of Research on Teaching. Chicago: Rand McNally College Publishing Co.
- Herne, S., Jesserl, J. & Griffith, J. (2000). Study to Teach: A Guide to Studying Teacher Education. Routledge Falmer, London and New York.
- https://en.wikipedia.org/wiki/National_Policy_on_Education#:~:text=The%20policy%20covers%20elementary%20education,Minister%20Narendra%20Modi%20in%202020 and https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- https://ncert.nic.in/desm/b-ed-textbooks.php?ln=hi
- Joyee, B. & Showers, B. (1983). Power in Staff Development Through Research on Training. Alexandria VirgnIs: ASCD.
- Learning outcomes https://ncert.nic.in/learning-outcome.php
- National digital library https://ndl.iitkgp.ac.in/
- National policy of education
- NCERT (2005). Teacher Education for Curriculum Renewal. NCERT, New Delhi. https://ncert.nic.in/pdf/focus-group/teacher_edu_final.pdf
- NCF 21 position parents NCFs and XXI National Focus Group Position Papers https://ncert.nic.in/focus-group.php?ln=
- NCTE (1988). Competency based and Commitment oriented teacher education for quality education; Pre service education. NCTE, New Delhi
- NCTE (1988). Competency based and Commitment oriented teacher education for quality education; In service education. NCTE, New Delhi
- NCTE (1988). Policy Perspective in Teacher Education- Critique and Documentation. NCTE, New Delhi. https://ncert.nic.in/focus-group.php?ln=
- NCTE (2006). Curriculum Framework for Teacher Education for Quality Education. NCTE, New Delhi. http://14.139.60.153/bitstream/123456789/1352/1/Curriculum%20Framework%20for%20Teacher%20Education%202006%20D-14456.pdf
- NCTE (2009). National Curriculum Framework for Teacher Education (NCFTE) Towards Preparing Professional and Humane Teacher. NCTE, New Delhi. https://ncte.gov.in/website/PDF/NCFTE_2009.pdf
- NCTE (2014). NCTE Regulations, 2014. NCTE, New Delhi.https://ncte.gov.in/WebAdminFiles/RCDownloadMaterial/NormsE-2014.pdf
- Rahman, H. (2005). Key Issues in Teacher Education; Teachers for Secondary Schools. Sanjay Prakashan, Delhi
- Raina, V.K. (1988). Teacher Educators: A Perspective. Vikas Publishing House, New Delhi
- Shodhganga: a reservoir of Indian theses https://shodhganga.inflibnet.ac.in/

## EE4.1: Educational Management, Administration and Leadership - II

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain about developmental process of educational management.
- discus perspective and structure of educational management
- identify the dynamics of educational management and trends in educational administration in India
- Critically examine the present administrative/managerial practice and the issues related.
- analyze the challenges and opportunities emerging in the management.
- define the nature of leadership and approaches
- describe the dimensions of leadership
- explain the concept of educational supervision
- identify Criteria for conducting school appraisal
- implementing the Supervisory Programme and Quality Management

**UNIT I** **Perspective and Structure of Educational Management**

- Management at different levels- Secondary and Higher Education,
- Constitution and Role of Different institutional management,

a) School Management Committee (SMC), (b) School Management Development Committee (SMDC), (c) Parents/Guardians/Teachers

- Emerging substructures: implications for management: Open School System, Open University system, NavodayaVidyalayas, KVS, KGBV and others.
- Role & Initiative of special agencies in Indian education: MHRD, UGC, CABE, NCERT, NUEPA, ICSSR, NCTE, Local Bodies and Private Agencies etc.
- India and International quality assurance agencies: Objectives, Functions
- Performance Indicator, National Assessment accreditation council (NAAC), Quality council of India (QCI), International Network for Quality Assurance Agencies in Higher Education (INQAAHE)

**UNIT II Developmental Process of Educational Administration**

- Development of Modern Concept of Educational Administration from 1900 to Present – day; The Period between 1900-1935, The Period between 1935-1950, The Period between1950 and onwards
- Specific trends in Educational Administration;

a) Decision making,
b) Organizational climate
c) Organizational change
d) Organizational Compliance,
e) Organizational Development,
f) Management by objectives(MBO)

PERT, (Programme, Evaluation and Review Technique), TaylorismSWOT Analysis, CPM

- Educational Administration in India, U.K., U.S.A., and U.S.S.R.

**UNIT III Dimensions of Educational Leadership and Supervision**

- Concept of Leadership as a: policy formulator, planner, an organiser, decision maker, co-ordinator, maintainer of human relationship with teacher-educators, an innovator , guardian, and community mobilizer
- Obstacles to Educational leadership: Resources and priorities, Political pressures, Social pressures, Personal antagonism.
- Meaning, Nature and importance of supervision
- Supervision as Service Activity, Supervision as a Process, Supervision as Functions, Supervision as Educational Leadership
- Functions of Supervision
- Planning of Supervisory Programme
- Organizing Supervisory Programme
- Factors Influencing Supervision

**Modes of Transaction:**

- lecture cum discussion,
- brain-storming,
- group discussion,
- case studies,
- group and individual field based project
- assignments followed by seminar presentation,
- workshop on field based topics of study,
- panel discussion,
- survey,
- ICT labwork,
- role play,
- field visits and
- narration etc.

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Study of leadership quality of educational administrator Head of the institution.
- Write essay on organizational compliance, group dynamics, conflict management, motivation of the staff and participatory decision making for effective educational leadership at school level.
- Supervision of in service and pre service teacher training program in DIET/RIE/SCERT/CTE/IASE

**Suggested Readings:**


- Adolph and Turner Harold, E. Supervision for change & Innovation. Houghton Miffin Company.
- Bhatnagar and Verma. Educational Supervision. Meerut: International Pub. House.
- Bhatnagar, R.P. and Agrawal, V (2006) Educational Administration Supervision, Planning and Financing. R.Lall Book Depot, Meerut.
- Campbell R. F. and Gagg R. T.AdministrativeBehavioral in Education, Harper Brothers, New York, 1957.
- Gregory Moorhead & Ricky W. Griffin. n. Mumbai: Jaico Pub. House.
- Griffiths, Daniel E: Human relations in school administration Appleton century croft, New York, 1956.
- James M. Huges, Human Relations in Educational Organization, Harper and Brothers, New York, 1957.
- James M. Liphem: Leadership and administrative in Behavioral Science and administration edited by Daniel E. Griffiths, Chicago, Uni. Of Chicago Press, 1964.
- Morphel, E. L. R. L. Jones and others: Educational Leadership Prentice Hall, 1959.
- Robert G. Oweus: Organizational Behavior, Prentice Hall. Inc. Englewood Clifs, 1970.
- Ronald C. Doll Leadership to improve schools Charles A Jones Publishing Co., Washington, 1970.
- S. N. Mukerji: Administration of Education, Planning and Finance, Baroda, Acharya Book Dept, 1970.
- V. Anderson and DaniesDavies: Patterns of Educational Leadership, Prentice Hall, 1956.
- Waber, Clarence A. Fundamentals of Educational Leadership. New York: Exposition Press.

## EE4.1: Educational Technology -II

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain meaning and need of integration of ICT in education
- describe concept and technologies related to e-learning
- appreciate the power of different tools and softwares in different school subjects
- produce educational audio and video programmes
- analyse the role of ict for teacher, educational administration and management

- aware about different ict tools and software used in assessment

**UNIT I** **Technological Pedagogical Content Knowledge (TPACK) and E-learning Standards**

- Technological Pedagogical Content Knowledge (TPACK)
- The Challenges of Teaching with Technology
- An Approach to Thinking About Technology Integration
- The TPACK Framework
- Content Knowledge
- Pedagogical Knowledge
- Pedagogical Content Knowledge
- Technology Knowledge
- Technological Content Knowledge
- Technological Pedagogical Knowledge
- Technology, Pedagogy, and Content Knowledge
- Implications of the TPACK Framework
- Evaluating E-content
- Objectives and student learning outcomes
- Instructional activities
- Assessment
- Interaction/Communication and feedback
- Instructional materials
- Layout/interface design
- Multimedia usage
- Course management

**UNIT II** **Subject Specific ICT Software and Tools**

- Language Learning
- Issues in ELL and foreign language instruction: Challenges presented by diversity, Language learning versus language acquisition in foreign language programmes, Required standards from TESOL and ACTFL
- Instruction strategies for integrating technology: Support for authentic oral and written practice (leapfrog.com), Support for practice in language sub skills (rosettastone.com, transparent.com), Presentation aids (2learn.ca), Support for text production (translation.net), Virtual field trips for modified language immersion experience (tramline.com), Virtual collaborations (globalschoolnet.org, iearn.org/projects), Productivity and lesson design (esl.net, babelfish. altavista.com)

