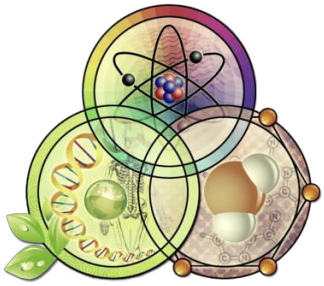
Analysis of learning achievements of the students in terms of learning outcomes in Chemistry, Physics, and Biology at Higher Secondary School Level



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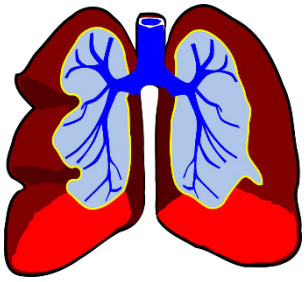

Research Project

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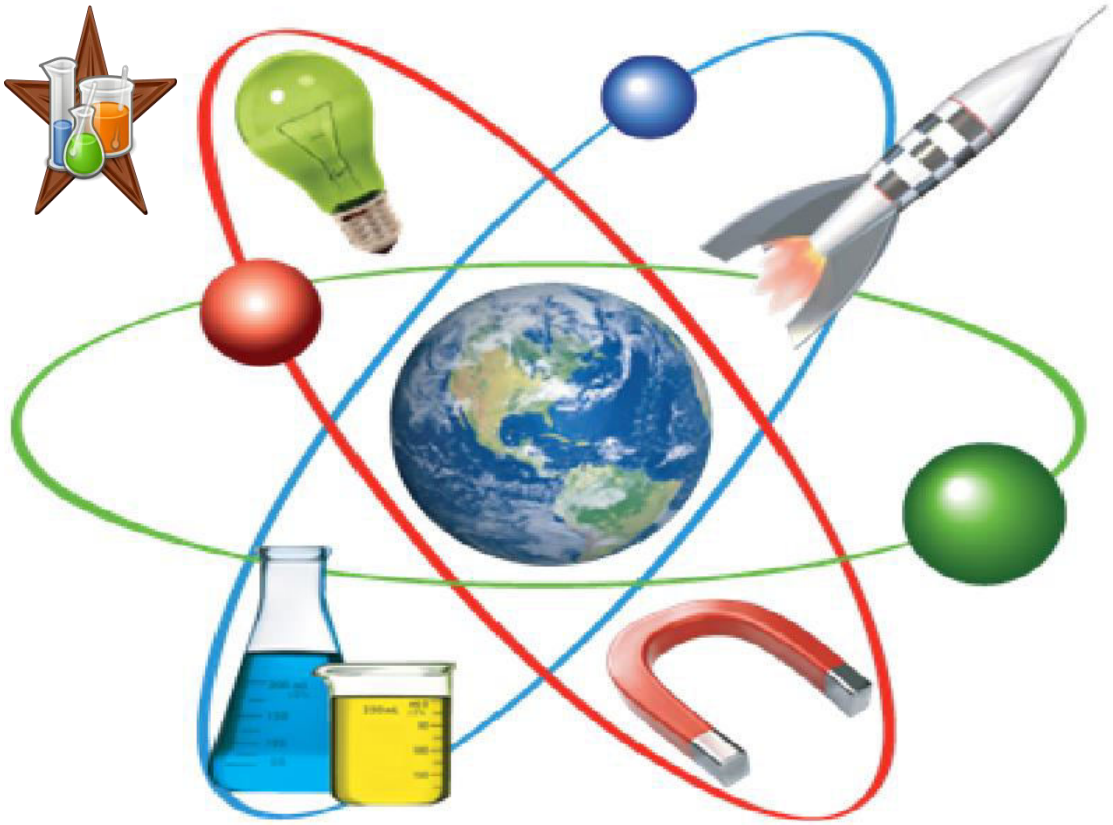

Learning Outcomes

Chapter – 1

Introduction to Learning Outcomes

1.1 Introduction

Scientific development in recent decades has, and will continue to have, a significant influence on topics that have great importance for humanity, quality of life, the sustainable development of the planet, and peaceful coexistence amongst peoples. From the immediate basic essentials of life such as access to water, food and shelter, to important issues that affect us all (management of agricultural production, water resources, health, energy resources, biodiversity, conservation, the environment, transport, communication), all have a strong science component to which everybody should have access to take part in local, regional, national and transnational decisions in a meaningful way. We also live in a world where poverty and riches live side by side and where the gap between them is increasing. In the 21st century, science must become a good shared by all, for the benefit of all people.

It is a view of science learning that will deal with scientific principles through an approach where children are taught, and learn, to write and talk about science, to argue for their views of the world and how they can draw on this knowledge to help in decision-making. This is no small challenge yet we are inspired by the ideas of Amartya Sen (2001) on the link between poverty and freedom, education and liberty. People need access to the necessities of life in a world where there is more than enough for everybody. They also need access to ways in which they can expand the freedoms they experience, and develop the capacities needed to take advantage of such opportunities, and so become more human.

Expectations for students' is an umbrella term that links learning outcomes with annotated examples of student work in the subject or short course specification. The purpose of the examples of student work is to show the extent to which the learning outcomes are being realised in actual cases.

1.1.1. What Are Learning Outcomes?

"… think first about what is essential that students know or be able to do after the course or program – what students need to know and could make powerful use of to enhance their lives and more effectively contribute to society. We believe that such reflection will lead instructors to focus on a broad synthesis of abilities that combine knowledge, skills and values into a whole that reflects how people really use knowledge." *So, what's a learning outcome anyway?* Mark Batters by, p. 1

Learning outcomes are statements that describe the knowledge or skills students should acquire by the end of a particular assignment, class, course, or program, and help students understand why that knowledge and those skills will be useful to them. They focus on the context and potential applications of knowledge and skills, help students connect learning in various contexts, and help guide assessment and evaluation.

The most commonly used and perhaps prudent definition of "learning outcomes" proposes that they are "…what a student is expected to be able to DO as a result of a learning activity."

To appreciate this definition of *learning outcomes,* a consideration of the meaning of the words and phrases in the definition may be helpful, since the simplicity of the definition may underestimate its exactness.

DO. The key word in the definition of learning outcomes is the word, "Do." The word suggests what skill, knowledge or behavior a student is able to demonstrate as a consequence of a learning activity. What is important is that there must be a doing in the **do** of a learning outcome. Examples of words that suggest such a doing are:

Words which suggest actions are examples of doing in "Do," such as:

Define	Discuss	Apply	Diagram	Express
Describe	Explain	Build	Differentiate	Compose
Identify	Give Examples	Compute	Illustrate	Generate
Label	Explain	Build	Prioritize	Arrange
List	Summarize	Implement	Compare	Plan
Tell	Estimate	Assess	Contrast	Write

Words which are less suggestive of actions and tend to result in weaker, less measurable learning outcomes are:

Know Understand Comprehend Feel Learn Appreciate

- **Learning activity.** For most classroom situations, learning activities are fairly easy to identify, since instruction and discussion are the common currency of course instruction. Learning activities can be found in such areas as, all of which are part of course/programs:
  Advisement Counseling Leadership Service Planning Workshops
- **Expected to be able to DO.** The inclusion of *expected* in the definition of a learning outcome suggests intentional learning rather than coincidental, incidental or accidental. When teachers identify intentional learning outcomes, they develop learning activities as the result of desired result, rather than having lots of activities and hope they result in learning. Activities are "expected" to result in specific learning outcomes.
- **A student.** Statements of learning outcomes include all the students with whom school may have contact. Even the briefest encounter may result in learning. However, in some specific instances, the contact may be so brief and the information so limited, that the identification of a learning outcome and its assessment may be a superficial and futile exercise. In those instances, school will focus on manageable, measurable learning outcomes.

1.2 Conceptual Framework

Good learning outcomes emphasize the application and integration of knowledge. Instead of focusing on coverage of material, learning outcomes articulate how students will be able to employ the material, both in the context of the class and more broadly. Learning outcomes are statements that describe the understanding, skills and values students should be able to demonstrate after a period of learning.

To support the exploration of the learning outcomes by teachers, parents, and students a glossary of the action verbs used in the specification is included. The outcomes are numbered within each strand. The numbering is intended to support teacher planning in the first instance and does not imply any hierarchy of importance across the outcomes themselves; it also does not suggest an order to which the learning outcomes should be developed in class.

1.2.1 Characteristics of Good Learning Outcomes

Good learning outcomes focus on the application and integration of the knowledge and skills acquired in a particular unit of instruction (e.g. activity, course program, etc.), and emerge from a process of reflection on the essential contents of a course. More specifically, good learning outcomes:

Are very **specific**, and use **active language** – and verbs in particular – that make expectations clear. This informs students of the standards by which they will be assessed, and ensures that student and instructor goals in the course are aligned. Where possible, avoid terms like understand, demonstrate, or discuss that can be interpreted in many ways.

- Should be **flexible**: while individual outcomes should be specific, instructors should feel comfortable adding, removing, or adjusting learning outcomes over the length of a course if initial outcomes prove to be inadequate.
- Are **focused on the learner**: rather than explaining what the instructor will do in the course, good learning outcomes describe knowledge or skills that the student will employ, and help the learner understand why that knowledge and those skills are useful and valuable to their personal, professional, and academic future.
- Are **realistic**, not aspirational: all passing students should be able to demonstrate the knowledge or skill described by the learning outcome at the conclusion of the course. In this way, learning outcomes establish standards for the course.
- Focus on the **application** and **integration** of acquired knowledge and skills: good learning outcomes reflect and indicate the ways in which the described knowledge and skills may be used by the learner now and in the future.
- Indicate useful **modes of assessment** and the specific elements that will be assessed: good learning outcomes prepare students for assessment and help them feel engaged in and empowered by the assessment and evaluation process.
- Offer a **timeline** for completion of the desired learning.

Each assignment, activity, or course might usefully employ between approximately five and ten learning outcomes; this number allows the learning outcomes to cover a variety of knowledge and skills while retaining a focus on essential elements of the course.

Key characteristics of learning outcomes include:

1. The intended achievement for the learners must be meaningful.
2. The intended achievement for the learners must be measurable.
3. The outcome should speak to the quality standards

Learning outcomes should be Smart:

- **Speak to the learner:** learning outcomes should address what the learner will know or be able to do at the completion of the course
- **Measurable:** learning outcomes must indicate how learning will be assessed
- **Applicable:** learning outcomes should emphasize ways in which the learner is likely to use the knowledge or skills gained
- **Realistic:** all learners who complete the activity or course satisfactorily should be able to demonstrate the knowledge or skills addressed in the outcome
- **Time-bound:** the learning outcome should set a deadline by which the knowledge or skills should be acquired;
- **Transparent:** should be easily understood by the learner; and
- **Transferable:** should address knowledge and skills that will be used by the learner in a wide variety of contexts

1.2.2 Why develop learning outcomes?

"…students already know they want a degree/certificate. The challenge is to help students become highly intentional about the forms of learning and accomplishment that the degree should represent." (*College Learning for the New Global Century*, AAC&U, p. 29)

Learning outcomes are valuable to learners, instructors, and administrators. Mark Batters by (1999) of the Learning Outcomes Network explains that learning outcomes are more than simply several sentences appended to existing lesson plans or curricula; instead, the development of learning outcomes and their use within a unit of instruction shapes learning and assessment activities and can enhance student engagement and learning.

Benefits of using learning outcomes

Because of their ability to benefit many groups in postsecondary education, the development of learning outcomes has become an increasing priority for instructors and institutions over the course of the last decade. Establishing a focus on integrated, generalizable, and transferable skills complements contemporary demands on graduates and builds a foundation for lifelong learning. As government and public attention on the products of higher education increases, learning outcomes help to define the goals and essential aspects of higher education within the institution, to students, and to the general public.

For students

- By focusing on the application of knowledge and skills learned in a course and on the integration of knowledge and skills with other areas of their lives, students are more connected to their learning and to the material of the course.
- The emphasis on integration and generalizable skills helps students draw connections between courses and between coursework and other kinds of knowledge, enhancing student engagement.
- Students understand the conditions and goals of their assessment.

Learning outcomes focus on the learner. Well-written learning outcomes should give students precise statements of what is expected of them. Students can use the

outcomes to measure and guide their own learning, and determine how much support to ask for/pursue.

For teachers

- The process of developing learning outcomes itself offers an opportunity for reflection on the content of the course in the context of its potential applications. Developing learning outcomes means that the context of the learning will always be emphasized, and courses focus on the knowledge and skills that will be most valuable to the student now and in the future.
- Learning outcomes point to useful methods of assessment.
- Learning outcomes allow instructors to set the standards by which the success of the course will be evaluated.

Learning outcomes also govern other processes that are part of instruction. Outcomes help in the planning instruction: they help break down the syllabus and the teaching process so that teachers select meaningful content/materials and activities to aid the meeting of an outcome; they help facilitate assessment and evaluation; and they (should) align a course with a program and curriculum, i.e., a set of course-level outcomes should nest within program outcomes.

For institutions & administrators

- In order to determine what is essential for students to know, a Teacher must consider the particular course or unit in the context of future coursework and the curriculum as a whole. This contributes to the development of a coherent curriculum within a decentralized institution while maintaining instructor autonomy, and helps to ensure that students are prepared for future work and learning.
- The application and integration of learning emphasized by learning outcomes reflect and support the contemporary nature and priorities of the university, enhancing student engagement, uncovering opportunities for interdisciplinary, and providing guidance and support for students with many different kinds of previous academic preparation.
- Learning outcomes provide structures from which courses and programs can be evaluated and can assist in program and curricular design, identify gaps or overlap in program offerings, and clarify instructional, programmatic, and institutional priorities.

We can create learning outcomes and exam questions that activate and assess varying levels of student thinking skills, including:

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation
- Creation

1.3. Types of Outcomes

There are two primary types of outcomes used in creating an assessment plan -

1. Operational outcomes and
2. Student learning outcomes.

Operational Outcomes

Outcomes that deal with functions, demand, resources, and efficiencies. Examples of Operational Outcomes include:

- Retention rates
- Graduation rates
- Percent of graduates continuing to graduate school
- Percent of graduates continuing to employment
- Student credit hours/faculty
- Cost per student to deliver service/instruction
- Office/service/course utilization rates
- Satisfaction with services

Student Learning Outcomes

Outcomes that describe the desired learning that must take place in order to achieve a stated goal.

Examples of Student Learning Outcomes include:

- Communication: oral and/or written
- Critical thinking
- Teamwork
- Professional/technical competency
- Productivity
- Research skills
- Intended learning outcomes are direct statements that describe the knowledge, skills, and attitudes that students are expected to demonstrate in successfully completing a course or program.
- Learning outcomes describe, from the student's perspective, what learning looks like. As such, they should be observable and assessable in some way and written in a way that is both rigorous and flexible -- rigorous in that they specify the complexity of the learning that's expected, and flexible in that the learning might be demonstrated in a variety of ways.

1.4. Need and Importance of Study

A learning outcome makes clear the intended result of the learning rather than what form the instruction will take. A good learning outcome states what a student will know or be able to do at the end of instruction. It focuses on student performance. Students will be able to:

- Know, use, and interpret scientific explanations of the natural world that are relevant to teaching science in the middle schools.
- Generate and evaluate scientific evidence and explanations.
- Explain how scientific knowledge is based on the study of natural phenomena, provides explanations, and makes testable predictions that are consistent with known evidence.

- Advance in their skills in quantitative reasoning and quantitative applications for understanding natural phenomena.
- Enhance skills in a broad array of technology, including computers, and have effective techniques for implementing them in the classroom.
- Be knowledgeable about recent research on how students learn science, including students with special needs, and will be capable of applying it to classroom practice.
- Be aware of the context of science education, including the role of state and national standards.
- Analyze, evaluate, and apply curricular materials and resources.
- **Recognize science is done as part of a community.**

General Learning Outcomes							Program Learning Outcomes							Outcomes for Secondary Education Majors	
Critical analysis and reasoning	Scientific reasoning	Quantitative reasoning	Oral communication	Written communication	Technological competence	Information reasoning	Foundation of knowledge - classical Physics	Foundation of knowledge - modern Physics	Modeling, mathematical & computing skills to solve scientific and technical problems	Experimental skills to solve scientific and technical problems	Ability to provide technical expertise on complex societal issues	Experience in Independent Research	Skills in communicating technical knowledge	Acquisition of modern pedagogical methods for physics classrooms	Proficient application of physics content and pedagogy as instructor

A stated learning outcome answers the question: What is it that your students should be able to do at the end of the course that they could not do before? i.e students will develop and be able to

- Understanding about science
- Investigating in science
- Communicating in science
- Science in society

Thus Effective learning outcomes:

- Are student-centered
- Focus on learning, resulting from an activity rather than the activity itself
- Reflect the institution's mission and the values it represents
- Align at the course/program, academic program/department, divisional, and institutional levels
- "*Learning outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate after completion of a process of learning.*" *(*Writing and Using Learning Outcomes*, p. 5)*
- This broad definition uses the term "process of learning" which describes everything from a single assignment to an entire degree. The definition that follows specifically describes course-level learning outcomes which are commonly found in a course syllabus.
- "*A formal statement of what students are expected to learn in a course. Expected learning outcomes statements refer to specific knowledge, practical skills, areas of professional development, attitudes, higher-order thinking skills, etc. that faculty members expect students to develop, learn, or master during a course.*" *(Suskie, Assessing Student Learning: A Common Sense Guide, 2004)*

1.5. Statement of the Problem

The present study was undertaken keeping in mind to find out the status of Learning Outcomes in State Government Schools of Goa at higher Secondary level and stated as follows:

"Analysis of learning achievements of the students in terms of learning outcomes in Chemistry, Physics, and Biology at Higher Secondary School Level"

1.6. Objectives of the Study

1. To develop the learning indicators in Chemistry, Physics and Biology at Higher Secondary school level.
2. To assess the students learning out comes in light of these learning indicators in Chemistry, Physics and Biology at Higher Secondary school Level

3. To find out and analyse the source of mismatch between the expected learning outcomes and the actual learning outcomes of the students in Chemistry, Physics and Biology at higher Secondary level, if required.

1.7. Hypotheses/Research questions

What are the learning indicators of student's achievements in Chemistry, Physics and Biology at Higher Secondary school level?

What is the status of students learning out comes in light of these learning indicators in Chemistry, Physics and Biology at Higher Secondary school Level?

What is the source of mismatch between the expected learning outcomes and the actual learning outcomes of the students in Chemistry, Physics and Biology at higher Secondary level and how this mismatch can be overcome?

1.8. Delimitations of the Study

1. The study was delimited to State Government Schools of Goa and that too at students of higher secondary level only.
2. The study was delimited to a sample of approximate 141 Students of various schools of Goa from Central, North and South zone

1.9. Chapterisation

The whole study for analysis would be split into the following chapters:

Chapter I: This chapter deals with a brief introduction of the topic, then explains Learning Outcomes in detail and its parameters, need, importance, statement of the problem, objectives, hypotheses/research questions and delimitations of the study.

Chapter II: This chapter deals with review of related literature in term of research problems, methodologies and majors findings of various studies and articles done previously on the topic.

Chapter III: It focuses on the methodology to be adopted by the researcher for the study.

Chapter IV: This chapter would contain the analysis and interpretation of the data collected from the respondents. The researcher would be using MS Office and SPSS for analysis and would represent it through various tables, graphs.

Chapter V: This chapter would contain the main findings inferred from the data collected and also the suggestions of the researcher based on the findings. This chapter would conclude the study giving suitable inference from the study.

Chapter – 2

Review of Related Literature

2.1 Introduction:

Review of related literature in any field of investigation has become an inevitable part of research work. Best (1977) is of strong opinion that "familiarity with the literature in any problem area helps the student to discover what is already known, what others have attempted to found out , what method of approach have been promising or disappointing and what problems remain to be solved". The investigator has made an earnest effort to find out and study the researches related to topic under investigation concluded by the various researchers and scholars.

Stern and Roseman (2004) pose the question, "Will better curriculum materials necessarily make a difference in student learning?" . Intuitively, it seems that good curriculum materials should make a difference in student learning outcomes. Specifically, Chambliss and Calfee (1989) state, "Theory and practice both suggest that well-designed science textbooks can enhance student understanding"

In recent decades, employers, parents, accrediting agencies, state legislators, the federal government, and students have begun to demand that post-secondary institutions be held more accountable for the education and training they provide to students (Albert, 1991; Eaton, 2003). "Student learning outcomes [SLOs] are rapidly taking center stage as the principal gauge of higher education's effectiveness" (Ruhland & Brewer, 2001, p. 142). Very few studies have empirically examined the impact of student learning outcomes (i.e., statements on learning expectations) on student learning and attitudes. As recent researchers have pointed out, "the (current popular) construct of student-centered learning appears to rely more on rhetoric than it does on evidenced-based pedagogical practice" (Maclellan & Soden, 2007, p. 4).

In order to better understand why there is a push for 'accountability' (i.e., meeting specified regional and federal standards) of student learning in post-secondary institutions, working definitions for 'student learning outcomes,' 'assessment,' and 'accountability' are needed. Student learning outcomes (SLOs) include the knowledge, skills, and dispositions (e.g, attitudes, beliefs, and attributes) that can be demonstrated by students as a result of their exposure to the educational environment (Entwistle, 1984). As noted by Jenkins & Unwin (1996, p. 2), the benefits associated with the use of SLOs are to

1. help students learn more effectively. They know where they stand, and the curriculum is made more open to them;

2. make it clear what students can hope to gain from following a particular course or lecture;
3. help instructors to design their materials more effectively by acting as a template for them;
4. help instructors select the appropriate teaching strategy;
5. help instructors more precisely to tell their colleagues what a particular [learning] activity is designed to achieve;
6. assist in setting examinations based on the materials delivered; and
7. ensure that appropriate assessment strategies are employed.

Ruhland and Brewer (2001) argue that learning outcomes should not only demonstrate what students know, but should also capture the changes that occur in their cognitive and affective development as a result of their college experiences (e.g., changes in critical thinking and level of civic mindedness).

