Faculty of Sciences

Syllabus

For

Bachelor of Science

Physics, Chemistry, Mathematics

(Program Code: SC0142)

(2020-21)

****Approved by the Academic Council vide resolution no ……***

INDEX

1. INTRODUCTION

The quality of higher education in B.Sc. (PCM) should be improved in such a manner that young minds are able to compete in this field globally in terms of their knowledge and skills, for this purpose Learning Outcome-based Curriculum Framework (LOCF) is developed.

Incorporation of Learning Outcome-based Curriculum Framework (LOCF)in the undergraduate B.Sc. (PCM) programme makes it student-centric, interactive and outcome-oriented to achievewell-defined aims, objectives and goals. The learning outcomes are attained by students through skills acquired during aprogramme of study.Programme learning outcomes will include subject-specific skills and generic skills,including transferable global skills and competencies. It would also focus on knowledge and skills that prepare students for further study, employment and society development. LOCF help ensure comparability of learning levels and academic standards across colleges/universities.

At present, the goal of higher education in B.Sc. (PCM) may be achieved using the following measures:

i. Curriculum reform based on learning outcome-based curriculum framework(LOCF).
ii. Improving learning environment and academic resources.
iii. Elevating the quality of teaching and research.
iv. Involving students in discussions, problem-solving and out of box thinking aboutvarious ideas and their applicability, which may lead to empowerment and enhancement of the social welfare.
v. Motivating the learners to understand various concepts of their educational programme keeping in view the regional context.
vi. Enabling learners to create research atmospherein their colleges/institutes/universities.
vii. Teach courses based on Choice Based Credit System (CBCS).

2. LEARNING OUTCOME-BASED APPROACH TO CURRICULUM PLANNING

The Bachelor's Degree in physical sciences (B.Sc. PCM) is awarded to the students on the basis of knowledge, understanding, skills, values and academic achievements. Hence, the learning outcomes of this programme are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for knowledge.

The LOCF have designed courses of B.Sc. in the light of graduate attributes, description of qualifications, courses and programme learning outcomes. It may lead to all round development and delivery of complete curriculum planning. Hence, it provides specific guidelines to the learners to acquire sufficient knowledge during this programme.

The programme has been planned in such manner that there is scope of flexibility and innovation in

i. Modifications of prescribed syllabi.
ii. Teaching-learning methodology.
iii. Assessment technique of students and knowledge levels.
iv. Learning outcomes of courses.
v. Addition of new elective courses subject to availability of experts incolleges/institutes/universities across the country.

2.1. Nature and Extent of Bachelor's Degree Programme

As a part of effort to enhance employability of B.Sc. (PCM) graduates expected learning outcomes are very essential in present day perspective. Therefore, higher education degrees must formulate Graduate Attributes (GAs), qualification descriptors, learning outcomes and course learning outcomes which will help in curriculum planning and development in the form of design and delivery of courses. The overall formulation of the degree programme must equip learner to have competencies to provide deliverables to the industry.

2.2. Aims of Bachelor's Degree programme in Physical Science (B.Sc. PCM)

The overall aims of B.Sc. Physical Science are to

i. Create deep interest in Physical Science learning.
ii. Develop broad and balanced knowledge and understanding of definitions, concepts and principles.
iii. Familiarize the students with suitable tools related to B.Sc. programme.
iv. Enhance the ability of learners to apply the knowledge and skills acquired by them during the B.Sc. programme to solve specific problems of their courses.
v. Provide learners sufficient knowledge and skills enabling them to undertake further studies in Physical Science and its allied areas.
vi. Encourage the students to develop a range of generic skills helpful in employment, internships and social activities.

2.3. Motive behind curriculum planning and development

The committee considered and discussed the following factors for LOCF for the graduates:

i. Framing of syllabi
ii. Learners attributes
iii. Qualification descriptors
iv. Programme learning outcomes
v. Course learning outcomes
vi. Necessity of having elective courses
vii. Academic standards

3. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: The graduate will have successful carrier in various service domains like banking consultancy, teaching, government jobs, defense, industry and entrepreneurship pursuit.

PEO2: The graduate will have specialized knowledge and expertise to identify, formulate, investigate, analyze and implement on the problems in physical sciences.

PEO3: The graduate will have continuous learning attitude to adopt new skills and techniques to overcome the challenges related with new technologies.

4. GRADUATE ATTRIBUTES (GAs)

The graduate attributes ofB.Sc. Physical Science are the summation of the expected course learning outcomes mentioned at the end of each course. Some of them are stated below.

GA1: Discipline-specific Knowledge: Capability of demonstrating comprehensive knowledge of B.Sc. programme and understanding of one or more disciplines which form a part of an undergraduate programme of study.

GA2: Critical Thinking,AnalyticalReasoning and Problem Solving:

(i) Ability to employ critical thinking in understanding the concepts in every area of B.Sc. programme.

(ii) Ability to analyze the results and apply them in various problems appearing in different courses.

(iii) Capability to solve problems by using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in every area of B.Sc. programme.

GA3: Research-related skills:

Develop a sense of inquiry and capability for asking relevant and intelligent questions, problematizing, synthesizing and articulating; ability to recognize and establish cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

GA4: Communications skills:

i. Ability to communicate various concepts of B.Sc. programme effectively using examples and their geometrical visualizations.

ii. Ability to use courses as a precise language of communication in other branches of human knowledge.

iii. Ability to communicate long standing unsolved problems in Physics, Chemistry, Mathematics.

iv. Ability to show the importance of their courses of B.Sc. as precursor to various scientificdevelopments since the beginning of the civilization.

GA5. Multicultural Competence:

Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

GA6. Leadership Readiness/Qualities:

Capability for mapping out the tasks in a team or an organization, self-motivating and inspiring team members to engage with the team objectives/vision; and using management skills to follow the mapped path to the destination in a smooth and efficient way.

GA7: Lifelong learning:

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

GA8: Moral and ethical awareness/reasoning:

Ability to identify unethical behaviour such as fabrication, falsification ormisrepresentation of data and adopting objective, unbiased and truthful actions in all aspects of their programme.

GA9: Employability Options:

This programme will also help students to enhance their employability for jobs in different sectors.

5. QUALIFICATION DESCRIPTORS (QDs)

The qualification descriptor suggests the generic outcomes and attributes to be obtained while obtaining the degree of B.Sc. in Physical Science. The qualification descriptors indicate the academic standards on the basis of following factors:

i. Level of knowledge
ii. Understanding
iii. Skills
iv. Competencies and attitudes
v. Values.

These parameters are expected to be attained and demonstrated by the learners after becoming graduates in this programme. The learning experiences and assessment procedures should be so designed that every graduate may achieve the programme learning outcomes with equal opportunity irrespective of the class, gender,community and regions. Each graduate in Physical Science should be able to:

i. Demonstrate fundamental systematic knowledge and its applications. It should also enhancethe subject specific knowledge and help in creating jobs in various sectors.
ii. Demonstrate educational skills in areas of their programme.
iii. Apply knowledge, understanding and skills to identify the difficult/unsolved problemsin courses of theirprogramme and to collect the required information in possible range of sourcesand try to analyse and evaluate these problems using appropriate methodologies.
iv. Apply one's disciplinary knowledge and skills in newer domains and uncharted areas.
v. Identify challenging problems and obtain well-defined solutions.
vi. Exhibit subject-specific transferable knowledge relevant to job trends and employment opportunities.

6. PROGRAMME LEARNING OUTCOMES (POs)

Students graduating with the B.Sc. Physical Science degree should be able toacquire

PO1: Capability of demonstrating comprehensive knowledge of B.Sc. programme.

PO2: Ability to employ critical thinking in understanding the concepts and Ability to analyze the results and apply them in various problems and Capability to solve problems by using research-based knowledge and research methods in every area of B.Sc. PCM programme.

PO3: Develop a sense of research to predict cause-and-effect relationships.

PO4: Ability to communicate various concepts of B.Sc. programme effectively using examples and their geometrical visualizations.

PO5: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PO6: Self-motivating and inspiring team members to engage with the team objectives by using management skills.

PO7: Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

PO8: Ability to identify unethical behavior and adopting objective, unbiased and truthful actions in all aspects of their programme.

PO9: This programme will also help students to enhance their employability for jobs in different sectors.

Mapping of Graduate Attributes (GAs) and Programme Learning Outcomes (POs):

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9
PO1	■								
PO2		■							
PO3			■						
PO4				■					
PO5					■				
PO6						■			
PO7							■		
PO8								■	
PO9									■

7. PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Demonstrate the ability to use skills in science and its related areas of technology forformulating and tackling scientific problems and identifying and applying appropriatephysical principles and methodologies to solve a wide range of problems.

PSO2: Apply the knowledge gained during the course of the program to identify, formulate and solve real life problems to meet the core competency with continuous up gradation.

PSO3: Graduates will acquire a comprehensive knowledge and sound understanding of Fundamentals of basic sciences.

8. TYPE OF COURSES

1. Courses in a programme may be of four kinds: Core, Elective, Ability Enhancement and Skill Enhancement.

a) Core Course:-

There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a requirement to complete the programme in a said discipline of study.

b) Elective Course:-

Elective course is a course which can be chosen from a pool of papers. It may be

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An Elective Course may be 'Discipline Centric/Specific' &Generic Elective

(i) Discipline Centric/Specific Elective(DSE): Elective courses offered under the main discipline/subject of study is referred to as Discipline Centric/Specific.

(ii) Generic/Open Elective(GE): An elective course chosen from an unrelated discipline/subject is called Generic/Open Elective. These electives will be focusing on those courses which add generic proficiency of students.

c) Ability Enhancement/ Liberal Courses (AEC):-

AECC courses are based upon the content that leads to knowledge enhancement, for example: English Communication, Environment Science/ Studies, etc.

d) Skill Enhancement Courses (SEC):-

SEC Courses provide value based and/or skill based knowledge and may content both Theory and Lab/Training/Field Work. The main purpose of these courses is to provide students life- skills in hands- on mode so as to increase their employability.

e) AnandamCourses:-

University has taken initiative for "Fostering Social Responsibility & Community Engagement. Anandam Courses provided a holistic and functional approach to community engagement, encompassing all the three functions of HEIs—teaching, research and service.

f) MOOC's Courses:-

Moocs (Massive open online courses) provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale.

2. List of Courses (B.Sc. -PCM)

Ability Enhancement/ Liberal Course (AEC):

- Communication Skills
- Universal Human Values
- Environmental Science
- Computer Fundamentals
- Professional Skills
- Leadership & Management Skills

Core Course (CC):

Core Courses of PHYSICS:

- Mechanics
- Electricity, Magnetism and EMT
- Thermodynamics)

- Optics
- Electronics and Solid State Devices
- Solid State Physics

Core Courses of CHEMISTRY:

- Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons
- Chemical energetic, Equilibria & Functional Group Organic Chemistry-I
- Thermodynamics & Electrochemistry
- Metal Complexes
- Quantum Chemistry, Phase Equilibrium, Photochemistry & Solutions
- Spectroscopy, Heterocyclic Compounds & Carbohydrates

Core Courses of MATHEMATICS:

- Differential Calculus
- Differential Equations
- Real Analysis
- Algebra
- Discrete Mathematics
- Numerical Analysis and Linear Programming

Discipline Specific Elective (DSE):

PHYSICS

Discipline Specific Elective-4A (Choose any one)

- Mathematical Physics and Special Theory of Relativity
- Analog Systems and Applications

Discipline Specific Elective-5A (Choose any one)

- Quantum Mechanics
- Digital Systems and Applications

Discipline Specific Elective- 6A (Choose any one)

- Nuclear and Particle Physics
- Communication System

CHEMISTRY

Discipline Specific Elective-4B (Choose any one)

- Functional Groups Chemistry-II
- Chemical Technology & Society

Discipline Specific Elective-5B (Choose any one)

- Inner Transition Elements, HSAB, Redox & Bio-Inorganic Chemistry
- Green Chemistry

Discipline Specific Elective- 6B (Choose any one)

- Spectroscopy, Chemical & Ionic Equilibrium
- Chemistry of Cosmetics & Perfumes

MATHEMATICS

Discipline Specific Elective-4C (Choose any one)

- Analytical Geometry
- Matrices

Discipline Specific Elective-5C (Choose any one)

- Complex Analysis
- Linear Programming

Discipline Specific Elective- 6C(Choose any one)

- Advanced Mechanics
- Theory of Equations and Number Theory

Skill Enhancement Course (SEC)

PHYSICS

- Crystallography and Statistical Physics

CHEMISTRY

- Functional Groups Chemistry-I

MATHEMATICS

- Integral and Vector Calculus

Coursebased on Social-Industry connect (AC):

- Anandam -I
- Anandam –II
- Anandam –III
- Anandam –IV
- Anandam –V
- Anandam –VI

MOOC's Courses (MC):

- MOOC

Computation of Workload:

Lecture (L) : 1 Credit = 1 Theory period of one hour duration
Tutorial (T) : 1 Credit = 1 Tutorial period of one hour duration
Practical (P) : 1 Credit = 1 Practical period of two hour duration

9. PROGRAMME STRUCTURE (B.Sc. (PCM))

Semester – I

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
Ability Enhancement/ Liberal Course									
BSC101	Communication Skills	AEC	2	-	-	30	70	100	2
	Core Course								
BSC102	Mechanics	CC	4	-	-	30	70	100	4
BSC103	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons	CC	4	-	-	30	70	100	4
BSC104	Differential Calculus	CC	5	1	-	30	70	100	6
PRACTICALS/VIVA-VOCE			**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
BSC105	Mechanics Lab	CC	-	-	4	30	20	50	2
BSC106	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons Lab	CC	-	-	4	30	20	50	2
Courses based on Social Industry connect		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
BSC107	Anandam -I	AC	**1**		**2**	**50**	**50**	**100**	**2**
BSC108	Universal Human Values	AEC	**2**			**30**	**70**	**100**	**2**
TOTAL			**18**	**1**	**10**	**260**	**440**	**700**	**24**

Semester - II

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
Ability Enhancement/ Liberal Course									
BSC201	Environmental Science	AEC	4	-	-	30	70	100	4
BSC202	Electricity, Magnetism and EMT	CC	4	-	-	30	70	100	4
BSC203	Chemical energetic, Equilibria & Functional Group Organic Chemistry-I	CC	4	-	-	30	70	100	4
BSC204	Differential Equations	CC	5	1	-	30	70	100	6
PRACTICALS/VIVA-VOCE		**Type**	**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
BSC205	Electricity, Magnetism and EMT Lab	CC	-	-	4	30	20	50	2
BSC206	Chemical energetic , Equilibria & Functional Group Organic Chemistry-I Lab	CC	-	-	4	30	20	50	2
Courses based on Social Industry connect and MOOC		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
BSC207	Anandam -II	AC	**1**		**2**	**50**	**50**	**100**	**2**
TOTAL			**18**	**1**	**10**	**230**	**370**	**600**	**24**

Semester - III

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC 301	Computer Fundamentals	AEC	2	-	-	30	70	100	2
	Core Course								
BSC 302	Thermodynamics	CC	4	-	-	30	70	100	4
BSC 303	Thermodynamics & Electrochemistry	CC	4	-	-	30	70	100	4
BSC 304	Real Analysis	CC	4	-	-	30	70	100	4
	Skill Enhancement Course								
BSC 305	Crystallography and Statistical Physics	SEC	2	-	-	30	70	100	2
BSC 306	Functional Groups Chemistry-I	SEC	2	-	-	30	70	100	2
BSC 307	Integral and Vector Calculus	SEC	2	-	-	30	70	100	2
PRACTICALS/VIVA-VOCE		**Type**	**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
BSC 308	Physics Lab-III	CC	-	-	4	60	40	100	2
BSC 309	Chemistry Lab-III	CC	-	-	4	60	40	100	2
BSC 310	Mathematics Lab-III	CC	-	-	4	60	40	100	2
Course based on Social-Industry connect									
BSC 311	Anandam -III	AC	-	-	4	50	50	100	2
TOTAL			**20**	**-**	**16**	**440**	**660**	**1100**	**28**

Semester - IV

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC 401	Professional Skills	AEC	2	-	-	30	70	100	2
	Core Course								
BSC 402	Optics	CC	4	-	-	30	70	100	4
BSC 403	Metal Complexes	CC	4	-	-	30	70	100	4
BSC 404	Algebra	CC	4	-	-	30	70	100	4
BSC 405	**Discipline Specific Elective-4A (Choose any one)**								
BSC 405A	Mathematical Physics and Special Theory of Relativity	DSE	3	-	-	30	70	100	3
BSC 405B	Analog Systems and Applications	DSE	3	-	-	30	70	100	3
BSC 406	**Discipline Specific Elective-4B (Choose any one)**								
BSC 406A	Functional Groups Chemistry-II	DSE	3	-	-	30	70	100	3
BSC 406B	Chemical Technology & Society	DSE	3	-	-	30	70	100	3
BSC 407	**Discipline Specific Elective-4C (Choose any one)**								
BSC 407A	Analytical Geometry	DSE	3	-	-	30	70	100	3
BSC 407B	Matrices	DSE	3	-	-	30	70	100	3
PRACTICALS/VIVA-VOCE		**Type**	**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
	Core Course								
BSC 408	Physics Lab-IV	CC	-	-	4	60	40	100	2
BSC 409	Chemistry Lab-IV	CC	-	-	4	60	40	100	2
BSC 410	Mathematics Lab-IV	CC	-	-	4	60	40	100	2
Course based on Social-Industry connect									
BSC 411	Anandam -IV	AC	-	-	4	50	50	100	2
TOTAL			**23**	**-**	**16**	**440**	**660**	**1100**	**31**

Semester - V

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC 501	Leadership & Management Skills	AEC	2	-	-	30	70	100	2
	Core Course								
BSC 502	Electronics and Solid State Devices	CC	4	-	-	30	70	100	4
BSC 503	Quantum Chemistry, Phase Equilibrium, Photochemistry & Solutions	CC	4	-	-	30	70	100	4
BSC 504	Discrete Mathematics	CC	4	-	-	30	70	100	4
BSC 505	**Discipline Specific Elective-5A (Choose any one)**								
BSC 505A	Quantum Mechanics	DSE	3	-	-	30	70	100	3
BSC 505B	Digital Systems and Applications	DSE	3	-	-	30	70	100	3
BSC 506	**Discipline Specific Elective-5B (Choose any one)**								
BSC 506A	Inner Transition Elements, HSAB, Redox & Bio-Inorganic Chemistry	DSE	3	-	-	30	70	100	3
BSC 506B	Green Chemistry	DSE	3	-	-	30	70	100	3
BSC 507	**Discipline Specific Elective-5C (Choose any one)**								
BSC 507A	Complex Analysis	DSE	3	-	-	30	70	100	3
BSC 507B	Linear Programming	DSE	3	-	-	30	70	100	3
PRACTICALS/VIVA-VOCE			**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
	Core Course								
BSC 508	Physics Lab-V	CC	-	-	4	60	40	100	2
BSC 509	Chemistry Lab-V	CC	-	-	4	60	40	100	2
BSC 510	Mathematics Lab-V	CC	-	-	4	60	40	100	2
Courses based on Life Skill and Social-Industry connect									
BSC 511	Anandam -V	AC	-	-	4	50	50	100	2
TOTAL			**23**	**-**	**16**	**440**	**660**	**1100**	**31**

Semester - VI

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Core Course								
BSC 601	Solid State Physics	CC	4	-	-	30	70	100	4
BSC 602	Spectroscopy, Heterocyclic Compounds & Carbohydrates	CC	4	-	-	30	70	100	4
BSC 603	Numerical Analysis and linear Programming	CC	4	-	-	30	70	100	4
BSC 604	**Discipline Specific Elective- 6A (Choose any one)**								
BSC 604A	Nuclear and Particle Physics	DSE	3	-	-	30	70	100	3
BSC 604B	Communication System	DSE	3	-	-	30	70	100	3
BSC 605	**Discipline Specific Elective- 6B (Choose any one)**								
BSC 605A	Spectroscopy, Chemical & Ionic Equilibrium	DSE	3	-	-	30	70	100	3
BSC 605B	Chemistry of Cosmetics & Perfumes	DSE	3	-	-	30	70	100	3
BSC 606	**Discipline Specific Elective- 6C (Choose any one)**								
BSC 606A	Advanced Mechanics	DSE	3	-	-	30	70	100	3
BSC 606B	Theory of Equations and Number Theory	DSE	3	-	-	30	70	100	3
PRACTICALS/VIVA-VOCE			**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
	Core Course								
BSC 607	Physics Lab-VI	CC	-	-	4	60	40	100	2
BSC 608	Chemistry Lab-VI	CC	-	-	4	60	40	100	2
BSC 609	Mathematics Lab-VI	CC	-	-	4	60	40	100	2
Course based on Social-Industry connect									
BSC 610	Anandam -VI	AC	-	-	4	50	50	100	2
TOTAL			**21**	**-**	**16**	**410**	**590**	**1000**	**29**

Note:

- A student is required to obtain min. 40% marks in individual paper to pass.
- The total credit of B.Sc. (PCM) Programme is 167. However, the minimum credit required for award of degree shall be 161.
- The credit relaxation will be applicable only on the elective course (i.e. the student can opt out only elective subject).
- Out of the total credits, 20% of the credits may be earned by the student through MOOCs (SWAYAM, NPTEL, Coursera etc.). However, the choice of online courses to be approved in advance by Dean/ HoD and Coordinator SWAYAM keeping in view the latest guidelines of the UGC/ respective regulatory body guidelines.