- Software and tools for Language Learning: Eclipse Crossword for crossword puzzles; For English alphabet: JILetters, Learn Letters, Sephonics; For alphabet and numbers: Roxie‘s ABC Fish, Sebran‘s ABC; Selingua for vocabulary training

- **Mathematics**

- Issues and problems in Mathematics Instruction: Accountability for Standards in Mathematics, Challenges in implementing the principles and standards for school mathematics

- Software and tools for Mathematics instruction: 2 + 2 Basic mathematics tool, Kid‘s Abacus – to learn numbers, Tux of Math Command mathematics drill game, TuxMathScrabble word game, Geogebra dynamic mathematics software, Graph to draw mathematical graphs, GraphCalc for everyday arithmetic to statistical analysis, Maxima for manipulation of symbolic and numerical expressions

- **Science**

- Issues in Science instruction: Accountability for Standards in Science, The narrowing pipeline of Scientific talent, Increasing need for scientific literacy
- Strategies for integrating technology: Supporting authentic science experiences (see the GLOBE project), Supporting scientific inquiry skills (see the Exploratorium), Supporting science concept learning (see example simulations), Accessing science information and tools
- Software and tools for science: PhET for simulations of physical phenomena, Physion physics simulation software, Solve Elec for electrical circuits, Virtual Lab Simulation software for experiments in chemistry

- **Social Studies**

- Issues in social studies instruction: Methods of addressing social studies standards, Dilemmas in teaching social studies effectively, Perils of the information explosion
- Strategies for technology integration: Simulated immersion experiences (see Muzzy Lane simulation), Graphic representations (see Tom Snyder‘s Time liner software), Virtual trips (see the Bodie, California, site), Student telecollaborations (see the Global School House-Global SchoolNet and International Education and Resource Network sites), Digital storytelling (see the Oral History Society Home Page), Digital information critiques (see PBS‘s Don‘t Buy It website), GIS and GPS lessons (see the ESRI website)
- Software and tools for Social studies: Solar System 3D Simulator, World Wind – to zoom from satellite altitude into any place on Earth, Atlas of World History – map animation software, Celestia space simulation, Seterra

geography programme with various exercises, StatPlanet – data visualization tool

- Arts, Graphics and Animation: BlockCAD building virtual models, Kea Coloring Book, Tux Paint drawing programme, Blender 3D graphic application, Dia – for informal diagrams, Gimp – graphics editor to process digital graphics and photographs, Inkspace – vector graphics editor
- Computer Literacy: Kiran‘s Typing Tutor, Little Wizard - computer development environment, OpenOffice4Kids fully functional office suit, Open Office office software, Scratch to create interactive stories, games, music and art, Tux Typing - for practicing typing, Alice - to object oriented programming, RobotProg to learn programming bases, Free Mind – mind mapping application, Gantt Project for project, Sribus DTP application

**UNIT III Educational Multimedia Production**

- Script Writing
- Hardware and software requirement
- Multimedia Systems and Software: Audacity audio editor and recorder, LMMS – to produce music, Muse Score music score writer, Songbird music player, VLC Media Player multimedia player
- Hardware: Voice Recorder, Camera, Camcorder, Scanner, Interactive White Board, Multimedia Projector
- Integration strategies for Video Production and Editing System
- Video (openshot/avidmux) tools for creating, editing and sharing,
- Working with Windows Movie Maker

**UNIT IV ICT for Teacher, Educational Administration and Management**

- Introduction: Role of teacher, ICT as library of learning resources, ICT in teacher training and ICT in management of examination
- Upgradation of Teacher Skills: Lesson plans, sharing lesson plans, FAQ‘s on any topic, curriculum development, ICT as an enhanced support, ICT as a partial support / Resource person,
- Better Teaching Practices: Online training, online educational projects, collaborative and interactive projects
- ICT for Educational Administration and Management: Collaborative Management, Commerce and Finance, Conference Management, Document Management, Issue Tracking, Learning Management System, Local Server, Mailing List, Online Journals, Online Survey, Picture Management, Project Management, School Management, Search Engine, Web counter

**UNIT V ICT for Evaluation**

- The role of ICT in evaluation

- Tools and techniques of ICT for evaluation
- E-portfolio
- Rubrics for assessment
- ICT assisted Self-Assessment
- Computer-Assisted Testing
- Providing Feedback through ICT
- Interacting with appropriate software- e.g.; Hot Potatoes – to create exercises for world wide web, iRubric, Edmodo, Polldaddy, Mahara, Sakai

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Developing an ICT integrated unit plan.
- Taking part in an integrated online project based or problem based learning activity.
- Survey of innovation practice in ICT integration in education.
- Developing a multimedia e-content for an educational topic using any authoring tool.
- A critical study of some e-learning courses and enrolling and completing some free e-learning courses.
- Critical evaluation of ICT integration efforts in the country.
- Developing and implementation an e-learning course.
- Developing an audio on an educational topic using software.
- Developing video on an educational topic using software.
- Developing an animated video on an educational topic using software.
- Critical study of ICT integration research studies. May use the reports available at www.publications. bectaorg,uk
- A study of status of technology integration in teacher education institutions
- Critical review of UNESCO ICT Competency Standards for Teachers 2008
- Developing e-rubrics with the help of rubistar.
- Developing an electronic assessment portfolio.
- Developing an electronic teaching portfolio

**Suggested Readings:**


- http://punya.educ.msu.edu/publications/journal _articles/mishrakoehier-tcr2006.pdf
- http://www.citejournal.org/vol9/iss1/general/article1.cfm
- http:www.matt-keohler.com/tpack/tpack-explained/
- Conard, Keri (2001), Instructional Design for Web Based Training, HRD Press
- Cox, M. J. & Webb, M. E. (2004) ICT and Pedagogy: a review of the research literature. Coventry: British Educational Communications and Technology Agency
- David Moursund (2005), Introduction to Information and Communication Technology in Education, David Moursund
- Koschmann, T. (1996). Paradigm shifts and instructional technology: An introduction, Chapter 1 in CSCL: Theory and practice, ed. T. Koschmann. Mahwah, N. J. LawenceEribaum Associates

- Lou, Yiping, Robert M. Bernard and Philip C. Abrami (2006). Media and Pedagogy in Under Grade Distance Education: A Theory-based Meta-Analysis of Empirical Literature. Educational Technology Research and Development 54 (2), 141-176 ISSN 1042-1629
- Webb, Mary and Margaret Cox, A review of pedagogy related to information and communications technology, Technology, Pedagogy and Education, Volume 13, Number 3/ October 2004, pp.235-286, DOI:1080/14759390400200183
- UNESCO's set of seven CDs especially, CD no 4, 5, and 6, URL: http://www.unescobkk.org/education/ict/
- CD on ICT and Curriculum, CIET, NCERT production


## EE4.1: Inclusive Education - II

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- explain concerns, challenges and issues in implementation of IE
- aware about controversial issues in inclusive education, including particularly marginalized groups, specific learning difficulties and the future of special schools
- enhance the ability to conduct and supervise research and action research activities
- explore research skills and understanding of various methods and tools used in research in ie in order to explore these issues further
- identify, analyse and utilize various techniques and methods required for development of practical skills among learners
- apply assistive devices and strategies for meeting diverse needs
- promote a positive attitude and sense of commitment towards actualizing the right to education for all learners
- develop an understanding of evaluation and alternative assessment

**UNIT I Teacher Preparation for Inclusive Education**

- Critical analysis of the curriculum of institutions preparing teachers with reference to Inclusive Education National and International
- Discussion on best practices in teacher preparation National and International
- Need identification of in-service teachers in addressing the diversities in the classroom
- Professional Growth of Teacher Educators (Sharing of Success Stories)

**UNIT II**

- **Resource Mobilizations and Coordination for Inclusive Education**
- Concept and Importance of Human and Material Resources
- Different Agencies at the national and state level to mobilize the resources
- Coordination among school, family and community and their specific roles and responsibilities

Managerial skills for mobilizing appropriate resources

**UNIT III** **Removal of Barriers for Effective learning**

- Physical Barrier- Physical Accessibility to school and classrooms to learners with physical disabilities, environmental barriers: Doors, Passage ways, stairs and ramps and recreational areas
- Socio-psychological- attitude of the society and individual towards learners with diverse needs, social discrimination, lack of awareness and traditional prejudices
- Academic barriers- Curricular, Pedagogical and Assessment.