According to Banta (1996) and Allen and Bresciani (2003), the use of SLOs serves two broad purposes:

a. to improve student learning and
b. To address the issue of institutional accountability.

Yet attaining these two objectives can be difficult because of a failure to recognize that the concepts of 'assessment' and 'accountability' represent different aspects of the review process. The word 'assessment' has several levels of meaning:

1. the methods used to measure learning;
2. the processes of administering measures and collecting information;
3. the process of interpreting and evaluating of the performance data; and
4. the process of making improvements based on the results of the data evaluated (e.g., Christopher Newport University Assessment Glossary, 2003; Leskes, 2002).

Ruhland and Brewer (2001) state that, "[a]ssessment of learning outcomes has been interpreted as a means to improving (a) student learning; (b) accountability for the quality of learning; (c) traditional and authentic measures of student learning; and (d) measures that show students have mastered the knowledge, skills, and abilities essential for employment".

One of the reasons learning outcomes are taking 'center stage' is because research on this topic asserts that learning is enhanced when students are made aware of the mastery expectations for their courses and degree programs (Appleby, 2003; Chappuis & Stiggins, 2002; Halonen, Appleby, Brewer, Buskist, Gillem, Halpern, Lloyd, Rudmann, and Whitlow, 2002; McKenney, 2003). Increasingly, colleges and universities are not only being asked to specify the learning expectations of their students, but to also provide evidence that those outcomes are being achieved (Allen & Bresciani, 2003; Crow, 2000; Wellman, 2000). Thus, the measure of success for institutions of higher education is not just in their enrollment and graduation rates, but also their documentation of student achievement of the learning outcomes associated with the degrees being awarded.

Science literacy is widely considered as indispensable in modern developed and highly technological countries (e.g., deBoer, 2011). Supporting students in developing science literacy is supposed to satisfy society's need for open- minded well- educated citizens and the industry market's need for skilled workers in science and science- related fields (Roberts, 2007).

At the primary level, Science Education, is one of the components of the General Studies curriculum which also embraces learning elements of Personal, Social & Humanities Education and Technology Education. At the junior secondary level, the core subject Secondary 1-3 Science, consisting of topics from various science disciplines, is taught in all schools. At the senior secondary level, Biology, Human Biology, Chemistry and Physics are offered as optional subjects at Secondary 4-5 while Biology, Chemistry and Physics are further developed into Advanced Supplementary Level and Advanced Level subjects in the sixth form curriculum. For these subjects, the intended curriculum aims to help students to:

- acquire knowledge of the empirical world;
- develop an ability to observe objectively and critically;
- develop an ability to solve problems and think scientifically;
- acquire an understanding of the relevance of science to our world and to the needs of a changing society; and
- acquire an ability to communicate using the language of science.

These aims fall in line with the broad educational aims to help students to acquire literacy and numeracy, develop thinking and reasoning abilities, acquire knowledge, and develop social, political and civic awareness as stated in the document School Education in Hong Kong: A Statement of Aims (1993). In 1999, Science Education, as one of the key learning areas of the school curriculum, has been critically examined in the process of the 3 holistic review of the school curriculum. The aims of science education are re-defined to align with the new aims of education for the 21st century -

enabling our students to enjoy learning, enhancing their effectiveness in communication and developing their creativity and sense of commitment. Essential learning elements in Science Education are identified for the all-round development of our students. Recommendations are made to introduce changes for improvement which will enable students to learn to learn better in science through an improved curriculum framework and improved teaching/ learning/assessment strategies. Science Education, besides contributing to the development of science capabilities in the students, will also promote the development of generic elements through a range of learning activities.

Science education aims for students to:

- develop curiosity and interest in science;
- develop the ability to inquire and solve problems;
- acquire the basic scientific knowledge and concepts for living in and contributing to a scientific and technological world;
- recognize the usefulness and limitations of science and the interactions between science, technology and society and to develop an attitude of responsible citizenship, including respect for the environment and commitment to the wise use of resources;
- be acquainted with the language of science and be equipped with the skills for communicating ideas in science related contexts;
- appreciate and understand the evolutionary nature of scientific knowledge;
- attain personal growth through studying science; and · be prepared for further studies or enter careers in science and technological areas.

2.2 On completion of the senior secondary level, all students should:

- have a fundamental understanding of essential scientific knowledge and concepts for contributing towards a scientific and technological world;
- have the ability to solve problems by employing scientific approaches and methods;
- make informed judgements and decisions based on scientific evidence;
- be able to comprehend issues related to the nature and development of science and technology;
- make sensible judgments on their personal health and take responsible actions in safety issues; and
- Acknowledge the effects of human activities on the environment and act responsibly in conserving the environment.

Assessment of students' science literacy often focuses on student achievement. However, in a world driven by ever- accelerating scientific and technological progress, today's students' and tomorrow's employees' motivation to engage in science or domains of science is also an important factor. With respect to students' future engagement, one prominent variable in educational settings is interest. Research in the past decades evidenced a decline in students' interest over middle school, which is particularly prominent in the science domains and specifically in physics (Schiefele, 2009). These findings had educational researchers focusing on students' interest in the field of physics, yet some researchers state that affective- motivational variables of students are still under- attended in science education (Fortus, 2014).

Student achievement is widely considered the major outcome of students' learning (about science, e.g., Organization for Economic Development and Co- operation [OECD], 2010; National Research Council [NRC], 2012). Student achievement is indicated not only by the knowledge of a broad range of facts, but also by a well- connected knowledge organized around the core ideas of a domain (Bransford, Brown, & Cocking, 2000). Knowledge organized in this way is expected to enable students to apply this knowledge to known contexts as well as new contexts that require further learning (Bransford & Schwartz, 1999). That is, a knowledge of science ideas as well as the relationships between these ideas in the light of the core ideas of science is considered to form the basis for student competence in science (e.g., NRC, 2012). However, research has repeatedly and consistently shown that many students struggle in developing such integrated knowledge (Beaton et al., 1996; OECD, 2004, 2010). In order to help students develop integrated knowledge, science instruction needs to systematically identify relationships between science ideas and

connect them to observations of the real world to make sense of and then explain phenomena or solve problems respectively (Fortus & Krajcik, 2012; Fortus, Sutherland Adams, Krajcik, & Reiser, 2015; Linn, 2000; Linn, Clark, & Slotta, 2003).

Prasad (1995) conducted a study on Interaction of Approaches to Studying and Achievement motivation on Process Outcomes in Physics of secondary school pupils. His study revealed that there is no significant difference between mean scores of boys and girls in Process Outcomes in Physics.

Paulose's (1995) study on the influence of scientific attitude of university entrants on their Process Outcomes in Physics found that three independent variables viz., Scientific Attitude, Sex and Residence exerted a significant influence on the dependant variable viz., Process Outcomes in Physical Science.

Chemistry education (or chemical education) is a comprehensive term that refers to topics related to the study or description of the teaching and learning of chemistry in schools, colleges and universities. Topics in chemistry education might include understanding how students learn chemistry, how best to teach chemistry, and how to improve learning outcomes by changing teaching methods and appropriate training of chemistry instructors, within many modes, including classroom lecture, demonstrations, and laboratory activities. There is a constant need to update the skills of teachers engaged in teaching chemistry, and so chemistry education speaks to this need.

Accreditation by the American Chemical Society (ACS) requires the following development of student skills:

1. Problem solving skills
2. Chemical literature skills
3. Laboratory safety skills
4. Communication skills
5. Team Skills
6. Ethics

Devaki and Mary Lily Pushpam (2011) the study on Meta cognitive ability and Academic achievement in Chemistry among XI standard students. This study aimed at the assessment of Meta cognitive Ability of XI standard students and its association with Academic achievement in Chemistry. Meta cognitive ability is the higher order thinking which is essential for meaningful learning. A sample of 244 students belonging to science group form Coimbatore district was selected as the subjects for the study. Meta cognitive inventory constructed and standardized by Schraw and Dennison in 1994, was the tool used. The survey method was used for the study. In this study it was found that there is significant association between metacognitive ability and Academic achievement in Chemistry.

Allen A Espinosa et. el., 2014 studied the "Analysis of Achievement Tests in Secondary Chemistry and Biology." The study analyzes the performances of students in a regular high school, a special school and a special science high school of different regions in the division achievement tests in chemistry for school year 2009-2010. It also identifies the content of the division achievement tests in chemistry as well as in biology. The biology achievement test serves as a benchmark on how sophomores are being prepared prior to taking a chemistry course. Test items in the division achievement tests are classified according to the level of thinking that they are developing. Difficulty index for each item in the chemistry achievement tests are also determined. The study found out that both chemistry and biology achievement tests focuses on factual knowledge which promotes lower order thinking skills. It also found out that the special school and regular high school's performance. Performance in the achievement test still fits a bell-shaped normal curve while a special science high school has a skewed to right curve . Performances of students are also affected by face validity.

Patrick (2010) determine the effects of field experiences on students' knowledge of process of science and biology achievement. The design of the study was experimental, 2 x 2, pre-test, post-test control group design. The sample of the study consisted of 100 biology students in two intact classes. Four research questions were raised and collapsed to four hypotheses. The first three hypotheses were tested with t-test statistic at 0.05 level of significance. The fourth hypothesis was tested with Pearson Product Moment Correlation Statistic. The major findings of this study included: a significance difference in process of science scores between pre-test and posttest of field trip students; a significant difference in process of science test scores between students exposed to field trip experiences and those who were not exposed; a significant difference in biology achievement test scores between students exposed to field trip experiences and those who were not; and a strong correlation between process of science score and biology achievement score. It was concluded that field trip experiences enhanced students' understanding of process of science, improved students' attitude towards biology and significantly influenced their biology achievement.

Noushad (1989) in a study to find the effect of sex, locale and attitude towards problem solving on Process Outcomes in Biology got significant relation between Attitude towards Problem Solving and Process Outcomes in Biology.

Varghese (1989) in a study of Affective Correlates of Process Outcomes in Biology, found that Process Outcomes in Biology can be predicted by using the score of attitude towards problem solving, attitude towards science and achievement motivation.

Mini (1989) reported significant and high mean difference for Process Outcomes in Biology between equated groups of boys and girls of equating age, intelligence, socio economic status and locale.

Chundang, et al. (2012) conducted a study aimed to investigate students‟ learning outcomes in classes in which the Interactive CAI (Computer Assisted Instruction) - based materials were implemented. The study revealed that, after the scores from the pre-test and post-test were compared, the students got better scores in the post-test, with statistical significance of 0.05. This implies that the CAI - based materials lead to the students‟ better learning outcomes.

James, J. and Marice, P.V. 2004 conducted a study on achievement in science as related to scientific aptitude and scientific attitude among 11th standard students in Tamil Nadu. To explore the relationship among the variables namely achievement in science, scientific aptitude and scientific attitude, to investigate the association between achievement in science, scientific aptitude, scientific attitude and some selected variables. The sample constituted 470 students of standard XI who had opted for science group drawn from 10 schools of Coimbatore District in Tamil Nadu. The tools used for data collection were the standardized Scientific Knowledge and Aptitude Test prepared by 63 Chatterji and Manjula Mukerji (1964). The standardized science attitude scale prepared by Mrs. Avinash Grewal, (1977) Marks secured by the students in science in the S.S.L.C. or Matriculation Board Examination, as the case may be, as the science achievement score; and personal data sheet prepared by the investigator to collect Information on the selected variables. The data were treated with one –way analysis of variance, 't' – test, chi –square test and coefficient of correlation (Person's product Moment Method). There was positive relationship between achievement in science and scientific aptitude whereas achievement in science and scientific attitude were not related. Students hailing from rural and urban areas had similar scientific attitude and same type of academic achievement in science. But they differed in their scientific aptitude. Students from Matriculation and State Board schools had same type of achievement score in science but they differed in their scientific aptitude and scientific attitude, favoring students from Matriculation schools. Students from different types of schools (gender wise) differed in their achievement in science favoring girls' schools. But they were found on par in their scientific aptitude and scientific attitude. There was significant association between gender and science achievement, and gender and scientific attitude whereas no significant association was observed between achievement in science and scientific aptitude. Significant association was observed between residential origin (rural and urban) and scientific aptitude. But students irrespective of their residential origin had similar scientific attitude and same type of achievement in science. School type (syllabus wise) was found to be significantly associated with scientific attitude. Achievement in science and scientific attitude were found to be significantly

associated with school type (gender wise) whereas no significant association was found between scientific aptitude and school type. The study cited 17 references.

Missett (2012) comprised three independently conducted studies and linked into the development of thinking skills deemed necessary for the 21st Century. While educators and policy makers advocate teaching students creative and critical thinking skills to address an increasingly global and complex world, they simultaneously mandate accountability through evidence-based educational practices. The results of these studies add to the literature base relating to the claims of specific programs and curricula purporting to teach 21st Century skills and to the relationship between two of those skills--creative and critical thinking. The first Study was a qualitative investigation of learning outcomes for secondary students who participated in an advanced, online, case-based course in environmental science. Growth in critical thinking outcomes was evident for most students exposed to the research-based curriculum. In the second, the researchers investigated learning outcomes in the areas of creative problem-solving, creative and critical thinking, and teamwork for middle school students who participated in a creativity enhancement program, Destination Imagination. Results indicated that participation supports growth in 21st Century skills for middle school participants. In the third study, the relationships between critical thinking and divergent thinking in middle school students were assessed, and the researcher investigated whether there were differences in these relationships for students who participated in creativity training as compared to students who did not participate. Collectively, this research program illustrates positive development of 21st Century skills following exposure to specific curricula and programs designed to build these competencies.

2.3 The Gaps Identified:

From the studies reviewed by the investigator, the following gaps have been identified.

- The learning outcomes of higher secondary students in Physics, Chemistry and Biology has not been found out.
- The factors affecting the different specifications of the academic achievement such as knowledge, understanding, application and skill have not been studied so deeply in Goa.
- Only a few studies have been undertaken to find out the academic achievement of higher secondary students in Physics, Chemistry and Biology in India.

2.4 The present study:

In order to bridge the gap mentioned above, the present study is undertaken to find out the academic achievement in terms of learning outcomes of higher secondary students in Physics, Chemistry and Biology in Goa State including different factors as the variables. Besides, the researcher endeavourers to study the specifications of academic achievement separately.

2.5 Conclusion:

The foregoing research reviews made it clear that learning outcomes in science has been attaining too much importance and significance in the field of education and attracting the attention of educational practitioners all over the world. The present review helped the researcher to define the scope and objectives of the study, formulate hypotheses and to get an insight into the methodology to be followed and how to construct and evaluate the tools. It also helped in the statistical interpretation of the data.

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Chapter – 3

Tools and Techniques

The entire research activities centred around learning outcomes has been carried out in following steps.

3.1. In house meeting:

An in-house meeting was conducted on 17th August, 2017 in presence of Principal, Prof. N. Pradhan, Prof. I.B. Chughtai (Dean of Instruction), Prof. B. Ramesh Babu (Dean Research), Prof. V.K. Kakaria, Prof. J. Mandal (Head, DESM), Dr. Rashmi Singhai, Dr. Shivalika Sarkar, Dr. Daksha M. Parmar (Co-PI), Dr. Kalpana Maski (Co-PI), Dr. Rashmi Sharma (Co-PI), and Prof. L.K. Tiwary (PI). A detailed discussion was made on the modalities to carry out this research investigation. Following decisions were taken regarding conduct of this research project.

i. The term learning achievements may be studied in terms of learning outcomes and the title of research project may also be modified accordingly.
ii. The workshop may be organized in order to develop learning outcomes in Chemistry, Physics and Biology at higher secondary school level. Accordingly researcher diverted their attention on formulation of learning outcomes in Chemistry, Physics and Biology for higher secondary school level and assessing the achievement of these learning outcomes by the students studying in the state of Goa. An important decision was taken in the meeting regarding the sample of investigation. It was decided to limit two schools each in all three regions i.e. North, South and Central regions with 20 students from each school in each subject (Physics, Biology and Chemistry)

3.2. Formulation of Learning Outcomes and tool for assessment:

As per suggestions made in in-house meeting a workshop was organized to develop learning outcomes for senior secondary Chemistry, Physics and Biology subjects on the of line of learning outcomes developed by NCERT for upper primary classes. In the same time this workshop organized from 28th August, 2017 to 1st September, 2017 was also intended to develop tools to assess the students of Goa towards the achievement of formulated learning outcomes in Physics, Chemistry and Biology. This workshop was attended by external resource persons like Prof. I.P. Aggrawal, Prof. A.B. Saxena and Prof. Reeta Sharma and internal resource persons namely Prof. L.K. Tiwary, Dr. Rashmi Sharma, Dr. Daksha Parmar, Dr. Kalpana Maski and Dr. Rashmi Singhai. The draft for learning outcomes in each subject was consisted of three parts namely curricular expectations, pedagogical processes and learning outcomes. The curricular expectations in each subject was bifurcated into two parts for each class XI and class XII in Physics, Chemistry and Biology. Similarly learning outcomes were prepared for class XI and class XII separately in Physics and Chemistry. But, the expert group in Biology felt appropriate to prepare a composite learning outcomes for higher secondary biology due to inseparable interconnectivity in contents of Class XI and Class XII Biology subject.

The next Task undertaken by the investigators is to develop tool to assess the attainment of learning outcomes in Chemistry, Physics and Biology by the higher secondary students of Goa state. The tool was decided to be administered on the students of class XII on the basic learning outcomes acquired by them during class XI. Hence, a questionnaire consisting of 50 questions was prepared in each subject (Physics, Chemistry and Biology) based upon the learning outcomes designed for class XI in the corresponding subjects. However, investigators considered some of the learning outcomes intimately related with class XI in Biology and the questions were framed accordingly.

The investigators also felt the necessity of holding a focus group discussion during field visit. Hence, a tool consisting of suggestive questions were designed to facilitate focus group discussion. This tool was also consisted of some suggestive points and activities that may be utilized during focus group discussion. The learning outcomes, questionnaire and guidelines for focus group discussion are annexed at the end of this chapter.

3.3. Collection of data:

The state of Goa was selected to study the extent of achievement of identified learning outcomes in Physics, Chemistry and Biology at higher secondary stage. The entire state was divided into three zones i.e. North, Central and South zones. The two schools were selected randomly from each zone. Out of two school one was government school and other government added. The list of the selected schools is mentioned below.

North Zone:

1. Govt. Higher Secondary School, Pernem, Goa.
2. Puroshottam Walawalkar Higher Secondary School, Mapusa, Goa.

Central Zone:

1. Govt. Higher Secondary School, Khandala, Goa.
2. Mustifund Higher Secondary School, Goa.

South Zone:

1. Government Higher Secondary School, Baina, Goa.
2. M.E.S. Higher Secondary School, Vasco, Goa.

The tool developed on the basis of learning outcomes of class XI were administrated on the class XII students of above six schools. The entire students of class XII were divided into three groups consisting of 20 students in each group. The selection of students in each group was made randomly based upon their subject combination. Randomly 20 students of PCM group were identified for Physics portion, 20 students from PCB were randomly given chance for Biology and remaining 20 students from both PCM and PCB were allowed to join in Chemistry portions. Each student was given 2 hours' time to attempt 50 items. However, some students were permitted to attempt items of more than one subject within permissible time limit. The Principal Investigator Prof. L.K. Tiwary and Co-PI Dr. Daksha Parmar, themselves visited all the six schools for collection of data. The number students participated in this research endeavor are listed below:

S. No.	Subject	Zone	No. of Students
1.	Chemistry	North	34
		Central	42
		South	44

2.	Biology	North Central South	45 40 33
3.	Physics	North Central South	41 38 33

The researchers conducted focus group discussion in each school consisting of teachers and students and they also received adequate support from state functionaries like State Council of Educational Research and Training (SCERT), CRCs and BRCs of Goa State.

3.4. Analysis of Data:

The data collected in the field were analyzed on workshop mode with the involvement of following researchers.

1. Prof. L.K. Tiwary
2. Dr. Rashmi Sharma
3. Dr. Kalpana Maski
4. Prof. A.B. Saxena (Retd. Professor)
5. Prof. Reeta Sharma (Retd. Professor)
6. Dr. Chitra Sharma (Contractual faculty)
7. Dr. Deepa Gupta (Contractual faculty)
8. Dr. Sabiha K. Khan (Contractual faculty)

The parameters and mode of analysis differed from subject to subject as researchers were given every autonomy to make analysis as per their own understanding. The physics group firstly saw a complete overview of scores attained by students. Then they found out scores and percentage of students in Physics from higher to lowest. They also studied the distribution of percentage and scores in exclusive series attained by students in Physics. The zone wise, score and percentage was compared from highest to lowest and the group made item analysis in terms of discrimination index and difficulty index. They finally studied the achievement of learning outcomes of students in physics including zone wise achievement of learning outcomes of students.

The Biology and Chemistry groups took the help of graphical representation to interpret their data. They represented achievement of learning outcomes of class XI by class XII students firstly in the whole state and then in the separate zone. They

analyzed the performance of students in the state and in the zone. They also found out the attainment of different learning outcomes in the whole state and then they compared the attainment among three zones. The researches tried to study the achievement of learning domains by students in the students and also compared such achievements among three zones.

Annexure – I

Curricular Expectations in Chemistry for Senior Secondary Classes

- Chemistry curriculum at senior secondary stage is intended to develop an interest in the students to study chemistry as discipline and encourage to make use of the gathered knowledge in real life situations.
- Strengthen the concepts developed at the secondary stage and to provide firm foundation for further learning of chemistry at tertiary level, more effectively.
- Develop positive scientific attitude and appreciate contribution of chemistry towards the improvement of quality of human life and inculcate the values of honesty, integrity, cooperation and concern for life.
- Develop problem solving skills and nurture curiosity, aesthetic sense and creativity.
- Internalize the language of chemistry which is helpful to assimilate chemistry as a separate discipline.
- Learn basic experimental or practical skills like weighing, titration, filtration, washings, determination of melting and boiling points, etc.
- Develop sensitivity towards judicious use of chemicals to save environment from pollution.
- Develop ability to understand the cause of any physical and chemical change, extent of physical and chemical reaction and the kinetics or time dependence of any chemical reaction.
- Develop ability to understand different types of interconnectivity among constituent particles.
- Develop ability to arrange elements according to their properties and process of their extraction from there Ores and minerals.
- Appreciate carbon as a special element forming numerous useful compounds beneficial for animals and plants.
- Make the learner realize the interface of chemistry with other disciplines of science such as Physics, Biology, Geology, etc.
- Equip students to face challenges related to health, nutrition, environment, population, industries and agricultures.
- Able to relate the gathered knowledge with immediate surroundings and carry out innovations in the field of chemistry through participation in various science activities and competitions at inter, intra, national and international level.