10. COURSE-WISE LEARNING OBJECTIVES, STRUCTURES AND OUTCOMES (CLOSOs)

Course learning outcomes of each course in B.Sc. Physical Science as a subject have been enshrined in the end of course contents of each course with their objectives those are in the beginning of the every course.

Semester - I

THEORY PAPERS		**Type**	**No. of Teaching Hours**			**Marks Allocation**			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC101	Communication Skills	AEC	2	-	-	30	70	100	2
	Core Course								
BSC102	Mechanics	CC	4	-	-	30	70	100	4
BSC103	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons	CC	4	-	-	30	70	100	4
BSC104	Differential Calculus	CC	5	1	-	30	70	100	6
PRACTICALS/VIVA-VOCE			**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
BSC105	Mechanics Lab	CC	-	-	4	30	20	50	2
BSC106	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons Lab	CC	-	-	4	30	20	50	2
Courses based on Social Industry connect		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
BSC107	Anandam -I	AC	**1**		**2**	**50**	**50**	**100**	**2**
BSC108	Universal Human Values	AEC	**2**			**30**	**70**	**100**	**2**
TOTAL			**18**	**1**	**10**	**260**	**440**	**700**	**24**

BSC 101: COMMUNICATION SKILLS

Course Objectives:

- To identify common communication problems that may be holding learners back.
- To identify what their non-verbal messages are communicating to others.
- To understand role of communication in teaching-learning process.
- To learn to communicate through the digital media.
- To understand the importance of empathetic listening and explore communication beyond language.

Course Contents:

Unit I: **Listening and Speaking:** Listening: Techniques of effective listening, Listening and comprehension, Probing questions, Barriers to listening, Speaking: Pronunciation, Enunciation, Vocabulary, Fluency, Common Errors.

Unit II: **Reading:** Techniques of effective reading, Gathering ideas and information from a given text:Identify the main claim of the text, Identify the purpose of the text, Identify the context of the text, Identify the concepts mentioned, Evaluating these ideas and information:Identify the arguments employed in the text, Identify the theories employed or assumed in the text, Interpret the text: To understand what a text says, To understand what a text does, To understand what a text means.

Unit III: **Writing and different modes of writing:**Clearly state the claims, Avoid ambiguity, vagueness, unwanted generalisations and oversimplification of issues, Provide background information, Effectively argue the claim, Provide evidence for the claims, Use examples to explain concepts, Follow convention, Be properly sequenced, Use proper signposting techniques, Be well structured: Well-knit logical sequence, Narrative sequence, Category groupings, Different modes of Writing: E-mails, Proposal writing for Higher Studies, Recording the proceedings of meeting, Any other mode of writing relevant for learners.

Unit IV: **Digital Literacy:**Role of Digital literacy in professional life, Trends and opportunities in using digital technology in workplace, Internet Basics, Introduction to MS Office tools: Paint, Office, Excel, Powerpoint, Effective use of Social Media: Introduction to social media websites, Advantages of social media, Ethics and etiquettes of social media, How to use Google search better, Effective ways of using Social Media, Introduction to Digital Marketing.

Unit V: **Non-verbal communication:** Meaning of non-verbal communication, Introduction to modes of non-verbal communication, Breaking the misbeliefs, Open and Closed Body language, Eye Contact and Facial Expression, Hand Gestures, Do's and Don'ts, Learning from experts, Activities-Based Learning

Reference Books:

- Sen Madhucchanda (2010), An Introduction to Critical Thinking, Pearson, Delhi
- Silvia P. J. (2007), How to Read a Lot, American Psychological Association, Washington DC

Course Outcomes:

At the end of the course, a student will be able to understand-

CO1. Understanding 'Listening' in a prolific manner. Improve listening, observational skills and problems solving capabilities. Grasp the importance and meaning marvelously.

CO2. Improve the fluency in spoken English. Enhance communication skills through grammar vocabulary with emphasis on skills.

CO3. Develop communication skill through various language learning activities.

CO4. Learn an ability to put ideas in a proper sequence. Build the language proficiency of the students in English with emphasis on English.

CO5. Show an understanding of opportunities in the field of communication, Use current technology related to the communication field.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

Course Outcomes	Blooms Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
CO1	L1	H	M	M	-	H	-	H	H	-	L	M	L
CO2	L6	H	H	M	-	M	-	M	H	-	M	M	M
CO3	L6	H	M	_	L	-	-	M	H	-	L	L	M
CO4	L1	H	H	_	L	M	-	M	H	-	M	L	M
CO5	L6	H	M	_	-	M	-	L	H	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5,CO6, CO7
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO7
CD3	Seminars	CO2,CO3,CO5,CO6
CD4	Self- learning advice using internets	CO1,CO2,CO3,CO4,CO5, CO6, CO7

BSC 102: MECHANICS

Course Objectives:

- To learn basics of the frame of reference and their transformations.
- To learn the concepts of Pseudo forces.
- To acquire basic knowledge of Centre of Mass Frame.
- To apply the concepts learnt to several real world problems.
- To develop skills to understand and solve the equation of central force problem.

Course Contents:

Unit I: **Physical Law and Frame of Reference:** Frame of Reference: Inertial and non-inertial frames, Transformation of displacement, velocity, acceleration between different frames of reference involving translation, Galilean transformation and invariance of Newton's laws.**CoriolisForce:** Transformation of displacement, velocity and acceleration between rotating frame, Pseudo forces, Coriolis force, Motion relative to earth, Foucault's pendulum.

Unit II: **Conservative Force and Centre of Mass:** Introduction about conservative and non-conservative forces, Rectilinear motion under conservative forces, Discussion of potential energy curve and motion of a particle.**Centre of Mass:** Introduction about Centre of Mass. Centre of Mass Frame, Collision of two particles in one and two dimensions (elastic and inelastic), Slowing down of neutrons in a moderator, Motion of a system with varying mass, Angular momentum concept. Conservation and charge particle scattering by a nucleus.

Unit III: **Rigid body and Motion under central Forces:** Equation of a motion of a rotating body, Inertial coefficient, case of $\vec{J}$ not parallel to $\vec{\omega}$, Kinetic energy of rotation and idea of principal axes, processional motion of spinning top.**Motion under central Forces**: Introduction about central Forces, Motion under central force, gravitational interaction, Inertia and gravitational mass, general solution under gravitational interaction, Keplers Laws, Discussion of trajectories, Cases of elliptical and circular orbits, Rutherford scattering.

Unit IV: **Damped Harmonic Oscillations:** Introduction about oscillations in a potential well, Damped force and motion under damping, Damped Simple HarmonicOscillations, Power dissipation, Anharmonic Oscillator and simple pendulum as an example.

Unit V: **Driven Harmonic and Coupled Oscillations:** Driven Harmonicoscillator with damping. Frequency response, Phase relation Quality factor, Resonance, Series and parallel of LCR circuit, electromechanical system-Ballistic Galvanometer.**Coupled Oscillations:** Equation of motion of two coupled Simple Harmonic Oscillator, Normal modes, motion in mixed modes, Transient behavior, Dynamics of a number of oscillators with neighbor interactions.

Reference Books:

1. Mechanics (SIF), Charles Kittel.
2. Introduction to Classical Mechanics, TMH.
3. The Physics of Waves & Oscillations, N. K. Bajaj, Tata McGraw-Hill.
4. H. Goldstein, Classical Mechanics.
5. L. N. Hand, J. D. Finch, Analytical mechanics (Cambridge, 1998).
6. L. Landau and. Lifshitz, Mechanics.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand Physical laws and frame of references.
CO2:	Analysis Coriolis and Conservative Forces.
CO3:	Understand concept of Centre of Mass.
CO4:	Evaluate rigid body system.
CO5:	Study motion under central forces.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
CO1	L2	H	H	M	H	L	L	L	L	L	L	M	L
CO2	L4	M	L	-	M	L	M	M	M	-	M	M	L
CO3	L2	L	L	L	H	M	M	-	H	M	L	L	M
CO4	L5	M	H	H	H	L	M	M	M	H	M	L	M
CO5	L4	-	L	M	M	L	M	L	L	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO1, CO5

BSC103: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Course Objectives:

- The course aims at making the students understand the atomic structure and behavior, interactions between matter and energy at both the atomic and molecular level.
- The students are taught to chemical bonding and molecular structure.
- To impart the knowledge of Stereochemistry
- To expose students to fundamentals of organic chemistry.
- Students are also expected to learn the physical and chemical properties of Aliphatic Hydrocarbons.

Course Contents:

Unit-I: Section A: Inorganic Chemistry-1

Atomic Structure:

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

Quantum Mechanics:

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit-II: **Chemical Bonding and Molecular Structure:**

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

Unit-III: MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1

Stereochemistry:

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C=C systems).

Unit-IV: Fundamentals of Organic Chemistry:

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Unit-V: Aliphatic Hydrocarbons:

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons).

Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons)

Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction).

Reactions: cisaddition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons)

Preparation: Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4. 17

Reference Books:

1 Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2 Cotton, F.A., Wilkinson, G. &Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3 Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4 Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. *Inorganic Chemistry:Principlesof Structure and Reactivity*, Pearson Education India, 2006.
5 Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. *Organic Chemistry*,John Wiley & Sons (2014).
6 McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7 Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
8 Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
9 Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
10 Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
11 Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

Course Outcome:

At the end of the course, student will be able to:

CO1: Understand atomic structure and behaviour, interactions between matter and energy at both the atomic and molecular level.

CO2: Understand chemical bonding and molecular structure.

CO3: Learn Stereochemistry

CO4: Understand fundamentals of organic chemistry.

CO5: Understand the physical and chemical properties of Aliphatic Hydrocarbons.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	POS1	PSO2	PSO3
CO1	L2	H	M	H	-	L	-	-	M	-	L	L	L
CO2	L2	H	L	H	-	L	-	-	M	-	H	M	M
CO3	L2	H	M	H	-	L	-	-	M	-	M	H	H
CO4	L2	H	M	H	-	-	-	-	M	-	H	H	H
CO5	L2	M	M	M	-	L	-	L	M	-	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC104: DIFFERENTIAL CALCULUS

Course Objectives:

The objective of this course is to expose student to understand the basic concepts of differential calculus like limit, continuity, differentiability of functions, Curvature, Asymptotesandtracing of curves, mean value theorems, partial differentiation of multi variable functions.

Course Contents:

Unit-I: Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability offunctions, Successive differentiation, Leibnitz's theorem.

Unit-II: Tangents and Normals, Curvature, Asymptotes, Singular points.

Unit-III: Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polarcoordinates and tracing of curves in polar coordinates.

Unit-IV: Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's andCauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, ex,log(l+x), (l+x)m.

Unit-V: Partial differentiation, Euler's theorem on homogeneous functions. Maxima and Minima with several variables, Indeterminate forms.

Reference Books:

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

Course Outcomes: This course will enable the students to:

CO1:	To Calculate the limit and examine the continuity and differentiablity of a function at a point
CO2:	To find tangents, normals and asymptotes of a curve and to calculate curvature
CO3:	To trace the curves
CO4	To Understand the consequences of various mean value theorems for differentiableFunctions
CO5	ToApply tests in optimization value of afunction appearing in physicalsciences, life sciences.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	H	H	-	H	-	H	M	H	H	M	M
CO2	L3	H	H	H	-	H	L	H	M	H	H	H	H
CO3	L3	H	H	H	-	H	L	H	M	H	H	H	M
CO4	L3	H	H	H	-	H	L	H	M	H	H	H	M
CO5	L3	H	H	H	-	H	L	H	M	H	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3
CD3	Seminars	CO3
CD4	Self- learning advice using internets	CO3

BSC 105: MECHANICS LAB

Course Objective:

- To review the concepts of mechanics and builds new concepts experimentally.
- To understand use of pendulum.
- To understand the concept of damping.
- To understand concept of moment of inertia.
- To apply the concepts learnt to several real world problems.

List of Experiments:

1. To find the value of 'g' and radius of gyration with the help of compound pendulum.
2. To verify relation $T = 2\pi\sqrt{\frac{l}{g}}$ for a simple pendulum.
3. To study the damping using compound pendulum.
4. To determine natural frequency of a spring mass system.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Moment of Inertia of a Flywheel.
7. To determine Young's Modulus of Elasticity by Searle's method.
8. To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam.
9. To generate the different type of waveforms using fundamental frequency and its harmonics and also analysis these waveforms.
10. To determine the coherence length and coherence time of laser using He – Ne laser.

Reference Books:

- B. L. Flint and H. T. Worsnop, Advanced Practical Physics for students, Asia Publishing House, 1971.
- Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, 4th Edition, Heinemann Educational Publishers, 1985.
- S. Panigrahi& B. Mallick, Engineering Practical Physics, Cengage Learning India Pvt. Ltd., 2015.
- InduPrakash and Rama Krishna, A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi, 2011.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Findcoherence length and coherence time of laser.
CO2:	Find Young's Modulus of Elasticity.
CO3:	Analysis damping using compound pendulum.
CO4:	Evaluate moment of inertia of a Flywheel.
CO5:	Generate the different type of waveforms.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	M	L	M	L	H	M	H	M	H	L	M	L
CO2	L3	H	H	M	H	H	-	M	M	M	M	M	M
CO3	L4	L	L	H	M	H	L	H	L	L	H	L	L
CO4	L5	-	L	H	L	H	H	H	M	-	M	L	M
CO5	L6	H	H	H	L	-	L	H	M	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 106: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONSLAB

Course Objectives:

- To understand the separation techniques.
- To understand the role of melting point and Crystallization
- To qualitative estimation of some chemical species.

Inorganic Chemistry

Separation and identification of six redicals (3 cations and 3 anions) in the given inorganic mixture including special combinations.

Organic Chemistry

Laboratory Techniques

(a) Determination of melting point (naphthalene, benzoic acid, urea, etc.), boiling point (methanol, ethanol, cyclohexane, etc.); mixed melting point (urea-cinnamic acid, etc.).

(b) Crystallization of phthalic acid and benzoic acid from hot water, acetanilide from boiling water, naphthalene from ethanol etc.; Sublimation of naphthalene, camphor, etc.

Qualitative Analysis

Element Detection (N. S and halogens).Functional group determination (unsaturation, phenolic, alcoholic, carboxylic, carbonyl, ester, carbohydrate, amine, amide, nitro) in simple organic solids and liquids.

Reference Books:

1 Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

2 Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

3 Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

4 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Course Outcomes:

At the end of the course, the students will be able to:

CO1:	Understand and analyze the separation techniques.
CO2:	Understand and analyze the melting point and Crystallization process
CO3:	Qualitative estimation of some chemical species

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	H	H	H	L	L	L	M	H	H	L	M	H
CO2	L4	H	H	H	L	L	L	M	H	H	L	M	H
CO3	L4	H	H	H	M	L	-	L	H	H	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	CO1, CO2, CO3
CD3	Experiments, Seminars	CO1, CO2, CO3
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 107: ANANDAM-I

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be excepted to engage in individual and group acts of service and goodness.

Action Plan: Students will be expected to

- Do at least one act of individual service each day
- Record this act of service in a dedicated Register / Personal Diary
- Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
- Undertake one group service project for 64 hours every semester (outside college hours)
- Upload the report on the group project on the Anandam platform
- Participate in a sharing and presentation on the group service in the discussion sessions held once in week
- There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

BSC 108: UNIVERSAL HUMAN VALUES

Course Objective:

- The present course deals with meaning, purpose, and relevance of universal human values.
- To inculcate and practice UHV consciously to be a good human being and realise one's potentials.
- Know about universal human values.
- Understand about love and compassion.
- The students will be able to understand the concepts learnt.

Unit I: **Love & Compassion:**Introduction: What is love? Forms of love—for self, parents, family, friend, spouse, community, nation, humanity and other beings, both for living and non-living, Love and compassion and inter-relatedness, Love, compassion, empathy, sympathy and non-violence, Individuals who are remembered in history for practicing compassion and love., Narratives and anecdotes from history, literature including local folklore, Practicing love and compassion: What will learners learn gain if they practice love and compassion? What will learners lose if they don't practice love and compassion?, Sharing learner's individual and/or group experience(s), Simulated Situations, Case studies.

Unit II: **Truth:**Introduction: What is truth? Universal truth, truth as value, truth as fact (veracity, sincerity, honesty among others), Individuals who are remembered in history for practicing this value, Narratives and anecdotes from history, literature including local folklore, Practicing Truth: What will learners learn/gain if they practice truth? What will learners lose if they don't practice it?, Learners' individual and/or group experience(s), Simulated situations, Case studies

Unit III: **Non-Violence:**Introduction: What is non-violence? Its need. Love, compassion, empathy sympathy for others as pre-requisites for non-violence, Ahimsa as non-violence and non-killing, Individuals and organisations that are known for their commitment to nonviolence, Narratives and anecdotes about non-violence from history, and literature including local folklore, Practicing non-violence: What will learners learn/gain if they practice nonviolence? What will learners lose if they don't practice it?, Sharing learner's individual and/or group experience(s) about non-violence, Simulated situations, Case studies

Unit IV: **Righteousness & Peace:** Righteousness: Introduction: What is righteousness?, Righteousness and dharma, Righteousness and Propriety, Individuals who are remembered in history for practicing righteousness, Narratives and anecdotes from history, literature including local folklore, Practicing righteousness: What will learners learn/gain if they practice righteousness? What will learners lose if they don't practice it?, Sharing learners' individual and/or group experience(s), Simulated situations, Case studies, Peace: Introduction: What is peace? Its need, relation with harmony and balance, Individuals and organisations that are known for their commitment to peace, Narratives and Anecdotes about peace from history, and

literature including local folklore, Practicing peace: What will learners learn/gain if they practice peace? What will learners lose if they don't practice it?, Sharing learner's individual and/or group experience(s) about peace, Simulated situations, Case studies.