**UNIT IV** **Changing Roles of Education in Schools**

- Assistive Devices and Strategies for meeting learning needs of diverse learners
- Techniques and methods used for adaptation of content, laboratory skills and organizing inclusive sports activities, yoga, arts and crafts, theatre, drama, etc.
- Challenges and Issues in implementation of inclusive education, controversial issues in inclusive education including particularly marginalized groups, specific learning difficulties and future of special schools, context in which these controversial issues in inclusive education arise
- Need for flexible evaluation system and alternative assessment

**UNIT V Research Educational Technologies and ICT in Inclusive Education**

- Diversity and debates about what this means for research and practice, planning and conducting research activities, selecting appropriate areas of research, research methods and research tools (case study, indepth interviewing, ethnography and observation, narratives, documents and diaries) needed, steps involved in planning and supervising research activities, recent trends in research in inclusive education, action research approaches
- Role of ICT in Inclusive Education, Accessible ICTs in support of inclusive education, roles for the use of accessible ICTs in Education, ICT and Inclusive Curriculum and benefits of accessible ICTs

**Modes of Transaction:**

- Lecture-cum-discussion
- Group work
- Using ICT
- Field visit to get first-hand experience on inclusive practices
- Library studies
- Project work/Assignment

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Make a list of existing resources in the local area and discuss their use and limitations based on survey of five inclusive schools
- Conduct a survey in the local area to ascertain the prevailing attitudes practices toward social, emotional and academic inclusion of children with diverse needs
- Reflective Journal Writing
- Preparation of IEPs, and Case Studies of LwDNs
- Administration of Psychological Tests
- Identification of an area and conduct Action Research
- Handling of Aids and appliances/ assistive devices used in the education of learners with diverse needs
- Review of National/ International Journals in Inclusive Education
- Conduct a survey on the type of supportive service needed for inclusion of learner of diverse need of your choice and share the findings in the class
- Preparation of ICT based teaching learning materials

**Suggested Readings:**


- Gunter, H. (2006). Educational leadership and diversity? Educational Management, Administration and Leadership. Special Edition Diversity.
- Jangira, N.K., & Mani, M.N.G. (1990). Integrated Education for Visually Handicapped. Gurgaon, Old Sabjimandi, Academic Press.
- Jha, M. (2002). Inclusive Education for All: Schools Without Walls. Heinemann Educational Publishers, Multivista Global Ltd, Chennai.
- Loreman, T., &Deppler, J., & Harvey, D. (2005). Inclusive Education - A practical guide to supporting diversity in the class. London: RoutledgeFalmer.
- Lowenfeld, B. (1973) (Ed). The Visually Handicapped Child in School. New York: Jhon Day.
- Nielsen, L.B. (1998). The exceptional child in a regular classroom – An educator' guide. Corwin Press Inc. A Sage Publication Company, California.
- Rao, et al. (2011). Moving away from label. Bangalore CBR Network (South Asia).
- Thomas, G., & Vaughan, M. (2004). Inclusive Education: Reading and Reflections. Maidenhead: Open University Press.
- Tilstone, C., Florian, L., & Rose, R. (Eds.) (1998). Promoting Inclusive Practice. London: Routledge.
- National Policy of Education 1986 (revised 1992)
- Index of Inclusion (2014) NCERT, New Delhi
- UNICEF (2003). Examples of inclusive education.
- York-Brar, J., Sommers, W.A. et al. (2001). Reflecting practice to improve school. Corwin Press Inc. A Sage Publication Company, California.
- Ysseldyke, J.E., &Algozzine, B. (1998). Special Education: A practical approach for teachers. New Delhi: Kanishka Publishers Distributors.
- Karantha, P. and Rozario, J. (2003). Learning Disabilities in India, New Delhi: Sage Publication India Pvt. Ltd.
- Jangira, N.K. and Ahuja, A. (2002). Effective Teacher Training; Cooperative Learning based approach: National Publishing House, 23, Daryaganj, New Delhi.


## EE4.1: Guidance and Counselling - II

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal: 15**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- Describe the nature, process, underlying assumptions and principles of psychological assessment and appraisal.
- Describe different types of psychological assessment-Qualitative and quantitative, their nature, scope and application in guidance and counselling.
- Develop knowledge and understanding of the major psychological concept such as Intelligence, Aptitude, Achievement, Personality, Interest and their assessment for providing guidance and counselling.
- Develop skills for administering, scoring, interpreting and analyzing test results for providing guidance and counselling to students.
- Use different techniques of qualitative assessment for holistic understanding of the individual learner.

**UNIT I Understanding Assessment and Appraisal**

- Assessment and appraisal in Guidance and Counselling: meaning, purposes, assumptions, principles, and process.
- Quantitative assessment: Psychological testing; distinction between testing and non-testing techniques, types and uses of psychological tests.
- Characteristics of a Psychological test.
- Problems, issues and cautions in using Psychological tests.

**UNIT II Qualitative Techniques for Assessment**

- Qualitative assessment: nature, need and importance of qualitative assessment
- Differences between quantitative and qualitative assessment
- Techniques for qualitative assessment: observation, interview, anecdotal records, case study, autobiography, rating scale, socio-metric, etc.
- Using Triangulation to validate qualitative data

**UNIT III Assessing Individual Attributes: Intelligence, Aptitude and Creativity**

- Concept of Intelligence: changing perspective
- Assessment of intelligence
- Aptitude: Concept and importance of aptitude assessment
- Creativity: Concept and importance of assessment of creativity

**UNIT IV Assessing Individual Characteristics: Achievement, Personality and Interest**

- Teacher-made and Standardized Achievement test, measurement of scholastic achievement and its significance in various educational and career decisions
- Concept of personality; methods of personality assessment
- Importance of assessing interest for educational and vocational guidance

**UNIT V Data Appraisal in Counselling**

- Dimensions of appraisal data
- Integrating assessment data
- Steps in using appraisal data
- Cautions in using appraisal data
- Ethics in appraisal

**Modes of Transaction:**

- Lecture-cum-discussion
- Individual and group assignment through self-study in the library and presentation in a seminar
- Demonstration
- Interpretation, analysis and reflection on observation in a group
- Library study
- Project work/assignment
- Workshop
- Group discussion
- Small survey

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Administer a Group Intelligence test on high school students and prepare a report.
- Review one test each of Aptitude, Personality and Interest.
- Prepare any qualitative technique and collect data, analyze and prepare a report.
- Identify gifted and creative children in the classroom
- Prepare a sociometry technique; administer it to a group of students. Draw a socio-gram and describe group climate in detail.

**Suggested Readings:**


- Anastasi, A. &Urbina, S. (1997). Psychological Testing, 7th Ed., Upper Saddle River. N. J. Prentice Hall
- Bhatnagar, Asha and Gupta, Nirmala (Eds.) (1999). Guidance and Counselling, Vol.I: A Theoretical Perspective, New Delhi: Vikas.
- Denzin, N. K. &LincoIn, Y. (2000). Handbook of Qualitative Research, New Delhi: Sage publications.
- Drummond, R. J. (1998). Appraisal Procedures for Counselors and Helping Professionals. Columbus, OH: Merrill.

- Gardner, H. (1999). Frames of Mind: The Theory of Multiple Intelligences, National Professional Resources: NY
- Kline, J. B. Theresa (2005). Psychological Testing: A Practical Approach to Design and Evaluation. London: Sage Publication.
- Le Compete, M. D.; Millory, W. L. &Presste, J. (1992). The Handbook of Qualitative Research in Education. New York: Academic Press.
- McLeod, J. &Cropley, A. J. (1989). Fostering academic excellence. Pergamon Press.
- Mohan, S. &Sibia, A. (1998). Handbook of personality measurement in India. New Delhi: NCERT.
- NCERT (2008) Module-6: Assessment and Appraisal in Guidance and Counselling-I
- NCERT Module-13: Assessment and Appraisal in Guidance and Counselling-II
- Oliver, W. & Randall, W. E. (2005). Handbook of understanding and measuring intelligence. London: Sage Publication.
- Patton, M. Q. (1990). Qualitative evaluation and research methods Califonia: Sage Publications.
- Saraswat, R. K. & Gaur, J. S. (1994). Manual for Guidance Counselors. NCERT: New Delhi

## SE4.1: Language Script Learning

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 4** **Internal Practicum: 50**

***LearningOutcomes:***

Oncompletionofthiscoursethelearnershall

- identify the language backgrounds of students and facilitate their movement from home /regionallanguageto standard language.
- analysisthenatureofclassroomdiscourseanddevisestrategiestoimprovecommunicationskills ofstudents.
- develop the appropriate skills of reading and writing among the learners and facilitatereadingwritingconnection
- envision their role as facilitators of learners' language enrichment irrespective of thesubjectstheyteach.