Annexure - II

Learning Outcomes in Chemistry for Senior Secondary Classes (Class-XI)

The learner;

- Understands the need of establishing a bigger unit in the form of mole which facilitates the process of counting all microscopic particles like electron, proton, neutron, atoms, molecules, ions etc.
- Performs the stoichiometric calculations and identifies the limiting reagent, if any for the given situation.
- Develops understanding about the nature of an indivisible atom and need of different models to establish its structure.
- Appreciates the need of wave mechanical model of an atom and able to differentiate between orbit and orbitals. Writes the electronic configuration of the element in terms of s, p, d, and f orbitals.
- Identifies electronic configuration as the main cause of variation in periodic properties like atomic radius, ionisation enthalpy, electron gain enthalpy, electronegativity, valency, oxidation states etc.
- Suggests the structure of molecules on the basic of VSEPR theory and hybridization and appreciates the need of introducing molecular orbital theory for the structure of various species.
- Recognizes the limitations of gas laws, understands the need of correction in Ideal gas equation to suggest an equation which depends upon the nature of the gas, applicable for wider range of temperature and pressure.
- Reflects the ability to analyze the feasibility of a chemical reaction on the basis of its enthalpy change, entropy change & free energy change.
- Expresses the criteria of recognizing the equilibrium stages of the reaction and is able to quantify a chemical reaction in terms of equilibrium constant.
- Suggests the condition under which a system can be shifted in a desired direction.
- Understands various acid – base systems, the concept of pH in daily life situations and in volumetric work.
- Reflects adequate understanding of the role of solubility product constant of a Salt (Ksp) for salt /mixture analysis and various industrial phenomenons.
- Develops understanding of a redox reaction in terms of loss or gain of electron change in oxidation state of the species & is able to balance a redox reaction by using half reaction method or change in oxidation number.

- Appreciates the role of redox reaction in carrying out the appropriate volumetric work.
- Describes an understanding of properties of hydrogen leading to production of useful substances & new technologies and also reflects adequate knowledge of physical & chemical properties of H_2O & H_2O_2.
- Explains the properties of S and P block elements and trend in Oxidation states dependent upon the valence shell electron presents in the species.
- Appreciates the need of introducing the idea of nomenclature in the study of organic chemistry.
- Recognizes electronic displacement in a covalent bond such as inductive effect, electronic effect, elimination reaction. Resonance & hyperconjugation to comprehend organic reactions.
- Differentiates between saturated & unsaturated hydrocarbons, alicyclic & aromatic hydrocarbons & structural sensitivity as the cause of various types of reactions shown by hydrocarbons.
- Reflects adequate knowledge of purification & ascertaining parameters related to elucidation of structure of organic compounds.
- Shows sensitivity towards environmental pollution & develops positive attitude toward the factors responsible for environmental imbalance & points out various ways to control it.
- Conducts experiments & makes appropriate interpretation about the shift in equilibrium.
- develops ability to prepare a standard solution & find out the strength of an unknown solution by suitable titrimetric work
- Develops ability to methodically analyse the given inorganic salt / mixture.

Annexure - III

Learning Outcomes in Chemistry for Senior Secondary Classes (Class XII)

The Lerner-

- Understands packing in solids & voids left during packing, efficiency of different types of packing and appreciates the importance of defects in crystal for technological advancements.
- develops the technique to determine molecular mass by the help of colligative properties like osmotic , presume , elevation in laving point, depletion in freezing points & relative livening of valance presume differentiates between normal & abnormal colligation properties .
- differentiates between electrolytic & electro chemical proven and deterring level's free energy & equlibrium coustant using emf of the cell. Reflects understanding about conductivity, molar conductivity its variation with dilution & importance of kohleruch law for determination of limiting molar conductivity for weak electrolyte. Role of eletrochemistry in the variation of cell potential with change in camc of room temp development of various types of galvanic (Cell) also understanding process like corrosion as an electro- chemical process .
- Differentiates between order & molecularity of a reaction and enables to propose mechanism of simple reaction after experimental determination of order / using rate law .
- Study and understands taking suitable example the dependence of reaction kinetics on temperature, presume concentration, light & catalyst.
- Ascretaius adscrption as a surface phenomenon & utilizes this surface phenomenon in the catalysis of various reactions.
- Understands one changed nature of colloidal particles and correlate this idea to understand the phenomenon like electrophonesis, electroosmosis, coagulation, peptization etc.
- Develops the knowledge to prepare lyophilic/ lyophobic solution and perform dialysis of lyophilic solution appreciates of collides in everyday life.
- Reflects a suitable understanding about various techniques used in the isolation of elements including the weakability of suitable reducing agents used under various conditions develops the knowledge of separating pigments of leafs of flora and inorganic mixture by clumatographic technique.

- Understands to correlate the properties of groups 15-18 elements with their electronic configuration and trends in oxidation state exhibited by these elements.
- Appreciates the role of some important compounds like phosphine, oxaacids of nitrogen, sulphur, phosphorous and chlorine. Understands the cause of unique chemistry associated with flamine.
- Explains the suitable cases for the chemistry associated with certain compounds of d-block elements like $KMnO_4$ & $K_2Cr_2O_7$, recognizes poor shielding effect of d and f orbitals as the cause of regular decrease in atomic size in transition and inner transition elements and also similarities in their properties.
- Differentiates between normal /denble salt & coordination compand & reflects suitable understanding on various issue related to famation of coordination compound , develops understanding of splitting of d-orbit ab due to dissimilar interaction of eg (dxy , dyz. & dxy) & t2g (dx^2 y^2&dz^2) with ligands due to their dissimilar stmetumes & correlates the phenomenon with spectral & magnetic properties of coordination compounds .
- applies the understanding of partial covalent band in S_N1 & S_N2 reactions and appreciate the role of stereochemistry in the properties exhibited by organic compounds
- Differentiate between C-OH bonds in 1^0,2^0,& 3^0 alcohols & phenols the difference in their reactivity due to structural difference .
- Explains the chemistry of carboxyl compound in terms of meleophilic addition reactions. Points out the role of resonancs in properties exhibited by various carboxylic acids.
- Recognizes amines (1^0 ,2^0,& 3^0) as the derivative of aminia & compares their basicity according to subtre effect of hydration , inductive & steric effects . Understanding synthetic importance of diazanium salts.
- Grains the knowledge for
- Identification of functional groups present in an organic compound to synthesize same simple organic compounds like acetanilide p- mitro acetanilide , dibenzal acetone etc.
- Acquiring capacity to apply the knowledge of chemistry to understand the structure & reactivity of sugars , proteins , hormones , vitamins & nucleic acids gains the knowledge for the test of carbohydrates, fats, and proteins in pure samples/food stuffs.

- Differentiates between natural and synthetic polymers and develops the techniques of synthesizing of polymers by addition and condensation mechanism. Understanding role of polymers in everyday life.
- Connects the knowledge of chemistry in everyday life e.g. in the synthesis of useful medicines, in the preparation of preservatives, antioxidants, artificial sweetening agents, in understanding the cleansing action of soap and detergents.
- Understanding the techniques of performing of redox filtration between KM_NO_4 vs oxalic acid or Molar's salt and also reflects the suitable understanding about the cause of H_2SO_4 as only suitable acid to carry out the filtration in the acidic media.
- Strengthening the knowledge of inorganic qualitative Analysis by identifying the cation and anion in the given inorganic salt.

Annexure - IV

Suggested Pedagogical Practices in Chemistry for (Class XI)

The learners should be provided opportunities in pairs/ groups/ individually and encouraged to –

- Compare the masses of the mole of various substances like water, common salt, sugar iron etc and give adequate practice to handle numerical data in terms of problem solving ability to comprehend the idea of mole concept.
- Use charts, model or audio-visual means to establish divisible nature of atoms and different models like Rutherford's model, Bohr's atomic model and Wave Mechanical model including shape of s, p, d and f orbitals and give adequate practice for mastering learning in writing s, p, d, f configuration.
- Prepare a chart or using ICT show electronic configuration of representative elements and highlighting the number of outermost electron and while transacting chemistry of non representative element (help of modern periodic table should be taken), differentiating their electronic configuration as discussion.
- Prepares models showing the structure of molecules like BCl_3, CH_4, PCl_5, SF_6, IF_7 etc. indicating bond angles and hybridization of the central element.
- Understand volume correction and pressure correction by the help of chart, models and videos assuming molecules as spherical.
- Design simple experiments to understand exothermic and endothermic reaction.
- Classify enthalpy and entropy driven reactions and highlights the importance of clubbing the two criteria and conversing to free energy change as the overall criteria for spontaneity of a reaction.
- Consult literature to collect equilibrium constant values for some significant equilibrium processes like Hebre's process, contact process and ionization phenomenon for different acids and bases.
- Conduct some simple experiments to study the concentration and temperature dependence of equilibrium process e.g. preparation of benzamide from benzyl chloride and ammonia.
- Understand the redox process in terms of gain or loss of electrons by simple experiments. (e.g. displacement of Cu by Zinc followed by fabricating a Daniel cell)

- Understand resemblance and gradation in physical and chemical properties of elements and their compounds belonging to s and p block elements by the help of simple experiments (e.g. reaction with cold and hot water, reaction with cold and hot mineral acids, electrolysis of their Melton salts and aqueous solution, action of heat, etc.)
- Make a chart/use ICT for electronic displacement process and corresponding organic reaction mechanism which can be explained by these electronic displacement processes.
- Suggest simple experiments to differentiate between saturated & unsaturated hydrocarbons (like treatment with Alkaline $KMnO_4$, Bromine water) and then introduce the ozonolysis as a criterion to establish the double bond present in the unsaturated hydrocarbons.
- Explore the possibility of taking an investigatory project on any one of the following areas:
    1. Air, Water, Noise & Soil pollution.
    2. Impact study of movements of Government like swacch bharat Abhiyan, Ganga Action Plan and the movements of NGOs like Narmada Bachao Abhiyan , Chipko movement etc.
- Design simple experiments to master the techniques of boiling points of the liquids, melting points of the solids, differential extraction, and simple ideas of chromatography, simple distillation & purifying organic / inorganic substance by crystallization.
- Perform experiments to determine pH of various substances like fruit juice, vegetable juice, saliva, blood etc. and connects this knowledge with everyday life.
- Learn the techniques of weighing and pipette out solution & titration by preparing standard solution & determine the molarity of unknown solution by the help of this standard solution.
- To learn the technique of analyzing colored and white salts & where so ever there is a need, the sodium carbonate extract may be prepared to analyze the anions & flame test for cations.

Annexure- V

Suggested Pedagogical Practices in Chemistry for (Class XII)

The learns should be provided opportunity in pairs /groups / individually and encourage to

- Prepare models use of ICT understand packing of solids and identity different types of voids resulting after packing.
- Assign individual task to the students about various modes of concentration used to express the strength of solutions and their doubts may be clarified, if any through discussion mode in the class.
- Discuss the two forms of raouit's law involving students through certain classroom questions & design simple experiments to communicate the idea and non – ideal solutions.
- Correlate the concept of vapour pressure of the liquid Henry's law with already acquired knowledge of equilibrium processer.
- And abnormal molecular masses in case of dissociation and association.
- To explore the possibility of arranging Beckmann's ther mometer from nearby institutes to dementrate the idea of elevation in boiling point / despression in freezing point & correlate with the idea of molecular man of nonvolatile solid .
- Concept of conductivity & molar conductance can be explained to the students and the variation in two said quantities with the dilution be discussed taking into consideration students perception.
- Faraday's laws be explained & few exercises pertaining to faraday's laws be given in the form of faraday's law and the solution of the exesise be discussed in the group .
- Constructs various galvanic cells and electrolytic cell and shidies the effect of concentration on the emf of galvanic cells and shidies the effect of concentration on the emf of galvanic cells & differentiate the process in electrochemical & electrolytic cells.
- Simple experiments affecting rate of reach on with variation in concentration, temperature and catalyst either be demanutrated or performed by the student and white discussing temperate effect mention of Arrhenius equation be brought into discussion.
- Conduct simple experiment to study kinetics of first order reaction and explore the cause for labeling the first order reaction. Students may be enemaped to determine rate constant value graphically.

- Design simple experiment to demeustrote adsorption phenomenon e-g adsorption of oxakic acid by activated charcoal there by reduction of acidic strength. Conduct experiment to understand the prosese of poetization, coaulation & electrophoresis & correlate with daily life experiences.
- Preferably visit to same nearby factories to understand and make report of detaitled extraction procen along with its purification or use ICT/ take investigatory project.
- Make chart or use commercially available chart showing electronic configuration. Physical and chemical properties of group 15-18 elements and correlate the properties exhibited by these elements and their compound with trend in oxidation states shown by elements of these groups.
- Collect date / visit same hear by heavy chemical industries and understand the process of manufacturing important heavy chemicals like nitric acid hyeho chtoric acid , sulpwric acid ammonia etc.
- Use ICT / draun & make models if possible of a and + orbitals and understand the poor shielding effect due to its elongated lobes. Show splitting of d- orbitals in presence of strong & weak ligand and correlation of this splitting with speetrochemical and magnetic properties of complexes and summarizg through discussion various ways by which speeies can show colour change.
- Teaching learning process in organic chemistry should be carried out by highlighting reachtion mechanism where so ever possible.
- Make a detailed chact sheming S_N1 & S_N2 mechanism. Conduit simple experiments to differentiate between properties of alcohols and phends e.g acidic behavieu , action with socliom and explain the possibility to demonstrate haves test between primary secondary and tertiary alcohol.
- Carry group work to exhibit the following Elam of reaction shown by carbonyl compounds

  1. Treatment with sodium bicarbonate
  2. Treatment with 2,4 DNP reagent .

  To strengthen nuculeo philic addition reaction
- Demeustante reaction exhibited by aldehydes with yollen's / fenling's reapent and hence convince the students to utilize as a way out to differentiate between different aldelydes and also with ketones.

- Perform simple experiment to show the acidic nature of cauboxylic acids like action with litrnus solution , sodium bi-carbanate test and also estevification reaction shown by covboxylic acids
- Perform simple experiments to show the basic nature of amines and prepare diazo dues to appreciate the versatile importance of diazonium saths.
- Preferably visit same medical college / carry out date collection / discs regarding the importance of bio- moteeules like ceublhyduates proteins , hormones , vitamius, nucleic acids ete.in the life of plants and animals and the disease caused due to the deficieny of these biomolecules .
- Make a trip to same nearby rubbes industry.
- Take the help of ICT. Literature & field trips to understand the application of chemistry in the everyday life i.e in the area of medicine , preservative ,sweetening apents , antioxidants , cleansing action of soaps and detergents
- Perform experiment using chromate graphic paper to understand ascending of substance due to adsorption and there by separation of pigments or ions.
- Propane simple organic compounds and understand synthetic techniques.
- Perform experiments to identify common functional groups in the organic compound.
- Perform redox titration between $KMnO_4$ and oxalic acid to understand the chemistry involved in the redox titration in detail.

Annexure – VI

Curricular Expectations in Biology for Senior Secondary Classes

Students at the senior secondary stage are expected to:

i. Develop interest to study biology as a separate discipline.
ii. To develop process skills including observation, drawing, critical thinking, problem solving, analytical approach & drawing conclusion.
iii. To develop sensitivity towards environmental concerns.
iv. To develop awareness about surroundings (flora & fauna) natural processes & phenomena.
v. To develop awareness about issues related to health, hygiene, sanitation & ethics.
vi. To prepare the learner to play a rational, responsible and informed role in the society by removing the prevalent myths & misconception.
vii. To appreciate the historical development & land mark discoveries in biology.
viii. To develop mathematical skills in students for better understanding of biological concepts
ix. To appreciate the contributions made by the scientist (women scientist in particular) that led to important discoveries.
x. To appreciate the diversity prevalent in the living world.
xi. To carry out investigatory projects for developing the future research capabilities.
xii. To develop an understanding about various biological phenomena and concepts related to day to day life.
xiii. To promote an interdisciplinary approach for better understanding of biology.
xiv. To provide orientation for professional / career opportunities available in medicine, agriculture, industry, teaching and research.
xv. To internalize acquire & appreciate values such as honesty, cooperation, collaboration & judicious use of resources.

Annexure – VII

Learning Outcomes in Biology for Senior Secondary Classes

1. Appreciates the number and types of living organisms and understands the characteristics of living organisms such as metabolism, consciousness and cellular organization.
2. Classifies organisms into five kingdoms, understands the limitations of two kingdom classification and appreciates taxonomical categories and aids (herbarium, botanical gardens and museums) and relates classification with evolution.
3. Develops the ability to compare the characteristics of different kingdom Divisions/Phylum with emphasis on plant and animal kingdom providing suitable examples.
4. Differentiates morphological characteristics of various plant parts along with their modifications & describes important plant families using technical terms for various parts of a plant.
5. Classifies different tissues on the basis of their structural & functional organizations and recognizes their role in the formation of organs & organ system in plant & animals.
6. Explains the morphology & anatomy of some animals (earthworm, cockroach & frog).
7. Explains the process of secondary growth in dicot plants & appreciates the process of formation of wood.
8. Draws the structures of morphological & anatomical features of plants & animals.
9. Prepares slides to observe & identifies the anatomical structures of plants & animals.
10. Understand the importance of different organelles / component of cell (ultrastructure) and phases of cell cycle.
11. Differentiate between prokaryotic & Eukaryotic cell, plant and animal cell & correlate the shape of the cells to their function (neuron, WBC, tracheids, RBC)
12. Enlist the chemical composition of living organisms (carbohydrates, proteins, lipids, nucleic acids) and understands their structure, formation & function in a cell.

13. Recognizes the importance of enzyme with respect to their action, nomenclature, classification & factors affecting their activity.
14. Appreciates & understand the significance of cell division – mitosis (equational) & meiosis (reductional division) and phases of cell cycle.
15. Draw labeled diagrams of cell (ultra structure), cell organelles and different stages of cell division (mitosis & meiosis).
16. Appreciates the biodiversity in the surroundings and causes of its depletion and efforts to conserve it
17. Discusses the environmental issues related to air, water and soil pollution and methods to overcome these.
18. Understands population growth models, population interaction, ecosystems and ecological succession
19. Appreciates the steps taken to solve the environmental problems by local people (Case Studies like Chipko movement, JFM, Narbada Bachao)
20. Conduct investigatory projects (cause effect relationship)
    - Soil quality
    - Water pollution
    - Air pollution
21. Appreciates the efforts and experiments carried out by scientists that led to scientific discoveries
22. Exhibits creativity in planning, designing and conducting experiment to establish scientific concepts, phenomena & processes related to digestion, circulation, excretion and control & coordination (reflex action), photosynthesis, respiration, transportation, role of plant growth regulators & mineral nutrition.
23. Explains various structures and related physiological processes, phenomena occurring in plants and animals to attain conceptual clarity as given below-

- Nutrition
- Digestion & absorption
- Locomotion & movement
- Respiration
- Transportation
- Excretion
- Control & coordination

24. Applies learning of scientific concepts in day to day life, application of growth hormones in agricultural fields, osmosis, apical dominance, parthenogenesis, vegetative propagation and fermentation.
25. Develops the ability to identify the causes of disorders related to various processes in plants and human body like digestion, circulation locomotion & movement and control & coordination
26. Draws labeled diagrams, flow charts & tables pertaining to structures & functioning of different organs and organ system in human body and plants parts involved in various physiological processes
27. Differentiates various modes of reproduction (sexual, asexual and vegetative) in plants
28. Explain the reproductive structures and the process of sexual reproduction in human beings
29. Develops awareness towards reproductive health, contraceptive, amniocentesis & STDs.
30. Draws labeled diagrams of reproductive structures in plants & animals.
31. Develops understanding of the Mendel's laws of inheritance and deviation with causes.
32. Differentiates between the terms like.
    - Dominant / recessive
    - Homozygous / Heterozygous
    - Phenotype / genotype.
33. Understand & draw structures of DNA and RNA .Explains & describe processes like transcription and translation in prokaryotic and eukaryotic cells, linkage and recombination, divergent and convergent evolution.
34. Discusses and appreciates scientific discoveries of genetic material, biogenesis and Human Genome Project.
35. Develops awareness about disorders and diseases caused by genetic variation.
36. Draws the diagrams flow charts graphs & tables to understand Mendelian ratios, protein synthesis and evolution.
37. Understand the concept of health and hygiene and develops awareness
38. About the common diseases in humans, concept of immunity.
39. Differentiates various drugs, alcohol and tobacco for their ill-effects and remediation.

40. Understands the necessity for enhancement of food production through improved practices in crop production dairy, poultry, agriculture, pisciculture.
41. Appreciates the role of microbes in household, industry and agriculture.
42. Prepares flow chart and diagrams for sewage treatment depicting the role of microbes and visit to a sewage treatment plant.
43. Appreciates uses of biotechnology in various fields – medicine, agriculture, industry and research.
44. Explains the tools, techniques and processes used in various biotechnological processes.
45. Develops the ability to understand the ethical issues related to biotechnological products.