Unit V: **Service &Renunciation:**Service: Introduction: What is service? Forms of service, for self, parents, family, friend, spouse, community, nation, humanity and other beings—living and non-living, persons in distress or disaster.Individuals who are remembered in history for practicing this value. Narratives and anecdotes dealing with instances of service from history, literature including local folklore, Practicing service: What will learners learn/gain gain if they practice service? What will learners lose if they don't practice it?, Sharing learners' individual and/or group experience(s) regarding service, Simulated situations, Case studies, Renunciation (Sacrifice): Introduction: What is renunciation? Renunciation and sacrifice. Self-restrain and Ways of overcoming greed. Renunciation with action as true renunciation, Individuals who are remembered in history for practicing this value.Narratives and anecdotes from history and literature, including local folklore about individuals who are remembered for their sacrifice and renunciation. Practicing renunciation and sacrifice: What will learners learn/gain if they practice Renunciation and sacrifice? What will learners lose if they don't practice it?, Sharing learners' individual and/or group experience(s), Simulated situations, Case studies

Bibliography and Suggested Readings:

1. MookerjiRadhaKumud, Ancient Indian Education, MotilalBanarasidass
2. Saraswati SwamiSatyananda, Asana Pranayama Mudra Bandha, Bihar School of yoga
3. Joshi Kireet, Education for Character Development, Dharma Hinduja Center of Indic Studies
4. Joshi Rokeach (1973).The Nature of Human Values. New York: The Free Press
5. Ghosh, Sri Aurobindo. 1998. The Foundations of Indian Culture. Pondicherry: Sri Aurobindo Ashram
6. Basham A.L., The Wonder That was India, London: Picador Press
7. Patra, Avinash (2012), The Sprirtual Life and Culture of India, Oxford University Press
8. ShantikumarGhosh, UniversalValues. The Ramakrishna Mission, Kolkata, 2004.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Know about universal human values a
CO2:	Understand the importance of values in individual, social circles, career path, and national life.
CO3:	Learn from case studies of lives of great and successful people who followed and practised human values and achieved self-actualisation.
CO4:	Become conscious practitioners of human values.
CO5:	Realise their potential as human beings and conduct themselves properly in the ways of the world.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PSO1	PSO2	PSO3
CO1	L4	H	H	M	-	L	H	L	H	L	L	M	L	L	M	M	L
CO2	L2	M	L	H	M	L	M	M	L	M	M	M	H	M	M	M	M
CO3	L3	L	L	H	H	M	-	-	M	H	L	M	L	L	M	L	L
CO4	L3	M	H	H	H	-	M	H	H	M	M	M	H	L	M	L	M
CO5	L4	-	L	M	L	L	M	L	H	L	H	L	L	H	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO3

Semester - II

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
Ability Enhancement/ Liberal Course									
BSC201	Environmental Science	AEC	4	-	-	30	70	100	4
BSC202	Electricity, Magnetism and EMT	CC	4	-	-	30	70	100	4
BSC203	Chemical energetic, Equilibria & Functional Group Organic Chemistry-I	CC	4	-	-	30	70	100	4
BSC204	Differential Equations	CC	5	1	-	30	70	100	6
PRACTICALS/VIVA-VOCE		**Type**	**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
BSC205	Electricity, Magnetism and EMT Lab	CC	-	-	4	30	20	50	2
BSC206	Chemical energetic , Equilibria & Functional Group Organic Chemistry-I Lab	CC	-	-	4	30	20	50	2
Courses based on Social Industry connect and MOOC		**Type**	**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
BSC207	Anandam -II	AC	**1**		**2**	**50**	**50**	**100**	**2**
TOTAL			**18**	**1**	**10**	**230**	**370**	**600**	**24**

BSC 201: ENVIRONMENTAL SCIENCE

Course Objective:

Course Contents:

Unit I: The Multidisciplinary nature of environmental studies.Definition.Scope and importance-Relationship between Environmental Studies and other branches of Science and Social Sciences. Need for Environmental awareness, Environmental education in present day context.

Unit II: Natural resources and associated problems.Classification of resources: renewable resources, non renewable resources, class of earth resources, resources regions: Definition and Criteria, resource conservation.Forest resources: Use of over-exploitation, Deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.Water resources: Use and over- utilization of surface and ground water, floods, drought conflicts over water, dams-benefits and problems.Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems. Water logging, salinity, case studies.Energy resources: Growing energy need, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies.Land resources: Land as a resource, Land degradation man induced Landslides, soil erosion and desertification. Role of an individual in conservation of natural resources., Equitable use of resources for Sustainable lifestyles.

Unit III: Ecosystems, Concepts, Structure, Functions and Types

Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, Food chains, food webs and ecological pyramids, Introduction, types characteristics features, structure and function of the following ecosystem, Forest ecosystem, Tropical Temperate and Alpine Ecosystem, Grass land ecosystem and their types, desert ecosystem with emphasis on thar desert, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) and Wet lands.

Unit IV: Biodiversity and its Conservation

Introduction-Definition, genetic, species and ecosystem diversity, Biogeographically classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values, Biodiversity at global, National and local level, India as mega-diversity nation, Hot-spot of biodiversity, Threats of biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, endangered, Threatened and endemic species of India, Conservation of biodiversity: In-sity and Ex-sity conservation of biodiversity, Red Data Book.

Environmental and Control Measures

Definition , Causes , effects and control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear

Hazards, Solid waste management :Cause, Effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit V : Social issues, Environment, Laws and Sustainability

From Unsustainable to sustainable development, Urban problems related to energy, water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people: its problems and concerns. Case studies, Environmental ethics: Issues and possible solution, Climate change, global warming, acid ozone layer depletion, nuclear accidents and holocaust, case studies, Wasteland reclamation, Consumerism and waste product, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Wild life protection Act, Forest conservation Act, Biological Diversity Act, Issues involved in enforcement of environmental legislation, Public Awareness.

Population growth, variation among nations, Population explosion-family welfare programme, Environmental and Human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of information technology in environmental and human health, Case studies.

Suggested Readings:-

1. Diwan A.P. and Aora D.K. 1995. Human Ecology Anmol Publication Pvt. Ltd. New Delhi.
2. Dubey, R.M. 1992. Human Ecology and Environmental Education, Chaugh Publications, Allahabad.
3. Goudie, Andrew. The Human Impact.
4. Husain Maxia 1994 Human Geography, Rawat Publication, Jaipur
5. Johnston, R.J. Ed. 1986 Dictionary of Human geography, National Publication, New Delhi.
6. Malik, S.L. and Bhattachrya D.K. 1986, Aspects of Human Ecology, Northern Book Center, New Delhi.
7. Mishra, R.P. and Bhooshan, B.S. 1979. Human settlements in Asia, Public, Policies and Programmes Haritage publisher, New Delhi.
8. Nathawat, G.S. 1985. Human Ecology, An Indian Perspective, Indian Human Ecology Council, Jaipur.
9. Russel, Bartrand, 1976, Impact of Science of society Unwin, Publisher, Indian (paper back).
10. Sinha Rajiv, 1996, Gloobal Biodiversity Ina, Shri Publication Jaipur.
11. Sinha Rajiv, K., 1994. Development without Desertction 14. Environmentalist, Jaipur. Sinha Rajiv K., 1996, Environmental Crises and Human at Risk , In A Shri Publication, Jaipur.
12. Smith, Dlanne, 1984. Urban Ecology, George Allen, London.
13. Swarnkar, R.C. 1985. Indian, Tribes. Printwell publisher, Jaipur.
14. Tivy, Joy and O'Hugegreg, 1985. Human Impact on the Ecosystem Edinburgh George Allen Boyd.
15. United Nations Development Report, 1996, Human Development Report, 1996 Oxford University Press. Delhi.
16. Vannathony & Rogers Paul, 1974. Human Ecology and World Development, Flehum Press, New York.

Course Outcomes:

At the end of the course, a student will be able to

CO1. Understand and evaluate the basic environmental Concepts, methods and scopes and to prepare students for analyzes environmental issues.

CO2. Create and apply applications of environmental Problem solving.

CO3. Understand the basic concepts of pollution and waste management process and evaluate their management.

CO4. Create and apply pollution control methods for society.

CO5. Understand the ecological balance and apply methods for disaster management.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial Visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

Course Outcomes	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PS01	PS02	PS03
CO1	L5	H	L	M	H	-	H	L	M	L	-	M	L
CO2	L6	H	M	-	-	-	M	L	H	H	H	L	H
CO3	L5	H	L	M	H	-	H	L	L	M	L	M	-
CO4	L6	-	M	L	H	M	M	M	H	M	M	M	M
CO5	L3	H	M	-	-	-	M	L	M	L	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4
CD3	Experiments, Seminars	CO2,CO3, CO4,CO5
CD4	Self- learning advice using internets	CO2,CO3,CO4
CD5	Industrial Visit	CO4

BSC 202: ELECTRICITY, MAGNETISM AND EMT

Course Objective:

- To understand concept of field.
- To learn invariance of charge.
- To derive electric field-due to a charge placed in dielectric medium.
- To find Magnetic field due to a uniformly magnetized material.
- To understand displacement current.

Unit-I: **Scalar and Vector Fields:** Concept of Field, Scalar and Vector Fields, Gradient of scalar field, Physical significance and formalism of Gradient, Divergence and Curl of a vector field in Cartesian co-ordinates system, Problems based on Gradient, Divergence and Curl operators, Concept of Solid angle, Gauss divergence and Stoke's theorem, Gauss law from inverse square law, Differential form of Gauss law.

Unit-II: **Electric Field and Potential Energy:** Invariance of Charge, Potential energy of system of (i) Discrete N-charges, (ii) Continuous charge distribution, Energy required to build a uniformly charged sphere, classical radius of electron, Electric field due to a short electric dipole, Interaction of electric dipole with external uniform and non-uniform electric field, potential due to a uniformly charged spherical shell. Poisson's and Laplace equations in Cartesian co-ordinates and their applications to solve the problems of electrostatics, Electric field measured in moving frames, Electric field of a point charge moving with constant velocity.

Unit-III: **Electric Field in Matter:** Multiple expansion, definition of moments of charge distribution, Dielectrics, Induced dipole moments, polar and non-polar molecules, Free and bound charges, Polarization, Atomic polarizabilty, electric displacement vector, electric susceptibility, dielectric constant, relation between them. Electric potential and electric field due to a uniformly polarized sphere (i) outside the sphere, (ii) at the surface of the sphere, (iii) inside the sphere, Electric field due to a dielectric sphere placed in a uniform electric field (a) outside the sphere, (b) inside the sphere, Electric field-due to a charge placed in dielectric medium and Gauss law, Clausius-Mossotti relation in dielectrics.

Unit-IV: **Magnetostatics and Magnetic field in Matter:** Lorentz force, properties of magnetic field, Ampere's law, field due to a current carrying solid conducting cylinder (a) outside (b) at the surface and (ii) inside the cylinder, Ampere's law in differential form, Introduction of Magnetic Vector potential, Poisson's equation for vector potential, Deduction of Bio-Savart law using Magnetic Vector potentials, Differential form of Ampere's law. Atomic magnet, Gyromagnetic ratio, Bohr-magneton, Larmor frequency, induced magnetic moment and dia-magnetism, spin magnetic moment, para- and ferro- magnetism, Intensity of Magnetization, Magnetic permeability and Susceptibility, free and bound current densities, Magnetic field due to a uniformly magnetized material and Non-uniformly magnetized material.

Unit-V: **Maxwell's Equations and Electromagnetic waves:** Displacement current, Maxwell's equations, Electromagnetic waves, Electromagnetic waves in an Isotropic medium, Properties of electromagnetic waves, Energy density of Electromagnetic waves, Pointing vector, Radiation pressure of free space, Electromagnetic waves in Dispersive medium, Spectrum of Electromagnetic waves.

References:

1. Electricity & Magnetism, A. S. Mahajan& Abbas A. Rangwala, Tata McGraw-Hill.
2. Introduction to Electrodynamics, David J. Griffith, Prentice Hall.
3. Berkley Physics Course, Vol.-II.
4. Fundamental University Physics, Vol.-II, Fields and Waves, M. Alonso and E. J. Finn, Addison-Wesley Publishing Company.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Analysis Scalar and Vector Fields.
CO2:	Understand Electric Field and Potential Energy.
CO3:	Evaluate Electric Field in Matter.
CO4:	Analysis Magnetic field in Matter.
CO5:	Understand Maxwell's Equations and Electromagnetic waves.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
CO1	L4	H	H	M	-	L	H	L	H	-	M	M	L
CO2	L2	M	L	H	M	L	M	M	L	L	M	M	M
CO3	L5	L	L	H	H	M	-	-	M	L	M	L	L
CO4	L4	M	H	H	H	-	M	H	H	H	M	L	M
CO5	L2	-	L	M	L	L	M	L	H	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO3

BSC203: CHEMICAL ENERGETIC, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY-I

Course Objectives:

- To impart the basic knowledge of chemical energetics and chemical equilibrium.
- To learn about ionic equilibria.
- Students are also expected to learn the synthesis, physical and chemical properties of aromatic hydrocarbons.
- To develop understand about synthesis, physical and chemical properties of alcohols, phenols and ethers.
- To learn the synthesis, physical and chemical properties of aldehydes and ketones.

Course Contents:

Unit-I: Section A: Physical Chemistry-1

Chemical Energetics:

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

Unit-II: Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Unit-III: Section B: Organic Chemistry-2

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons:

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides:

Alkyl Halides: (Upto 5 Carbons)

Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination v/s substitution.

Aryl Halides:

Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit-IV: Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols:

Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case)

Preparation: Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Unit-V: **Aldehydes and ketones (aliphatic and aromatic):** (Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-PondorffVerley reduction.

Reference Books:

1 Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2 McMurry, J.E. *Fundamentals of Organic Chemistry*, 7thEd. Cengage Learning India Edition, 2013.
3 Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4 Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5 Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6 Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
7 Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
8 Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
9 Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
10 Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
11 Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Understand the chemical energetics and chemical equilibrium.
CO2:	Understand ionic equilibria.
CO3:	Understand the synthesis of aromatic hydrocarbons with their physical and chemical properties.
CO4:	Understand the synthesis, physical and chemical properties of alcohols, phenols and ethers.
CO5:	Understand the synthesis, physical and chemical properties of aldehydes & ketones.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	L	-	-	-	-	M	-	L	M	M
CO2	L2	M	M	L	-	-	-	-	M	-	H	L	M
CO3	L2	L	M	M	L	L	-	L	L	-	M	H	M
CO4	L2	M	M	M	L	L	-	L	M	-	H	M	H
CO5	L2	M	M	M	L	L	-	L	M	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO2,CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO4, CO5

BSC204: DIFFERENTIAL EQUATIONS

Course Objectives:

The objective of this course is to expose student to understand the basic concepts and solution methodologies of differential Equations and partial differential equations of various orders and degrees, classification of differential equations and partial differential equations and their applications in the field of science and engineering and technology.

Course Contents:

Unit-I: First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p.

Unit-II: Methods for solving, higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

Unit-III: Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Unit-IV: Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-V: Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Reference Books:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984. 117
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

Course Outcomes: The course will enable the students to

CO:1	Understand the genesis of ordinary differential equations.
CO2:	Learn various techniques of getting exact solutions of solvable first order differentialequations and linear differential equations of higher order.
CO3:	Know Charpit's method to find the solutions of Partial differential equations
CO4:	Grasp the concept of a general solution of a linear differential equation of an arbitraryorder and also learn a few methods to obtain the general solution of such equations.
CO5:	Formulate mathematical models in the form of ordinaryand partial differential equationstosuggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	H	H	L	H	-	H	M	H	M	H	M
CO2	L3	H	H	H	M	H	-	H	M	H	H	H	H
CO3	L2	H	H	H	M	H	-	H	M	H	M	M	M
CO4	L3	H	H	H	M	H	-	H	M	H	H	H	H
CO5	L3	H	H	H	M	H	-	H	M	H	M	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Seminars	CO4
CD4	Self- learning advice using internets	CO5

BSC 205: ELECTRICITY, MAGNETISM AND EMT LAB

Course Objective:

- To review the concepts of electromagnetism from a more advanced perspective.
- To study the charge and discharge of a condenser.
- To study the magnetic field along the axis of a currant carrying circular coil.
- To determine the specific resistance of a material
- The students will be able to apply the concepts learnt to several real world problems.

List of experiments:

1. To convert a galvanometer into an ammeter of a given range and calibrate it.
2. To convert a galvanometer into a voltmeter of a given range and calibrate it.
3. To study the charge and discharge of a condenser and hence determine the time constant both current and voltage graphs are to be plotted.
4. To study the magnetic field along the axis of a currant carrying circular coil. Plot the necessary graph and hence find radius of the circular coil.
5. To determine the specific resistance of a material and determine difference between two small resistance using Carey Fosters Bridge.
6. To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3, & 4 inputs using gates with 2, 3, & 4 inputs).
7. To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR realized using NAND & NOR gates.
8. To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables
9. Calibrate an ammeter using D.C. slide wire potentiometer.
10. To determine the capacitance of a capacitor by Ballistic Galvanometer.

Reference Books:

1. B. L. Flint and H. T. Worsnop, Advanced Practical Physics for students, Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, 4th Edition, Heinemann Educational Publishers, 1985.
3. S. Panigrahi& B. Mallick, Engineering Practical Physics, Cengage Learning India Pvt. Ltd., 2015.
4. InduPrakash and Rama Krishna, A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi, 2011.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Study charge and discharge of a condenser.
CO2:	Conversion of galvanometer into an ammeter and a voltmeter
CO3:	Plot gain- frequency characteristic of emitter follower.
CO4:	Describe the magnetic field produced by electric currents.
CO5:	Verify the truth table of OR, AND, NOR gate.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
CO1	L4	H	H	M	-	L	H	L	H	M	M	M	L
CO2	L2	M	L	H	M	L	M	M	L	M	L	M	M
CO3	L3	L	L	H	H	M	-	-	M	-	M	L	L
CO4	L3	M	H	H	H	-	M	H	H	-	M	L	M
CO5	L4	-	L	M	L	L	M	L	H	H	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiments, Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 206: CHEMICAL ENERGETIC, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY-I LAB

Course Objectives:

- To understand the concept and measurement of surface tension, viscosity, chemical kinetics.
- To understand the process of Volumetric and Gravimetric Analysis.

Physical Chemistry

(One of the following experiments should be given in the examination)

(i) Chemical Kinetics:

(a) To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl acetate catalyzed by hydrogen ions at room temperature.

(b) To study the effect of acid strength on the hydrolysis of an ester.

(c) To compare the strengths of HCI and H_2SO_4 by studying the kinetics of hydrolysis of ethyl acetate.

(d) To study kinetically the reaction rate of decomposition of iodide by H_2O_2.

(ii) Viscosity, Surface Tension:

(a) To determine the viscosity/ surface tension of a pure liquid (alcohol etc.) at room temperature. (using the Ostwald viscometer/ stalagmometer).

(b) To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

(c) To determine the percentage composition of a given mixture (non-interacting systems) by viscosity method.

(d) To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.

Inorganic Chemistry

(a) Preparation of Standard Solution

(b) Volumetric Analysis

(c) Gravimetric Analysis

Course Outcomes:

CO1:	Understand the concept and measurement of surface tension, viscosity and chemical kinetics.
CO2:	Understand the process of Volumetric and Gravimetric Analysis.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L5	H	M	M	L	L	-	L	H	H	M	M	H
CO2	L5	H	M	M	L	L	M	L	H	H	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiments	CO1, CO2
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 207: ANANDAM-II

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be excepted to engage in individual and group acts of service and goodness.

Action Plan: Students will be expected to

1. Do at least one act of individual service each day
2. Record this act of service in a dedicated Register / Personal Diary
3. Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
4. Undertake one group service project for 64 hours every semester (outside college hours)
5. Upload the report on the group project on the Anandam platform
6. Participate in a sharing and presentation on the group service in the discussion sessions held once in week
7. There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Semester - III

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC 301	Computer Fundamentals	AEC	2	-	-	30	70	100	2
	Core Course								
BSC 302	Thermodynamics	CC	4	-	-	30	70	100	4
BSC 303	Thermodynamics & Electrochemistry	CC	4	-	-	30	70	100	4
BSC 304	Real Analysis	CC	4	-	-	30	70	100	4
	Skill Enhancement Course								
BSC 305	Crystallography and Statistical Physics	SEC	2	-	-	30	70	100	2
BSC 306	Functional Groups Chemistry-I	SEC	2	-	-	30	70	100	2
BSC 307	Integral and Vector Calculus	SEC	2	-	-	30	70	100	2
PRACTICALS/VIVA-VOCE		**Type**	**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
BSC 308	Physics Lab-III	CC	-	-	4	60	40	100	2
BSC 309	Chemistry Lab-III	CC	-	-	4	60	40	100	2
BSC 310	Mathematics Lab-III	CC	-	-	4	60	40	100	2
Course based on Social-Industry connect									
BSC 311	Anandam -III	AC	-	-	4	50	50	100	2
TOTAL			**20**	**-**	**16**	**440**	**660**	**1100**	**28**

BSC 301: COMPUTER FUNDAMENTALS

Course Objective

- To familier with the concepts of information Technology
- To know the MS office
- To learn about the electronic spreadsheets
- To know internet and ethics

Course Contents:

Unit I : Introduction to information technology: Evolution and generation of computers, type of computers, micro, mini, mainframe and super computer. Architecture of a computer system: CPU, ALU, Memory (Ram, Rom families) cache memory, input/output devices, pointing devices.