**UNIT I**

***LanguageBackgroundoftheLearners***

- Varied language contexts of the learners: dialect, regional varieties and standardlanguage;significanceoffirstlanguagein learning
- Spoken Vs Written Language; Home language Vs school language – Transmission andmovement:challenges and strategies
- Understandingmultilingualcontext-challengesandstrategies

**UNIT II**

***LanguageinClassroom***

- Natureofclassroomdiscourseandsignificanceof language
- Communication skills – promotion of oral skills through questions, discussion,sharingand interaction
- Language across various disciplines and subjects – humanities and science; Role oflanguageinensuringoptimumlearningin subject areas

**UNIT III**

***Reading-WritingConnection***

- Readings in different content areas for information and data gathering and criticalunderstand; Strategies for developing reading skills such as scanning, skimming, in-depthreading, note making, reflectivereading
- Reading-writing connection in different content areas - Use of note making forpreparingawrite-up,useofinformationgatheringforsummarizing.
- Writing for various purpose- preparing report, writing paragraph, explanatory notes,expansionofideas,presentinginformationinvariousformsuchasflow-chart, diagram,pie-chart,histogram.
- Processwriting-generation/gatheringideas,drafting,revisingandfinalizing.

***SuggestedReadings:***


- Anderson, R.C. (1984). Role of the Reader's Schema in Comprehension, Learning andMemory.InR.C.Anderson,J.Osbon&R.J.Tierney(ed.)*LearningtoReadinAmericanschools:BasedReadersandcontenttexts.*Hillsdole,LawranceErlbaumAssociates:New Jersey.
- ApplyingaVygotskianModelofLearningandDevelopmentinB.Spodek(ed.) *Handbookofresearchontheeducationofyoung children.* Macmillan:New York.
- Armbruster,BonnieB.(1984)TheProblemof"InconsiderateText"InDuffy,G.G.(ed.)*ComprehensionInstruction,PerspectivesandSuggestions*.Longman:NewYork.
- Butler,A.andJ.Turnbill,(1984)*TowardsReading-WritingClassroom*PrimaryEnglishTeachingAssociation Cornell University: New York.
- Freedman S. W. andA. H. Dyson(2003) Writing inFloodJ. et. al.Handbook ofResearch on Teaching English Language Arts: Lawrence Erlbaum Associates Inc: NewJersey,USA..
- Kumar Krishna (2007)*The Child's Language and the Teacher*.National Book Trust:newDelhi.
- Labov,W.(1972)ThelogicofNon-StandardEnglish.In*LanguageinEducation.* PreparedbyLanguageand LearningcourseTeam. Routledge:London.
- Martin, Jr. B. (1987) The Making of a Reader: A Personal Narrative. In Bernice E.Cullinan,*Children'sLiteratureintheReadingProgramme.*InternationalReadingAssociation:Michigan.
- Mason, J. M. and S. Sinha (1992) Emerging Literacy in the Early ChildhoodYears. Monson, R. J. (1991) Charting a New Course with Whole Language. *Edn.Leadership.*
- Pinnell,G.S.(1985)WaystoLookattheFunctionsofChildren'sLanguage.InA.Jaggar, M. Trika and Smith-Burke (ed.) *Observing the language learner.* InternationalReadingAssociation: Newark, DE.
- Purves,AlanC.(1988).TheAestheticMindof LouiseRosenblatt.*Reader20.*
- Rhodes,L.K.andN.L.Shanklin(1993)*WindowsintoLiteracy.*Heinemann,TheUniversityof Michigan:UK.
- Rothleen,L.andA.M.Meinbach(1991)*TheLiteratureConnection:UsingChildren'sBooksin Classroom.* Good YearBooks: Tucson,USA.
- Sinha,S.(2000)AcquiringLiteracyinSchools.*RedesigningCurricula:*Asymposiumonworking aframeworkforSchool education*Seminar.*
- Sinha,Shobha. (2009). Rosenblatt's Theory of Reading: Exploring Literature.*ContemporaryEducationDialogue.*
- Teals, W. and E. Sulzby (1986) Introduction: Emergent Literacy as a perspective forExamining how young Children Become Writers and Readers. In W. Teals, E. Sulzby(ed.)*Emergent Literacy: Writing andReading.*Norwood: NewJersey.

## SE4.1: EducationforSustainableDevelopment

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 3** **External: 35**

**Internal:15**

***LearningOutcomes:***

Oncompletionofthecourse, the learnerwillbeableto:

- explaintheconceptofsustainabledevelopment,
- describetheneedandimportanceofsustainable development,
- identifytheissues andchallenges ofsustainable development,
- describetherelationshipbetween human andenvironment withsustainabledevelopment,
- explainthedifferentsustainablegoalsandqualityeducationand
- acquirecompetenciesasteachersforimplementingskillsrequiredforpracticingsustainabledevelopment.

**UNIT I**

***UnderstandingSustainableDevelopment***

- Introductiontosustainabledevelopment;needandimportance
- TheGaia‘shypothesis: debatesandimplications
- Emergenceoftheideaofsustainability:Stockholmconference(1972),RioConference(1992)andJohannesburgconference(2002),UnitedNationsEnvironmentalProgramme(UNEP)-ObjectivesandFunctions
- Pillarsofsustainabledevelopment:natural,social,economicandenvironment
- Strategies for sustainable development: suggested in agenda - guiding principles for sustainabledevelopment
- Contextualsignificanceofsustainabledevelopment(SD)inIndia,issuesandchallengesofsustainabledevelopment– National andInternational.

**UNIT II**

***UnderstandingEducationforSustainableDevelopment(ESD)***

- Frameworksforknowledgebuildingforsustainabledevelopment
- UNESCOsustainabledevelopmentgoals(SDG)(2015);SDG-4:Inclusiveandequitablequalityeducationand lifelonglearningopportunitiesforall.
- Sustainablelifestyle,humanrights,educationforsustainabledevelopment(ESD),targets,indi

catorsand challengesforachievingESDgoal 4

- Foundationalliteracyandnumeracy(FLN)forachievingsustainabledevelopment
- Skilldevelopmentforsustainabledevelopment
- Strategiesforsustainabledevelopment:suggestedinAgenda-guidingprinciplesforsustainabledevelopment
- Environmentalimpactassessment(EIA)-meaning,steps,principlesandimportanceofEIAinsustainabledevelopment.

Roleofenvironmentaleducationinsustainabledevelopment-needofaninterdisciplinaryapproach

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**UNIT III** ***PedagogicalPracticesandICTforSustainableDevelopment***

- Approaches:disciplinary,thematicandintegrated
- Teaching for sustainability; observation, group discussion, dramatization, cooperative learning,play-based and project-based learning, field trips, community-based learning, culturally responsivepractices
- Campusassustainabilityclassroom,virtualtoursandvirtuallabs,teachingwithecologicalfootprints,theatrepedagogy,game-based pedagogy, etc.
- Sustainabilityauditand analysis, correctiveanalysis
- Roleofmediainsustainabledevelopment – printmediaandelectronicmedia

**UNIT IV**

***Policies,InitiativesandInnovativePractices***

- Educationalpolicyandcurriculumforsustainabledevelopment,governmentalandnon-governmental initiatives, sustainable lifestyle; cross-cultural and culture- specific understanding,public-privatepartnership.
- Reviews of at least10 innovative practices and experimentsin diverse areas such as waterconservation,soil conservation, forest conservation
- Reducing use of plastic pollution, solid waste management, e-waste management, environmentalpollutionwith reflections on their objectives, methodologyand outcomes.

**UNIT V**

***ChallengesforSustainableFuture***

- Awarenessaboutsustainabledevelopment,promotionofnon-conventionalsourcesofenergy,promotinggood mental health and wellbeing
- Imbibingskillsforsustainabilitydevelopmentthrough education
- Promotinggreenskillpracticesindifferentjobsandlocations
- Researchesintheareaofsustainability.