Annexure – VIII

Suggested Pedagogical Practices in Biology for Senior Secondary (Class XI)

The learner is to be provided with opportunities in an inclusive setup to:

1. Explore the surroundings to observe and identify flora & fauna through field trips and classify these according to taxonomic categories.
2. Preparation of charts showing diagrams / photograph and flow charts depicting classification and displays these in laboratories / classroom for ready reference.
3. Integration of ICT in classroom processes to show - photograph / video films / diagrams of different types of plants and animals specially those which are not available in their immediate surroundings.
   - Morphological and anatomical features of flora and fauna studied through field trips
   - Different types of cells, stages of cell division.
   - Working of different organ and organ system through videos available on internet.
4. Record observations in order to classify and arrange the given organism to their respective categories and study their morphological, anatomical and taxonomical description.
5. Draw the labeled diagram of:
   - Specimens of plants & animals studied
   - Ultra structure of plant & animal cell, eukaryotic & prokaryotic cell, various cell organelles.
   - Stages of cells division
   - Tissues, organs and organ system
   - Morphological & anatomical structure of various plant parts – roots, stem, leaves, inflorescence, flowers, fruits & seeds
6. Conducts activities and investigations for
   - Demonstration & Experimentation
   - Slide preparation
   - Handling of apparatus & equipments
   - Observation
   - Recording and analysis of data
   - Interpretation of results
   - Drawing inferences & sharing of ideas.
7. Pose questions and find answers through reflection, discussion, designing and performing appropriate activities, role plays & debates.

Annexure – IX

Suggested Pedagogical Practices in Biology for Senior Secondary (Class XII)

The learner is to be provided with opportunities in an inclusive setup to:

1. Explore surroundings to observe modes of vegetative propagation in plants e.g. Cutting, Grafting, Budding etc.
2. Demonstration of hybridization techniques e.g. emasculation, bagging, tagging.
3. Observe permanent / temporary slides of sections of testes, ovaries, blastulas stages, anther, pollen grains, and ovary with ovules.
4. Conduct experiments / activity to extract DNA from plant material.
5. Prepared charts, Punnett squares to explain Mendel's law and derivations observed.
6. Use of ICT to explain the process of human reproduction, sexual and asexual reproduction and vegetative propagation.
7. Explain the process of protein synthesis.
8. Recombinant DNA technology.
9. Conduct discussions debates elucidate the application of biotechnology in human life and role of microbes in day to day life.
10. Conduct visit to tissue culture lab, sewage treatment plant, and biotechnological lab.
11. Internalize, acquire and appreciate values such as cooperation, collaboration, honest reporting and judicious use of resources while conducting experiments in the lab.

Annexure - X

Curricular Expectations in Physics for Senior Secondary Classes

Physics curriculum at the senior secondary stage is intended to develop:

1. Scientific temper and scientific thinking
2. Understanding fundamental concepts of physics and their applications.
3. Appreciation of the relevance of concepts of physics to his / her environment.
4. Skills of observation , data collection , interpretation of data , analysis and drawing conclusion
5. Problem solving ability and thinking critically, scientifically, objectively and its applicability.
6. Relationship between theoretical physics and experimental physics.
7. Sensitivity towards environmental concerns.
8. Respect for human dignity, rights, gender equality, values of honesty, integrity, cooperation, aesthetic sense and concern for life.
9. Interdisciplinary approach of physics.
10. To learn data handling techniques and integrate it as a necessary Part and parcel of experimentations in physics
11. Numerical solving ability with the help of non-empirical formula.

Annexure - XI

Learning Outcomes in Physics for Senior Secondary (Class XI)

The learner……..

1. Relates nature of physics and its scope with technology & society.
2. Explains and identifies different systems of units, various physical quantities and their units.
3. Appreciates and learns quantitative nature of measurements and need for its standardization.
4. Understands dimensional analysis and its applications.
5. Derives and apply kinetic equations for uniformly accelerated motion.
6. Plots, analyses and interprets graphs related to displacement, time and velocity.
7. Understands relative velocity and its applications.
8. Performs vector analysis in one and two dimension.
9. Analyses & explains projectile motion.
10. Solve problems on applications of Newton's laws of motion in one and two dimensions.
11. Analyse's situations involving the force due to friction.
12. Establishes the relationship between work, energy and power.
13. Differentiates between conservative and non –conservative forces and identifies them in environment.
14. Describes characteristics of elastic and inelastic collisions.
15. Describes rotational motion in terms of torque, angular momentum, angular frequency, angular acceleration & moment of inertia and their relationships.
16. Characterise's the law of gravitation and its applications
17. List & explain Keplar laws of motion.
18. Applies Hook's law to the deformation of materials.
19. State the properties of viscous and non – viscous fluids.
20. Analyse's the flow of fluids in different conditions

21. Understands / Explains the principle of calorimetery and its application
22. Applies the laws of thermodynamics in different conditions
23. Explains properties of S.H.M & phenomenon of resonance.
24. Describe and differentiates between Longitudinal & Transverse waves.
25. Explain the phenomenon of apparent frequency of sound due to motion of source / listener /medium.
26. Describes various characteristics of sound such as pitch, loudness, intensity and reflection.
27. Explain occurrence of interference of sound in the form of beats, stationary waves etc.
28. Use graphical methods to analyse results of experiments.

Annexure - XII

Learning Outcomes in Physics for Senior Secondary (Class XII)

The learner will

Develop the concept of electrical charge and its properties.

1. Discuss the concept of electric field and its manifestation in different situations.
2. Understand and applies the concept of electrostatic potential in different conditions.
3. Describes the behavior of conductors and dielectrics in electric field.
4. Describe properties and behavior of electrical capacitor.
5. Discuss relation between electric current, potential difference and resistance.
6. Explain behavior of cells and resistances in different combinations,
7. Analyse complicated ac and dc circuits ,
8. Differentiate different properties of various magnetic materials, conduct and interpret results of Michael faraday's experiments.
9. Describe Lenz's law and relate to conservation of energy
10. Relate displacement current and electric current.
11. Describe various features of electromagnetic spectrum.
12. Describe functioning and role of different elements of communication system.
13. Explain process of electromagnetic communication.
14. Discuss properties of light is view of wave and particulate nature.
15. Draw and explain diagram showing formation of image by a curved surface with object in different medium
16. Relationship between u, v, f and R for lens / mirror.
17. Draw labelled ray diagram showing working of various optical instruments.
18. Appreciate strength and weakness of different models of atoms.
19. Describe important features of hydrogen spectrum.
20. Explain characteristics of nucleus and nuclear processes.
21. Classify substances into conductor's insulator and semiconductor on the basis of energy band diagram.
22. Construct electrical circuits containing diode, transistor etc. and its applications.

Annexure - XIII

Suggested Pedagogical Practices in Physics for Senior Secondary

Learner is encouraged to

1. Participate in class room activities – setting apparatus, making observations and drawing conclusions.
2. Discuss the concepts taught, their implications and applications with–day to day life.
3. Record observations, collect data, analyse it and draw conclusions.
4. Present and discuss creative ideas by making models, diagrams etc.
5. Perform activities, experiments etc. based on topic taught.
6. Inculcate scientific values and attitude.
7. Discuss concepts and their implications among peers.
8. Make charts, models etc. and participate in science exhibition, field trip, Olympiad, etc.
9. Plan and design investigatory projects in various areas of physics.
10. Develop geometrical and physical significance of linear and quadratic equations and calculus.
11. Develop numerical solving ability.
12. To develop mathematical modeling ability.
13. Use ICT as an effective tool to overcome abstractness of physics.
14. Develop problem solving ability.

Annexure – XIV

Date: _____

Name of Student: _____
Name of School: _____

Assessment of Learning Outcomes (Chemistry)

Q.1. Which of the following contains maxi number of atoms?

a. 44g CO_2 b. 36 mL H_2O (density 1 g ml^{-1})
c. 22.4 litre of CH_4 at STP d. 11.2 litre of C_4H_{10} at STP

Q.2. If 0.1mL HCl of strength 0.1M issues from the tip of the burette then the no. of hydrogen ions issuing from the tip of the burette is

a. $6.022x10^{23}$ b. $6.022x10^{22}$
c. $6.022x10^{18}$ d. $3.011x10^{23}$

Q.3. To 110 mL 1 M HCl and 4g NaOH (Molecular mass 40g mol^{-1}) is added, then the number of moles of water produced in the reaction would be

a. 0.01 mol b. 0.11mol
c. 0.1mol d. 0.001mol

Q.4. If 12g carbon is allowed to react with 24g of oxygen then the ratio of carbon monoxide and carbon dioxide formed is

a. 1:1 b. 1:2
c. 2:1 d. 3:1

Q.5. Which type of spectra is used for identification of elements**???**

a. Spectrum b. Absorption spectrum
c. Emission spectrum d. Visible spectrum

Q.6. Bohr's model can account spectra of

a. Li^{2+} b. Na^{2+}
c. Li^{+} d. He^{2+}

Q.7. Lowest value of n that allows 'g' orbital will be

a. 4 b. 5
c. 6 d. 7

Q.8. Which of the following represents the set of quantum numbers for unpaired electron in aluminium?

a. n = 2, l= 0, m=0, s=$+\frac{1}{2}$
b. n = 3, l= 1, m=-1, s=$+\frac{1}{2}$
c. n = 2, l= 1, m=-1, s=$+\frac{1}{2}$
d. n = 3, l= 1, m=+1, s=$+\frac{1}{2}$

Q.9 Correct arrangement in increasing order of ionic radii of the species $N^{3-,}$ O^{2-} , F^{-} , Na^{+} , Mg^{2+}, Al^{3+} (L-5)

a. $N^{3-} < O^{2-} < F^{-} < Na^{+} < Mg^{2+} < Al^{3+}$
b. $O^{2-} < N^{3--} < Na^{+} < Mg^{2+} < Al^{3+} < F^{-}$
c. $Al^{3+} < Mg^{2+} < Na^{+} < F^{-} < O^{2-} < N^{3-}$
d. $Al^{3+} < Mg^{2+} < Na^{+} < Na^{+} < N^{3-} < O^{2-} < F^{-}$

Q.10. The correct order of actual ionization enthalpy in second period will be (L-5)
a. B < Be < C < N < O < F < Ne
b. Li < B < Be < C < N < O < F < Ne
c. Li < Be < B < C < O < N < F < Ne
d. Li < B < Be < C < N < O < F < Ne

Q.11. As per VSEPR theory the shape of BrF_3 molecule will be (L6)
a. Trigonal Planner
b. Bent T- shape
c. shape
d. See-saw

Q.12. MOT was more successful than VBT in explaining
a. paramagnetic nature of oxygen
b. colour of various species
c. reactivity of compounds
d. overlapping of orbitals

Q.13. Which of the following statement may be considered as a cause of error encountered in the ideal gas equation (L-7)
a. The Molecular collisions are perfectly elastic
b. Volume occupied by the gaseous molecules is negligible fraction of total volume of container
c. The intermolecular force of attraction affects pressure of the gas
d. At high temperature all gases nearly behave like an ideal gas

Q.14. What will be the nature of curve P vs PV isotherm for a permanent gas like hydrogen? (L7)
a. It will first go below the RT line and at high pressure it will go crossing the RT line
b. It will run parallel to RT line
c. It is always below the RT line
d. It is always above the RT line

Q.15. Which thermodynamic function is able to explain the feasibility of endothermic reaction? (L8)
a. ΔH
b. ΔS
c. ΔU
d. q_v

Q.16. Which is considered as the best option to assign feasibility of any chemical reaction?
a. ΔG
b. ΔH
c. ΔH
d. ΔU

Q.17. Consider the reaction- $2A + 3B \rightleftharpoons 4C + 5D$

If [A], [B], [C] and [D] are the equilibrium concentration of A, B, C and D respectively at equilibrium then the value of equilibrium constant 'K_c' for the forward change is- (L-9)

a. $\frac{[C]x[D]}{[A]x[B]}$ b. $\frac{[C]4x[D]5}{[A]2x[B]3}$

c. $\frac{[C]4x[D]5}{[A]x[B]}$ d. $\frac{[A]x[B]}{[C]x[D]}$

Q.18. Consider the change- $2AB_{3(g)} \rightleftharpoons A_{2(g)} + 3B_{2(g)}$

If the reaction in carried out in flask of capacity 1 litre containing 8 moles of AB_3 and at equilibrium 2 moles of A_2 are formed then the value of equilibrium constant for the reaction is- (L-9)

a. 16 b. 216

c. 27 d. 108

Q.19. Consider the change- (L10)

$O_{2\,(g)}$ + water $_{(l)} \rightleftharpoons$ oxygenated Water; ΔH= -ve

Then conditions favouring high dissolution of oxygen in water are- (L-10)

a. High temperature and high pressure
b. Low temperature and high pressure
c. Low temperature and low pressure
d. High temperature and low pressure

Q.20. Consider the change

$4NO_{2(g)} + 2H_2O_{(l)} + O_{2(g)} \rightleftharpoons 4HNO_{3(g)}$ ΔH= -ve

The conditions favoring high yield of nitric acid in view of this reaction would be- (L-10)

a. Hot water and low concentration of oxygen.
b. Hot water and high concentration of oxygen.
c. Cold water and low concentration of nitrogen dioxide.
d. Cold water and High concentration of oxygen.

Q.21. Which of the following is not a conjugate acid-base pair- (L-11)

a. H_3O^+, H_2O b. NH_4^+, NH_3

c. NH_4^+, NH_2^- d. H_2CO_3, HCO_3^-

Q.22. To 0.2 moles of CH_3COONa present in 1 litre of its solution, 0.1 mole of HCl is added. If pKa of CH_3COOH is 4.47 then the pH of such a buffer is- (L – 11)

a. 2.37 b. 9.26

c. 4.47 d. 4.63

Q.23. If NH_4Cl is not available in the laboratory to affect analysis of radicals of III group then its replacement can be- (L-12)

a. $(NH_4)_2SO_4$ b. NH_4NO_3

c. $(NH_4)_3PO_4$ d. $(NH_4)_2C_2O_4$

Q.24. A given solution of Ag^+ (water soluble sample) can be most easily precipitated as – (L-12)

a. Ag_2S b. AgI

c. AgBr d. AgCl

Q.25. In which of the following reactions SO_2 acts as an oxidizing agent- (L-13)

a. $SO_{2\,(g)} + H_2O_{2\,(l)} \rightarrow H_2SO_4$ b. $H_2S_{(g)} + SO_{2(g)} \rightarrow 3S + 2H_2O_{(l)}$

c. $SO_{2\,(g)} + Cl_{2(g)} \rightarrow SO_2Cl_{2\,(g)}$ d. $2SO_{2\,(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

Q.26. Which of the following change is not possible- (L-13)

a. $2I^- + Cl_2 \rightarrow 2Cl^- + I_2$ b. $2Br^- + Cl_2 \rightarrow 2Cl^- + Br_2$

c. $2I^- + Br_2 \rightarrow 2Br^- + I_2$ d. $2F^- + Cl_2 \rightarrow 2Cl^- + F_2$

Q.27. Ferrous ions of Mohr salt can the oxidized to forric ions by – (L-14)

a. MnO_4^- ions in acidic media b. $Cr_2O_7^{2-}$ ions in acidic media

c. NO_3^- ions in acidic media d. All the three oxyanions in acidic media

Q.28. Which of the following species is not said to have peroxide linkage- (L - 14)

a. H_2SO_5 b. $H_2S_2O_8$

c. O_2F_2 d. H_2O_2

Q.29. Consider the following reactions carried out under suitable conditions- (L-15)

1. $CO_{(g)} + H_{2(g)} \rightarrow HCHO_{(vapour)}$
2. $CO_{(g)} + 2H_{2(g)} \rightarrow CH_3OH_{(vapour)}$
3. $CO_{(g)} + 3H_{2(g)} \rightarrow CH_{4(g)} + H_2O_{(g)}$
4. $CH_2{=}CH_{2(g)} + H_{2(g)} \rightarrow CH_3\text{-}CH_{3(g)}$

Hydrogen for these reaction is best reduced in reaction at serial number-

a. 1 b. 2

c. 3 d. 4

Q.30. In which of the following reactions water acts as an oxidizing agent- (L-15)

a. $F_{2(g)} + 2H_2O_{(l)} \rightarrow 4HF_{(g)} + O_{2(g)}$

b. $6CO_{2(g)} + 12H_2O_{(l)} \rightarrow C_6H_{12}O_{6(s)} + 6H_2O_{(l)} + 6O_2$

c. $2Na_{(S)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2\,(g)}$

d. $H_2O + CO_2 \rightarrow H_2CO_3$

Q.31. Lead pipes are corroded by- (L16)

a. $Zn\,Cl_2$ b. $HgCl_2$

c. $SnCl_2$ d. $AlCl_3$

Q.32. Which of the following is amphoteric in its behaviour– (L16)

a. CO_2 b. Al_2O_3

c. SiO_2 d. GeO_2

Q.33. What is the oxidation state of chlorine in bleaching powder – (L16)

a. +1 and +2 b. -1 and +1

c. +1 and -2 d. +2 and -2

Q.34. X and Y are two metals. When burnt in air X forms only oxide while Y forms oxide and nitride. The metals X and Y may be respectively – (L16)

a. Ca and Mg b. Na and Mg

c. Li and Na d. Na and K

Q.35. The number of hydrocarbons represented by the formula C_4H_6 and reacting with ammonical silver nitrate solution is - (L17)

a. 1 b.2 c.3 d.4

Q.36. Consider the following compounds:- (L17)

(i) $CH_2=C=CHCH_3$ and (ii) $CH_2=CH—CH=CH_2$

What is not true about these species?

a. Both are unsaturated compounds
b. The state of hybridization of each carbon in both the compounds is the same
c. Both these compounds undergo ozonolysis
d. Both the compounds will decolourize the colour of bromine water

Q.37. The strongest acid among the following is- (L18)

a. $Cl\ CH_2\ CH_2\ CH_2\ COOH$ b. $CH_2\ Cl\ CH\ CH_2\ COOH$
c. $CH_2CH_2\ CH_2\ COOH$ d. $CH_3\ CH_2\ CHCl\ COOH$

Q.38. Which of the following carbocation is most stable- (L18)

a. $(CH_3)_3C^+$ b. $CH_3\ CH_2CH_2^+$
c. $CH_3\ CH^+CH_2\ CH_3$ d. $CH_3C^+H_2$

Q.39. Which of the following may have tertiary carbon:- (L19)

a. 2-methybutane b. Pentane
c. Isopentane d. neopentane

Q.40. $C_2H_5Cl + KOH \longrightarrow$ C_2H_4 is an example of :- (L19)

a. Hydrohalogenation reaction b. Substitution reaction
c. Elimination reaction d. Hydrolysis reaction

Q.41. A mixture of Acetone (boiling temperature 333K) and 1-Butanol (boiling temperature 391K) can be separated by :- (L20)

a. Ordinary distillation b. Steam distillation
c. Distillation under reduced pressure d. Any of the above listed techniques

Q.42. Nucleophile among the following is: - (L20)

a. BF_3 b. NH_3
c. NO_2^+ d. C^+H3

Q.43. Class XI students took a project to check pollution of local water bodies. The localities reported that in a pond fish are dying daily. They interpreted that it might be due to dense plant population, killing animal life by depriving it of oxygen. This process is known as - (L21)

a. Eutrophication b. Biochemical Oxygen demand
c. Environment depletion d. Stratospheric pollution

Q.44. The gas which is produced from sewage, sawdust, scrap wood, newspapers etc is widely used to prepare important organic compounds called syngas. It is mixture of – (L21)

a. $[CO + N_2]$ b. $[CO_2 + H_2]$
c. $[CO_2 + N_2]$ d. $[CO + H_2]$

Q.45. Consider the reaction:- (L22)

$FeCl_3 + KCNS \leftrightarrow Fe(CNS)Cl_2 + KCl$

(blood red colour)

Here blood red colour is diluted by adding in the mixture

a. $FeCl_3$ b. NaCNS

c. KCl d. KCNS

Q.46. Consider the ionization process (L22)

$H_2S \longleftrightarrow 2H^+ + S^{2-}$

If ZnS is precipitated under high S^{2-} ion concentration, then presence of which of the following reagent in equilibrium mixture may facilitate precipitation of ZnS

a. CH_3COOH b. NH_4OH

c. HCl d. HNO_3

Q.47. Standard solution of which of the following reagent can be prepared in the laboratory:- (L23)

a. KCl b. KOH

c. $KMnO_4$ d. NaOH

Q.48. Solution of Oxalic acid ($(COOH)_2.2H_2O$) can be standardized by using:- (L24)

a. NaOH b. KMnO4

c. NaOH and $KMnO_4$ both d. NaOH and KOH both

Q.49. Salt analysis /mixture analysis makes use of – (L24)

a. Concept of Ksp b. Concept of buffer systems

c. Ionization theory d. a, b and c - all

Q.50. Which of the following solid salt will not produce coloured gas/vapours on treatment with concentrated H_2SO_4 :- (L24)

a. KNO_3 b. KBr

c. KCl d. KI

Annexure – XV

Date: _____

Name of Student: _____
Name of School: _____

Assessment of Learning Outcomes (Biology)

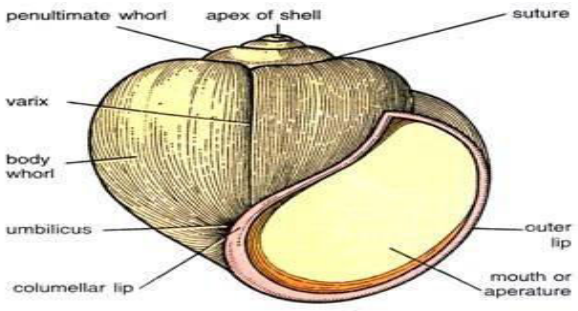
Q.1. The number and types of organisms present on earth refer to — LO1

a. Biodiversity
b. Biosphere
c. Plants and Animals
d. Ecosystem

Q.2. From the given classes of fungi, identify the *'Sac fungi'* — LO2

a. Phycomycetes
b. Ascomycetes
c. Basidiomycetes
d. Deuteromycetes

Q.3. From the diagram identify the phylum of the organism — LO2



Diagram

a. Arthropoda
b. Mollusca
c. Ctenophora
d. Porifera

Q.4. The binomial nomenclature of fruitfly is — LO3

a. *Musca donestica*

b. *Mangifera indica*
c. *Drosophila melenogaster*
d. *Panthera leo*

Q.5. Root like structures that help in anchorage and absorption of water in the bryophytes LO3
a. Scales
b. Rhizoids
c. Prothallus
d. Fibres