Concepts of Operating system , need types of operation systems. Batch single user multi-processing, distributed and timeshared operation systems, introduction of Unix, Linux. Windows NT. Programming languages Low level and high level languages. Generation of languages.3 GL and 4 GL languages.Graphic User Interfaces.

Unit II : Word Processing tool: Introduction, Creating, Saving, Copy, Move and Delete, Checking Spelling and Grammer. Page Layout.Interface, Toolbars, ruler. Menus keyboard shortcut, editing. Text Formatting, Insert headers and footers. Bullets and Numbering. Find and Replace etc. Insert Table and Picture. Macro, Mail Merge.

Power Point: Creating and Viewing a presentation, managing slide shows Navigating through a presentation using hyperlinks advances navigation with action setting and action buttons. Organizing formats with Master Slides Applying and modifying designs adding graphics. Multimedia and special effects.

Unit III: Electronic Spreadsheet : Worksheet types of create and open a worksheet. Entering data text numbers and formula in a worksheet inserting and deleting cells. Cell formatting. Inserting rows and columns in a worksheet formatting worksheets. Using various, formula and inbuilt function, update worksheet using special tools like spell check and auto correct setup the page. Format the data in the worksheet globally selectively, creating charts, Finance worksheet using charts, multiple worksheets concepts.

Unit IV: The Internet –History and functions of the internet, Working with internet. Web Browers. World Wide Web, Uniform Resource Locator and Domain Names, Uses of Internet, Search for Information, Email, Chatting, Instant messenger Services. News, Group, Teleconferencing, Video-Conferencing.E-Commerce and M-Commerce.

Manage an E-mail account, E-Mail Address configure E-Mail account, log to an E-mail, Receive E-mail, Sending mails, sending files an attachments and address book, downloading files, online form filling, E-Services, E-Banking and E-Learning.

Unit V: Social Ethical and legal matters-effects on the way we: work socialize, Cyber crime, Prevention of crime, cyber law: Indian IT Act, intellectual property software piracy, Copyright and patent, Software licensing, Proprietary software, free and open source software.

Network Security: Risk assessment and security measures. Assets and types (data, applications, system and network). Security threats and attacks (passive, active): types and effects (e.g. identity theft, denial of services. Computer virus etc.) Security issues and security measures(firewalls encryption/decryption). Prevention.

Practical

The Practical exercise will be designed to help in the understanding of concepts of computer and the utilization in the areas outlined in the theory syllabus. The emphasis should be on practical usage rather than on theoretical concepts only.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Fundamental terms and the concepts of information Technology
CO2:	Use the MS office.
CO3:	Apply the electronic spreadsheets.
CO4:	Use the internet technology
CO5:	Understand different Ethical and legal matters

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**BLOOMS LEVEL**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	M	L	M	M	M	L	M	H	L	L
CO2	L3	H	M	H	H	H	L	H	L	H	L	L	M
CO3	L3	H	H	L	M	H	L	H	L	H	H	M	H
CO4	L3	H	L	M	L	H	H	H	L	H	M	L	M
CO5	L2	M	M	L	M	M	M	M	L	M	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	-

BSC 302: THERMODYNAMICS

Course Objective

- To study system in thermal contact with a heat reservoir.
- To understand the fundamental laws of thermodynamics.
- To understand applications to various thermodynamical systems and processes.
- To understand distribution of molecular velocities.
- To understand various transport phenomena.

Course Contents:

Unit-I: **Thermal and Adiabatic Interactions:** Thermal interaction, Zeroth law of thermodynamics, System in thermal contact with a heat reservoir (canonical distribution), Energy fluctuations, Entropy of a system in a heat bath, Helmholtz free energy, Adiabatic interaction and enthalpy, General interaction and first law of thermodynamics.

Unit-II: **Infinitesimal general interaction:** Gibb's free energy, Phase transitions, Clausius-Clapeyron equation, Vapour pressure curve, Heat engine and efficiency of engine, Carnot's Cycle, Thermodynamic scale as an absolute scale, MaxwelI relations and their applications.

Unit-III: **Production of low temperatures and applications:** Joule Thomson expansion and J-T coefficients for ideal as well as Vander-Waal's gas, porous plug experiment, temperature inversion, Regenerative cooling, Cooling by adiabatic expansion and demagnetization, Liquid Helium, He-I and He-II superfludity, Refrigeration through Helium dilution, Quest for absolute zero, Nernst heat theorem.

Unit-IV: **The distribution of molecular velocities:** Distribution law of molecular velocities, most probable, average and r. m. s. velocities, Energy distribution function, effusion and molecular beam, Experimental verification of the Maxwell velocity distribution, principle of equipartition of energy.

Unit-V: **Transport phenomena:** Mean free path, distribution of free paths, coefficients of viscosity, thermal conductivity, diffusion and their interaction.

Reference Books:

1. S. Garg, R. Bansal and C. Ghosh, Thermal Physics, Tata McGraw-Hill, 1993.
2. MeghnadSaha, and B. N. Srivastava, A Treatise on Heat, Indian Press, 1969.
3. Enrico Fermi, Thermodynamics, Courier Dover Publications, 1956.
4. M. W. Zemasky and R. Dittman, Heat and Thermodynamics, McGraw Hill, 1981.
5. F. W. Sears & G. L. Salinger, Thermodynamics, Kinetic theory & Statistical thermodynamics, Narosa, 1988.
6. Ronald Lane Reese, University Physics, Thomson Brooks/Cole, 2003.
7. A. Kumar and S. P. Taneja, Thermal Physics, S. Chand Publications, 2014.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand Thermal and Adiabatic Interactions.
CO2:	Understand Infinitesimal general interaction.
CO3:	Analysis production of low temperatures and applications.
CO4:	Analysis distribution of molecular velocities.
CO5:	Analysis Transport phenomena.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**Blooms Level**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	M	M	L	L	M	M	L	M	H	L	L
CO2	L2	M	M	H	H	L	L	-	L	-	L	L	M
CO3	L4	M	H	L	M	L	L	M	L	H	H	M	H
CO4	L4	H	L	M	L	-	H	L	L	-	M	L	M
CO5	L4	M	M	L	M	L	M	H	L	L	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO1, CO4

BSC 303: Thermodynamics & Electrochemistry

Course Objective

- To impart an insight into the basic principles of Thermodynamics and laws of Thermodynamics
- To understand the basic concepts of conductance and electrochemistry and their applications.

Course Contents:

Unit-I: Thermodynamics-I

Definition of thermodynamic terms: System, Surroundings etc. Types of systems, Intensive and extensive properties.State and path functions and their differentials.Thermodynamic, process, concept of heat and work.

First Law of Thermodynamics: Statement, Definition of internal energy and enthalpy, heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient.Calculation of w, q, dU & dR, for the expansion of Ideal gases under adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation, Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume.Enthalpy of neutralization.Bond dissociation energy and its calculation from thermo-chemical data, Temperature dependence of enthalpy.Kirchhoff's equation.

Unit-II: Thermodynamics-II

Second law of Thermodynamics: Need for the Law, different statements of the law: Carnot cycle and its efficiency, Carnot-Theorem. Thermodynamic scale of temperature.

Concept of entropy: Entropy as a state function, entropy as a function of V&T, Entropy as a function of P&T, Entropy change in physical change, Clausius inequality and Entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Unit-III: Third Law of Thermodynamics: Nernst heat theorem. Statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions: Gibbs function (G) and Helmholtz functions (A) as: Thermodynamic quantities. A & G as criteria for Thermodynamic euuilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V, and T.

Unit-IV: Electrochemistry-I: Electrical Transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation' and its limitations, weak and strong electrolytes, Ostwald dilution law, its uses and limitations.Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method and moving boundary method.

Applications of conductivity measurements:

Determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Unit-V: **Electrochemistry-II:** Types of reversible electrodes:Gas-metal-ion; metal-metal ion, metal-insoluble salt anion and redox electrodes, electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells:

EMF of a cell and its measurements, Computation of cells EMF. Calculation of themodynamic quantities of cell reactions (Δ G, Δ H and K), polarization, over potential and hydrogen overvoltage.

Concentration cell with and without transport, liquid junction potential, application of concentration cells.Valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes, by potentiometric methods.

Reference Books

1 Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).

2 Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

3 Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).

4 Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).

5 Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).

6 Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

7 Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

8 Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

9 Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Bioch*emistry *7th Ed.*, W. H. Freeman.

10 Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Acquire the knowledge of first law of thermodynamics
CO2:	Understand the Second law of Thermodynamics
CO3:	Learn the third law of Thermodynamics
CO4:	Understand the basic concepts of conductance and electrochemistry and their applications.
CO5:	Learn about types of reversible electrodes, electrolytic and galvanic cells and EMF

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	L	L	-	-	-	-	M	M	M	M	H
CO2	L2	M	M	M	-	-	M	-	M	M	M	M	M
CO3	L2	M	M	M	L	L	-	L	M	M	H	M	M
CO4	L2	M	M	M	L	L	-	L	M	M	L	L	L
CO5	L2	M	M	M	L	L	-	L	M	M	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC 304: Real Analysis

Course Objective

- This course will introducereal number system.
- To understand theLimit and Convergence of a sequence.
- Understandproperties of derivable functions.
- To understandRiemann integration.
- To Understandsequence and series of functions.

Course Contents:

Unit I: Real numbers as complete ordered field, Limit point, Bolzano-Weierstrass theorem, closed and Open sets. Concept of compactness and connectedness.Heine-Borel theorem. Holder inequality & Minkowski inequality, Metric space - Definition and examples, Open and Closed sets, Interior and Closure of a set, Limit point of a set in metric space.

Unit II: Real sequences- Limit and Convergence of a sequence, Monotonic sequences. Cauchy's sequences, Subsequences, Cauchy's general principle of convergence. Properties of continuous functions on closed intervals.

Unit III: Properties of derivable functions, Darboux's and Rolle's theorem. Notion of limit, continuity and differentiability for functions of several variables.The directional derivative, the total derivative, expression of total derivative in terms of partial derivatives.

Unit IV: Riemann integration - Lower and Upper Riemann integrals, Riemann integrability, Mean value theorem of integral calculus, Fundamental theorem of integral calculus. Functions of bounded variations. Introduction, properties of functions of bounded variations, total variation.

Unit V: Sequence and series of functions - Pointwise and Uniform convergence, Cauchy's criterion, Weierstrass M-test, Abel's test, Dirichlet's test for uniform convergence of series of functions, Uniform convergence and Continuity of series of functions, Term by term differentiation and integration.

Reference Books :

1. KA. Ross, Elementary Analysis: The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
2. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis (3rd edition), Johun Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Charles G. Denlinger, Elements of Real Analysis, Jones and Bartlett (Student Edition), 2011.
4. S. Kumaresan, Topology of Metric Spaces, Narosa Publishing House, Second Edition 2011.
5. G. F. Simmons, Introduction to Topology and Modem Analysis Mcgraw-Hill Edition

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Learn about topological properties of real number system.
CO2:	Learn about real sequences and their convergence.
CO3:	Learn the limit, continuity, differentiability of functions of several variables.
CO4:	Learn about Riemann integration concept.
CO5:	Learn about convergence of sequence and series of functions.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**Blooms Level**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	H	H	M	M	M	H	M	H	M	M	L
CO2	L3	M	H	H	M	M	M	H	M	H	M	M	M
CO3	L2	M	H	M	M	M	H	H	M	H	M	L	L
CO4	L3	M	H	H	M	M	H	H	M	H	M	L	M
CO5	L4	M	H	H	H	M	H	H	M	H	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments/ Seminars	CO1, CO4
CD4	Self- learning advice using internets	CO4, CO5

BSC 305: CRYSTALLOGRAPHY AND STATISTICAL PHYSICS

Course Objective

- To understand basic crystal structure.
- To understand X-ray diffraction by solids.
- To understand formation of bands in solid.
- Understand the concepts of Statistical Mechanics.
- To understand the connection between the macroscopic observations of physical systems.

Course Contents:

Unit I: **Crystal structure:**Bonding in Solids,Force between atoms, ionic bonds, Covalent and metallic bonds, Vander waal's and Hydrogen bonding, Periodicity in lattices, Basis, lattice point and space lattice, Translation vectors, Unit and primitive cell, Crystal systems, Packing fractions for Simple Cubic (SC), Body Centered Cubic (BCC), Face Centered Cubic (FCC) and Hexagonal lattice structures, Bravais space lattices.

Unit II: **Diffraction by Solid:** Direction, planes and miller indices in a crystal lattice, Reciprocal lattice and its significance, Conversion of SC and FCC structures in reciprocal lattice frame, Concept of crystalline, polycrystalline and amorphous materials, X-ray diffraction by solids: Laue and Braggs equation, Study of crystals by X-rays: FWHM, Sherrer formula and Lattice Constants (for simple cubic structure), Electron and Neutron diffraction (qualitative).

Unit III: **Band Theory of Solids:** Formation of bands, Periodic potential and Bloch Theorem, Number of states in the bands, Kroning Penny model, Brilliuon zones, Crystal momentum and physical origin of effective mass, Negative Effective Mass and Holes, Energy dispersion relations: weak and tight binding.

Unit IV: **Classical Statistics:** Validity of Classical approximation, Phase space, micro and macro States, Thermodynamic probability, relation between entropy and thermodynamic probability, Monoatomic ideal gas, Barometric equation, Specific heat capacity of diatomic gas, Heat capacity of solids.

Unit V: **Quantum Statistics:** Black body radiation and failure of classical statistics, Postulates of quantum statistics, indistinguishability, wave function and exchange degeneracy, a priori probability, Bose-Einstein statistics and its distribution function, Planck distribution function and radiation formula, Fermi-Dirac statistics and its distribution function, contact potential, thermionic emission, specific heat anomaly of metals, nuclear spin statistics (para- and ortho- hydrogen).

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, Wiley Publication.
2. Elementary Solid State Physics, M. Ali Omar, Pearson Education.
3. Elements of X-ray diffraction, B. D. Cullity, Prentice Hall.
4. S. Garg, R. Bansal and C. Ghosh, Thermal Physics, Tata McGraw-Hill, 1993.
5. A. Kumar and S. P. Taneja, Thermal Physics, S. Chand Publications, 2014.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand Crystal structure and bonding in Solids.
CO2:	Understand diffraction by Solid.
CO3:	Study band theory of Solids.
CO4:	Apply classical statistics to findheat capacity of solids.
CO5:	Apply Quantum Statistics to explainblack body radiation.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**Blooms Level**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	M	M	L	L	M	M	L	L	H	L	L
CO2	L2	M	M	H	H	L	L	-	L	M	L	L	M
CO3	L4	M	H	L	M	L	L	M	L	-	H	M	H
CO4	L3	H	L	M	L	-	H	L	L	-	M	L	M
CO5	L3	M	M	L	M	L	M	H	L	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO1, CO4

BSC 306: Functional Groups Chemistry-I

Course Objectives:

- To develop understand about synthesis, physical and chemical properties of alcohols and phenols.
- To learn the synthesis, physical and chemical properties of aldehydes and ketones.
- To understand the synthesis, physical and chemical properties of Carboxylic Acids and their derivatives.

Course Contents:

Unit-I: **Alcohols** (Upto 5 Carbons)

Alcohols: Monohydric alcohols- methods of formation by reduction of aldehydes,ketones, carboxylic acids and esters. Hydrogen bonding.Acidic nature. Reaction of alcohols with mechanism.

Dihydric alcohols- methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement.

Trihydric alcohols- methods of formation, chemical reactions of glycerol.

Unit-II: **Phenols:** Nomenclature structure and bonding,*Preparation of phenols.Physical properties and acidic character.Comparative acidic strength of alcholos and phenols. Reaction of* phenols electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fisher rearrangement, claisen rearrangement, Gattermann synthesis, Houben–Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann Reaction.

Unit-III: **Aldehydes and Ketones:** Structure of the carbonyl.Syntheses of aldehydes from acid chlories, synthesis of aldehydes and ketones using 1, 3-dithianes, syntheses of ketones from nitries and from carboxylic acids, physical properties.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Parkin and Knoevenagel condensations.Condensation with ammonia and its derivatives, Wittig reaction, Mannich reaction.Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction. MPV (Meervein-Pondrof-Verley), Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ rductions. Halogenations of enolizable ketones. Use of acetals and 1,3-dithiane as protecting groups.

Unit-IV: **Carboxylic Acids:** Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength.Preparation of carboxylic acids.Reactions of carboxylic acids.Hell-Volhard-Zelinsky reaction.Reduction of carboxylic acids, mechanism of decaroxylation.

Methods of formation and chemical reactions of halo acids.Hydroxyl acids-malic, tartaric and citric acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids).

Unit-V: **Carboxylic Acid Derivatives:** Structure, nomenclature and synthesis of acid chlories, esters, amides and acid anhydrides.Relative stability of acyl derivatives.Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.
Preparation of carboxylic acid derivatives, chemical reactions, mechanisms of esterification and hydrolysis (acidic and basic).

Reference Books:

1 Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).

2 McMurry, J.E. *Fundamentals of Organic Chemistry*, 7thEd. Cengage Learning India Edition, 2013.

3 Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).

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5 Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.

6 Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

7 Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).

8 Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

9 Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).

10 Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).

11 Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Understand the synthesis of alcoholswith their physical and chemical properties.
CO2:	Understand the synthesis, physical and chemical properties of phenols.
CO3:	Understand the synthesis, physical and chemical properties of aldehydes & ketones.
CO4:	Learn the synthesis, physical and chemical properties of Carboxylic Acids
CO5:	Obtain the knowledge about the synthesis, physical and chemical properties of Carboxylic Acid Derivatives

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	L	-	-	-	-	M	L	L	M	M
CO2	L2	M	M	L	-	-	-	-	M	L	H	L	M
CO3	L2	L	M	M	L	L	-	L	L	M	M	H	M
CO4	L2	M	M	M	L	L	-	L	M	M	H	M	H
CO5	L2	M	M	M	L	L	-	L	M	M	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO2,CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO4, CO5

BSC 307: Integral and Vector Calculus:

Course Objective

- To understand improper integrals.
- To understand double and triple integration.
- To understand various application of double and triple integration.
- To Understand the differentiation and integration of scalar and vector point function.
- To understand the Gauss, Green's and Stokes Theorems and their application.

Course Content:

Unit I: Beta and Gamma functions, Reducation formulae (simple standard formulae),

Unit II: Double integrals in Cartesian and Polar Coordinates, Change of order of intergration. Triple integrals . Dirichlet's Integral.

Unit III: Areas, Rectification, Volumes and Surfaces of solids of revolution.

Unit IV: Scalar and Vector point functions. Differentiation and integration of vector point functions. Directional derivative.Differential operators.Gradient, Divergence and Curl.

Unit V: Theorems of Gauss, Green, Stokes (without proof) and problems based on these theorems.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Learn theimproper integrals.
CO2:	Handle the problems of double and triple integration
CO3:	Applythe double and triple integration concept.
CO4:	Finddifferentiation and integration of scalar and vector point function.
CO5:	Use theGauss, Green's and Stokes Theorems.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom s level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	H	H	H	H	H	H	M	H	M	M	L
CO2	L3	H	H	H	M	M	M	H	M	H	M	M	M
CO3	L3	H	H	H	H	H	H	H	M	H	M	L	L
CO4	L2	M	H	H	H	H	H	H	H	H	M	L	M
CO5	L3	H	H	H	M	M	M	H	H	H	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO4
CD4	Self- learning advice using internets	CO4, CO5

BSC 308: PHYSICS LAB-III

Course Objective

- To understand thermodynamic phenomena.
- To understand the thermal conductivity.
- To understand emissivity of the test plate surface.
- To understand heat transfer coefficient.
- To determine rates of heat transfer for different materials.

List of experiments:

1. To study the random decay and determine the decay constant using the statistical board.
2. To Determine Thermal Conductivity of Insulating Powders.
3. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
4. To determine the transfer Rate and Temperature Distribution for a Pin Fin.
5. To Measure the Emissivity of the Test plate Surface.
6. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
7. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
8. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
9. To Find the Heat transfer Coefficient in Forced Convection in a tube.
10. To study the rates of heat transfer for different materials and geometries.