- Possibilitiesofprofessionaldevelopmentofin-serviceteachersfor ESD

***Modesof Transaction:***

- FieldsVisits
- Surveys
- GroupDiscussion
- Debates
- Lectures
- VideoTalks
- Movies
- Documentaries

***SessionalWork:***

Thelearners areexpected to takeanytwo from thefollowing:

- Tosuggeststrategies/solutionsforconcerningenvironmentalissues
- Reviewofabookon environmentalissues andconcerns
- Prepareasurveyreport on localecosystem
- Visitavillageandidentifythesustainabledevelopmentpractices

***SuggestedReadings:***


- Datta,A.K.(2000).IntroductiontoEnvironmentalScience&Engineering.RajuPrimlaniforOxford& IBH Publishing, Co. Pvt.Ltd.: New Delhi.
- Dayani,S.N.(1993).ManagementofEnvironmentalHazards.VikasPublishingHouse,Pvt.Ltd.:NewDelhi.
- Iyer,G.(1996).SustainableDevelopmentEcological&Socio-culturalDimension.VikasPublishingHouse Ltd.: New Delhi.
- James,G.(1999).EthicalPerspectivesonEnvironmentalIssuesinIndia.APHPublishing:NewDelhi.
- Lovelock,J.(2000).Gaia:ANewLookatlifeon Earth.OxfordUniversityPress.
- Karpagam,M.(1999).EnvironmentalEconomics.SterlingPublisherPvt.Ltd.
- Mukherjee,B.(1996).EnvironmentalBiology.Tata-Mc-GrawHill,PublishingCo.Ltd.:NewDelhi.
- Nasrin.(1999).EnvironmentalEducation.APHPublishingCorporation:NewDelhi.
- NCERT.(2000).NationalCurriculumFramework2000.NewDelhi:NCERTPress.
- NCERT.(2005).NationalCurriculumFramework2005.NewDelhi:NCERTPress.
- NCTE.(2005).EnvironmentalEducationCurriculumFrameworkingforTeachersandTeacherEducation.NewDelhi.
- NCERT(2005).HabitatandLearning.NCERT,NewDelhi.
- Rao,D.B.(1998).EarthSummit.DiscoveryPublishingHouse:NewDelhi.
- Shimray,C.(2019).Teachingenvironmental education:TrendsandpracticesinIndia.SagePublications:India PvtLtd.
- TheWorldSummitonSustainableDevelopment:Agenda21 Chapter36,UNESCO2002http://habitat.igc.org/agenda21/a21-36.htm. (20 June2004)https://ncert.nic.in/pdf/h_focus_group/Awaas%20Aur%20Shiksha.pdf
- Schumacher,E.F.(1993)SmallisBeautiful.Vintagebooks: London

- Gandhi,M.K(1909)IndianHomeRule.

**PC4.1: Internship in Educational Institute (Education Core Elective)**

**Credits: 2** **Max Marks: 50**

**Two weeks attachment** **Internal: 50**

**Rationale:** The M.Ed. students will be attending the educational institutes related to education core electives selected by them.

***LearningOutcomes:***

Oncompletionofthiscourse,the learnershall:

- acquainthimself/herself withtheactivity/programmerelatedtotheireducation core electives.
- developinsightintotheactualfunctioningof theelementsacquired inthe areas ofspecializationthroughdirectobservationandexperienceinthe areasofaction.

***Organization***

Thepracticumshallbeorganizedbyattachingtheprospectiveteachereducatorstodifferentschools/teachereducationinstitutions,computerlaboratoriesandotheragenciesengagedwithactivities related to the theme based specialization with a view to study issues in real context.Necessaryorientation to students shall be provided beforeorganizingtheactivities.

***1. Educational Management, Administration and Leadership***

- *Visit any School/TEI and observe the leadership qualities of the head of institution and its teachers/teacher educators.*
- *Analyse the content and processes of any teacher education programme (pre-service or in-service) in respect of the elements of educational leadership inbuilt in such program*

***2. Educational Technology***

- Analyze the e-contents available in elementary (CALschools) or in secondary schools/ TEIs and their use forlearning.
- Discusswith teachers of elementaryschoolsor teachereducatorsinTEIsregardingtheirexperienceinMOOCprogramme.

**3. InclusiveEducation**

- To study the structural and functional setup of EducationalManagementinasecondaryeducationInclusiveschools.
- Preparation of a plan for procurement, utilization andmaintenance of resources in secondary level inclusiveschools.

**4. Guidance and Counselling**

- Exploring the existence and possibility of providing careercounsellingtostudentteachersinDIETs/TEIsinaplannedmannerthrough individualandgroupcounselling.
- Identifythesocio-educational problemsofunderachievementandconduct counselling some such identified underachievers forimprovementintheirlearning performance

# Semester 5

## EC5.1: Science Education and Different Pedagogies

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**LearningOutcomes:**

Oncompletion ofthe course, the learnerswill be able to:

- recognizetheneedandimportanceofcrosscurricularpedagogies
- identifystagespecificcrosscurricularpedagogies
- useemergingapproachesofteachinglearning
- employthe pedagogicalandassessmentstrategies

**UNIT I**

**CrossCurricularPedagogy**

- AperspectiveonPedagogyandCrossCurricularPedagogy,
- Meaning, NeedandImportanceofCrossCurricularPedagogy,
- Typesof cross curricular pedagogy:ArtIntegrated Pedagogy, SportsIntegrated Pedagogy, Toybas Media Pedagogy, MuseumPedagogy, ResponsivePedagogy,WorkintegratedPedagogy,CriticalPedagogy,LiberationistPedagogy

**UNIT II**

**UnderstandingtheNeedandImportanceofCrossCurricularPedago**

- PlaceofCrossCurricularPedagogyacrossthedifferentlevelofschooling-Primary,UpperPrimary,Sec Secondary;inHigherEducationandinteacherEducationProgrammes,
- Theteacher‘sneedforknowingthedifferent stages,
- CrossCurricularexperiencesasmediumofcreativeself-expression,
- Meaningofcreativeactivityinchild‘swork:self-expression,self-adjustment,
- EvaluationinCrossCurricularPedagogy,DilemmasinEvaluationofmeaningfulnessofCrossCurricu

**UNIT III**

**IntroductiontoEmergingApproaches**

- Concept,Need, and ImportanceofemergingApproaches:UniversalDesignofLearning(UDL),
- Multi-sensoryApproach,

- STEM,STEAM,STREAM(Science,Technology,Reading,Engineering,Arts,andMath),
- Project-basedlearningandexperientialeducation

**UNIT IV** **PedagogicstrategiesandModels**

- ConstructivistPedagogyandExperientialLearning:5EModel,7EModel,InquiryModel,
- ConceptAttainmentModel,Kolb‘sModel,ICONModel.
- ConstructivistPedagogy: RoleoftheTeacher

**UNIT V** **TransformingAssessmentforStudentDevelopment**

- $360^0$Assessmentforcomprehensive assessment,FunctionalAssessment,
- Contemporarymethodsandtoolsforformativeevaluation:Portfolio:Definition,Types,Development flectiveJournal;Rubrics:Concept,Kinds,andEffective Application
- HolisticProgressCard:ProvidingFeedbacktostudents,teachers,parentsandeducationalfunctionarie

**ModesofTransaction:**

- Lecture-cum-discussion
- Individualandgroupassignment
- Self-studyinthelibrary/Online
- Demonstration
- Interpretation,analysisandreflectiononobservationinagroup
- Projectwork/assignment
- Workshop
- Groupdiscussion
- Smallsurvey

**SessionalWork:**

Prospectiveteacher educatorsare expectedtotakeanytwotasksfrom thefollowing:

- Prepare aplan in integrationwith anycross curricularpedagogyforclassroom
- Preparetherubricsof aconcept
- Analysisofreport cardsofschools
- ComparativeAnalysisofdifferentapproaches

**SuggestedReadings:**


- IGNOU(2000).EducationalTechnology:Stateof theArt.New Delhi: IGNOU.
- Kumar,K.L.(1996).EducationalTechnology.NewDelhi:NewAgeInternational.
- Kumar, Shravan. (2017). Teaching Materials and Teaching Aids - 1 (teachingmaterial).ePGPathshala. 12. 2016.
- Lal,H.(2011).ManualofLowCostTechnologicalAids.Faridabad:SaiPublications.
- Chapman,L.H.N.(1978).ApproachestoArtinEducation.MarcourtBraceJovanovich,Inc.NewYork.San Drego,