Q.6. Green, multicellular, asexual buds that develop in small receptacles on the thalli are called LO3
a. Archegonia
b. Antheridia
c. Gemmae
d. Rhizoids

Q.7. Fungal association found in roots of some genera of gymnosperms(*Pinus*) is called LO3
a. Coralloid roots
b. Mycorrhiza
c. Taproot
d. Fasciculated root

Q.8. Identify the correct floral formula of the Family Fabaceae LO4
a. % ♀ ♂ $K_{(5)}\ C_{1+2+(2)}\ A_{(9)+1}\ \underline{G}_1$
b. ⊕ ♀ ♂ $P_{3+3}\ \ A_{3+3}\ \ \underline{G}_{(3)}$
c. ⊕ ♀ ♂ $K_{(5)}\ C_{(5)}\ \ A_{(5)}\ \underline{G}_{(2)}$
d. % ♀ ♂ $K_5\ C_5\ A_{(5)}\ \ \underline{G}_{(2)}$

Q.9. When stamens are attached to the petals they are known as LO4
a. Epiphyllous
b. Epipetalous
c. Diadelphlous
d. Monoadelphous

Q.10. From the given characters identify the family LO4

i. Tricarpellary, syncarpous, ovary superior, trilocular, with many ovules, axile placentation

ii. Stamen six in number

a. Fabaceae b. Solanaceae c. Malvaceae d. Liliaceae

Q.11. Phyllotaxy refers to the arrangements of LO4

a. Leaves on a branch b. veins in a leaf

c. phloem in the vascular bundle d. flowers on a branch

Q.12.Cells of cardiac muscle are LO5

a. Voluntany b. Non – striated

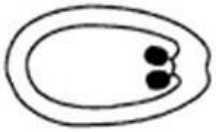
c. Spindle shaped d. Branched and striated

Q.13.As *Pheretima:* Nephridia choose the correct option for *Rana* LO5

a. Flame cells b. Kidney

c. Protonephridia d. Malpighian tubules

Q.14. Observe the diagram and write the name of placentation. LO5



Diagram

a. free central b. parietal c. axile d. marginal

Q.15. From the given characters identify the plant material LO5

i. Sclerenchymatous hypodermis

ii. Vascular bundles are arranged in a ring

iii. Vascular bundle is conjoint open and endarch

iv. Central portion constitute the pith

a) Monocot stem b) Dicot Stem c) Dicot Root d) Monocot Root

Q.16. Which of the following is a C4 Plant LO5

a. Mango tree b. Sugar Cane c. Jasmine d. Hibiscus

Q.17. Mouth parts of cockroach are of which type? LO 6

a. Piercing and Sucking

b. Biting and Sucking

c. Biting and Chewing

d. Sponging Type

Q.18. Which of the following denotes the technical name of frog? LO 6

a) *Periplanta americana*
b) *Pheretima posthuma*
c) *Rana tigrina*
d) *Hirudinaria granulosa*

Q.19. Which of the following organism is involved in the process of vermicomposting LO 6

a) *Rana tigrina*
b) *Pheretima posthuma*
c) *Periplanta americana*
d) *Drosophila melagonester*

Q.20. Identify the poikilotherms animal LO 6

a) Sparrow b) Frog c) Bat d) Dog

Q 21. Which of the following statement is/are NOT true LO 7

i. Cork cambium is called phellogen
ii. Cork is called phellem
iii. Secondary cortex is called periderm
iv. Cork cambium, cork and secondary cortex are collectively called phelloderm.

a) iii and iv only b) i and ii only c) ii and iii only d) ii and iv only

Q.22. Which of the following gives mechanical support and has living cells. LO 8

a. Parenchyma b. Collenchyma c. Chlorenchyma d. Sclerenchyma

Q.23. Which of the following is NOT character of cartilage fishes LO 8

a. Presence of operculum
b. Swim constanthy
c. Placoid scales
d. Teeth are backwardly directed

Q.24. Name the pinkish pigment found in the root nodules of legume plants LO 8

a. Nitrogenase b. Leghaemoglobin c. Anthocyanin d. Myoglobin

Q.25. Ribosomes are composed of LO 10

a) DNA and RNA b) DNA and Proteins
c) RNA and proteins d) DNA only

Q.26. In protein two amino acid molecules are linked in protein is LO 12

a. Peptide bond b. Phosphodiester bond

c. Glycosidic bond d. Hydrogen bond

Q.27. The RNA contains a base uracil in place of the following in DNA LO 12

a. Adenine b. Guanine c. cytosine d. thymine

Q.28. Which of the following Macronutrients acts as a activator of RUBP and PEP carboxylase. LO 12

a. Zinc b. Potossium c. Magnesium d. Calcium

Q.29. Oxygen evolved during photosynthesis comes from LO 12

a. Co_2 b. H_2O c. Sugar d. Starch

LO 12

Q.30. Photorespiration involves

a. Mitochondria, Glyoxysomes, Peroxisome

b. Preoxisomes alone

c. Mitochondria and Peroxisomes

d. Chloroplast, Peroxisomes, Mitochondria

Q.31. Coconut milk is used in certain plant tissue culture experiments because

a. It contains nutrients LO 12

b. Contains natural cytokinins

c. Contain Auxins

d. Contain gibberellins

Q.32. In which phase of mitosis chromosome align at central part of a cell LO 15

a. Anaphase b. Metaphase c. Prophase d. Telophase

Q.33. Match columns I with column II and choose correct option LO 16

Column I	Column II
a. Preserved plants & animals	(i) KEW (England)
b. Quick referral systems	(ii) Zoological Parks
c. Botanical Garden	(iii) museum
d. Animals in Protected environment	(iv) Herbarium

a. a-i b-ii c-iii d-iv

b. a-ii b-iii c-iv d-i

c. a-iii b-iv c-i d-ii

d. a-iv b-iii c-ii d-i

Q.34. Joseph Priestly conduct a series of experiments with a mouse, a mint plant and candle. He concluded that

a. Plants restore to the air whatever is removed by the mouse and the burning candle.

b. Plants give out CO_2 and O_2 LO

c. Plants require animal (mouse) for their survival

d. Burning candle is required for plants.

Q.35. When you perform experiment to separate the plants pigments, the sequence of pigments from bottom to top is LO

a. Carotenoid , Xanthophyll , Chlerophyll b, Chlorophyll a

b. Xanthophyll , Carotenoid , Chlorophyll a , Chlorphyll b

c. Cholorophyll b, Chlorophyll a, Xanthophyll, Corotenoid

d. Chlorophyll a, Chlorophyll b , Xanthophyll, Carotenoid

LO

Q.36. Liver dysfunction results into –

a. Carbohydrate indigestion

b. fat indigestion

c. Protein indigestion

d. All of the above

Q.37. Emphysema is a disorder of – LO

a. Respiratory system

b. Exertory system

c. Circulatory system

d. Digestive system

Q.38.Which of the following joints is found in cranium? LO

a. Gliding joint

b. Ball – Socket joint

c. Hinge Joint

d. Fused Joint

Q.39. A Person having brown eyes, blue eyes or black eyes depends upon the particular pigment present in the – LO 26

a. Pupil b. Cornea c. Iris d. Choroid

Q.40. Male and Female gametes are
a) haploid b) Diploid c)triploid d) polyploidy

LO 27

Q.41. Sertoli cells occur in
a) Brain b) Testes c) kidney d) Lungs

LO 28

Q.42. Amniocentesis is used for determining
a) Heart disease b) Brain disease
c) Hereditary diseases of embryo d) All of the above

LO 29

Q.43. A method of birth control is
a) ZIFT b) ICSI c) GIFT d) IUD

LO 29

Q.44. In Mendelian genetic experiments dominant character out of following is
a. wrinkled seed b. green seed
c. Green pod d. Constricted Pod

LO 32

Q.45. Wings of bat, sparrow & mosquito exhibit the phenomenon called
a. Divergent evolution b. Convergent evolution
c. Adaptive radiation d. Founder effect

LO 33

Q.46. In Sickle cell anaemia
a. Glutamic and is substituted by valine
b. Valine is substituded by Glulamic acid
c. Glutamic and is substituted by AGU
d. Methionine is substituted

LO 35

Q.47. Daughter born to haemophilic father and normal mother will be
a. Normal b. Carrier
c. Haemophilic d. Either normal or haemophilic

LO 35

Q.48. The Bt toxin is coded by a gene named cry. Name the genes which control cotton ball worm from the following options
a. Cry I Ab
b. Cry I Ab and Cry II Ab
c. Cry I Ac and Cry II Ab
d. All of these

LO 43

Q.49. Choose the Correct palindromic nuclecotide sequence from the following examples

LO 44

a. 5^1 – C A T A G C T -3^1
   3^1- G T A T C G A -5^1
b. 5^1 – A A C G T A C -3^1
   3^1- T T G C A GT G -5^1
c. 5^1 – G A A T T C -3^1
   3^1- C T T A A G -5^1
d. 5^1 – A T C G T A C -3^1
   3^1- T A G C A GT G -5^1

Q.50. Name the cereal which is indigenous to India but its patency is obtained by US

LO 45

a. Sorgham
b. Maize
c. Rice
d. Wheat

Annexure – XVI

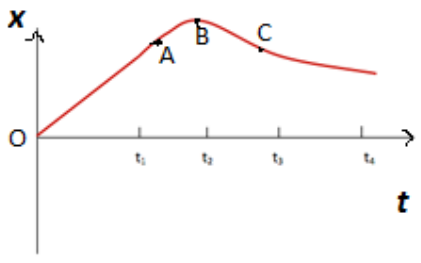
Date: _____

Name of Student: _____
Name of School: _____

Assessment of Learning Outcomes (Physics)

1. Which is strongest force in nature?
    a) Gravitational force
    b) Electromagnetic force
    c) Nuclear force
    d) Weak force
2. What is not conserved in nature?
    a) Mass
    b) Charge
    c) Energy
    d) Momentum
3. The unit of amount of substance is
    a) Litre
    b) Kilogram
    c) Mole
    d) Pound
4. Which of the following relation relates unit of S.I system with CGS system
    a) $1J = 10^7$ erg
    b) 1 decimeter = 10 cm
    c) 1quintal = 100kg
    d) 1 Atmosphere = 10^5 Pascal

5. 10^{-10} m represent
    a) 1 Parsec
    b) 1 Fermi
    c) 1 Angstrom
    d) 1 Micron
6. The number of significant figures in 4.700m are
    a) 4
    b) 2
    c) 1
    d) 3
7. Which of the following has dimensions
    a) Strain
    b) Angular displacement
    c) Relative density
    d) Angular velocity
8. Which of the following cannot have value positive, negative and zero
    a) Displacement
    b) Acceleration
    c) mass
    d) Angle
9. In the x-t graph for a body, the velocity is negative at point

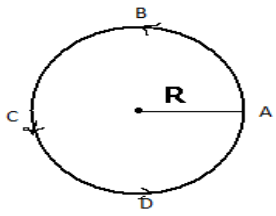


    a) O
    b) A

c) B

d) C

10. A body moves in a circular path starting from point A, it moves from A to B, C ,D and comes back to A in 1 second . The average velocity for the entire motion is



a) $2\pi r$

b) Zero

c) 2R

d) πr^2

11. A body is moving with a velocity of 30 ms^{-1} and acceleration is 1 ms^{-2}. Its velocity after 20 s will be

a) 40 ms^{-1}

b) 50 ms^{-1}

c) 30 ms^{-1}

d) 20 ms^{-1}

12. At maximum height of a projectile the velocity is

a) Negative

b) horizontal

c) vertically upward

d) zero

13. If $\mathbf{r} = x\mathbf{i} + y\mathbf{j}$ is a position vector of a point then its distance from origin is

a) x+y

b) $\sqrt{x^2 + y^2}$

c) xy

d) x/y

14. The magnitude of a displacement vector , $\mathbf{r} = 3\mathbf{i} + 4\mathbf{j}$ is

a) 3

b) 4

c) 5

d) 7

15. A body is projected successively at 10^o, 20^o, 30^o, 45^o, 60^o, 70^o, 80^o. In which two cases the range of projectile would not be equal

a) 20^o , 70^o

b) 30^o, 60^o

c) 30^o, 70^o

d) 10^o , 80^o

16. Which of the following pair of physical quantities have same dimensions

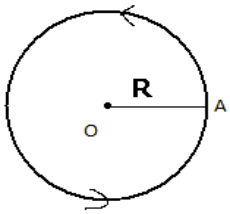
a) Force and momentum

b) Work and energy

c) Force and acceleration

d) Displacement and velocity

17. A body is moving in a circle, with constant speed in a horizontal plane. The force responsible for its motion in circle at point A is in the direction



a) Along OA

b) Along tangent at A

c) Along AO

d) Along the circumference of the circle

18. Which of the following method is not for reducing friction

a) spread coarse sand on the road
b) lubricating surface
c) using ball bearing
d) streamlining

19. A force $\mathbf{F} = 3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}$ (N) is acting on a body of mass 5kg. The acceleration of the mass would be

a) $\sqrt{2}$ m/s^2
b) 25m/s^2
c) 2.4 m/s^2
d) 2 m/s^2

20. A force of friction $\mathbf{F} = (3\mathbf{i} + 4\mathbf{j} - 5\mathbf{k})$ unit displaces a mass by $\mathbf{r} = (5\mathbf{i} + 4\mathbf{j} + 3\mathbf{k})$ units. The work done on the mass will be

a) 16 units
b) 26 units
c) 36units
d) 46units

21. Kilowatt hour is the unit of

a) energy
b) power
c) work
d) force

22. In an inelastic collision what is conserved

a) Kinetic energy
b) momentum
c) potential energy
d) momentum and potential energy

23. A car is moving on a road with uniform velocity. The motion of a point on its tyre is

a) Rectilinear motion

b) Oscillatory motion

c) Rotational and translational motion

d) Oscillatory and translational motion

24. The torque of force $\mathbf{F} = 7\mathbf{i} + 3\mathbf{j} - 5\mathbf{k}$ acting on a particle with position vector, $r = \mathbf{i} - \mathbf{j} + \mathbf{k}$ about the origin is

a) $\mathbf{i} - 12\mathbf{j} - 10\mathbf{k}$

b) $2\mathbf{i} + 2\mathbf{j} + 5\mathbf{k}$

c) $2\mathbf{i} + 12\mathbf{j} + 10\mathbf{k}$

d) $2\mathbf{i} - 12\mathbf{j} + 10\mathbf{k}$

25. A ball of mass m = 100 grams moving in a circular path of radius 2m the angular momentum of the ball is in the direction

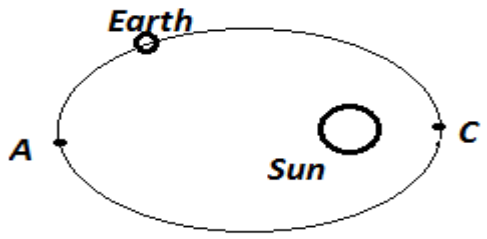
a) parallel to the plane of motion

b) along the direction of velocity

c) along the radius of circular path

d) perpendicular to the plane of motion

26. Earth revolves round the sun in an elliptical path as shown. Its linear speed is



a) maximum at A

b) equal at A and C

c) maximum at C

d) same all along the orbit

27. The acceleration due to gravity (g) is

a) equal at all points on surface of earth

b) maximum on equator and minimum on pole

c) maximum at the center of earth

d) maximum on poles and minimum an equator

28. The period of geostationary satellite is

a) 24 hours

b) 6 hours

c) 12 hours

d) 1 year

29. Young's modulus of aluminum = $70x10^9$ N/m^2, copper = 120×10^9 N/m^2, wrought iron = 190×10 N/m^2 and steel = 200×10^9 N/m^2. The most elastic material is

a) Aluminum

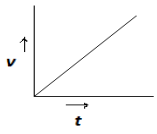
b) Copper

c) Wrought iron

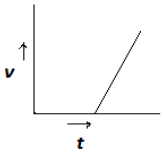
d) Steel

30. A vertical tube apparatus is filled with glycerine. When a ball bearing is dropped slowly in the tube from the top. The v-t graph of the ball bearing will be

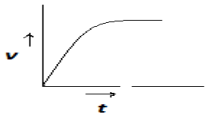
a)



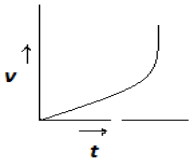
b)



c)



d)



31. One end of a towel dips into a bucket full of water and other end hangs over the bucket. It is found that after some time the towel becomes fully wet. It happens because of viscosity
    a) capillary action
    b) gravitational force
    c) evaporation of water

32. Choose the wrong statement
    a) Small droplets of a liquid are spherical due to surface tension
    b) Oil rises through wick of a lamp due to capillary action
    c) Gum is used to stick two surfaces, the property of adhesion is responsible for this
    d) In drinking cold drinks through a straw, the phenomenon of capillary rise is used

33. When state is being changed from gas to liquid through process of condensation, temperature of liquid
    a) increases
    b) decreases
    c) remains constant

d) may increases or decreases

34. Unit for specific latent heat is

a) watts per joule

b) joules per watt

c) joules per kilogram

d) pascal per watt

35. During adiabatic process the pressure of a gas is found to be proportional to cube of its absolute temperature. The ratio of $\frac{Cp}{Cv}$ for the gas is

a) $\frac{2}{3}$

b) $\frac{3}{2}$

c) $\frac{4}{3}$

d) $\frac{5}{3}$

36. A real gas behaves like an ideal gas if its

a) pressure and temperature are both high

b) pressure and temperature are both Low

c) pressure is high and temperature is low

d) pressure is low and temperature is high

37. If a string fixed at both ends, vibrates in four loops, the wavelength is 10cm. The length of the string is

a) 5cm

b) 15cm

c) 20cm

d) 30cm

38. Wave of frequency 500Hz has phase velocity $360ms^{-1}$. The phase difference between two displacement at a certain point at time 10^{-3} s apart will be

a) π- radian

b) $\frac{\pi}{2}$ radian

c) $\frac{\pi}{4}$ radian

d) 2 π radian

39. A particle executes simple harmonic motion with a frequency '*f*'. The frequency with which the potential energy oscillates is

a) *f*

b) *f/2*

c) 2*f*

d) zero

40. A force of 6.4 N stretches a vertical spring by 0.1m. The mass that must be suspended from the spring so that it oscillates with period of $\frac{\pi}{4}$ seconds is

a) 2kg

b) 1kg

c) 1.5kg

d) 2.5kg

41. Sound waves in air cannot be polarized because

a) their speed is small

b) they require a medium

c) these are longitudinal

d) their speed is temperature dependent

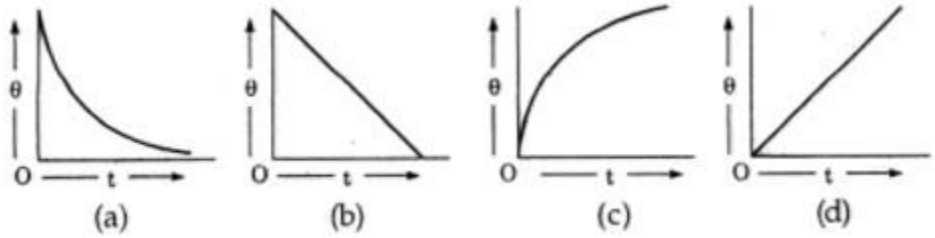
42. The force for which work done is independent of path is
    a) Friction
    b) Surface tension
    c) Viscosity
    d) Gravitational force

43. The minimum distance of an obstacle from the source of sound required to hear an echo is
    a) 1.7m
    b) 17 m
    c) 7m
    d) 71m

44. Two bodies having kinetic energy 30J and 50 J collide. After elastic collision their kinetic energies could be
    a) 20 J and 40 J
    b) 40 J and 30 J
    c) 10 J and 70 J
    d) 25 J and 45 J

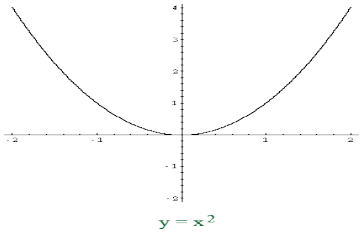
45. SONAR determines the speed of submarines using the principle of
    a) Interference
    b) Diffraction
    c) Doppler effect
    d) Formation of beats

46. Bats determines the presence of obstacle or prey using
    a) Ultrasonic waves
    b) Infrasonic waves
    c) Light waves
    d) Ultraviolet waves
47. Sound waves of wavelength λ travelling in a medium with a speed of v m/s enter into another medium in which its speed is 2v m/s. wavelength of sound wave in the second medium is
    a) λ/2
    b) λ
    c) 2 λ
    d) 4 λ
48. Which characteristics of sound waves changes with change in temperature of medium
    a) Frequency
    b) Amplitude
    c) Wavelength
    d) Loudness
49. Which of the following graph best represents cooling curve?

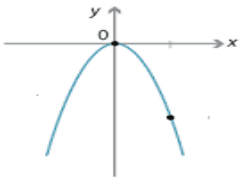


50. Which of the following curve represents $y = x^2$

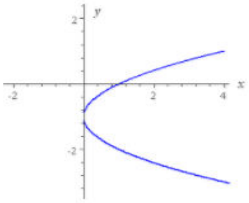
a)



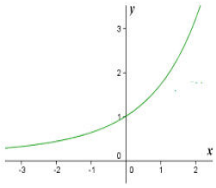
b)



c)



d)



Annexure – XVII

Assessment of Learning Outcomes
(Guidelines for Focus Group Discussion for Students/Teachers/Parents)

Identifying Information

Name of the school: _____

Village / Town:_____

District: _____

Location (Rural/Urban): _____

Type of Participants: Students/Teachers/Parents

In case of Student Participants, Classes Involved: _____

No of participants: Male: _____ Female: _____Total: _____

Type of Management (Govt. /Pvt. /Govt. Aided): _____

Instructions

1. The field Investigator shall conduct Focus Group Discussions with student (of classes XII), teachers and parents along questions listed under sections A, B and C respectively. These questions, however, are suggestive. More questions can be asked and/or explanations can be made for further probing/clarification.