Reference Books:

1. B. L. Flint and H. T. Worsnop, Advanced Practical Physics for students, Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, 4th Edition, reprinted, Heinemann Educational Publishers, 1985.
3. S. Panigrahi& B. Mallick, Engineering Practical Physics, Cengage Learning India Pvt. Ltd., 2015.
4. InduPrakash and Ramakrishna, A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi, 2011.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Understand random decay and determine the decay constant.
CO2:	Evaluate thermal conductivity of a good conductor of heat.
CO3:	Understand effectiveness in parallel and counter flow heat exchangers..
CO4:	Evaluate the rates of heat transfer for different materials and geometries.
CO5:	The students are expected to perform the experiments related to heat transfer.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	L	L	H	L	H	M	H	M	M	M	M	L
CO2	L2	L	-	M	-	L	L	M	M	M	L	L	M
CO3	L2	L	L	M	M	M	L	-	L	L	M	M	L
CO4	L2	H	L	-	L	L	H	L	M	L	L	L	M
CO5	L4	-	H	H	L	H	L	H	M	H	M	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 309: Chemistry Lab-III

Course Objective:

- To get the skills of Chromatography which is a Separation Techniques and identification of Functional Groups
- To understand the Phase Equilibrium.

Organic Chemistry

(a) Thin Layer Chromatography
(b) Paper Chromatographic Separation
(c) Detection of Elements
(d) Tests of Functional Groups
(e) Determination of important organic compounds and their specification
(f) Formation of Derivatives

Physical Chemistry

(a) Transition Temperature
(b) Distribution Law and distribution Coefficient
(c) Phase Equilibrium
(d) Thermo Chemistry

Reference Books:

1 Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
2 Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3 Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
4 Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
5 Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
6 Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
7 Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
8 Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Get the skills of Separation Techniques by Chromatography and identification of Functional Groups.
CO2:	Understand and analysis of the Phase Equilibrium.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L5	H	H	M	M	M	L	L	H	H	H	H	H
CO2	L5	M	M	M	L	L	L	L	M	M	H	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	CO1, CO2
CD3	Experiments	CO1, CO2
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 310: MATHEMATICS LAB-III

Course Objective

- To familiar with concept of C programming language.
- To learn the art to write algorithm and flowchart.
- Able to prepare programme in C to find LCM and GCD.
- Able to write programme of sum of sequence.
- Able to make programmes for mean and standard deviation.

List of experiments:

1. Practicals with Computer Programming in C Language.
   Programming languages and problem solving on computers, Algorithm, Flow chart, Programming in C- Constants, Variables, Arithmetic and logical expressions, Input-Output, Conditional statements, Implementing loops in Programs, Defining and manipulation arrays and functions.
2. Printing terms of Fibonacci sequence.
3. Finding n!, $\sum n$, $\sum n^2$ etc.
4. Defining a function and finding sum of n terms of a series/sequence whose general term is given (e.g. $a_n = \frac{n^2+3}{n+1}$).
5. Printing Pascal's triangle.
6. Finding ged and Iem of two numbers by Euclid's algorithm.
7. Checking prime/composite number.
8. Finding number of primes less than n, n € Z.
9. Finding mean, standard deviation and ${}^{n}P_{r}{}^{n}C_{r}$ for different n and r. 1. Printing n terms of Fibonacci sequence.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Learn the concept of C programming language.
CO2:	Learn the art to write algorithm and flowchart.
CO3:	Know prepare programme in C to find LCM and GCD.
CO4:	Learn write programme sum of sequence..
CO5:	make programmes for mean and standard deviation.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	H	H	M	M	M	H	M	H	M	M	L
CO2	L2	H	H	H	H	H	M	H	H	H	L	L	M
CO3	L2	H	H	H	H	H	H	H	H	H	M	M	L
CO4	L2	M	H	H	M	M	H	H	M	H	L	L	M
CO5	L4	M	H	H	M	M	H	H	H	H	M	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	CO1, CO2,

BSC 311: ANANDAM-III

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be excepted to engage in individual and group acts of service and goodness.

Action Plan: Students will be expected to

1. Do at least one act of individual service each day
2. Record this act of service in a dedicated Register / Personal Diary
3. Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
4. Undertake one group service project for 64 hours every semester (outside college hours)
5. Upload the report on the group project on the Anandam platform
6. Participate in a sharing and presentation on the group service in the discussion sessions held once in week
7. There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join
8. Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

SEMESTER - IV

THEORY PAPERS		**Type**	**No. of Teaching Hours**			**Marks Allocation**			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC 401	Professional Skills	AEC	2	-	-	30	70	100	2
	Core Course								
BSC 402	Optics	CC	4	-	-	30	70	100	4
BSC 403	Metal Complexes	CC	4	-	-	30	70	100	4
BSC 404	Algebra	CC	4	-	-	30	70	100	4
BSC 405	**Discipline Specific Elective-4A (Choose any one)**								
BSC 405A	Mathematical Physics and Special Theory of Relativity	DSE	3	-	-	30	70	100	3
BSC 405B	Analog Systems and Applications	DSE	3	-	-	30	70	100	3
BSC 406	**Discipline Specific Elective-4B (Choose any one)**								
BSC 406A	Functional Groups Chemistry-II	DSE	3	-	-	30	70	100	3
BSC 406B	Chemical Technology & Society	DSE	3	-	-	30	70	100	3
BSC 407	**Discipline Specific Elective-4C (Choose any one)**								
BSC 407A	Analytical Geometry	DSE	3	-	-	30	70	100	3
BSC 407B	Matrices	DSE	3	-	-	30	70	100	3
PRACTICALS/VIVA-VOCE		**Type**	**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
	Core Course								
BSC 408	Physics Lab-IV	CC	-	-	4	60	40	100	2
BSC 409	Chemistry Lab-IV	CC	-	-	4	60	40	100	2
BSC 410	Mathematics Lab-IV	CC	-	-	4	60	40	100	2
Course based on Social-Industry connect									
BSC 411	Anandam -IV	AC	-	-	4	50	50	100	2
TOTAL			**23**	**-**	**16**	**440**	**660**	**1100**	**31**

BSC 401: PROFESSIONAL SKILLS

Course Objective

- Acquire career skills and fully pursue to partake in a successful career path.
- Prepare good resume, prepare for interviews and group discussions.
- Explore desired career opportunities in the employment market in consideration of an individual SWOT.
- Understand the significance of Team Skills and help them in acquiring them.
- To help them design, develop and adapt to situations as an individual and as a team.

Course Contents:

Unit-I: **Resume Skills and Interview Skills:** Resume Skills-Preparation and Presentation: Introduction of resume and its importance, Difference between a CV, Resume and Bio data, Essential components of a good resume, common errors: Common errors people generally make in preparing their resume, Prepare a good resume of her/his considering all essential components.Interview Skills-Preparation and Presentation:Meaning and types of interview (F2F, telephonic, video, etc.)**,** Dress Code, Background Research, Do's and Don'ts**,** Situation, Task, Approach and Response (STAR Approach) for facing an interview**,** Interview procedure (opening, listening skills, closure, etc.)**,** Important questions generally asked in a job interview (open and closed endedquestions), Simulation: Observation of exemplary interviews, Comment critically on simulated interviews, Common Errors: Discuss the common errors generally candidates make in interview, Demonstrate an ideal interview.

Unit-II: **Group Discussion Skills and Exploring Career Opportunities:** Group Discussion:Meaning and methods of Group Discussion**,** Procedure of Group Discussion**,** Simulation**,** Common Errors, Exploring Career Opportunities:Knowing yourself – personal characteristics**,** Knowledge about the world of work, requirements of jobs including self-employment.Sources of career information**,** Preparing for a career based on their potentials and availability of opportunities.

Unit-III: **Presentation Skills and Trust and Collaboration:** Presentation Skills**:** Types of presentations, Internal and external presentation, Knowing the purpose, Knowing the audience, Opening and closing a presentation, Using presentation tools, Handling questions, Presentation to heterogenic group, Ways to improve presentation skills over time, Trust and Collaboration: Explain the importance of trust in creating a collaborative team, Agree to Disagree and Disagree to Agree – Spirit of Team work, Understanding fear of being judged and strategies to overcome fear.

Unit-IV: **Listening as a Team Skill and Brainstorming:** Listening as a Team Skill: Advantages of Effective Listening, Listening as a team member and team leader. Use of active listening strategies to encourage sharing of ideas (full and undivided attention, no interruptions, no pre-think, use empathy, listen to tone and voice modulation, recapitulate points, etc.). Brainstorming: Use of group and individual brainstorming techniques to promote idea generation. Learning and showcasing the principles of documentation of team session outcomes.

Unit-V: **Social and Cultural Etiquette & Internal Communication:** Social and Cultural Etiquette: Need for etiquette (impression, image, earn respect, appreciation, etc), Aspects of social and cultural/corporate etiquette in promoting teamwork, Importance of time, place, propriety and adaptability to diverse cultures, Internal Communication: Use of various channels of transmitting information including digital and physical, to team members.

Bibliography:

1. Foundation Skills In IT (FSIT) - Refer the websites like https://www.sscnasscom.com/ ssc-projects/capacity-building-and-development/training/fsit/
2. Global Business Foundation Skills (GBFS) – Refer websites like https://www.sscnasscom. com/ssc-projects/capacity-building-and-development/training/gbfs/
3. IT-ITeS Sector Skills Council readiness program namely Global Business Foundation Skills (GBFS) in website (https://www.sscnasscom.com/ssc-projects/capacity-building-anddevelopment/training/gbfs/)
4. Generic and the entrepreneurial NOS at NSQF Level 4 -7.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Prepare their resume in an appropriate template without grammatical and other errors and using proper syntax.
CO2	Participate in a simulated interview.
CO3	Actively use and operate online team communication tools: Webinar, Skype, Zoom, Google hangout etc.
CO4	Participate in a digital lifestyle conversant with computers, applications, Internet and nuances of cyber security.
CO5	Engage in effective communication by respecting diversity and embracing listening skills.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	L	H	M	M	M	M	L	L	L	L	L
CO2	L2	H	H	M	-	H	H	-	M	M	M	L	M
CO3	L2	L	M	L	M	L	M	L	M	-	M	L	H
CO4	L4	M	H	-	L	M	L	M	-	M	L	L	M
CO5	L4	H	M	M	M	L	M	M	L	L	H	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO5

BSC 402: OPTICS

Course Objective

- To understand various optical phenomena.
- To know about principles, workings and applications of optical instruments.
- To develop an understanding of waves propagation in an optical fibre.
- To understand the wave phenomena of light.
- To learn concepts of Holography.

Course Contents:

Unit I: **Interference:** Concept of Spatial and Temporal Coherence, coherence length, coherence time, Definition and propagation of a wave front, Huygen's principle of secondary wavelets, Young's Double slit experiment, Types of interference, interference by division of wavefronts, Fresnel's Biprism, Measurement of wavelength λ and thickness of a thin transparent sheet.Interference by division of Amplitude: Interference in thin films of constant thickness in transmitted and reflected waves, Interference produced by a wedge shaped film, Newton's rings, Determination of wavelength λ and refractive index μ by Newton's Rings, fringes of equal inclination (Haidinger fringes) and equal thickness (Fizeau fringes), Michelson's Interferometer, shape of fringes, Measurement of wavelength, difference between two spectral lines and thickness of a thin transparent sheet.

Unit II: **Diffraction:** Fresnel's diffraction: Half period zones, Fresnel's diffraction at a circular aperture, straight edge and a rectangular slit, Zone plate, Multiple foci of zone plate, comparison between zone plate and convex lens.Fraunhofer diffraction by single slit and a circular aperture, Fraunhofer diffraction by N parallel slits with two slits as a special case, Missing order, Plane diffraction grating and its use in determining wavelength, Dispersion by a grating, Rayleigh's criterion of resolution, Resolving power of a Telescope and a Grating.

Unit III: **Polarization:** (i) Plane polarized light, (ii) Circularly polarized light and (iii) elliptically Polarized light, Production of Plane polarized light: (i) by reflection, (ii) by refraction, (iii) by double refraction and (iv) by dichroism (Polaroid), identification of polarized light, Hygen’s theory of double refraction, Production of Circularly and elliptically polarized light, Quarter wave and half wave plates, Analysis of polarized light, Laws of optical Activity, Fresnel’s explanation of optical activity, experimental verification of Fresnel’s theory, Specific rotation, polarimeter, types of Polarimeter (i) Laurent’s half shade polarimeter and (ii) Biquartzpolarimeter.

Unit IV: **Laser:** Spontaneous and stimulated emission, Einstein's A & B coefficients, Energy density of radiation as a result of stimulated emission and absorption, population inversion, Methods of optical pumping, energy level schemes, He-Ne, Ruby, CO_2 lasers.

Unit V: **Fiber Optics:** Introduction of Optical Fiber, Necessity of Cladding, Optical fiber system, Optical fiber cable, Total internal Reflection, Explanation of Propagation of light through an optical fiber.**Holography:** Basic concepts of Holography, principle of holography, Theory, Construction and reconstruction of image, application of holography.

Reference Books:

1. Optics by BrijLal&Subramnium, S. Chand.
2. Optics by D. P. Khandelwal.
3. Principles of optics by B. K. Mathur.
4. Introduction to Modern Optics by A. K. Ghatak.
5. An introduction to Modern Optics by G. R. Fowels.
6. Essentials' of Lasers by Allen.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand working of Laser.
CO2:	Analysis propagation of light through an optical fiber.
CO3:	Understand concepts of Holography.
CO4:	Understand interference, Fresnel's and Fraunhofer diffraction.
CO5:	Analysis of polarized light.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	M	-	H	M	M	-	M	H	L	M	L
CO2	L4	L	-	M	L	L	M	L	M	H	M	H	M
CO3	L2	M	M	H	H	H	L	H	L	L	H	M	M
CO4	L2	M	M	L	M	-	M	M	L	-	M	L	M
CO5	L4	H	L	H	M	L	H	M	L	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO4

BSC 403: Metal Complexes

Course Objective

- To learn about the behavior of transition Metal complexes.
- To impart knowledge regarding Electron Spectra of Transition Metal Complexes.
- To get comprehensive knowledge of Thermodynamic and Kinetic Aspects of Metal Complexes.
- To get the knowledge about Organometallic Chemistry.

Course Contents:

Unit-I : Metal-ligand bonding in Transition Metal complexes:
Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal-field splitting in octahedral, tetrahedral and square planar complex, factors affecting the crystal-field parameters.

Unit-II : Magnetic properties of Transition Metal Complexes:
Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L - S coupling of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

Unit-III : Electron Spectra of Transition Metal Complexes:
Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $\{Ti(H_2O)_6]^{3+}$ complex ion.

Unit-IV : Thermodynamic and Kinetic Aspects of Metal Complexes:
A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planer complexes.

Unit-V : Organometallic Chemistry:
Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Ag, Sn and Ti, a brief account of metalethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Reference Books

1 Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2 Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3 Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4 Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5 Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6 Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
7 Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
8 Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
9 Rodgers, G.E. *Inorganic &Solid State Chemistry*, Cengage Learning India Ltd., 2008.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Understand Metal-ligand bonding in Transition Metal complexes
CO2:	Understand Magnetic properties of Transition Metal Complexes
CO3:	Interpret the Electron Spectra of Transition Metal Complexes
CO4:	Get comprehensive knowledge of Thermodynamic and Kinetic Aspects of Metal Complexes
CO5:	Obtain knowledge of Organometallic Chemistry

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO's	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	L	-	-	-	-	M	-	M	M	M
CO2	L2	M	M	M	-	-	-	-	M	-	M	M	H
CO3	L2	M	M	L	-	-	-	-	M	L	L	L	M
CO4	L2	M	M	L	-	-	-	-	M	L	H	M	M
CO5	L2	M	M	M	-	-	-	-	M	L	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO2, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC 404 : Algebra

Course Objective

- To understand about Groups and Subgroups.
- To know about Normal subgroups and Quotient Groups.
- To develop an understanding of Rings and Subrings.
- To understand about the Ideals and Fields.
- To understandVector Space and sub spaces.

Course Contents:

Unit I: Definition and simple properties of Groups and Subgroups. Permutation group, Cyclic group, Cosets, Lagrange's theorem on the order of subgroups of a finite order group.

Unit II: Morphism of groups. Cayley's theorem.Normal subgroups and Quotient groups.Fundamental theorems of Isomorphism.

Unit III: Definition and simple properties of Rings and Subrings. Morphism of rings.Embedding of a ring, intergral domain and field.Characteristics of a Ring and Field.

Unit IV: Ideals and Quotient Ring. Maximal ideal and Prime ideal.Principal Ideal domain.Field of quotients of an integral domain.Prime fields.Definition, Examples and Simple properties of Vector spaces and Subspaces.

Unit V: Linear combination, Linear depends and Linear independence of vectors. Basis and Dimension.Generation of subspaces.Sum of subspaces.Direct sum and Complement of subspaces.Quotient space and its dimension.

Reference Books:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4^{th} Edition), Narosa Publishing House, New Delhi, 1999 (IX Edition 2010).
2. S Lang, Introduction to Linear Algebra (2^{nd} edition), Springer, 2005.
3. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
4. S. Kumaresan, Linear Algebra-A Geometric Approach, Prentice Hall of India, 1999.
5. Kenneth Hoffman, Ray Alden-Kunze, Linear Algebra 2^{nd} Ed. Prentice- Hall of India Pvt. Ltd. 1971.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	understandthe theory of Groups and Subgroups.
CO2:	KnowNormal subgroups and Quotient Groups
CO3:	Use the principles of Rings and Subrings.
CO4:	Understand about the Ideals and Fields.
CO5:	understand Vector Space and sub spaces

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**Blooms Level**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L3	M	H	H	H	M	H	H	H	H
CO2	L3	M	H	H	M	M	M	H	H	H
CO3	L3	M	H	H	M	M	M	H	H	H
CO4	L3	M	H	H	M	M	M	H	H	H
CO5	L1	H	H	H	H	M	H	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 405A: MATHEMATICAL PHYSICS AND SPECIAL THEORY OF RELATIVITY

Course Objective:

- To acquire proficiency in doing calculations with gradient, divergence, curl.
- To gain ability to learn four vector formulation.
- To know transformation between laboratory and center of mass system.
- To find electric field measured in moving frames.
- To review the concepts of mathematical physics.

Course Contents:

Unit I: **Orthogonal curvilinear coordinate system:** Scale factors, expression for gradient, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate, coordinate transformation and Jacobian, transformation of covariant, contra-variant and mixed tensor, addition, multiplication and contraction of tensors, metric tensor and its use in transformation of tensors, Dirac delta function and its properties.

Unit II: **Lorentz transformation:** Length contraction, Time dilation, Mass variation, rotation in space-time like and space like vector, world line, macro- causality, four vector formulation, energy momentum four vector, relativistic equation of motion, invariance of rest mass, orthogonality of four force and four velocity, Lorentz force as an example of four force.

Unit III: **Transformation of four frequency vector:** Longitudinal and transverse Doppler's effect, transformation between laboratory and center of mass system, four momentum conservation, kinematics of decay products of unstable particles and reaction thresholds, Pair production, inelastic collision of two particles, Compton effect.

Unit IV: **Transformation of electric and magnetic fields between two inertial frames:** Electric field measured in moving frames, electric field of a point charge moving with constant velocity, the second order linear differential equation with variable coefficient and singular points, series solution method and its application to the Hermite's, Legendre's and Laguerre's differential equations, basic properties like orthogonality, recurrence relation, graphical representation and generating function of Hermite, Legendre, Laguerre functions (simple applications).

Unit V: **Techniques of separation of variables and its application to boundary value problems:** (i) Laplace equation in three dimensional Cartesian coordinate system-line charge between two earthed parallel plates, (ii) Helmholtz equation in circular cylindrical coordinates- cylindrical resonant cavity, (iii) Wave equation in spherical polar coordinates- the vibrations of a circular membrane, (iv) Diffusion equation in two dimensional Cartesian coordinate system- heat conduction in a thin rectangular plate, (v) Laplace equation in spherical coordinate system-electric potential around a spherical surface.