Chicago, San Francisco, Atlanta.
- Dales,E.(1956). AudioVisual.(4thEdition).DrydenPress,New York.
- Dewey,J.(1934).ArtasExperience.Minton,BalchandCompany,NewYork.
- Faulkner, R.,Ziegfeld,E.,&Hill,G.(1956).ArtToday.PeterOwen Limited, London.
- Lowenfeld,V. (1952).CreativeandMentalGrowth.MacmillanCompany, NewYork.
- Head,H. (1967).EducationThrough Art.Faber andFaber,London.1967.
- Viola,W.(1936).ChildArtandFranz Cizek.ReynalandHitchcock,New York.
- Amico,V.(1943).CreativeTeachinginArt. InternationalTextbookCo.
- Efland,A.D.(1990).AHistoryOfArtEducation:IntellectualAndSocialCurrentsInTeachingTheVisual Art. TeachersCollegePress,ISBN-0807729779

- Lakhyani,S.(2012).Art,CreativityandArtEducation.LapLambertAcademicPublishing,ISBN-978-3-8473-7821-1.
- Brown,M.,&Korzenik,D.A.(1993).ArtMakingAndEducation:DisciplinesInArtEducationAndContexts Of Understanding. UniversityOfIllionoisPress,ISBN-0252063120
- Aanderson,T.,&Milbrandet, M.K.(2004).ArtForLife:AuthenticInstructionInArt.McgrawHill,ISBN-0072508647


**EE5.1: Learner's Assessment**

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- differentiate between the ideas behind assessment of learning, assessment for learning, and assessment as learning;
- analyse the importance of assessment in student learning, and differentiate between various terms used - measurement, assessment and evaluation;
- select and use appropriate tools and techniques in assessment of student learning;
- explore various alternative assessment techniques such as portfolio, rubrics, reflective diary, self-evaluation, peer evaluation; and
- assess learning of children with special needs (cwsn} using alternative techniques.
- utilize the digital gazettes in assessment of students learning
- analyse and report assessment results

**UNIT I** **Concept and Nature of Assessment**

- Meaning, nature and importance of assessment, basic teachinglearning model and assessment
- Defining test, examination, measurement, assessment and evaluation
- Purposes of Assessment-Assessment of learning, Assessment for learning, and Assessment as learning,
- Continuous and Comprehensive Assessment (CCA} in schools: meaning and purpose
- Stakeholders of Assessment- students, teachers, parents
- System of Learner Assessment: Annual system, semester system,
- credit system, external and school-based system

**UNIT II** **Development of an Achievement Test**

- Achievement Test and its Development : Process and standardization
- Characteristics of a good test
- Estimation of Reliability and Validity
- Diagnostic test: Construction and use
- Idea of large scale achievement survey

**UNIT III Alternative Assessment**

- Spontaneous and planned observations- with or without checklist /rating scale
- Performance-based assessment: Portfolio, rubrics, reflective diary
- Self and peer assessment
- Assessment of learning of Children with Special Needs (CWSN)

**UNIT IV Analysis and Reporting of Assessment**

- Classical and Item Response theory of Question Analysis
- Grading system
- Norm Referenced and Criterion Referenced Interpretation
- Norms and Percentiles
- Profile Reporting

**UNIT V ICT in Assessment**

- Computer Assisted and Adaptive Testing
- Computerized question bank
- Computers in management of examinations
- Computers for Alternative Assessment such as e-portfolio, e-rubric, ereflective diary etc.
- Computers for preparing and analysing assessment Results-Profile
- Reporting, result card, analysis report etc.

**Modes of Transaction:**

- lecture cum discussion,
- brain-storming,
- group discussion,
- case studies,
- group and individual field based project
- assignments followed by seminar presentation,
- workshop on field based topics of study,
- panel discussion,
- survey,
- ICT labwork,
- role play,
- field visits and

- narration etc.

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Students in group will be asked to prepare rubrics for assessment of science projects, Essay, reports, dramas, paintings etc. Teacher will act as a facilitator.
- Each student will be assigned to prepare two lesson plans one following Interpretation Construction (ICON) design model and other following SE model, in their own discipline.
- Each student will be asked to prepare a-portfolio of their own activities/ performances.
- Each students will be asked to grade 5 assignments of one of his classmates in a 5 point scale and then to calculate the grade point average

**Suggested Readings:**


- Altman, H., and W. Cashin. 1992. Writing a syllabus (IDEA Paper no.27). Manhattan, KS: Center for Faculty Evaluation and Development, Kansas State University.
- Angelo, T.A., and K.P. Cross. 1993. Classroom assessment techniques: A handbook forcollege teachers. 2nd ed. San Francisco: Jossey-Bass
- Assessment for learning in the classroom. Phi Delta Kappan 86 (1): 8-21.
- Baecker, D. 1998. Uncovering the rhetoric of the syllabus. College Teaching 46 (2): 58-62.
- Black, P., and D. Wiliam. 1998. Inside the black box: Raising standards through classroom assessment. PhiDeltaKappan 80 (2): 139-148. Black, P., C. Harrison, C. Lee, B. Marshall, and D. Wiliam. 2004.Working inside the black box :
- Cullen, R., and M. Harris. 2009. Assessing learner centredness through course syllabi.
- Assessment and Evaluation in Higher Education 34 (1): 115-125.
- Garavalia, L., J. Hummel, L. Wiley,and W. Huitt. 1999. Constructing the course syllabus: Faculty and student perceptions of important syllabus components. Journal onExcellence in College Teaching 10 (1):5-21.
- Gronlund, N.E. 2003. Writing instructional objectives for teaching and assessment. 7th ed. Upper Saddle River, NJ: Pearson/Merrill/Prentice Hall. Littlefield, V.M. 1999. My syllabus? It's fine. Why do you ask? Or the syllabus: A tool for improving teaching and learning. Paper presented at the Society for Teaching and Learning in Higher Education, Calgary, Canada. syllabi for improved communication. Ann Arbor: University of Michigan, National Center for Research to lmprove Post-Secondary Teaching and Learning.
- Nilson, L.B. 2007. Teaching at its best: A research-basedguidef or college instructors. San Francisco: Jossey-Bass.
- O'Brien, J.G., B.J. Millis, and M.W. Cohen. 2008. The course syllabus: A learning-centered approach. 2"ded. San Francisco: Jossey-Bass.
- Parkes, J., and M. Harris. 2002. The purposes of a syllabus. College Teaching 50 (2): 55-61.
- Singham, M. 2007. Death to the syllabus. Liberal Education 93 (4): 52-56.
- Slattery, J.M., and J.F. Carlson. 2005. Preparing an effective syllabus. College Teaching 53 (4): 159-164.
- Tro, N.J. 2008. Chemistry: A molecular approach. Upper Saddle River, NJ: Pearson/ Prentice Hall.

- Wirth, K., and S. Perkins, D. 2006. Knowledge surveys: An indispensable course design and assessment tool. Presentation at Innovations in the Scholarship of Teaching.
- Wirth, K.R., D. Perkins, and E.B. Nuhfer. 2005. Knowledge surveys: An ideal tool for assessing learning and for evaluating instructional practices and curricula. Geological Society of America annual meeting, Salt Lake City, Utah.Abstracts with Programs 37 (7): 119.

## EE5.1: Historical, Political and Economic Perspectives of Education

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to:

- develop perspective on the origin and nature of Institutionalized Education
- appreciate the relationship between education and political economy
- review and interpret education from political economy perspective
- provide opportunity to develop critical understanding about the politic-economic basis of emerging education
- analyze the intellectual property rights of national and international organization
- provide opportunity to develop consciousness and sensitivity among learners towards preservation of indigenous knowledge systems

**UNIT I History of Institutionalized Education**

- Schooling across civilizations with special reference to India
- Origin of Schooling : Socio-historical context of origin;
- Need, nature, functions and purpose of schooling;
- Schooling For All: Genesis, Need and purposes
- Functions of schools: Cognitive, economic, socio-cultural, normative and ideological: A historical Analysis
- Relationship between Policies and Education, Linkage between Educational Policy and National Development, Determinates of Educational Policy and Process of Policy formulation: Analysis of the existing situation, generation of policy options, evaluation of policy options, making the policy decision, planning of policy implementation, policy impact assessment and subsequent policy cycles.