2. The focus group consists, in any case, of 5-10 members.

3. Purposive/judgement sampling technique will be used in the selection of members.

4. There shall be at least two persons- one called moderator, who asks questions; and the other called rapporteur, who records conversation.

5. The members participating in the FGD should sit comfortably in semi-circle.

Chapter – 4

Analysis and Interpretation of Data

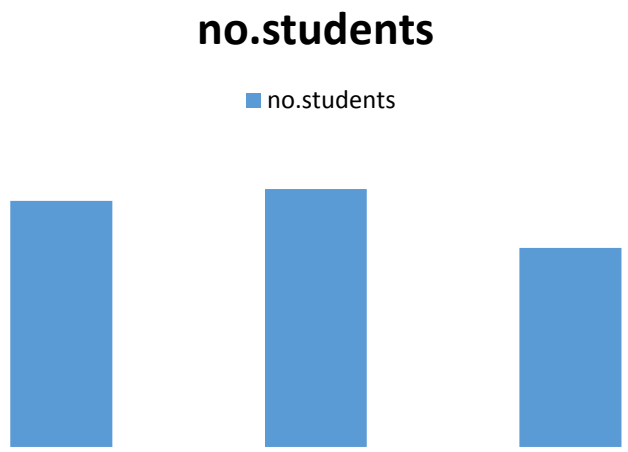
4.1. Chemistry

4.1 A Questionnaire containing 50 questions based on 24 learning outcomes was administered on 120 students of 3 educational zones namely Central, South and North Zone of Goa state. The responses of students are compared on the basis of educational zones. Item wise analysis of the students' responses was also done. The 50 items in questionnaire were designed on the basis of knowledge, comprehension and application domain. The attainment of learning outcomes for attaining to particular domain were also analysed zone-wise.

The table 4.1.1 shows that 42 students from central zone, 44 students form south zone and 34 students from north zone have responded to the questionnaire. Table reflects the zone wise distribution of students those have responded the questionnaire based on learning outcomes.

Students of Different Zones	
Zone	**No. Students**
Central	**42**
South	**44**
North	**34**

Table 4.1.1 Students of Different Zones

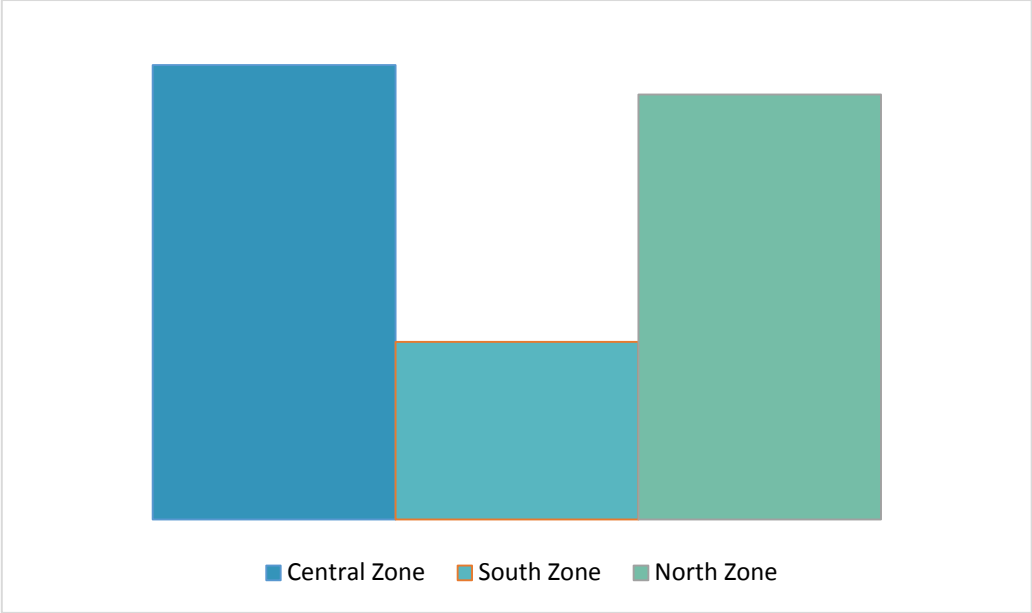


Graph 4.1.1 No. of Students in Different Zones of Goa state

4.1.2 Attainment of learning outcomes of students of Goa state in Chemistry

An attempt to analyse the attainment of learning outcomes of students at Sr. Sec. level in Chemistry of Goa state was done by administrating a questionnaire containing 50 multiple choice items **(Annexure-XIV)**. The analysis of data reveals that the overall attainment of learning outcomes in chemistry is 29.8% by the students of Goa.

Item-wise attainment of learning outcomes of students of Goa state in Chemistry is shown in the following graph:



Graph 4.1.2 (O) Item wise attainment (in percentage) of learning outcome of students of Goa

When attainment of the learning outcomes in chemistry of the students of Goa was compared amongst the different educational zone namely Central, North and South when compared, it is found that the students of Central zone have shown better performance (30.71%) as compared to North & South zone students. The North zone students have shown 30.47% and South zone students have shown (28.45%) of attainment of learning outcomes in Chemistry. Table No. 4.1.2 reflects the zone-wise comparison and overall attainment of learning outcomes.

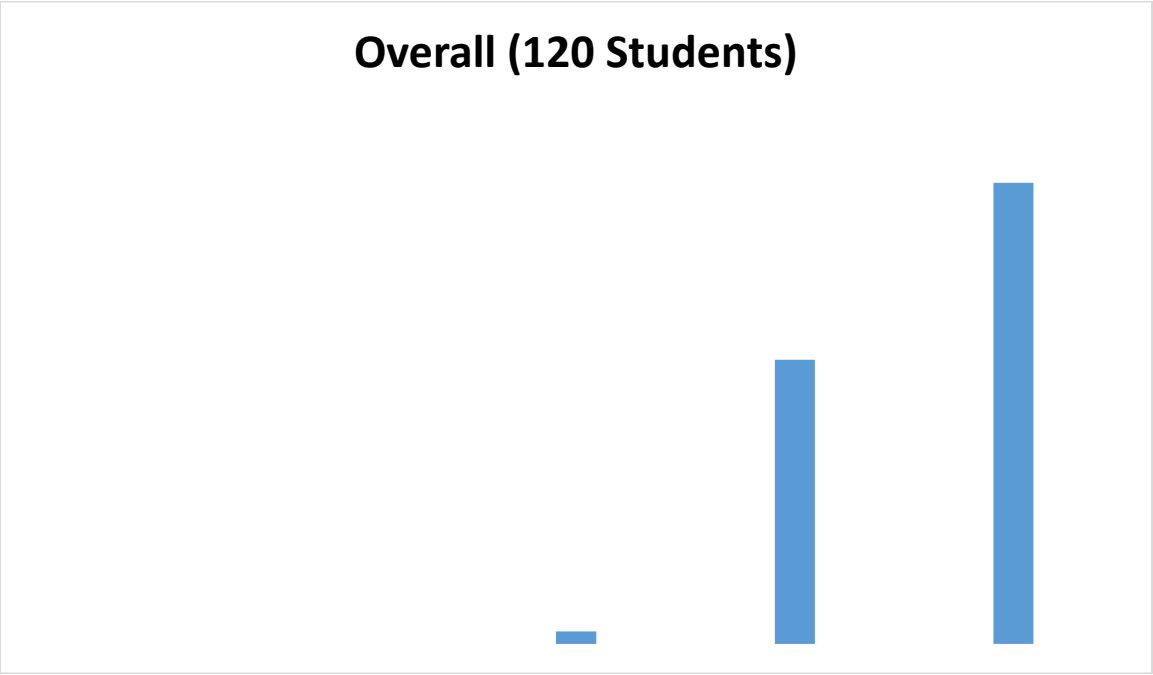
S. No.	Percentage of marks obtained by students (120)		
	South zone (44 students)	Central zone (42 students)	North zone (34 students)
1	30	34	32
2	32	34	32
3	30	34	26
4	30	34	32
5	24	34	22
6	24	34	24

7	16	34	22
8	22	34	36
9	28	34	34
10	28	34	30
11	12	34	20
12	32	34	36
13	28	34	26
14	34	30	32
15	14	36	34
16	32	26	38
17	38	24	38
18	24	16	34
19	28	14	28
20	34	26	30
21	34	36	28
22	22	34	34
23	12	28	30
24	34	14	42
25	38	28	32
26	24	48	20
27	24	40	24
28	40	18	30
29	28	36	38
30	34	36	36
31	26	44	26
32	32	38	30
33	32	28	26
34	44	26	34
35	38	24	
36	24	22	
37	32	28	
38	26	26	
39	36	8	
40	30	30	
41	22	38	
42	22	46	
43	34		
44	24		
Zone-wise Percentage	**28.45 %**	**30.71 %**	**30.47 %**

Overall attainment of Learning Outcomes	**29.8%**

Table 4.1.2 Zone wise comparison of Percentage of attainment of Learning Outcomes by students of Goa State

The following graph reflects the zone-wise comparison of attainment of learning outcomes of students in Chemistry at Sr. Sec. level.



Graph 4.1.2 Performance percentage of Students of different zones

4.1.3 Attainment of learning outcomes of the students of Goa on five point scale

Analysis of the student's responses with respect to different learning outcomes in Chemistry where done on the basis of five point scale as mentioned below:

Attainment of LO (in percentage)	75 – 100%	60 – 74.9%	45 – 59.9%	33 – 44.9%	0 -32.9%
Grade	A	B	C	D	E

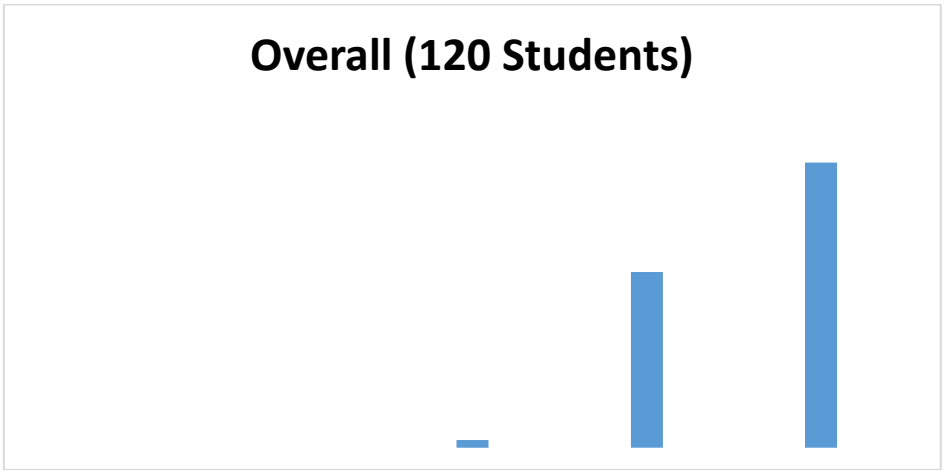
The following table reflects that the none of the students of Goa state could attain the learning outcome in the range of 60% and above. The table reflects that the attainment of learning outcomes by the students of Goa state in Chemistry is not very satisfactory majority of the students (60.83%) of Goa state have shown the level of attainment of learning outcomes in the range 0-33%. Another range which is having significant percentage of students (37.5%) is upto 45% only. It is reflective that the almost 98%

students of Goa state have shown the attainment of learning outcomes in Chemistry upto 45% only.

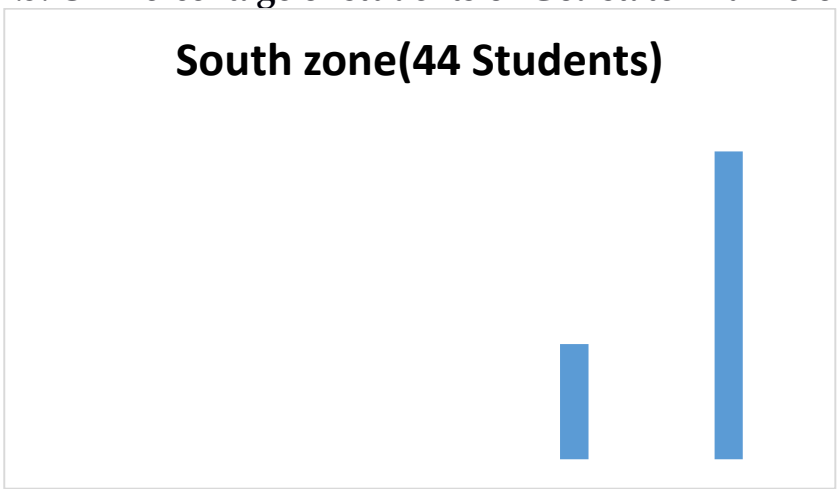
Zone-wise analysis of learning outcomes with respect to different ranges was also done. The same table reflects that Central zone students have performed better as compared to North and South zone students. The performance of South zone students is found to be the lowest level amongst three educational zones of Goa state.

Attainment of LO (in percentage)	Grade	South zone (44 Students)	Central zone (42 students)	North zone (34 students)	Overall (120 students)
75 – 100%	A	--	--	--	--
60 – 74.9%	B	--	--	--	--
45 – 59.9%	C	--	4.76 %	--	1.66 %
33 – 44.9%	D	27.27 %	52.38 %	32.35 %	37.5 %
0 -32.9%	E	72.72 %	42.85 %	64.64 %	60.83 %

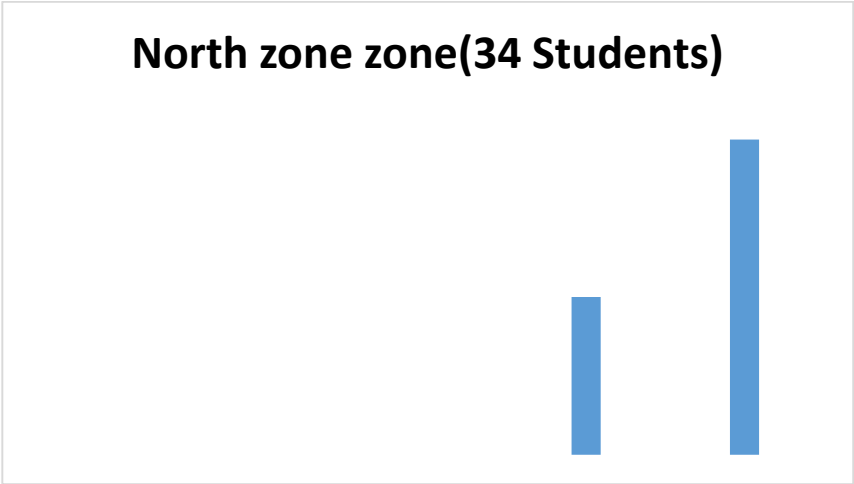
Table 4.1.3 Attainment of learning outcomes of the students of Goa on five point scale



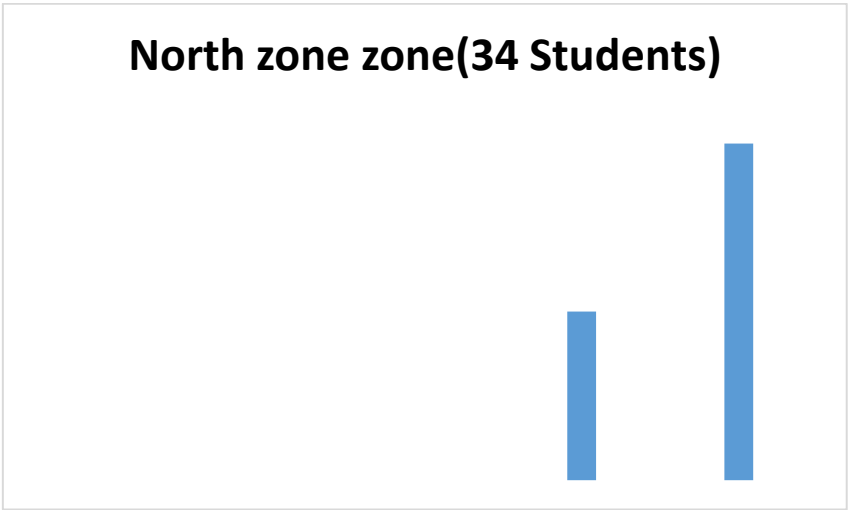
Graph 4.1.3. O – Percentage of students of Goa state in different ranges



Graph 4.1.3. S – Percentage of students of South zone in different ranges



Graph 4.1.3. C – Percentage of students of Central zone in different ranges



Graph 4.1.3. N – Percentage of students of North zone in different ranges

4.1.4 Difficulty level of items in the questionnaire on the basis of students responses

The 50 items pertaining to 24 learning outcomes were of different difficulty level. The difficulty level of the items are shown in the Table no. 4.1.4

Criteria	Attainment by students	No of item in questionnaire
Extremely easy	60% and above	11
Very easy	50 % to 59.9 %	17,32,33,43
Easy	40 % to 49.9 %	10,15,16,19,26,28,30,40,42
Average	30 % to 39.9 %	3,5,7,25,31,46,49
Difficult	20 % 29.9 %	6,8,9,12,13,14,21,22,23,27,29,34,36,37,39 44,45,48,50
Very difficult	10 % to 19.9%	1,18,20,35,38,41

Extremely difficult	0 % to 0.9 %	2,4,24,47

Table 4.1.4 Analysis of Difficulty Level of Items in Questionnaire on the basis of students Responses

The table 4.1.4. clearly shows the criteria in terms of difficulty level of each item and attainment of that item by the students of Goa state. It is reflected from the table that the item no. 2, 4, 24, 47 were of most difficult items and item no. 11 was the most easy item for the students of Goa state.

4.1.5 Domain-wise distribution of 50 items pertaining to 24 LOs

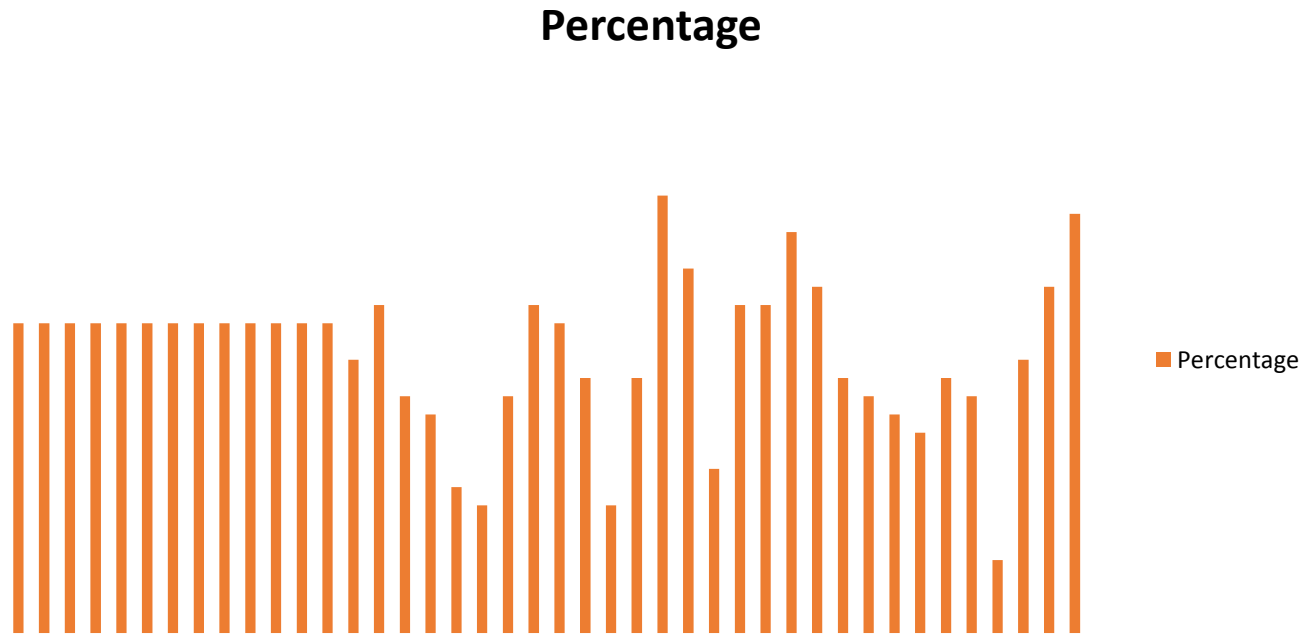
The distribution of 50 items pertaining to 24 LOs are as follows:

Domain	No. of Items	Item No.
Knowledge	12	5, 7, 11, 14, 15 , 16, 21, 32, 40, 41, 47, 49
Comprehension	26	1, 2, 6, 8 ,9 10, 12, 13, 17, 19, 20, 23, 24, 27, 28, 31, 33, 34, 36, 38, 39, 42, 43, 44, 46, 48
Application	12	3, 4, 18, 22, 25, 26, 29, 30, 35, 37, 45, 50

Table 4.1.5 Domain Wise Distribution of 50 Items

4.1.6 Attainment of Learning Outcomes by Students of Central Zone

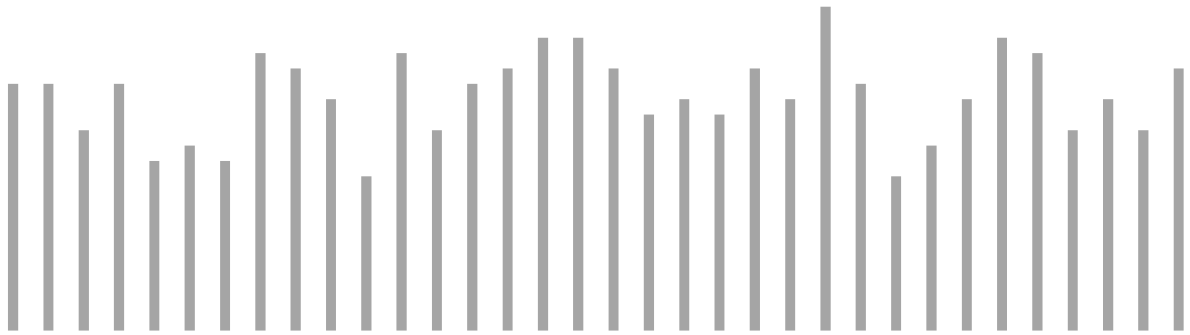
The central zone students have shown the average attainment of learning outcomes very low which is 30.71%. The graph 4.1.6 reflects the item wise attainment of the learning outcomes of the students of Central zone.