Reference Books:

1. Mathematical Methods for Physicists, Arfken, Weber, Harris, Elsevier, 2005.
2. Fourier Analysis, M. R. Spiegel, Tata McGraw-Hill, 2004.
3. Mathematics for Physicists, Susan M. Lea, Thomson Brooks/Cole, 2004.
4. An Introduction to Ordinary Differential Equations, Earl A Coddington, PHI Learning, 1961.
5. Differential Equations, George F. Simmons, Tata McGraw-Hill, 2006.
6. Essential Mathematical Methods, K. F. Riley and M. P. Hobson, Cambridge University Press, 2011.
7. Partial Differential Equations for Scientists and Engineers, S. J. Farlow, Dover Publications, 1993.
8. Mathematical methods for Scientists and Engineers, D. A. McQuarrie, Viva Books, 2003.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand orthogonal curvilinear coordinate system.
CO2:	Analysis rotation in space-time like and space like vector.
CO3:	Analysis kinematics of decay products of unstable particles.
CO4:	Understand transformation of electric and magnetic fields between two inertial frames.
CO5:	Apply techniques of separation of variables.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	BLOOMS LEVEL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	H	H	L	L	L	-	L	-	H	M	M
CO2	L4	M	L	-	M	M	L	M	M	-	M	L	-
CO3	L4	L	-	M	L	L	-	L	L	L	L	L	M
CO4	L2	M	L	H	H	-	L	M	M	M	M	-	H
CO5	L3	L	L	M	L	M	L	L	L	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO5

BSC 405B: ANALOG SYSTEMS AND APPLICATIONS

Course Objective

- To learn basic concepts of semiconductor diodes.
- To learn about junction transistor and their applications.
- To learn about different types of amplifiers.
- To learn about sinusoidal oscillators.
- To understand various analog systems.

Course Contents:

Unit I: **Semiconductor Diodes:** P and N type semiconductors. Energy Level Diagram.Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode.Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.

Unit II: **Two-terminal Devices and their Applications:** (1) Rectifier Diode: Half-waveRectifiers.

Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell. **Bipolar Junction transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CEand CC Configurations.Current gains α and β Relations between α and β. Load Line analysis of Transistors.DC Load line and Q-point.Physical Mechanism of Current Flow.Active, Cutoff and Saturation Regions.

Unit III: **Amplifiers:** Transistor Biasing and Stabilization Circuits. Fixed Bias and VoltageDivider Bias.Transistor as 2-port Network.h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains.

Classification of Class A, B & C Amplifiers.Coupled Amplifier:Two stage RC-coupled amplifier and its frequency response.

Unit IV: **Feedback in Amplifiers:** Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.**Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency.Hartley &Colpitts oscillators.**Operational Amplifiers (Black Box approach):** Characteristics of an Ideal andPractical Op-Amp. (IC 741) Open-loop and Closed-loop Gain.Frequency Response.CMRR. Slew Rate and concept of Virtual ground. 154

Unit V: **Applications of Op-Amps:** (1) Inverting and non-inverting amplifiers, (2) Adder, (3)Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossingdetector (8) Wein bridge oscillator. Conversion:Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation).

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan& N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., OxfordUniversity Press.
7. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
8. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
9. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
10. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand mechanism in forward and reverse biased diode
CO2:	Analysis two-terminal devices and their applications.
CO3:	Understand transistor biasing and stabilization circuits.
CO4:	Analysis effects of positive and negative feedback on input impedance.
CO5:	Analysis applications of Op-Amps.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	M	-	H	M	M	-	M	H	L	M	L
CO2	L4	L	-	M	L	L	M	L	M	-	M	H	M
CO3	L2	M	M	H	H	H	L	H	L	L	H	M	M
CO4	L4	M	M	L	M	-	M	M	L	-	M	L	M
CO5	L4	H	L	H	M	L	H	M	L	H	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO4

BSC 406A: Functional Groups Chemistry-II

Course Objectives:

- To impart the basic knowledge of Ethers, Epoxides, Proteins and Nucleic Acids and their synthesis
- To learn the synthesis, physical and chemical properties of Organosulphur Compounds and Organic Compounds of Nitrogen.

Course Contents:

Unit-I: Ethers and Epoxides:

Methods of formation, *Physical properties, chemical reaction cleavage and autooxidation Ziesel's method.*

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxides ring opening, reactions of Grignard and organolithium reagents with epoxides.

Unit-II: Organic Synthesis via Enolates: Acidity of a-hydrogens in neactive methylene compounds, alkylation of diethyl malonate and ethyl acetoacetate. Claisen condensation, Keto-enoltautomerism in ethyl acetoacetate.Synthetic applications of ethyl acetoacetate and malonic ester.

Unit-III: Amino Acides, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids.Acid-base behaviour, isoelectric point and electrophoresis.Preparation and reactions of a-amino acids.

Structure and nomenclature of peptides and proteins.Classification of proteins. Peptide structure determination, end-group analysis, selective hydrolysis of peptides. Classical peptide synthesis.Solid-phase peptide synthesis.

Nucleic acids – introduction, constituents of nucleic acids – nucleosides and nucleotides.

Unit-IV: Organosulphur Compounds:

Nomenclature, structural features, features, methods of formation and chemical reactions of thiols, sulphonic acids, sulphonamides and Sulpha drugs: sulphaguanidine, sulphadiazine (sulphapyrimidine), sulphamethoxazole, sulphacetamide.

Synthetic Polymers:

Addition or chain-growth polymerization.Free radical and ionic polymerization.Ziegler-Natta Catalyst Condensation or step-growth polymerization.Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes.Natural and synthetic rubber.

Synthetic Dyes:

Colour and constitution (electronic concept).Classification of dyes. Chemistry and synthesis of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

Unit-V: Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes.Chemical reactions of nitroalkanes.Mechanisms of nucleophilic substitutions in nitroarenes and their reductions in acidic, neutral and alkaline media.Picric acid.

Amines: Structure, nomenclature and preparation of alkyl, and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Physical properties, stereochemistry of amines.Separation of a mixture of primary, secondary and tertiary amines.Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Gabricl phthalimide reaction and Haffmann bromamide reaction with mechanism.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.Diazotisation and mechanism. Synthetic transformation of aryl diazonium salts, azocoupling and its applications.

Reference Books:

1 Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).

2 McMurry, J.E. *Fundamentals of Organic Chemistry*, 7thEd. Cengage Learning India Edition, 2013.

3 Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).

4 Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.

5 Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.

6 Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

7 Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).

8 Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

9 Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).

10 Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).

11 Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Understand the properties and synthesis of Ethers and Epoxides
CO2:	Understand Organic Synthesis via Enolates
CO3:	Learn aboutAmino Acides, Peptides, Proteins and Nucleic Acids
CO4:	Understand the Organosulphur Compounds.
CO5:	Obtain the knowledge aboutOrganic Compounds of Nitrogen

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	L	-	-	-	-	M	-	L	M	M
CO2	L2	M	M	L	-	-	-	-	M	-	H	L	M
CO3	L2	L	M	M	L	L	-	L	L	L	M	H	M
CO4	L2	M	M	M	L	L	-	L	M	L	H	M	H
CO5	L2	M	M	M	L	L	-	L	M	L	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO2,CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO4, CO5

BSC406B: Chemical Technology & Society

Course Objective:

- To understand the use of basic principles of chemical technology.
- To introduce the scope of different equipments needed in chemical technology.
- To develop scientific solutions for societal needs.
- To learn about energy from natural sources.
- To acquire the knowledge of proteins and nucleic acids.

Course Contents:

Unit-I: Chemical Technology:

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid liquid extraction, separation by absorption and adsorption.

Unit -II: An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry.Introduction to clean technology.

Unit -III: Society:

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants).

Unit -IV: Energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues.

Unit -V: Proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

Reference Books:

1 John W. Hill, Terry W. McCreary & Doris K. Kolb, *Chemistry for changing times*13th Ed.

Course Outcomes:

At the end of the course, the students will be able to:

CO1:	Understand the basic principles of chemical technology.
CO2:	Know the scope of different equipments needed in chemical technology.
CO3:	Develop scientific solutions for societal needs.
CO4:	Learn about energy from natural sources.
CO5:	Acquire the knowledge of proteins and nucleic acids.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	-	L	L	-	L	M	-	H	M	H
CO2	L2	M	M	M	L	L	M	L	M	M	H	M	H
CO3	L4	M	M	-	-	-	-	L	M	M	H	M	H
CO4	L2	M	M	-	-	-	-	L	M	M	H	M	H
CO5	L2	L	L	-	-	-	-	L	L	M	H	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO4

BSC 407A: ANALYTICAL GEOMETRY

Course Objective

- To understand about polar equation of conics and polar equation of tangent.
- To know aboutsphere, cone, cylinder.
- To develop an understanding ofcentral conicoids.
- To understand aboutreduction of a general equation of second degree in three-dimensions to standard forms.
- Learn techniques for sketching parabola, ellipse and hyperbola.

Course Contents:

Unit I : Polar equation of conics, Polar equation of tangent, normal and asymptotes, chord of contact, auxiliary circle, director circle of conics

Unit II : Sphere, Cone, Cylinder

Unit III: Central Conicoids _ Ellipsoid, Hyperboloid of one and two sheets, tangent line and tangent planes, Direct sphere, Normals.

UnitIV: Generating line of hyperboloid of one sheet and its properties. Reduction of a general equation of second degree in three-dimensions to standard forms.

Unit V: Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Know about the basicsof conics.
CO2:	Use the concepts of sphere, cone and cylinder.
CO3:	Understand about tangent line and tangent planes, direct sphere and normals.
CO4:	Understandreduction of a general equation of second degree in three-dimensions to standard forms.
CO5:	Learn techniques for sketching parabola, ellipse and hyperbola

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	M	H	H	M	M	M	H	M	H	M	M	L
CO2	L3	M	H	H	H	M	M	H	M	H	L	L	M
CO3	L3	M	H	H	M	H	H	H	H	H	M	M	L
CO4	L3	M	H	H	M	H	H	H	H	H	L	L	M
CO5	L2	M	H	H	M	M	M	H	M	H	M	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 407 B: MATRICES

Course Objective

- To Learn basic concepts of Vector Space.
- To Learn aboutBasis and dimension.
- To Learn aboutquotient spaces and linear transformation.
- To Learn abouteigen values and eigen vectors.
- To understand the Rank of Matrix.

Course Contents:

Unit-I: Vector spaces, Subspaces, algebra of subspaces, R, R2, R3 as vector spaces over R subspaces, linear combination of vectors, linear span, linear independence.

Unit-II: Basis, Standard basis for each of R, R2, R3 and dimension, dimension of subspaces.

Unit-III: Quotient spaces , Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.

Unit-IV: Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Unit-V: Rank of matrix. Solutions of a system of linear equations using matrices.Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Reference Books:

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall ofIndia Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill,1989.
4. Sarangi, K.C., Elements of Abstract Algebra, Ramesh Book Depot, 2005.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Apply basic knowledge of Vector Space.
CO2:	Understand about Basis and dimension
CO3:	Understand aboutquotient spaces and linear transformation
CO4:	Understandeigen values and eigen vectors.
CO5:	understand the Rank of Matrix and its application

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	M	H	H	H	M	H	H	H	H	M	M	L
CO2	L3	M	H	H	M	M	M	H	M	H	L	L	M
CO3	L3	M	H	H	H	H	H	H	H	H	M	M	L
CO4	L3	M	H	H	H	M	H	H	H	H	L	L	M
CO5	L2	M	H	H	H	M	H	H	H	H	M	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 408: PHYSICS LAB-IV

Course Objective

- To understand Malus Law for plane polarized light.
- To determine wave length of monochromatic light.
- To understand the wave phenomena of light.
- To understand transmission coefficient.
- To understand resolving power of a Telescope.

List of experiments:

1. To determine the wave length of prominent lines of mercury by plane diffraction grating with the help of spectrometer.
2. To verify Malus Law (Cosine square law) for plane polarized light with the help of a Photovoltaic cell.
3. To measure the numerical aperture of an optical fibre.
4. Measurementof Propagation and bending loss in an optical fibre.
5. To determine the transmission coefficient by using Lummer Brodhum Photometer.
6. To determine wavelength of sodium light using Biprism.
7. To determine the wave length of monochromatic light with the help of Michelson's interferometer.
8. To determine the wave length of sodium light by Newton's Ring.
9. To determine resolving power of a Telescope.
10. To determine the specific rotation of glucose using Polarimeter.

Reference Books:

1. B. L. Flint and H. T. Worsnop "Advanced Practical Physics for students", Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn "Advanced level Physics Practicals" 4th Edition, reprinted, Heinemann Educational Publishers, 1985.
3. S. Panigrahi& B. Mallick "Engineering Practical Physics" Cengage Learning India Pvt. Ltd., 2015.
4. InduPrakash and Ramakrishna "A Text Book of Practical Physics" 11th Edition, KitabMahal, New Delhi, 2011.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Understand working of plane diffraction grating with the help of spectrometer.
CO2:	Evaluate numerical aperture of an optical fibre.
CO3:	Analysis specific rotation of glucose using polarimeter.
CO4:	Analysis propagation and bending loss in an optical fibre.
CO5:	In the laboratory course, student will gain hands-on experience of using various instruments.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	L	L	H	L	-	M	H	-	-	H	M	M
CO2	L5	L	H	M	H	L	L	M	M	H	M	H	L
CO3	L4	L	L	M	M	M	L	-	L	L	M	H	M
CO4	L4	-	L	-	L	L	H	L	M	H	M	L	L
CO5	L3	H	H	H	L	H	L	H	M	-	H	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 409: Chemistry Lab-IV

Course Objective:

- To acquire the skills of preparation of some inorganic and organic compounds and Stereochemical Study.
- To understand the extraction and separation methods.

Inorganic Chemistry

Synthesis and Analysis of:

(a) Potassium trioxalatoferrate (III), $K_3[Fe(C_2O_4)_3]$

(b) Bis (dimethyloximato) nickel (II) complex, $[Ni(DMG)_2]$

(c) Tetra ammonia copper (II) sulphate, $[Cu(NH3)_4]SO_4$

(d) Potassium cis-diaquabis (oxalato) chromate (III) dehydrate, K[cis-$Cr(H_2O)_2(C_2O_4)2]2H_2O$ Instrumentation

Calorimetry

(a) Job's

(b) Mole-ration method

Adulteration-Food stuffs

Effluent analysis water analysis

Solvent Extraction

Separation and estimation of Mg (II) and Fe (II)

Ion Exchange Method

Separation and estimation of Mg (II) and Fe (II)

Organic Chemistry

Laborntory Techniques

Steam Distillation

Naphthalene from its suspension in water

Clove oil from Clove

Separation of o- and p-nitrophenols

Column Chromatography

Separation of florescein and methylene blue

Separation of leaf pigments from spinach leaves

Resolution of recemic mixture of (+) medelic acid

Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, for separation and preparation of suitable derivatives.

Synthesis of Organic Compounds

(a) Acerylation of salieylic acid, aniline, glucose and hydroqulone.
Benzoylation of aniline and phenol

(b) Aliphatic electrophilic substitution
Preparation of idoform from ethanol and acetone

(c) Aromatic electrophilic substitution
Nitration
Preparation of m-dinitrobenzene
Preparation of p-nitroacetanilide
Halogenations
Preparation of p-bromoacetanilide
Preparation of 2, 4, 6 – tribromophenol

(d) Diazotization / cupling
Preparation of methyl orange and methyl red

(e) Oxidation
Preparation of benzonic acid from toluene

(f) Reduction
Preparation of aniline from nitrobenzene
Preparation of m-nitroaniline from m-dinitrobenzene.

Stereochemical Study of Organic Compounds via Models

R and S configuration of optical isomers.

E, Z configuration of geometrical isomers.

Conformational analysis of cyclohexanes and substituted cyclohexames.

Reference Books:

1 Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.

2 Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Acquire the skills of preparation of some inorganic and organic compounds and Stereochemical Study.
CO2	Understand and apply the extraction and separation methods

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L5	M	L	L	L	L	-	L	M	M	H	H	H
CO2	L5	M	M	M	L	L	-	L	M	M	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	CO1, CO2
CD3	Experiments	CO1, CO2
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 410: MATHEMATICS LAB-IV

Course Objective

- To understandmatrix operations.
- To knowrank of matrix, inverse of a matrix.
- To understand the solution of linear algebraic equations by Gauss elimination methods.
- To understandplotting of the curve.
- To understand phenomena of tracing parabola, ellipse and hyperbola.

List of experiments:

1. Matrix operations: addition, subtraction, multiplication,
2. Find Rank of a matrix,
3. Find Inverse of a matrix.
4. Solution of linear algebraic equations by Gauss elimination methods,
5. Solution of linear algebraic equations by Matrix method,
6. Solution of linear algebraic equations by Gauss Jordan method.
7. Plotting of the curve parabola,
8. Plotting of the curve ellipse
9. Plotting of the curve hyperbola.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Use matrix operations.
CO2:	Findrank of matrix, inverse of a matrix.
CO3:	Find theinverse of a matrix.
CO4:	ApplyGauss elimination methods, matrix method, Gauss Jordan method to solve linear algebraic equations.
CO5:	Understand tracing parabola, ellipse and hyperbola.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L4	M	H	H	H	M	H	H	M	H	M	M	L
CO2	L4	H	H	H	H	H	H	H	H	H	L	L	M
CO3	L3	M	H	H	H	M	H	H	M	H	M	M	L
CO4	L2	H	H	H	H	H	H	H	H	H	L	L	M
CO5	L4	H	H	H	H	H	H	H	H	H	M	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	CO1, CO2, CO3, CO4, CO5

BSC 411: ANANDAM-IV

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be excepted to engage in individual and group acts of service and goodness.

Action Plan: Students will be expected to

1. Do at least one act of individual service each day
2. Record this act of service in a dedicated Register / Personal Diary
3. Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
4. Undertake one group service project for 64 hours every semester (outside college hours)
5. Upload the report on the group project on the Anandam platform
6. Participate in a sharing and presentation on the group service in the discussion sessions held once in week
7. There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

8. Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Semester-V

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Ability Enhancement/ Liberal Course								
BSC 501	Leadership & Management Skills	AEC	2	-	-	30	70	100	2
	Core Course								
BSC 502	Electronics and Solid State Devices	CC	4	-	-	30	70	100	4
BSC 503	Quantum Chemistry, Phase Equilibrium, Photochemistry & Solutions	CC	4	-	-	30	70	100	4
BSC 504	Discrete Mathematics	CC	4	-	-	30	70	100	4
BSC 505	**Discipline Specific Elective-5A (Choose any one)**								
BSC 505A	Quantum Mechanics	DSE	3	-	-	30	70	100	3
BSC 505B	Digital Systems and Applications	DSE	3	-	-	30	70	100	3
BSC 506	**Discipline Specific Elective-5B (Choose any one)**								
BSC 506A	Inner Transition Elements, HSAB, Redox & Bio-Inorganic Chemistry	DSE	3	-	-	30	70	100	3
BSC 506B	Green Chemistry	DSE	3	-	-	30	70	100	3
BSC 507	**Discipline Specific Elective-5C (Choose any one)**								
BSC 507A	Complex Analysis	DSE	3	-	-	30	70	100	3
BSC 507B	Linear Programming	DSE	3	-	-	30	70	100	3
PRACTICALS/VIVA-VOCE			**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
	Core Course								
BSC 508	Physics Lab-V	CC	-	-	4	60	40	100	2
BSC 509	Chemistry Lab-V	CC	-	-	4	60	40	100	2
BSC 510	Mathematics Lab-V	CC	-	-	4	60	40	100	2
Courses based on Life Skill and Social-Industry connect									
BSC 511	Anandam -V	AC	-	-	4	50	50	100	2
TOTAL			**23**	**-**	**16**	**440**	**660**	**1100**	**31**

BSC 501: LEADERSHIP AND MANAGEMENT SKILLS

Course Objective

- Help students to develop essential skills to influence and motivate others.
- Inculcate emotional and social intelligence and integrative thinking for effective leadership.
- Create and maintain an effective and motivated team to work for the society.
- Nurture a creative and entrepreneurial mindset.
- Make students understand the personal values and apply ethical principles in professional and social contexts.

Course Contents:

Unit-I: **Leadership Skills:** Understanding Leadership and its Importance: What is leadership?, Why Leadership required?, Whom do you consider as an ideal leader?, Traits and Models of Leadership: Are leaders born or made?, Key characteristics of an effective leader, Leadership styles, Perspectives of different leaders, Basic Leadership Skills: Motivation, Team work, Negotiation, Networking.

Unit-II: **Managerial Skills:** Basic Managerial Skills: Planning for effective management, How to organise teams?, Recruiting and retaining talent, Delegation of tasks, Learn to coordinate, Conflict management, Self-Management Skills: Understanding self-concept, Developing self-awareness, Self-examination, Self-regulation.