**UNIT II Understanding Political Economy**

- Political Economy: Meaning and Purpose
- Political Economy as method of understanding education and its nature
- Relationship between Political Economy and education
- Political Economy: The ideological Foundation of Education
- Education: The instrument of Political Economy

**UNIT III** **Political Economy of Indian Education: A historical journey**

- Political Economy of:
  - Ancient Indian Education-Vedic and Buddhist
  - Medieval Indian Education
  - British Education
    - McCauley Minutes
    - Woods Dispatch
    - Hunter Commission

**UNIT IV** **Political Economy of Contemporary Indian Education**

- Basic Education-1937
- Education Commission- 1948, 1952 and 1964-66;
- Education Policies- 1968, 1986 (POA, 1992) and 2020
- National Knowledge Commission (NKC), 2005

**UNIT V** **Knowledge Economy and Education: Knowledge as property**

- Knowledge as property: Distinct characteristics
- Politics of Knowledge: Intellectual Property Rights (IPR) Concept, Origin and Development
- Liberalization, Privatization, and Globalization: Changing nature of knowledge

- Role of International Agencies in transforming knowledge into property: World Trade Organization (WTO) and General Agreement on Trade and Services (GATS)
- Four Pillars of Education as stated in Delor's Report (Learning The Treasure Within)
- Implications of IPR to Education Particularly Higher Education
- Concept of Economics of Education: Cost Benefit Analysis Vs Cost Effective Analysis in Education, Economic returns to Higher Education Signaling Theory Vs Human Capital Theory, Concept of Educational Finance; Educational finance at Micro and Macro Levels, Concept of Budgeting

**Mode of Transaction**:

- Initiation of dialogue by the Most Knowledgable Other (MKO)
- Library Readings
- Observational studies and activities
- Presentation of students on different themes- individually and collectively.
- Documenting the dialogues

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Debate on knowledge as property and its impact on the indigenous knowledge
- Analyze Indian Education Commision (1964-66)in terms of its politico-economic prescriptions
- Debating on the impact of categorizing education as merit good and non-merit good n the accessibility to higher education
- Conducting brainstorming session on the impact of the privatization on the educational opportunities

**Suggested Readings**:


- Reports of Commission, Policies
- Althusser, L.(1971).Ideology and ideological state apparatus. New Left Books: London
- Anuradha DE & Jean Dreze (1999).PROBE. Oxford University Press. New Delhi.
- Apple W. Michel & Bean A James (2006). Democratic School Lessons from Chalk face. Ekalavya Bhopal

- Bowels S &Ginitis H (1976).The schooling capitalist America. Routledge and Kegan Paul, London.
- Chandra Rajashree (2010) Knowledge as Property: Issues in the moral grounding of Intellectual Property Rights. Oxford Universal Press. New Delhi.
- Chattopadhyay, S. (2012). Education and Economics: Disciplinary evolution and policy discourse. Oxford India Pvt. Ltd.
- Geeta Gandhi Kingdon&Mohd.Muzammil(2008) A political economy of education system in India : The case of Uttar Pradesh. Oxford Policy Institute
- GeetaKingdon( lead investigator) (2014) A rigorous review of the political economy of education system in developing countries. Institute of Education, London.
- Harry Broudy S (1998). The uses of schooling.Routledge, New York
- Illicit Ivan (2012).Deschooling society. Motion Boyars, London.
- Kumar Krishna (1991). Political Agenda of Education: A study of colonist and nationalist ideas. SAGE Publcation, New Delhi.
- Kumar Krishna (1996). Agriculture, Mordernization , and Education: The contours of a point of departures.Economic and Political Weekly,31, ( 35-37). 2367- 373.
- Naik, JP. (1997). The Education commission and after. Nataraj Books.
- O`Neil Williams (1981). Educational Ideologies.: Contemporary expressions of educational philosophy. Good year Publishing house, California.
- Reimer E. (1971). School is dead: Alternatives in education. AnchosBooks,Double day & Co. , New York.
- Richman WK. (1975). Education and Schooling. Methuen, London
- Sai Deepak, J. (2021). India, that is Bharat: Coloniality, Civilization, Constitution. Bloombury India. New Delhi
- Tilak, J.B.G. (2008). Financing of Secondary Education in India. Shipra Publications. New Delhi
- Tilak, J.B.G. (2019). Education and Development. Academic Foundation.
- Young.F.D. & Whitty. G. (ed). (1997). Society state and schooling. The Falmer Press.
- Young, M.F.D (1971). Knowledge and Control: New Directions for the sociology of education. McMillan, London.
- Tilak, B.G. Jandhyala, (ed). (2014). Higher education in India: In search of equality, quality and quantity. Orient Blackswan, Hyderabad.
- Ashok Kumar,M.&Mohd. Iqbal Ali.(2008). Intellectual Property Rights. Serials Publication, New Delhi.


## PC5.1B:Dissertation (Proposal Development)

**Credits: 2** **Max Marks: 50**

**Contact hours per week: 4** **Internal: 50**

**PreparationofResearchProposalandToolDevelopment**

| Sl. No | Activities | Marks |
|---|---|---|
| 1 | Reviewoftherelatedliterature | 10 |
| 2 | PreparationofResearch Proposal | 10 |
| 3 | Toolselection/development/adaptation/Try-out | 10 |
| 4 | Planningfordatacollection | 10 |
| 5 | Presentation | 10 |
| | **Total** | **50** |

# SEMESTER 6

## EC6.1: Philosophical and Sociological Perspectives of Education

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 5** **External: 70**

**Internal: 30**

**Learning Outcomes:**

On completion of the course, the prospective teacher educators will be able to develop :

- insights into nature and purpose of philosophy of education
- critical understanding about the relationship between philosophy and education
- abilities to identify processes, and sources of knowing in different contexts and different subject knowledge
- critical understanding of normative nature of education
- educational institution as an agency of socialization apply the knowledge of sociology in analysis of present day education system,
- analyze the relationship of education with culture, social stratification and social mobility
- reflect educational issues that relate to education system, changes occurring in framework of education and their factors, the need to have a critical understanding of education and society

**UNIT I** **Understanding Philosophy of Education**

- Philosophy: Meaning, Nature, and Purpose
- Philosophy of Education: Meaning, Nature and Purpose
- Relationship between Philosophy and Education
- Branches of Philosophy – Ontology (Meta-physics), Epistemology and Axiology
- **Philosophical Inquiry into:** Human Nature: Natural-Social; Consciousness: Freewill-Determinism; Freedom and necessity; Structure and agency; Education: Changing Meaning, Nature and Purpose
- Defining of education in terms of /from the perspective of--- Education as process; Education as purpose; Education as system; Education as profession
- Functions of Education.
- **Indian:** Sankhya, Yoga, Vedanta, Buddhism, Jainism and Islam.
- **Western:** Idealism, Realism, Naturalism, Pragmatism, Marxism and Existentialism.

**UNIT II** **Understanding knowing and Knowledge: Epistemological Enquiry**

- Knowledge: Meaning, nature process of knowing (Indian and Western)
- Constituents of Knowledge: Facts, Principles, Laws, Concepts and Theories
- Different facets of knowledge: Concrete –Abstract; Particular-Universal;
- Role of generalization in knowledge
- Origin of Knowledge: contending theories; Empiricism and Rationalism
- Types of Knowledge: A priori, A posteriori, Explicit, Tacit, Propositional and procedural
- Nature of school knowledge

**UNIT III** **Understanding Values: Axiological Enquiry**

- Values: Meaning and their role in individual and social life
- Role of education in value transformation
- Determinants of Purpose of Education: Individual, Community, Religion, State and Market to identify the changing normative foundations and nature of education as when there is a change in the determinant of the purpose of education.
- Normative Foundations of Education: Constitutional Values and Education - A dialogue: Liberty, Equality, Fraternity, Justice, Freedom, Socialism and Secularism.
- Globalization and its impact on the Purposes of education.