Graph 4.1.6 Attainment of Learning Outcomes by Students of Central Zone

4.1.7 Attainment of Learning Outcomes by Students of North Zone

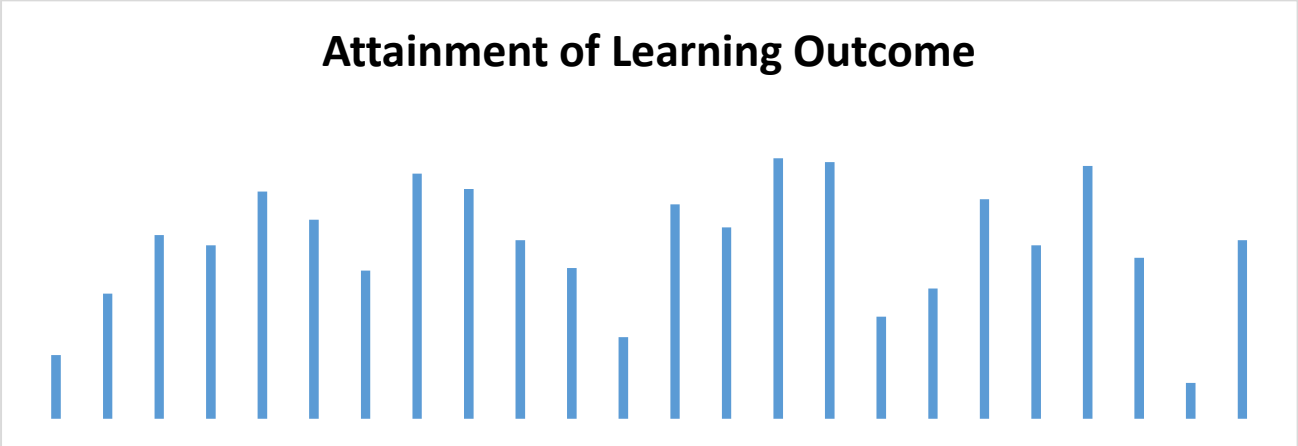
The north zone students have shown the average attainment of learning outcomes very low which is 30.47%. The graph 4.1.7 reflects the item wise attainment of the students.



Graph 4.1.7 Attainment of Learning Outcomes by Students of North Zone

4.1.8 Attainment of Learning Outcomes by Students of South Zone:

The south zone students have shown the average attainment of learning outcomes which is 28.48%. The graph 4.1.8 reflects the item wise attainment of the students.



Graph 4.1.8 Attainment of Learning Outcomes by Students of South Zone

4.1.9 Attainment of Learning Outcomes by the Students of Goa State:

Out of 24 learning outcomes only few learning outcomes have been attained by majority of the students. The table 4.1.9 reflects that the learning outcome no. 8 (thermodynamics), 15 & 16 have been attain by most of the students. Further learning outcome no. 5 (periodic properties) and 19 (Hydro Carbon) have been attained by majority of the students (14.33%) and learning outcome no. 23 (Titration) has been attained by least number of students (2.33%). Apart from this learning outcome number 1 (Mole Concept) also found difficult to be attained by students, only 4.16% students could attain this learning outcome.

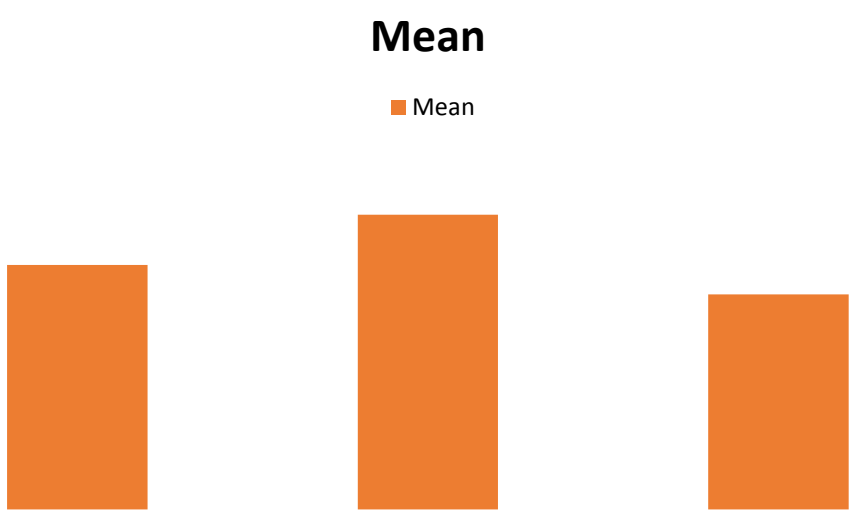
Graph 4.1.9 Attainment of Learning Outcomes by the Students of Goa State

4.1.10 Domain wise attainment of learning outcomes of the students of Goa:

The questionnaire containing 50 items is comprising of items pertaining to knowledge, comprehension and application domain. Out of 50 items, 12 items each from knowledge and application and remaining 26 items pertained to comprehension domain. Domain-wise analysis of attainment of learning outcomes is done. Results are reflected in table no. 4.1.10 and in graph no. 4.1.10

Attainment of learning outcomes of Students (Total Responses 120)		
Comprehension domain (Total Items 26)	**Knowledge Domain (Total Items 12)**	**Application Domain (Total Items 12)**
15	41	40
10	39	9
31	76	23
29	31	27
30	54	42
59	52	56
28	32	26
27	66	48
67	52	13
48	16	32
22	07	24
26	41	30
06		
24		
51		
42		
61		
32		
27		
19		
34		
52		
64		
35		
39		
34		
Average 35%	**42%**	**31%**

Able 4.1.10 Domain Wise Attainment of Learning Outcomes of the Students of Goa



Graph 4.1.10 Domain Wise Attainment of Learning Outcomes of the Students of Goa

From analysis of the attainment of Learning outcomes of Goa state in Chemistry it is concluded that, the South zone has not even attain the learning outcomes upto satisfactory level. Perhaps the routine classroom transactions in these regions have not given much emphasis on adequate and appropriate pedagogical processes, rather product based transactional strategies are given priority. Though the performance of North and Central zone are satisfactory but these zones are also having ample scope to improve to acquire National and Global standard.

4.2. Physics

This chapter deals with data analysis of learning achievement relating to learning outcomes, school-wise as well as parameter-wise mean score, overall mean score, their variance and mean difference through analysis. This chapter has analysed the data in order to achieve the objective of the study (i) to assess the students learning out comes in light of developed learning indicators in Chemistry, Physics and Biology at Higher Secondary school Level, and (ii) To find out and analyse the source of mismatch between the expected learning outcomes and the actual learning outcomes of the students in Chemistry, Physics and Biology at higher Secondary level, if required.

The purpose of this investigation is to determine the status of learning outcomes in terms of learning achievement of students of class XI in state government schools of different zones (North, South, and Central zone) in Goa. To find out the status of learning outcomes attained by students in the State government schools of Goa, mean has been calculated.

In order to analyses the learning outcomes of students in government schools of different zones in Goa in class XI, learning achievement is analyzed with respect to different domains i.e knowledge, understanding, and application.

Table 4.2.1 shows the complete overview of scores and percentage attained by 113 students of Class XI in Physics in schools of various zones in Goa. It is clear from the table that 33 students from south zone, 39 from central zone and 41 students from north zone involved in the study. The overall mean of scores attained by all students is 19.43 and the mean of percentage attained by all students of class XI is 38.87. These results shows that the achievement of students in physics is not that much satisfactory in the state schools of Goa.

Table 4.2.1 A Complete overview of scores and percentage attained by students of Class XI in Physics

S.No	Zone	TOT	(%)
1	S	23	46
2	S	24	48
3	S	28	56
4	S	24	48
5	S	21	42
6	S	18	36
7	S	14	28
8	S	15	30
9	S	17	34
10	S	20	40
11	S	15	30
12	S	18	36
13	S	20	40
14	S	16	32
15	S	16	32
16	S	23	46
17	S	16	32
18	S	17	34
19	S	15	30
20	S	22	44
21	S	16	32
22	S	26	52
23	S	12	24
24	S	19	38
25	S	15	30
26	S	25	50
27	S	25	50
28	S	14	28
29	S	28	56
30	S	23	46

31	S	18	36
32	S	16	32
33	S	20	40
34	C	15	30
35	C	19	38
36	C	29	58
37	C	27	54
38	C	38	76
39	C	18	36
40	C	23	46
S.No	Zone	TOT	%
41	C	23	46
42	C	20	40
43	C	15	30
44	C	20	40
45	C	21	42
46	C	19	38
47	C	31	62
48	C	19	38
49	C	27	54
50	C	19	38
51	C	13	26
52	C	14	28
53	C	17	34
54	C	19	38
55	C	19	38
56	C	12	24
57	C	19	38
58	C	15	30

59	C	9	18
60	C	12	24
61	C	16	32
62	C	21	42
63	C	19	38
64	C	19	38
65	C	15	30
66	C	21	42
67	C	13	26
68	C	12	24
69	C	14	28
70	C	17	34
71	C	13	26
72	C	25	50
73	N	20	40
74	N	26	52
75	N	15	30
76	N	14	28
77	N	14	28
78	N	30	60
79	N	31	62
80	N	17	34
S.No	Zone	TOT	%
81	N	19	38
82	N	16	32
83	N	22	44
84	N	21	42
85	N	21	42
86	N	12	24

87	N	29	58
88	N	29	58
89	N	22	44
90	N	19	38
91	N	26	52
92	N	24	48
93	N	26	52
94	N	18	36
95	N	21	42
96	N	19	38
97	N	18	36
98	N	18	36
99	N	16	32
100	N	21	42
101	N	19	38
102	N	12	24
103	N	11	22
104	N	18	36
105	N	25	50
106	N	16	32
107	N	22	44
108	N	16	32
109	N	20	40
110	N	22	44
111	N	19	38
112	N	18	36
113	N	18	36
	Mean	**19.43**	**38.87**

Source: Primary Survey

Table 4.2.2. shows scores and percentage of students in Physics of class XI from highest to lowest. It is apparent that the highest score attained by the student in physics is 38 out of 50 and 76% belongs to central zone and the lowest score attained by the student is 9 out of 50 and 18% also belong to central zone.

Table-4.2.2. Scores and percentage of students in Physics of class XI from highest to lowest

S.No.	Zone	TOTAL	(%)
1	C	38	76
2	C	31	62
3	N	31	62
4	N	30	60
5	C	29	58
6	N	29	58
7	N	29	58
8	S	28	56
9	S	28	56
10	C	27	54
11	C	27	54
12	S	26	52
13	N	26	52
14	N	26	52
15	N	26	52
16	S	25	50
17	S	25	50
18	C	25	50
19	N	25	50
20	S	24	48
21	S	24	48
22	N	24	48
23	S	23	46
24	S	23	46
25	S	23	46
26	C	23	46
27	C	23	46
28	S	22	44
29		22	44
30	N	22	44
31	N	22	44
32	N	22	44
33	S	21	42
34	C	21	42
35	C	21	42
36	C	21	42
37	N	21	42
38	N	21	42
39	N	21	42

40	N	21	42
41	S	20	40
42	S	20	40
43	S	20	40
44	C	20	40
45	C	20	40
46	N	20	40
47	N	20	40
48	S	19	38
49	C	19	38
50	C	19	38
51	C	19	38
52	C	19	38
53	C	19	38
54	C	19	38
55	C	19	38
56	C	19	38
57	C	19	38
58	N	19	38
59	N	19	38
60	N	19	38
61	N	19	38
62	N	19	38
63	S	18	36
64	S	18	36
65	S	18	36
66	C	18	36
67	N	18	36
68	N	18	36
69	N	18	36
70	N	18	36
71	N	18	36
72	N	18	36
73	S	17	34
74	S	17	34
75	C	17	34
76	C	17	34
77	N	17	34
78	S	16	32
79	S	16	32
80	S	16	32
81	S	16	32

82	S	16	32
83	C	16	32
84	N	16	32
85	N	16	32
86	N	16	32
87	N	16	32
88	S	15	30
89	S	15	30
90	S	15	30
91	S	15	30
92	C	15	30
93	C	15	30
94	C	15	30
95	C	15	30
96	N	15	30
97	S	14	28
98	S	14	28
99	C	14	28
100	C	14	28
101	N	14	28
102	N	14	28
103	C	13	26
104	C	13	26
105	C	13	26
106	S	12	24
107	C	12	24
108	C	12	24
109	C	12	24
110	N	12	24
111	N	12	24
112	N	11	22
113	C	9	18

Table 4.2.3. Represents distribution of percentage and Scores in Exclusive Series attained by students of Class XI in Physics in schools of different zones in Goa. The table clearly shows that the percentage of maximum students lies in the range of exclusive series 30-40 and the number of student's lies in this range is 49, only one student in the range of having percentage in between 70-80 and one student having percentage in the range of 10-20.

In terms of scores it can be observed that 65 of the students having scores in the range of 10-20, 43 of the students having scores in the range 20-30, 4 0f the students' scores in the range of 30-40 and 1 student have scores in the range 0-10 and none has achieved above 40.

This tables shows that the performance of the students of class XI in physics is not satisfactory. The reason may be the school organizational climate, may be the lack of interest in physics, may be engagement in other assignment of school or some other.

Table 4.2.3 Distribution of percentage and Scores attained in Exclusive Series attained by students of Class XI in Physics

C.I (%)	frequency of students
0-10	0
10-20	1
20-30	16
30-40	49
40-50	28
50-60	15
60-70	3
70-80	1
Total	113

C.I (scores)	frequency of Students
0-10	1
10-20	65
20-30	43
30-40	4
40-50	0
Total	113

Table 4.2.4 Represents zone-wise comparison of scores and percentage of students from highest to lowest along with their mean scores and mean percentage. The mean of scores in north zone is 20 and the mean percentage is 40 and in south zone the mean of scores is 19.363 and the corresponding mean percentage is 38.727 and in the central zone the mean score is 18.897 and the mean percentage is 37.794. It can be concluded from this table that the overall scenario in scores in physics attained by students of Goa is not at all satisfactory. It also shows that the performance of students in physics in class XI in all the zones is more or less same.

Table 4.2.4 Zone wise Comparison of Scores and percentage from highest to lowest

S.No.	North	South	Central	S.No.	North (%)	South(%)	Central (%)
1.	31	28	38	1.	62	56	76
2.	30	28	31	2.	60	56	62
3.	29	26	29	3.	58	52	58
4.	29	25	27	4.	58	50	54
5.	26	25	27	5.	52	50	54
6.	26	24	25	6.	52	48	50
7.	26	24	23	7.	52	48	46
8.	25	23	23	8.	50	46	46
9.	24	23	21	9.	48	46	42
10.	22	23	21	10.	44	46	42
11.	22	22	21	11.	44	44	42
12.	22	21	20	12.	44	42	40
13.	22	20	20	13.	44	40	40
14.	21	20	19	14.	42	40	38
15.	21	20	19	15.	42	40	38
16.	21	19	19	16.	42	38	38
17.	21	18	19	17.	42	36	38
18.	20	18	19	18.	40	36	38
19.	20	18	19	19.	40	36	38
20.	19	17	19	20.	38	34	38
21.	19	17	19	21.	38	34	38
22.	19	16	19	22.	38	32	38
23.	19	16	18	23.	38	32	36
24.	19	16	17	24.	38	32	34
25.	18	16	17	25.	36	32	34
26.	18	16	16	26.	36	32	32
27.	18	15	15	27.	36	30	30
28.	18	15	15	28.	36	30	30
29.	18	15	15	29.	36	30	30
30.	18	15	15	30.	36	30	30

31.	17	14	14	31.	34	28	28
32.	16	14	14	32.	32	28	28
33.	16	12	13	33.	32	24	26
34.	16		13	34.	32		26
35.	16		13	35.	32		26
36.	15		12	36.	30		24
37.	14		12	37.	28		24
38.	14		12	38.	28		24
39.	12		9	39.	24		18
40.	12			40.	24		
41.	11			41.	22		
Mean	**20**	**19.363**	**18.897**	**Mean**	**40**	**38.727**	**37.794**

Table 4.2.5 Represents the achievement of learning outcomes of students of class XI in Physics. In the study 50 items are used to analyse 28 learning outcomes identified for the students. It indicates that maximum correct responses are obtained for item no. 3 for learning outcome 2 is attempted by 84 students out of 113 i.e 74% of students mark their response correctly for this learning outcome. Also item no. 49 for learning outcome 28 attempted by 84 students i.e 74% who gave their responses correctly.

The minimum responses were obtained for item no. 17 and item no. 38 for learning outcome 10 and learning outcome 24 from 16 students only who attempted and gave response correctly.

Table 4.2.5 Achievement of Learning outcomes of students of class XI in Physics

S.No.	Item No.	L.O	No. of Students	%
1	1	1	56	49.56
2	2	1	20	17.7
3	3	2	84	74.34
4	4	2	41	36.28
5	5	2	68	60.18
6	6	3	48	42.48
7	8	3	67	59.29
8	7	4	43	38.05
9	16	4	65	57.52
10	10	5	33	29.20
11	11	5	53	46.90
12	9	6	73	64.60
13	23	7	57	50.44
14	13	8	63	55.75
15	14	8	46	40.71
16	12	9	28	24.78
17	15	9	51	45.13
18	17	10	16	14.16
19	19	10	35	30.97
20	18	11	50	44.25
21	21	12	51	45.13
22	42	12	79	69.91
23	20	13	34	30.09
24	22	14	27	23.89
25	44	14	31	27.43
26	24	15	20	17.69
27	25	15	19	16.81
28	27	16	18	15.93
29	28	16	61	53.98
30	26	17	28	24.78
31	29	18	30	26.55
32	30	19	48	42.47
33	31	20	71	62.83
34	32	20	38	33.63
35	33	21	19	16.81
36	34	21	27	23.89
37	35	22	34	30.09

38	36	22	30	26.55
39	39	23	40	35.40
40	40	23	18	15.93
41	37	24	50	44.25
42	38	24	16	14.16
43	43	25	28	24.78
44	48	25	36	31.86
45	41	26	36	31.86
46	45	26	47	41.59
47	46	27	63	55.75
48	47	27	41	36.28
49	49	28	84	74.34
50	50	28	75	66.37

Table 4.2.6 presents the actual learning outcomes gained by the students in Physics in class XI. Figure-1 shows graphical representation for table 4.2.6 From the graph it is clear that learning outcome 28 is attained by 80 % of the students approximately. And the learning outcome 6 is attained by 73% of the students whereas the learning outcome 15 is attained by 19.5% of the students i.e. the minimum number of students attained this learning outcome 15. The attainment of other learning outcomes shows average performance of the students.

Table 4.2.6 Achievement of actual learning outcomes attained by students in physics in class XI

LO	Actual Learning Outcome
1	38
2	64.33
3	57.5
4	54
5	43
6	73
7	57
8	54.5
9	39.5
10	25.5
11	50
12	56.5
13	51

14	29
15	19.5
16	39.5
17	28
18	30
19	48
20	54.5
21	23
22	32
23	29
24	33
25	32
26	41.5
27	52
28	79.5
Mean	**44.08**

Figure 4.2.1 Presents zone wise percentage of achievement of learning outcomes of students of class XI in Physics with its graphical representation also in Figure 4.2.1 The table clearly indicates that only few learning outcome were attained by the students above 50% whereas maximum learning outcomes attained by the students in physics lies in the range of 20-40% in all the zones of Goa which indicates that the attainment of learning outcomes by the students in class XI is not satisfactory in any zone of Goa.

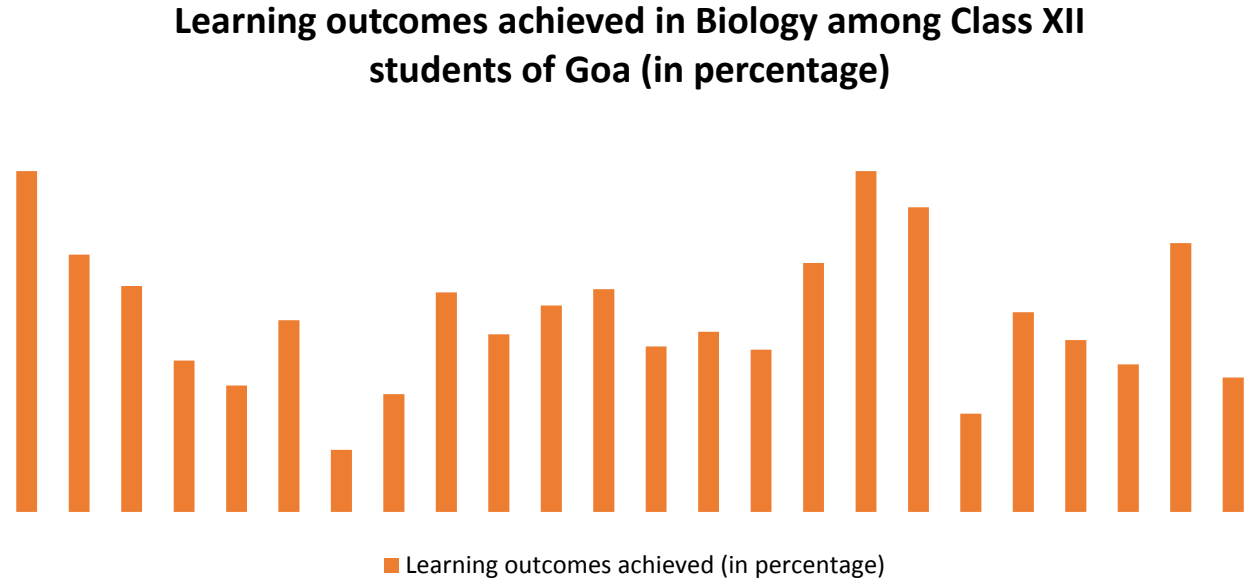


Figure: 4.2.1 Learning outcomes attained by the students in physics in class XI

4.3 Biology

A questionnaire containing 50 questoins was administered on the studetns of different educational zones of Goa. The result was analysed on the basis of each item (50) and learning outcome (45).