Unit-III: **Entrepreneurial Skills:** Basics of Entrepreneurship: Meaning of entrepreneurship, Classification and types of entrepreneurship, Traits and competencies of entrepreneur, Creating Business Plan, Problem identification and idea generation, Idea validation, Pitch making.

Unit IV: **Innovative Leadership and Design Thinking:** Innovative Leadership: Concept of emotional and social intelligence, Synthesis of human and artificial intelligence, Why does culture matter for todays, global leaders, Design Thinking: What is design thinking?, Key elements of design thinking: Discovery, Interpretation, Ideation-Experimentation - Evolution. How to transform challenges into opportunities?, How to develop human-centric solutions for creating social good?

Unit V: **Ethics and Integrity:** Learning through Biographies: What makes an individual great?, Understanding the persona of a leader for deriving holistic inspiration, Drawing insights for leadership, How leaders sail through difficult situations?, Ethics and Conduct: Importance of ethics, Ethical decision making, Personal and professional moral codes of conduct, Creating a harmonious life.

Reference Books:

1. Ashokan, M. S. (2015). Karmayogi: A Bbiography of E. Sreedharan. Penguin, UK.
2. Brown, T. (2012). Change by Design. Harper Business
3. Kalam A. A. (2003). Ignited Minds: Unleashing the Power within India. Penguin Books India
4. Kelly T., Kelly D. (2014). Creative Confidence: Unleashing the Creative Potential Within Us All. WilliamCollins
5. McCormack M. H. (1986).What They Don't Teach You at Harvard Business School: Notes From A Street-Smart Executive. RHUS
6. Sternberg R. J., Sternberg R. J., & Baltes P. B. (Eds.). (2004). International Handbook of Intelligence.Cambridge University Press.

E-Resources

- India's Hidden Hot Beds of Invention Ted Talk by Anil Gupta - https://www.ted.com/talks/anil_gupta_india_s_hidden_hotbeds_of_invention
- Knowledge@ Wharton Interviews Former Indian President APJ Abdul Kalam - ." A Leader Should Know How to Manage Failure " https://www.youtube.com/watch?v=laGZaS4sdeU
- NPTEL Course on Leadership - https://nptel.ac.in/courses/122105021/9

Course outcomes:

At the end of the course, the student will be able to:

CO1	Examine various leadership models and understand/assess their skills, strengths and abilities that affect their own leadership style and can create their leadership vision.
CO2	Learn and demonstrate a set of practical skills such as time management, self-management, handling conflicts, team leadership, etc.
CO3	Understand the basics of entrepreneurship and develop business plans.
CO4	Apply the design thinking approach for leadership.
CO5	Appreciate the importance of ethics and moral values for making of a balanced personality.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	L	H	M	M	M	M	L	L	L	L	L
CO2	L2	H	H	M	-	H	H	-	M	M	M	L	M
CO3	L2	L	M	L	M	L	M	L	M	-	M	L	H
CO4	L4	M	H	-	L	M	L	M	-	M	L	L	M
CO5	L4	H	M	M	M	L	M	M	L	L	H	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO5

BSC 502: ELECTRONICS AND SOLID STATE DEVICES

Course Objective

- To understand formation of PN junction.
- To understand voltage stabilization.
- To know applications of Transistor.
- To understand concept of feedback.
- To understand criteria for self-excited and self-sustained oscillation.

Course Contents:

Unit I: **Circuit Analysis:** Networks- Some important definitions, loop and nodal equation based on D. C. and A. C. circuits (Kirchhoffs laws), Four terminal network: Ampere volt conventions, open, close and hybrid parameters of any four terminal network, Input, output and mutual impendence for an active four terminal network.Various circuit theorems: Superposition, Thevenin, Norton, reciprocity, compensation, maximum power transfer and Miller theorems.

Unit II: **PN junctions and Rectifiers:** Charge densities in N and P materials, Conduction by drift and diffusion of charge carriers, PN diode equation, capacitance effects.**Rectifiers:** Basic idea of Half-wave, full wave and bridge rectifier, calculation of ripple factor, efficiency and regulation, Filters, series inductor, shunt capacitor, L-section and π-section filters, Voltage regulation: Voltage regulation and voltage stabilization by Zener diode, voltage multiplier.

Unit-III: **Transistors:** Notations and volt-ampere characteristics for bipolar Junctions transistor, Concept of load line and operating point, Hybrid parameters, CB, CE, CC configurations, Junction field effect transistor (JEFT) and metal oxide semiconductor field effect transistor (MOSFET), Circuit symbols, biasing and volt-ampere characteristics, source follower operation of FET as variable voltage resister.Transistor biasing: Need of bias and stability of Q point, stability factors, and various types of bias circuits for thermal bias stability, fixed bias, collector to base feedback bias and four resistor bias.

Unit-IV: **Amplifiers:**Analysis of transistor amplifiers using hybrid parameters and its gain-frequency response, Cascade amplifiers, basis idea of direct coupled and RC coupled amplifiers, Amplifier with feedback: Concept of feedback, positive and negative feedback, voltage and current feedback circuits, Advantage of negative feedback, Stabilization of gain effect of negative feedback on output and input resistance, reduction of nonlinear distortion, effect on gain- frequency response.

Unit-V: **Oscillators and Logic Circuits:** criteria for self-excited and self-sustained oscillation, circuit requirement for build- up of oscillation, basic transistor oscillator circuit and its analysis, Colpitt's and Hartely oscillators, RC Oscillators.**Logic circuits:** Logic fundamentals, AND, OR, NOT, NOR, NAND, XOR gates, Boolean algebra, De Morgan's theorem, positive and negative logic, logic gates circuit realization using DTL and TTL logic, simplification of Boolean expressions.

Reference Books:

1. J. Millman and C. C. Halkias, Integrated Electronics, Tata Mc-Graw Hill, 1991.
2. S. Salivahanan and N. Suresh Kumar, Electronic devices and circuits, Tata Mc-Graw Hill, 2012.
3. M. H. Rashid, Microelectronic Circuits, 2nd Edn.,Cengage Learning, 2011.
4. Helfrick& Cooper, Modern Electronic Instrumentation & Measurement Tech., PHI Learning, 1990.
5. A. P. Malvino, D. P. Leach &Saha, Digital Principles & Applications, 7th Ed., Tata McGraw Hill, 2011.
6. A. S. Sedra, K. C. Smith, A. N. Chandorkar, Microelectronic circuits, 6thEdn., Oxford University Press, 2014.
7. A. Anand Kumar, Fundamentals of Digital Circuits, 2nd Edition, PHI Learning Pvt. Ltd., 2009.
8. R. A. Gayakwad, OP-AMP and Linear Digital Circuits, PHI Learning Pvt. Ltd., 2000.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand formation of PN junction.
CO2	Analysis stabilization by Zener diode.
CO3	Understand concept of load line and operating point.
CO4	Analysis of transistor amplifiers using hybrid parameters.
CO5	Understand criteria for self-excited and self-sustained oscillation.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	H	H	H	L	L	-	M	L	L	L	H	L
CO2	L2	M	L	H	-	L	M	-	-	H	M	M	M
CO3	L3	L	M	H	L	M	M	-	L	-	M	L	M
CO4	L2	M	-	H	-	L	M	-	-	M	M	L	H
CO5	L4	-	L	M	L	L	M	L	L	-	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO5

BSC 503: Quantum Chemistry, Phase Equilibrium, Photochemistry & Solutions

Course Objective:

- To learn about Quantum Mechanics
- To develop an understanding of Molecular Orbital Theory and Phase Equilibrium.
- To understand the Photochemistry
- To impart the basic knowledge of Solutions, Dilute Solutions and Colligative Properties.

Course Contents:

Unit-I: Elementary Quantum Mechanics:

Black-body, radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's mode of hydrogen atom (no derivation) and its defects. Compton effect.

De Broglie hypothesis, the Hisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function postulates of quantum mechanics, particle in a one dimensional box.

Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions.Radial wave functions, angular wave functions.

Unit-II: Molecular Orbital Theory:

Basic ideas-criteria for forming M.O. from A.O. construction of M.O's by LCAO-H_2 ion calculation of energy level from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics. Hybrid orbitals – sp, sp^2, sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals.

Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

Unit-III: Phase Equilibrium: Statement and meaning of the terms: phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, CO_2 and sulphur systems.

Phase euqilibria of two component system – Solid-liquid equilibria simple eutectic Bi-Cd, Pb- Ag systems, desilverisation of lead.

Solid solutions – Compound formation with.Congruent melting point (Mg-Zn) and incongruent melting point.(NaCl-H_2O) system.Freezing mixture acetone-dry ice.

Liquid – Liquid mixtures: Ideal liquid mixtures Raoult's and Henry's law non ideal system-azeotropes, HCI-H_2O and ethanol-water system. Partially miscible Liquids: phenol-water. Lower and upper consolute temperature.Effect of impurity on consolute temperature Nernst Distribution law – thermodynamic derivation, applications.

Unit-IV: Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the exited sate, qualitative description of fluorescence, phosphorescence non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

Physical properties and Molecular Structure

Optical activity, polymerization – (Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetic.

Unit-V: Solutions, Dilute Solutions and Colligative Properties:

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point.Experimental methods for determining various colligative properties.Abnormal molar mass, degree of dissociation and association of solutes.

Reference Books:

1 Banwell, C. N. &McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).

2 Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).

3 House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).

4 Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).

5 Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).

Course Outcomes:

By the end of the course, the students will be able to:

CO1	Learn the Quantum Mechanics
CO2	Develop an understanding of Molecular Orbital Theory
CO3	Understand the Phase Equilibrium
CO4	Obtain the basic knowledge of Photochemistry
CO5	Impart the basic knowledge of Solutions, Dilute Solutions and Colligative Properties..

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	H	H	H	-	L	M	L	H	M	H
CO2	L2	M	M	H	H	H	-	L	M	L	M	L	M
CO3	L2	M	M	H	L	M	-	L	M	L	M	L	M
CO4	L5	H	H	H	H	H	H	M	M	H	H	M	H
CO5	L2	M	M	M	L	L	-	L	M	L	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC 504: DISCRETE MATHEMATICS

Course Objective

- To understand various relations and functions.
- To understandboolean algebra.
- To knowlogic and propositional calculus.
- To understand basic concepts of graph theory.
- To understand criteria forMatrix representation of graphs.

Course Contents:

Unit-I: Sets, Cardinality, Principal of inclusion and exclusion, Mathematical induction, Relations and Functions, Binary relations, Equivalence relations and partitions, Partial order relations and Lattices, Chains and Anti-chains. Pigeon hole principle.

Unit-II: Boolean Algebra- Lattices and Algebraic structure, Duality, Distributive and Complemented Lattices, Boolen Lattices, Bolean functions and Boolean expression.

Fundamental theorem of arithmetic, Divisibility in Z, Congruence's, Chinese reminder theorem, Euler's functions, Primitive roots.

Unit-III: Logic and propositional calculus, Simple and compound propositions, Basic logical operations, Truth tables, Tautologies and contradictions, Propositional functions, Quantifiers. Discrete numeric functions, Generating functions, Recurrence relations and Recurrence algorithms, Linear recurrence relation with constant coefficients and their solutions, Total solutions, Solution by the method of generating functions.

Unit-IV: Basic concepts of graph theory, Types of graph (Connected Graphs, Regular graphs, Planar graphs), walk, Paths & Circuits, Shortest path problem. Operations on graphs (union, join, products)

Unit-V: Matrix representation of graphs, Adjacency matrices, Incidences matrices, Tree, Spanning tree, Minimumm spanning tree, Distance between vertices, Center of tree, Binary thee, Rooted tree. Hamintonian and Eulerian graphs

Reference Books:

1. K.H. Rosen, Discrete Mathematics and it's Applications, McGraw Hill, 1999.
2. N.L. Biggs, Discrete Mathematics, Oxford Science Publication, 1985.
3. C.L.Liu and D.P. Mohapatra, Elements of Discrete Mathematics, Tata McGraw Hill, 2008.
4. T.Koshy, Discrete Mathematics with Applications, Academic Press, 2005.
5. N. Deo, Graph Theory, Prentice Hall of India, New Delhi, 2004.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Know ofbinary relations, equivalence relations and partitions, partial order relations.
CO2	Know of concepts of Boolean algebra.
CO3	Understand logic and propositional calculusand linear recurrence relation with constant coefficients and their solutions.
CO4	Apply theconcepts of graph Theory.
CO5	Find the Adjacency matrices, Incidences matrices, Tree, Spanning tree, Minimum spanning tree.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms LeveL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	H	H	M	M	H	H	H	H	H	M	H
CO2	L3	H	H	H	H	H	M	H	H	H	M	L	M
CO3	L3	H	H	H	H	H	M	H	H	H	M	L	M
CO4	L2	M	H	H	M	M	M	H	H	H	H	M	H
CO5	L3	M	H	H	M	M	H	H	H	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 505A: QUANTUM MECHANICS

Course Objective:

- To understand advanced concepts in quantum physics and their applications.
- To review the concepts of quantum mechanics.
- To develop an understanding of how to model a given problem such as particle in a box.
- To understand the different Quantum systems.
- To understanding the applications of quantum concepts on real world problems.

Course Contents:

Unit I: **Evolution of quantum physics:** Difficulties of classical mechanics to explain: the black-body emission spectrum, specific heat of solids, Plank quanta concept and radiation law, Photo electric effect and Einstein's explanations, Compton Effect, De-Broglie hypothesis, diffraction and interference experiments of particle (Davisson-Germer experiment).Uncertainty principle: position and momentum, angle and angular momentum, energy and time, Application of uncertainly principle: (i) Ground state energy of hydrogen atom, (ii) Ground state energy of simple harmonic oscillator, (ii) Natural width of spectral lines, (iv) Non-existence of electron in nucleus.

Unit II: **Operators and Schrödinger wave equation:** Operators: linear operators, product of two operators, commuting and non-commuting operators, simultaneous eigen functions and eigen values, orthogonal wave functions, Hermitian operators, their eigenvalues, Hermitianadjoint operators, eigenvalues and eigenfunctions, expectation values of operators: position, momentum, energy, Ehrenfest theorem and complementarity, Concept of group and phase velocity, wave packet, Gaussian wave packet, bra-ket notation.Schrödinger wave equation: general equation of wave propagation, propagation of matter waves, time dependent and time-independent Schrödinger equation, wave function representation (ψ), physical meaning of ψ, properties and conditions on ψ, postulates of wave mechanics, operators, observable and measurements, probability current density.

Unit III: **Time independent Schrödinger equation:** stationary state solution, one dimensional problem: particle in one dimensional box, eigenfunctions and eigenvalues, discrete energy levels, generalization into three dimension and degeneracy of energy levels, concept of a potential well and barrier, step potential, penetration through rectangular barrier, reflection and transmission coefficients, barriers with special shapes (graphical representation), quantum mechanical tunneling (alpha decay).

Unit IV: **Schrödinger equation solutions in special cases:** Symmetric square well potential, reflection and transmission coefficients, resonant scattering, Bound state problems: particle in one dimensional infinite potential wall and finite depth potential well, energy eigenvalues and eigenfunctions, transcendental equation and its solution, Simple harmonic oscillator, Schrödinger equation for simple harmonic oscillator and its solution, eigenfunction, eigenvalues, zero point energy, quantum and classical probability density, parity, symmetric and antisymmetric wave functions with graphical representation.**Schrödinger equation in spherical coordinates:** Schrödinger equation for one electron atom in spherical coordinates, separation into

radial and angular variables, solution of radial equation and angular equation, qualitative discussion of spherical harmonics, series solution and energy eigenvalues, stationery state wave function, Wave-functions of H-atom for ground and first excited states, average radius of H-atom, Bohr correspondence principle, orbital angular momentum and its quantization, commutation relation, eigenvalues and eigenfunctions.

Unit V: **H-atom, Atomic and Molecular Spectroscopy:** Energy level derivation for H-atom, quantum features of hydrogen spectra and hydrogen like spectra, Stern-Gerlach experiment, electron spin, spin magnetic moment, spin-orbit coupling, qualitative explanation of fine structure, Franck-Hertz experiment, Zeeman effect, normal Zeeman splitting, Qualitative understanding about Stark effect.**Absorption and Emission Spectroscopy:** its block diagram, brief explanation about function of each element and its limitations, single beam spectrophotometer.**Molecular Spectroscopy:** concept of rigid rotator, rotational energy levels, rotational spectra, selection rules, intensity of spectral lines, isotopic effect, Vibrational energy levels, vibrational spectra, selection rules, isotopic effect, effect of anharmonicity in vibrational spectra, vibrational-rotational spectra of CO and HCI molecules

Reference book:

1. David J. Griffiths, Introduction to Quantum Mechanics, 2nd edition.
2. R. Shankar, Principles of Quantum Mechanics, 2nd edition.
3. Arthur Beiser, Perspective of modem Physics, 6th edition.
4. K. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and application.
5. H. S. Mani, G. K. Mehta, Introduction to modem Physics.
6. C. N. Banwell and E. M. McCash, Fundamental of Molecular Spectroscopy, 4th edition.
7. H. E. White, Introduction to atomic physics,

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand photo electric effect and Einstein's explanations.
CO2:	Apply Operators and Schrödinger wave equation.
CO3:	Analysis stationary state solution.
CO4:	Analysis bound state problems.
CO5:	Apply Schrödinger equation for one electron atom in spherical coordinates.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with ProgramLearning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	M	-	L	L	L	M	L	-	L	H	L
CO2	L3	M	-	L	L	M	M	M	M	-	L	M	M
CO3	L4	H	L	M	M	M	L	L	M	-	H	L	M
CO4	L4	M	H	M	L	-	M	M	-	M	M	L	M
CO5	L3	L	M	L	L	M	L	L	L	L	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO5

BSC 505B: DIGITAL SYSTEMS AND APPLICATIONS

Course Objective

- To acquire skills to understanding the functioning and operation of CRO.
- To learn the basics of IC and digital circuits.
- To learn fundamental of Boolean algebra and their role in constructing digital circuits.
- To understand basics of microprocessor and assembly language programming with examples.
- To learn about combinatorial and sequential systems by building block circuits.

Course Contents:

Unit-I: **CRO and Integrated Circuits:** Introduction to CRO:Block Diagram of CRO. Electron Gun, Deflection System and TimeBase.Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement ofVoltage, Current, Frequency, and Phase Difference. Integrated Circuits(Qualitative treatment only): Active & Passive components.Discretecomponents.Wafer.Chip.Advantages and drawbacks of ICs. Scale of integration: SSI, MSI,LSI and VLSI (basic idea and definitions only). Classification ofICs. Examples of Linear andDigital lCs. 144

Unit-II: **Digital Circuits:** Difference between Analog and Digital Circuits. Binary Numbers.Decimalto Binary and Binary to Decimal Conversion.BCD, Octal and Hexadecimal numbers.AND, ORand NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as UniversalGates.XOR and XNOR Gates and application as Parity Checkers.Boolean algebra:De Morgan's Theorems. Boolean Laws.Simplification of LogicCircuitusing Boolean Algebra.Fundamental Products.Idea of Minterms and Maxterms.Conversion ofa Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) KarnaughMap.

Unit-III: **Data processing circuits**: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. Arithmetic Circuits:Binary Addition. Binary Subtraction using 2's Complement. Half andFull Adders.Half & Full Subtractors, 4-bit binary Adder/Subtractor.Sequential Circuits:SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop.M/S JKFlip-Flop.

Unit-IV: **Timers**: IC 555: block diagram and applications: Astablemultivibrator and Monostablemultivibrator. **Shift registers:** Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallelin-Parallel-out Shift Registers (only up to 4 bits). **Counters (4 bits):** Ring Counter. Asynchronous counters, Decade Counter. SynchronousCounter.**Computer Organization**: Input/output Devices. Data storage (idea of RAM andROM).Computer memory.Memory organization & addressing.Memory Interfacing.MemoryMap.

Unit-V: **Intel 8085 Microprocessor Architecture:** Main features of 8085. Block diagram. Components. Pin-out diagram. Buses.Registers.ALU.Memory. Stack memory. Timing And Control circuitry.Timing states.Instruction cycle, Timing diagram of MOV and MVI.**Introduction to Assembly Language:** 1 byte, 2 byte & 3 byte instructions.