**UNIT IV**

**Understanding Sociology of Education**

- Sociology of Education: nature, scope, need and relevance
- Acculturation, Enculturation, Cultural Mosaic, Cultural Capital
- Social Structure:meaning and definition of social structure. Role and Function of Education in Social Structure
- Sociology of Knowledge: Karl Manheim

- Class Codes and Social Control: Basil Bernstein
- Cultural Capital: Pierrie Bourdieu
- Social Character of Learning: Krishna Kumar

**UNIT V**

**Sociological Concepts and their relationship with Education**

- Social Stratification:

➢ Concept, Theories and Types of Social Stratification

➢ Education and Social Stratification

- Social Mobility:

➢ Concept, Theories and Forms of Social Mobility

➢ Factors affecting Social Mobility

➢ Education and Social Mobility

➢ Concept of Social Movement and Theories (Relative Deprivation, Resource Mobilization, Political Process Theory and New Social Movement Theory)

- Social Institution: School as a Social Institution-Analytical understanding

- Emile Durkheim: Functionalism (on Education and Society)

- Talcott Parsons: School as a Social System

**Modes of Transaction:**

- Expositions, Lectures, Reflective Talks, Dialogue, Discussion
- Initiation of the dialogue by the most knowledgeable other (MKO)
- Library readings
- Observational studies and activities
- Presentations by students on selected themes – individually and collectively
- Documenting the dialogues

**Sessional Work:**

Prospective teacher educators are expected to take any two from the following:

- Every student is required to analyze aims of education in successive curriculum frameworks starting from McCauley Minutes – 1835, 1975, 1988, 2000 and 2005 – to reflect on the change and continuity in the articulation of aims of school education and ideological reasons for change and continuity.
- A debate may be organized on the value framework of Indian schooling
- Review the volumes, field studies in sociology of education, published by NCERT (1978).
- Book review pertaining sociology of education. Apart from highlighting the ideas that book articulates and the way arguments with evidences are provided, students will have to critically review the strengths and weaknesses of book. Also, the relevance of the book in understanding day to day phenomena that are happening in the school and teacher education system at large have to brought at the end of book review.
- A term paper based on the topics and syllabus. It has to be very argumentative and analytical nature.

**Suggested Readings:**


- A.H.Halsey et.al (ed.). (2002). Education Culture, economy, society. Oxford: Oxford University Press ( selected papers)
- Agarwal, A. (1995). Dismantling the Divide between Indigenous and Scientific Knowledge', Development and Change, 26:413-439.
- Aggarwal, J.C. (2010). Theory and Principles of Education. Agra: Shri Vinod Pustak Mandir.
- Alfred North Whitehead. (1967). Aims of Education and other Essays. The Macmillan Company, New York.
- Ant Weiler, C. (1988). Low Knowledge and Local Knowledge: An Anthropological Analysis of Contested Cultural Products in the context of Development. Anthropos, 93, 46-94.
- Apple, M.W. (1982) Cultural and Economic reproduction in education:: essays on class, ideology and the state. London : RKP( Chapter1,9)
- Banks, Olive (1971). Sociology of education, ( 2nd edition) London: Batsford
- Benei, Veronique (2009). Schooling in India. Hindus, Muslims and the Forging of citizens. NEW DELHI: Orient Blackswan
- Berger, P., &Luckmann, T. (1966). The Social Construction of Reality. A Treatise in Sociology of Knowledge. Penguine Books, London.
- Bernstein, Basil. (1996). Pedagogy symbolic control and identity. London: Taylor and Francis (chapter1)
- Bernstein, Basil. (1996). Pedagogy Symbolic Control and Identity. London: Taylor and Francis.
- Bernstein. (1971). On Classification and Framing of Educational Knowledge in Class, Codes and Control, Volume 3: Towards a Theory of Educational Transmission, Second Edition (1977) edited by M.F.D. Young.

- Beteille, A. 1985. Equality of opportunity and the equal distribution of benefits. Pune: Orient Longman (Gokhale Institute of Politics and Education)
- Blackledge, D., & Hunt, B. (1985). Sociological Interpretations of Education. London, Crom Helm
- Blacklisted, D. and Hunt B. (1985). Sociological interpretation of education London, Crom Helm
- Brown, D.M. (1958). The White Umbrella: Indian Political Thought from Manu to Gandhi. University of California Press, Berkeley.
- Butchvarov, P. (1970). The Concept of Knowledge: Evanston, Illinois: North Western University Press.
- Chomsky, N. (1986). Knowledge of Language. Prager, New York.
- Datta, D.M. (1972). Six ways of knowing. Calcutta University Press, Calcutta.
- Dewey, J (1916). Democracy and education. An introduction to the philosophy of education. New york: free press.
- Dewey, J. (1916). Democracy and Education. An Introduction to the Philosophy of Education. New York: Free Press.
- Diane Tellman. (2000). Living Values: An Educational Program. Sterling Publishing Private Limited, USA.
- Durkheim, E. (1961). Education and society. New York Teaches College Press.
- Durkheim, E. (1961). Education and Society. New York: Teachers College Press.
- Freire, P. (1970). Pedagogy of the Oppressed. New York : Continuum
- Friere, P. (1970). Pedagogy of the Oppressed. New York: Continuum.
- Globalization, educational trends and the open society https://www.opensocietyfoundations.org/uploads/7fab0f35-4f84-4ed7-82d6-ee2346b7c142/carnoy_english.pdf
- Gore, M.S. et al. (ed.). (1975). Papers on Sociology of Education. New Delhi: NCERT.
- Haralambos and Holborn. (2002). Sociology: Themes and Perspectives. Collins. London.
- Haris Kevin. (1979). Education and Knowledge: The Structured Misinterpretation of Reality. Routledge&Kegan Paul Ltd., London.
- Impact of Globalization in Education https://edtechreview.in/news/2730-globalization-ineducation#:~:text=%2D%20Globalization%20enhances%20the%20student's%20ability,make%20sense%20of%20new%20situations
- John S Brubacher. (1969). Modern Philosophies of Education. Tata Mcgraw Hill Pub., Co., Pvt., Ltd, New Delhi.
- Keddie, N. (1971). Classroom Knowledge. M.F.D Young.
- Knowledge and Inquiry: An Introduction to Epistemology https://www.researchgate.net/publication/281223897_Knowledge_and_Inquiry_An_Introduction_to_Epistemology
- Krishna Murthy, J. (1947). On Education. Orient Longman, New Delhi.
- Kumar Krishna. (1996). Learning from Conflict. Orient Longman, New Delhi.

- Mani, R.S. (1964). Educational Ideas and Ideals of Gandhi and Tagore. New Book Society, New Delhi.
- Manoj Das. (1999). Sri Aurobindo on Education. National Council for Teacher Education, New Delhi.
- Margaret. (1999). The Open Classroom: A Journey through Education. Orient Longman, New Delhi.
- Mother. (1960). Education and Aims of Human Life. Aurobindo Ashram Press, Pondicherry.
- National digital library https://ndl.iitkgp.ac.in/
- NCERT (2014). Basics in Education. National Council of Educational Research and Training, New Delhi.
- NCERT. (2005). National Curriculum Framework – 2005. National Council of Educational Research and Training, New Delhi.
- Padma M. Sarangapani. (2003). Constructing School Knowledge, An Ethnography of Learning in an Indian Village. Sage Publications, New Delhi.
- Peters, R.S. (1967). The Concept of Education. Routledge, United Kingdom.
- Philips, D.C. (Ed) (2000). On Behalf of the National Society for the Study of Education (NSSE). Constructivism in Education. Opinions and Second Opinion on Controversial Issues. Part 1, The University of Chicago Press, Chicago.
- PHILOSOPHICAL FOUNDATION OF EDUCATION https://ddceutkal.ac.in/Syllabus/MA_Education/Paper_1.pdf
- Philosophical Inquiry in Education: Any Relevance https://www.researchgate.net/publication/338453055_Philosophical_Inquiry_in_Education_Any_Relevance
- PHILOSOPHICAL INQUIRY IN TEACHER EDUCATION https://edwp.educ.msu.edu/research/wp-content/uploads/sites/10/2020/11/IP896.pdf
- Prema Clarke. (2001). Teaching & Learning: The Culture of Pedagogy. Sage Publications, New Delhi.
- Russell Bertrand. (1977). Education and the Social Order. Unwin Paper Back, London.
- Saxena, N.R.S. (2019). Philosophical and Sociological Foundation of Education. R. Lall Book Depot
- Sen, Amartya &Dreze, Jean (2014). An Uncertain Glory: India and its Contradictions. Penguin Books Limited.
- Sengupta, M. (2022). Knowledge and Curriculum. Prentice Hall India Pvt.
- Shodhganga: a reservoir if Indian theses https://shodhganga.inflibnet.ac.in/
- Stella Van Petten Henderson. (1960). Introduction to Philosophy. The University of Chicago Press, Chicago.
- Steven H. Cahn. (1970). The Philosophical Foundation of Education. Harper & Row Publishers, New York.
- Winch, C. (1986). Philosophy of Human Learning. Routledge, London.

## PC6.1:Dissertationin Education (Implementation and ReportSubmission

**Credits: 4** **Max Marks: 100**

**Contact hours per week: 8** **External: 50**

**Internal: 50**

**ProposedActivities**

| Sr. No | Activity | Marks |
|---|---|---|
| 1. | ReportWritingandsubmission | 50 |
| 2. | Viva-voce | 50 |

| | | |
|---|---|---|
| | **Total** | **100** |