4.3.1 Learning outcomes achieved in Biology among Class XII students of Goa:

It is reflected from the graph that the learning outcome no. 1, 28, 29 and 44 were achieved by majority of the students whereas learning outcome no. 7 and 32 were achieved by least number of students.

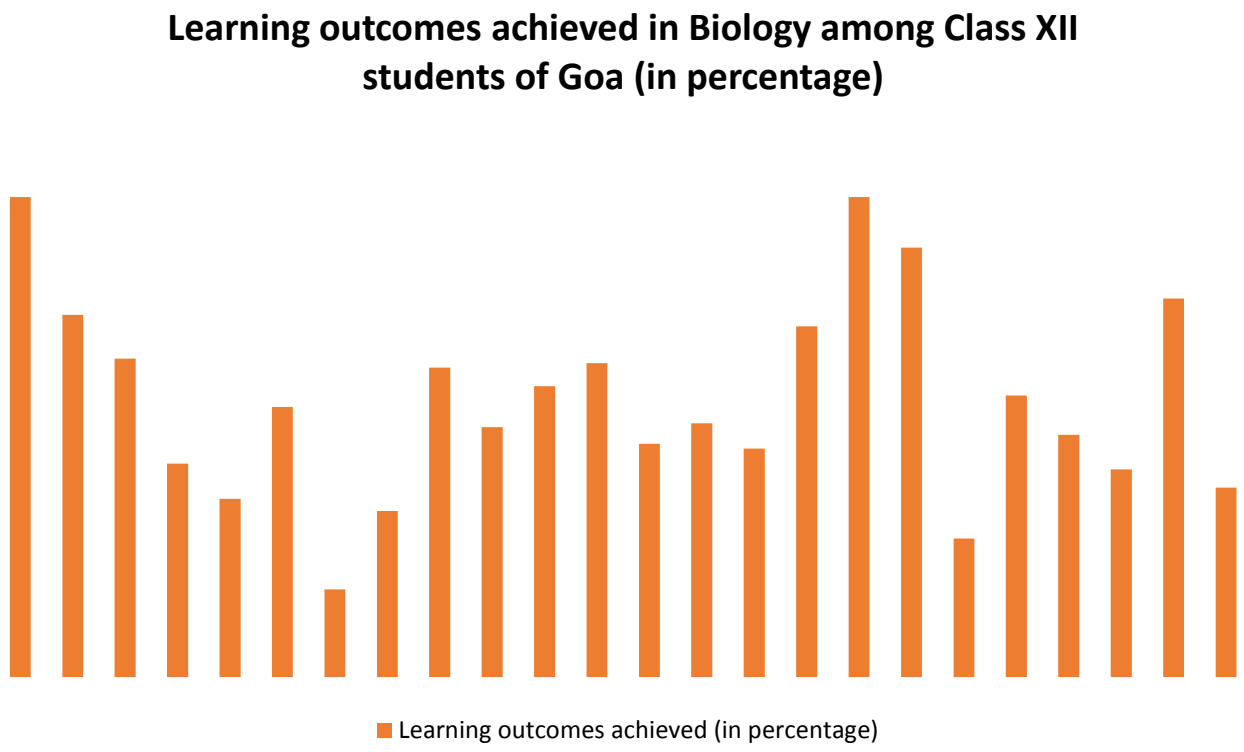


Figure 4.3.1 Learning outcomes achieved in Biology among Class XII students of Goa

4.3.2 Zone- wise analysis of learning outcomes achieved in Biology among Class XII students of Goa:

It is reflected from the graph that the percentage of learning outcome no. 28 and 1 were achieved by majority of the students whereas percentage of learning outcome no. 7and 32 wereachieved by least number of students.

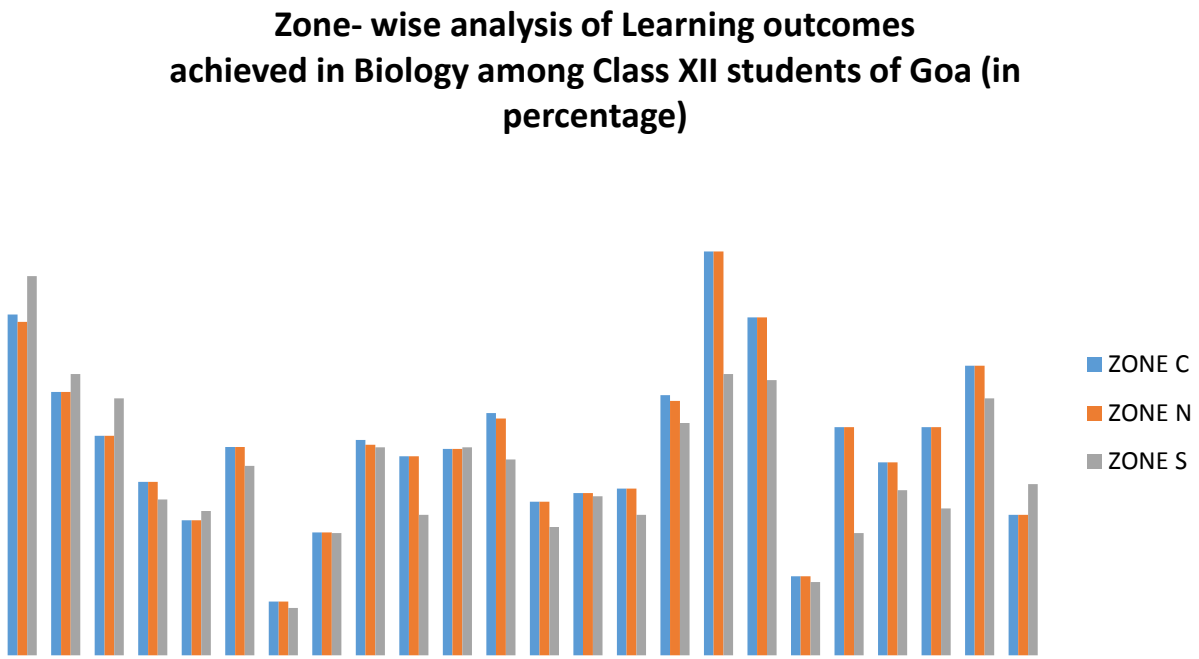
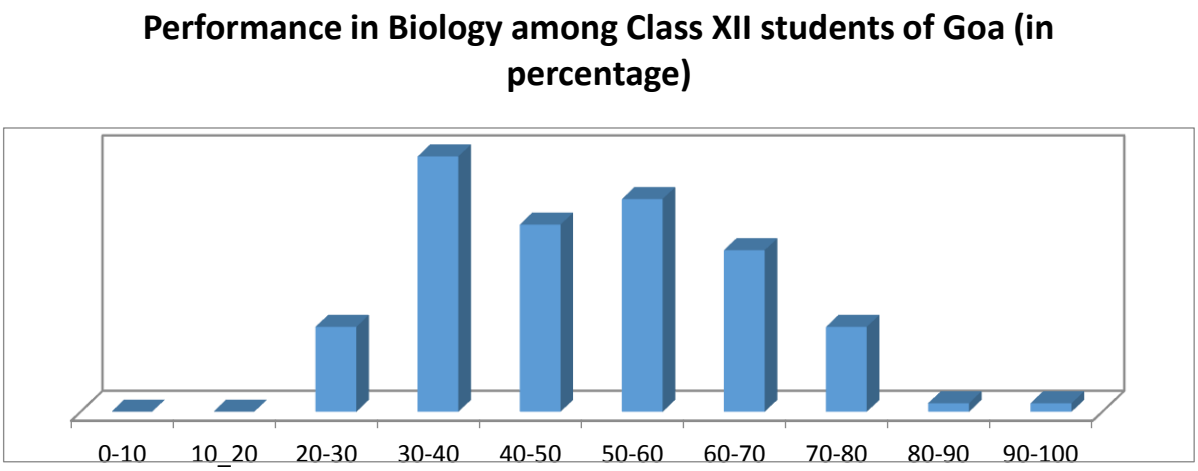


Figure 4.3.2 Zone- wise analysis of Learning outcomes achieved in Biology among Class XII students of Goa (in percentage)

4.3.3 Performance in Biology among Class XII students of Goa:

It is reflected from the graph that the percentage of learning outcome no. 28 has been achieved by the maximum number of students. Nxt is learning outcome no. 1 which is achieved by majority of students. Learning outcome number 7 and 32 have been achieved by least number of students.

Figure 4.3.3 Performance in Biology among C



lass XII students of Goa (in percentage)

4.3.4. Zone- wise Performance in Biology among Class XII students of Goa:

It is reflected from the graph that the percentage of learning outcome no. 30-40 and 50-60 were achieved by majority of the students whereas percentage of learning outcome no. 80-90 and 90-100 were achieved by least number of students.

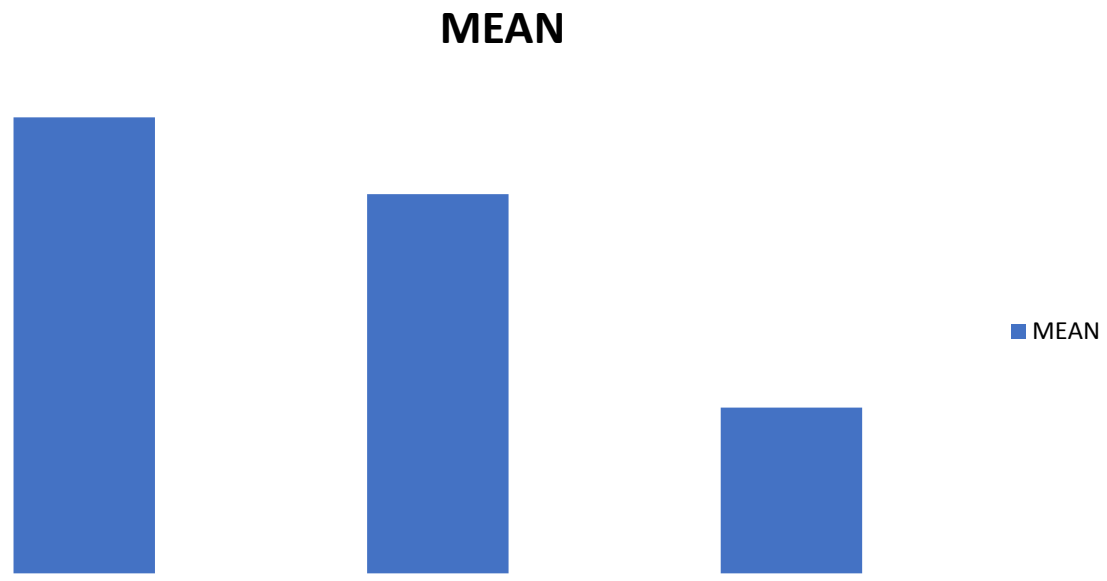


Figure 4.3.4 Zone- wise Performance in Biology among Class XII students of Goa

Graph reflects that students from North Zone have performed better than the other two zones named Central zone and South Zone. 30 – 40 percentage Learning outcomes have been achieved by majority of the students. Out of 100% learning outcomes, none of the students could achieve 100%, whereas very less number of students could achieve 80 – 90 %.

4.3.5. Mean scores in Biology among Class XII students of Goa:

It is reflected from the graph that the mean score of attainment of learning outcomes in biology of Central Zone was maximum as compared to North zone. Mean score of attainment of learning outcomes in biology of South zone is found to be least amongsts all three educational zones of Goa state.

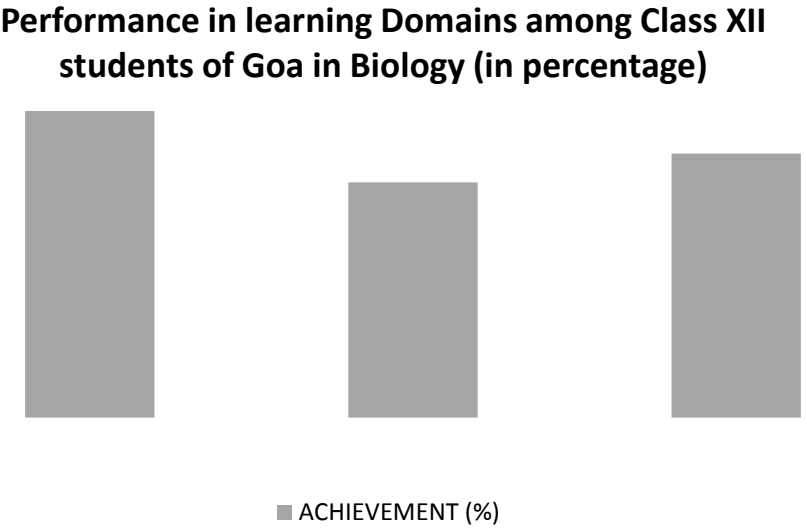


Figure 4.3.5 Mean scores in Biology among Class XII students of Goa

When domain wise performance of students in Biology in Goa is compared it is found that performance of students in knowledge domain is best as compared to application and comprehension domain. Graph reflects that the performance in comprehension domain is attained least.

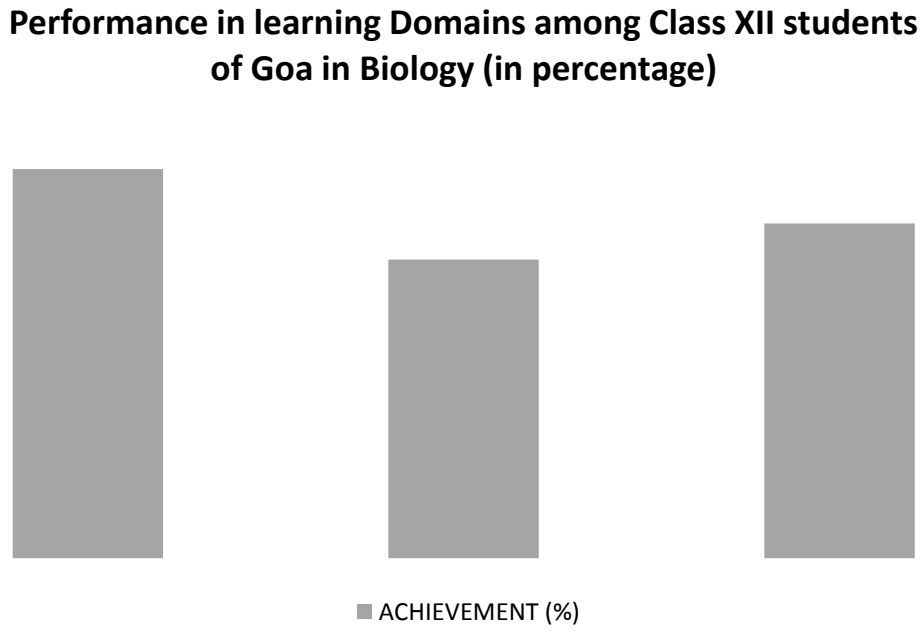


Figure 4.3.6 Domain wise performance of students in Biology

Graph 4.3.7 Domain wise performance of students in Biology in different educational zones of Goa

Graph 4.7 reflects domain wise performance of students in Biology in different educational zones of Goa. This is event from the graph that all the knowledge domain has been attained by majority of the students in all the zones, whereas comprehension and application have been attained by least number of students.

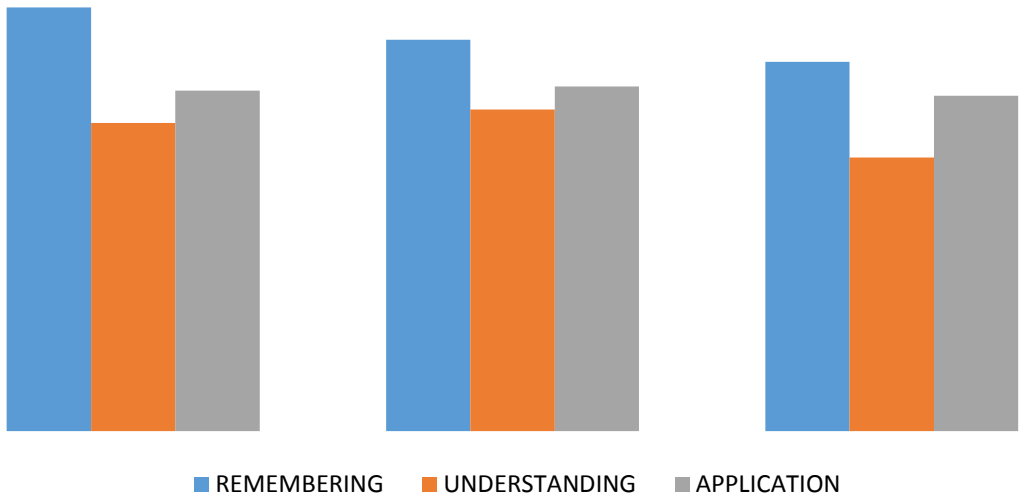


Figure 4.3.7 Zone wise performance of students in Biology

4.4. Analysis of Responses under Focus Group Discussion

After taking written responses in the form of prepared items based on Learning Outcomes students, teachers as well as Principal and Vice-Principals, depending on their availability, are requested to participate in a focus group discussion. Matter related mainly on the pedagogy were discussed and it was tried to know whether process of acquiring knowledge is given priority or not. If yes, then at what extent. All responses from various schools under investigation are summarized below:

1. The teachers as well as students were not aware of constructivist theory or any recent theory of learning.
2. Around 90% of the teachers were not aware of NCF-2005.
3. About 95% of the teachers were not knowing about learning outcomes.
4. Students intimated regarding no concern on learning outcomes by their teachers.
5. Though students are conducting practicals but they conduct only routine experiment as a requirement of syllabus. They do not try to think about any new experiment connected with scientific theory.
6. The students reported to use ICT and in one school in North Zone students also reported to use Visual Laboratory.
7. The government and government aided schools of North and Central Zone seen to be properly equipped but the government school of South Zone is seen to be less equipped.

Chapter – 5
Conclusion

The major focus of this research activity entitled ***"Analysis of Learning Achievements of the Students in Terms of Learning Outcomes in Chemistry, Physics and Biology at Higher Secondary School Level"*** was on process of learning. At present majority of institutions either government, semi government or private, are product oriented and the entire system is oriented to achieve better results in Class/Board examinations as well as competitive examinations. There is least attention on the process of acquiring knowledge. However, recently policy makers have diverted their attention on the process of learning and in the same endeavor learning outcomes have been developed for primary and upper primary classes. The learning outcomes developed by NCERT has been made public for the benefits of students, teachers, parents and educational functionaries. The extent of attainment of these learning outcomes has also been studied by NCERT through National Achievement Survey (NAS) throughout country. The items prepared in the NAS were on the line of learning outcomes prepared for primary and upper primary classes.

This particular research project is an attempt to develop learning outcomes for higher secondary classes in the subjects Chemistry, Physics and Biology and to study the extent of attainment of these learning outcomes by the higher secondary science students of Goa state. Similar to NAS, items were developed based on learning outcomes and were administered on the students of Goa state. After complete analysis of data following conclusions have been made.

5.1. Attainment of Learning Outcomes in Chemistry.

1. The performance of Central zone students have been found better compared to South and North zone.
2. The average attainment of learning outcomes by South zone students have been found to be 28.45%, which is lowest whereas this percentage has been found to be 30.47% for North zone, which is slightly lower than Central zone (30.71%). The attainment of learning outcomes in Chemistry by Central and North zone students has been found upto satisfactory level only.
3. Out of 24 learning outcomes identified, the learning outcomes 2, 4, 24 and 47 are found to be most difficult and learning outcome 11 is found to be easy for the students.
4. Analysis of the attainment of 24 learning outcomes was done. It is found that the learning outcome no. 13 (redox reaction, item no. 25 & 26), 21 (Environmental Issues, item no. 43 & 44) and 16 (S & P Block Elements, item no. 31-34) have been attained by majority of students whereas attainment of learning outcome no. 1 (Mole Concept, item no. 1 & 2), 12 (Solubility Product Ksp, item no. 23 & 24) and 18 (Electronic Displacement, item no. 37 & 38) were found to be most difficult for the students.
5. After making domain-wise analysis it is concluded that students have been able to attain 43.25% knowledge type and 35.07% understanding type and 30.8% application type learning outcomes out of total attained learning outcomes.
6. From analysis it is concluded that with respect to attainment of Learning Outcome in Chemistry, the South zone has not even attain the learning outcomes upto satisfactory level. Perhaps the routine classroom transactions in this region have not given much emphasis on adequate and appropriate pedagogical processes, rather product based transactional strategies are given priority. Though the performance of North and Central zone are satisfactory but these zones are also having ample scope to improve to acquire National and Global standard.

5.2. Attainment of Learning Outcomes in Physics:

1. The achievement of students in physics is not that much satisfactory in the state of Goa.
2. The highest score obtained in physics is 76% from Central zone and lowest score is 18% also from Central zone.
3. Maximum students achieve the score in the range 30-40%.
4. The performance of students in physics in all three zones is more or less same and lies in the range of 37-40%.
5. Maximum learning outcomes attained by the students lies in the range of 20-40%.

5.3. Attainment of Learning Outcomes in Biology:

1. After analysis of result it is concluded that learning outcome No. 28 and 1 have been achieved by majority of students whereas No. 7 and 32 have been attained by least number of students.
2. Maximum number of students have shown 30-40% and 50-60% attainment of learning outcomes.
3. The students of North zone have performed better in attainment of learning outcomes compared to Central or South zones. But, none of the students achieved 100% learning outcomes.
4. Mean score achieved by Central zone students has been found to be maximum (nearly 50) whereas mean score of South zone is seen to minimum (nearly 45).
5. The achievement in knowledge domain is found to be maximum compared to application and comprehension domain. The same trend has been reflected when the result is analyzed for individual zones.

Overall Reflections:

The students of Goa are seen to be adopting better learning process in Biology. They stand up to satisfactory level in Physics but in Chemistry educational functionaries has to draw higher attention. Since the traditional approach of teaching and evaluation is product oriented the students are also trained to respond on the same line. If they will be trained to achieve learning outcomes certainly there is ample possibility for the state to come up to National and Global standard.