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, TataMcGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics G K Kharate ,2010, Oxford University Press
5. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
6. Logic circuit design, Shimon P. Vingron, 2012, Springer.
7. Digital Electronics, SubrataGhoshal, 2012, Cengage Learning.
8. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill
9. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Understand block diagram of CRO.
CO2:	Analysis analog and digital circuits
CO3:	Understand data processing circuits.
CO4:	Analysis computer memory.
CO5:	Understand Microprocessor and assembly language programming.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	M	-	H	M	M	-	M	H	L	M	L
CO2	L4	L	-	M	L	L	M	L	M	L	M	H	M
CO3	L2	M	M	H	H	H	L	H	L	-	H	M	M
CO4	L4	M	M	L	M	-	M	M	L	M	M	L	M
CO5	L2	H	L	H	M	L	H	M	L	M	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO2, CO4

BSC 506A: Inner Transition Elements, HSAB, Redox& Bio-Inorganic Chemistry

Course Objective:

- To understand the basics of **Hard and Soft Acids and Bases**.
- To get the basics of Lanthanide and **Actinides** Elements.
- To understand the fundamentals of Oxidation and Reduction
- To impart the knowledge of bio-inorganic chemistry and role of metal ions present in biological systems.

Course Contents:

Unit-I: Hard and Soft Acids and Bases (HSAB):

Classification of acids and bases as hard and soft.Pearson's HSAB concept, acid-base strength and hardness and softness.Symbiosis, theoretical basis and hardness and softness, electronegativity and hardness and softness.

Unit-II: Chemistry of Lanthanide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Unit-III: Chemistry of Actinides

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

Unit-IV: Oxidation and Reduction

Use of redox potential data – analysis of redox cycle redox stability in water – Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Unit-V: Bioinorganic Chemistry:

Essential and trace lements to Biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+} Nitrogen fixation.

Inorganic Polymers:

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

Reference Books:

1 James E. Huheey, Ellen Keiter& Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
2 G.L. Miessler& Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
3 J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
4 F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley & Sons.
5 I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S.
6 John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall.
7 R.M. Silverstein, G.C. Bassler& T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley & Sons.
8 R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
9 Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
10 Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

Course Outcomes:

At the end of the course, the students will be able to:

CO1:	Understand the Hard and Soft Acids and Bases.
CO2:	Get the basics of LanthanideElements
CO3:	Learn about **Actinides** Elements
CO4:	Understand the fundamentals of Oxidation and Reduction
CO5:	Impart the knowledge of bio-inorganic chemistry and role of metal ions present in biological systems.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	-	-	-	-	-	M	-	M	M	H
CO2	L2	M	L	-	-	-	-	-	M	-	M	H	H
CO3	L3	M	M	M	L	L	-	-	M	-	L	M	M
CO4	L5	M	M	H	M	L	-	M	M	H	M	M	H
CO5	L4	M	M	H	M	L	M	M	M	H	M	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC506B: Green Chemistry

Course Objective:

- To understand the twelve principles of green chemistry, toxicity, hazard, risk of chemical substances, atom economy and minimization of toxicity.
- To understand benefits of use of catalyst and bio catalyst, green solvents, microwaves and ultrasonic energy.
- To know the ISD, Bhopal Gas Tragedy, and Flixiborough accident.
- To green synthesis of some compounds, microwave assisted reactions in water, ultrasound assisted reactions and surfactants for carbon dioxide.
- To get the skills for designing of environmentally safe marine antifoulant, rightfit pigment, green synthesis of plastic from corn.

Course Contents:

UNIT-I Introduction to Green Chemistry:

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

Principles of Green Chemistry and Designing a Chemical synthesis I:

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (1-2):

1. Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.
2. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

UNIT-II Principles of Green Chemistry and Designing a Chemical synthesis II:

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (3-6):

1. Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
2. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
3. Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.
4. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

UNIT-III Principles of Green Chemistry and Designing a Chemical synthesis II:

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (7-8):

1. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD “What you don’t have cannot harm you”, greener

alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.

2. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

UNIT-IV Examples of Green Synthesis/ Reactions and some real world cases I:

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)

2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction

3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)

4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments.

UNIT-V Examples of Green Synthesis/ Reactions and some real world cases II:

5 Designing of Environmentally safe marine antifoulant.

6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.

7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

8 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils

9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal ontrolled solid state synthesis (C2S3); Green chemistry in sustainable development.

Reference Books:

1 Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).

2 Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).

3 Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).

4 Cann, M.C. &Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).

5 Ryan, M.A. &Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).

6 Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

Course Outcomes:

At the end of this course, students will be able to:

CO1	Understand the all principles of green chemistry.
CO2	Know the benefits of catalysts/ bio catalyst, green solvents, microwaves and ultrasonic energy.
CO3	Understand the ISD and know the facts of Bhopal Gas Tragedy, and Flixiborough accident.
CO4	Know the green synthesis of some compounds, microwave assisted reactions in water, ultrasound assisted reactions and surfactants for carbon dioxide.
CO5	Get the skills for designing of Environmentally safe marine antifoulant, rightfit pigment, green synthesis of plastic from corn.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3
CO1	L2	H	M	L	M	L	-	L	H	M	-	H	H	L	M	M	H
CO2	L2	H	H	M	-	-	-	L	H	H	-	H	H	-	M	M	H
CO3	L2	H	H	M	-	-	-	L	H	H	L	H	H	-	L	M	M
CO4	L3	H	H	M	L	L	-	L	H	H	-	H	H	M	M	M	H
CO5	L6	H	H	M	M	M	-	L	H	H	-	H	H	M	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO4, CO5

BSC 507A : Complex Analysis

Course Objective

- To understandcomplex functions and Analytic functions.
- To understand fundamental theorem of integral calculus for complex functions.
- To understand Taylor's theorem and Laurent's theorem and power series.
- To understand applications ofCauchy's residue theorem.
- To understand bilinear transformation and its properties.

Course Contents:

Unit-I: Complex plane. Connected and Compact sets.Curves and Regions in complex plane. Jordan curve Theorem (statement only). Extended complex plane.Stereographic Projection.Complex value function-Limits Continuity and Differentiability, Analytic functions, Cauchy-Riemann equation (Cartesian and Polar form).Harmonic functions, Construction of an analytic function.

Unit-II: Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function.Morera's theorem, Poisson integral formula Liouville' theorem.

Unit-III: Taylor's theorem. Laurent's theorem.Maximum modulus theorem. Power series-Absolure convergence, Abel's theorem, Cauchy-Hadamard theorem, Circle and Radius of convergence, Analyticity of the sum function of power series.

Unit-IV: Singularities of an analytic function, Branch point. Meromorphic and Entire function, Riemann's theorem, Casorati-Weierstrass theorem.

Residue at a singularity, Cauchy's residue theorem, Argument principle.Rouche's theorem.Fundamental theorem of Algebra.

Unit-V: Conformal mapping. Bilinear transformation and its properties. Elementary mappings: $W(z) = \frac{1}{2}\left(z + \frac{1}{z}\right)$, z^2 , e^z, Sinz, cosz, and logz.

Evaluation of a real definite integral by contour integration.

Analytic continuation.Power series method of analytic continuation.

Reference Books :

1. James Ward Brown and Ruel V. Churhill, Complex Variables and Applications (Eighth Edition), McGraw-Hill International Edition 2009.
2. Joseph Bak and Donald J. Newman, Complex analysis (2nd Edition), Undergraduate Texts in Mathematics, Springer- Verlag New York, Inc., New York 1997.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Know Complex value function and their Limit,Continuity and Differentiability.
CO2:	Know Complex integration and Morera's theorem, Poisson integral formula and Liouville' theorems.
CO3:	UnderstandTaylor's theorem and Laurent's theorem and power series.
CO4:	Use Residue theorem concept and Evaluation of a real definite integral by contour integration
CO5:	Apply bilinear transformation and its properties

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	H	H	H	H	H	H	H	M	H	H	M	H
CO2	L3	M	H	H	M	M	M	H	M	H	M	L	M
CO3	L3	H	H	H	H	H	H	H	M	H	M	L	M
CO4	L3	H	H	H	H	H	H	H	M	H	H	M	H
CO5	L2	M	H	H	M	M	M	H	M	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 507B : LINEAR PROGRAMMING

Course Objective

- To understandLinear Programming Problems.
- To understandconvex sets and hyperplanes.
- To understandsimplex method.
- To understandDuality and formulation of the dual problem.
- To understandassignment and transportation problems.

Course Contents:

Unit-I: Linear Programming Problems, Graphical Approach for Solving some Linear Programs.

Unit-II: Convex Sets, Supporting and Separating Hyperplanes. Theory of simplex method, optimality and unboundedness, the simplex algorithm.

Unit-III: **S**implex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit-IV: Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis.

Unit-V: Assignment and Transportation problems

Reference Books:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research,* 8th Ed., Tata McGraw Hill, Singapore, 2004.
3. Hamdy A. Taha, *Operations Research, An Introduction,* 8th Ed., Prentice-HallIndia, 2006.

Course outcomes:

At the end of the course, the student will be able to:

CO1:	Knowledge of graphical approach for solving some linear programs.
CO2:	Knowledge of theory of simplex method, optimality and unboundedness of solutions to L.P.P.
CO3:	Understandtwo-phase method, Big-M method and their comparison.
CO4:	Understanding of primal- dual relationships in L.P.P.
CO5:	Evaluation of Assignment and Transportation problems

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	H	H	H	M	M	H	H	H	H	H	M	H
CO2	L3	M	H	H	M	M	M	H	L	H	M	L	M
CO3	L4	H	H	H	H	M	M	H	M	H	M	L	M
CO4	L4	H	H	H	H	M	H	H	H	H	H	M	H
CO5	L4	H	H	H	M	L	M	H	H	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 508: PHYSICS LAB-V

Course Objective

- To plot frequency response curve for single stage amplifier.
- To understand application of Diode.
- To plot gain- frequency characteristic of two stage RC coupled amplifier.
- To understand characteristics of MOSFET.
- To characteristics of UJT.

List of experiments:

1. Plot frequency response curve for single stage amplifier and to determine gain bandwidth product
2. Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of I_{dss}&V_p.
3. Application of Diode as clipper & clamper.
4. To study characteristics of Tunnel Diode.
5. Plot gain- frequency characteristic of two stage RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.
6. Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters
7. Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripple factor.
8. Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple factor.
9. To study and plot the characteristics of MOSFET.
10. To plot the characteristics of UJT and UJT as relaxation.

Reference Books:

1. B. L. Flint and H. T. Worsnop “Advanced Practical Physics for students”, Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn “Advanced level Physics Practicals” 4th Edition, reprinted, Heinemann Educational Publishers, 1985.
3. S. Panigrahi& B. Mallick “Engineering Practical Physics” Cengage Learning India Pvt. Ltd., 2015.
4. InduPrakash and Ramakrishna “A Text Book of Practical Physics” 11th Edition, KitabMahal, New Delhi, 2011.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand application of diode as clipper & clamper.
CO2	Analysis characteristics of MOSFET.
CO3	Analysis characteristics of UJT and UJT as relaxation.
CO4	Understand the working half wave rectifier and effect of filters on wave.
CO5	Analysis characteristics of Tunnel Diode.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	H	H	L	L	-	M	L	L	L	H	L
CO2	L4	M	L	H	-	L	M	-	-	M	M	M	M
CO3	L4	L	M	H	L	M	M	-	L	H	M	L	M
CO4	L2	M	-	H	-	L	M	-	-	M	M	L	H
CO5	L4	-	L	M	L	L	M	L	L	L	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiments, Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 509: Chemistry Lab-V
(Select any one group)

Course Objective:

- To learn the skill of conductometry, saponification of ethyl acetate ionization, Refractometry, and Polarimetry, Volumetric and Gravimetric Analysis.
- To get the knowledge and analysis of Molecular Weight Determination andColorimetry.

Group – A

Physical Chemistry

Electrochemistry

(a) To determine the strength of the given acid conductometrically using standard alkai solution.

(b) To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

(c) To study the saponification of ethyl acetate conductometrically.

(d) To determine the ionization constant of a weak acid conductometrically.

(e) To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of Fe^{++}/ Fe^{+++} system on the hydrogen scale.

Refractometry, Polarimetry

(a) To verify the law of refraction of mixture (e.g. of glycerol and water) using Abbe's refractometer.

(b) To determine the specific rotation of a given optically active compound.

Molecular Weight Determination

(a) Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.

(b) Determination of the apparent degree of dissociation of an electrolyte (e.g. NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry

(a) To verify Beer-Lambert law $KMnO_3/ K_2Cr_2O_7$ and determined the concentration of the given solution of the substance.

Inorganic Chemistry

(a) Volumetric Analysis

(b) Gravimetric Analysis

Group - B

GREEN CHEMISTRY LAB

S. No.	Experiments
1	**Safer starting materials** Preparation and characterization of nanoparticles of gold using tea leaves.
2	**Using renewable resources** Preparation of biodiesel from vegetable/ waste cooking oil.
3	**Avoiding waste** Principle of atom economy.
4	Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
5	Preparation of propene by two methods can be studied
6	(I) Triethylamine ion + OH^- → propene + trimethylpropene + water
7	(II) 1-propanol H_2SO_4/Δ propene + water
8	Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.
9	**Use of enzymes as catalysts** Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
10	**Alternative Green solvents** Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice. Mechanochemical solvent free synthesis of azomethines
11	**Alternative sources of energy** Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II). Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books:

1 M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
2 H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
3 F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
4 J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
5 P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
6 L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
7 M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
8 Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Learn the skill of conductometry, saponification of ethyl acetate ionization, Refractometry, and Polarimetry, Volumetric and Gravimetric Analysis.
CO2	Get the analysis knowledge of Molecular Weight Determination andColorimetry.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L4	M	M	L	L	L	-	L	M	H	M	H	H
CO2	L5	H	H	M	L	L	-	L	H	M	M	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	CO1, CO2
CD3	Experiments	CO1, CO2
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 510: MATHEMATICS LAB-V

Course Objective

- To understand modelling of industrial and engineering problems.
- To understand assignement Problems and Transporatoin Problems and their solutions.
- To write program for set operations.
- To write program for addition and multiplication modulo.
- To write program forBoolean expression.
- To write program for operation of complex numbers

List of experiments:

1. Modeling of industrial and engineering problems into assignment Problems and Transportation Problems and their solutions.
2. Modeling of industrial and engineering problems into Linear Programming Problems and their solutions.
3. Implementation of various set operations (union, intersection, difference, symmetric difference, Power set, cardinality).
4. Write program to perform following operation:
   (i) Is the given relation is reflexive
   (ii) Is the given relation is symmetric
   (iii) Is the given relation is Transitive?
5. Write program to: Perform + m (addition modulo) and
   xm (multiplication modulo)for a particular set.
6. Write program to: Implement the following Boolean expression:
   (i) A’B+AB’
   (ii) (AB’+C)+ C’A
7. Complex numbers: Operations like addition, subtraction, multiplication, division, Moduls.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Know the modelling of assignment Problems and Transportation Problems
CO2	Write program for set operations
CO3	Write program for addition and multiplication modulo.
CO4	Write program forBoolean expression.
CO5	Write program for operation of complex numbers

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	H	H	H	M	M	M	H	M	H	H	M	H
CO2	L2	H	H	H	H	H	H	H	H	H	M	L	M
CO3	L3	H	H	H	H	H	H	H	H	H	M	L	M
CO4	L2	H	H	H	M	M	M	H	M	H	H	M	H
CO5	L4	H	H	H	H	H	H	H	H	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	CO3, CO4, CO5

BSC 511: ANANDAM-V

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be excepted to engage in individual and group acts of service and goodness.

Action Plan: Students will be expected to

1. Do at least one act of individual service each day
2. Record this act of service in a dedicated Register / Personal Diary
3. Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
4. Undertake one group service project for 64 hours every semester (outside college hours)
5. Upload the report on the group project on the Anandam platform
6. Participate in a sharing and presentation on the group service in the discussion sessions held once in week
7. There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

Semester - VI

THEORY PAPERS		Type	No. of Teaching Hours			Marks Allocation			
Code	**Subject/Paper**		**L**	**T**	**P**	**IA**	**EA**	**Total**	**Credits**
	Core Course								
BSC 601	Solid State Physics	CC	4	-	-	30	70	100	4
BSC 602	Spectroscopy, Heterocyclic Compounds & Carbohydrates	CC	4	-	-	30	70	100	4
BSC 603	Numerical Analysis and Linear Programming	CC	4	-	-	30	70	100	4
BSC 604	**Discipline Specific Elective- 6A (Choose any one)**								
BSC 604A	Nuclear and Particle Physics	DSE	3	-	-	30	70	100	3
BSC 604B	Communication System	DSE	3	-	-	30	70	100	3
BSC 605	**Discipline Specific Elective- 6B (Choose any one)**								
BSC 605A	Spectroscopy, Chemical & Ionic Equilibrium	DSE	3	-	-	30	70	100	3
BSC 605B	Chemistry of Cosmetics & Perfumes	DSE	3	-	-	30	70	100	3
BSC 606	**Discipline Specific Elective- 6C (Choose any one)**								
BSC 606A	Advanced Mechanics	DSE	3	-	-	30	70	100	3
BSC 606B	Theory of Equations and Number Theory	DSE	3	-	-	30	70	100	3
PRACTICALS/VIVA-VOCE			**No. of Teaching Hours**			**Sessional**	**Practical**	**Total**	**Credits**
	Core Course								
BSC 607	Physics Lab-VI	CC	-	-	4	60	40	100	2
BSC 608	Chemistry Lab-VI	CC	-	-	4	60	40	100	2
BSC 609	Mathematics Lab-VI	CC	-	-	4	60	40	100	2
Course based on Social-Industry connect									
BSC 610	Anandam -VI	AC	-	-	4	50	50	100	2
TOTAL			**21**	**-**	**16**	**410**	**590**	**1000**	**29**

BSC 601: SOLID STATE PHYSICS

Course Objective:

- To learn basics of energy band structures.
- To learn phonon dispersion relations.
- To understand the physics of insulators, semiconductor and conductors.
- To comprehend the basic theory of superconductors.
- To understand the importance of solid state physics in modern society.

Course Contents:

Unit-I: **Semiconductors:** Energy band Structures in Insulators, Conductors, Semiconductors, Concept of Direct and Indirect band gap in semiconductors, Generation and recombination of charge carriers Mobility of current carriers, Hall Effect in semiconductors: Hall coefficient, Mobility, Charge carrier, concentration, Conductivity and Hall angle.

Unit-II: **Thermal properties of Materials:** Elastic waves, Phonon, Phonon dispersion relations in monoatomic and diatomic linear lattice, Lattice heat capacity, Classical theory of specific heat, Dulong-Petit's law, Einstein and Debye's theory of specific heat of solids and limitations of these models, concept of Thermoelectric Power.

Unit-III: **Electrical properties of Materials:**Drude-Lorentz theory, Sommerfeld's Model, Thermal conductivity, Electrical conductivity, Widemann-Franz relation, Thermionic Emission, Escape of electrons from metals, Hall Effect in Metals, Density of states

Unit-IV: **Magnetic properties of Materials:** Classification of Magnetic Materials, Origin of Atomic Magnetism, Classical Langevin Theory of dia- and Paramagnetic Domains, Quantum theory of Paramagnetism, Curie's law, Weiss's theory of Ferromagnetism, Concept of Domain Wall, Magnetostriction, Heisenberg's Exchange Interaction, Relation between Exchange Integral and Weiss Constant.

Unit-V: **Superconductivity**: Experimental features of superconductivity: Critical Temperature, Critical magnetic field, Meissner effect, Type-I and type-II Superconductors, London's Equation and Penetration Depth, Isotope effect, Idea of BCS theory (No derivation), Cooper Pair and Coherence length, Josephson Effect (No derivation).

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, Wiley Publication.
2. Elementary Solid State Physics, M. Ali Omar, Pearson Education.
3. Elements of X-ray diffraction, B. D. Cullity, Prentice Hall.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Understand concept of direct and indirect band gap in semiconductors.
CO2:	Analysis thermal properties of materials.
CO3:	Analysis electricalproperties of materials.
CO4:	Analysis magnetic properties of materials.
CO5:	Understand the Idea about superconductors and their classifications.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	M	L	L	M	L	M	L	-	L	M	H
CO2	L4	M	H	M	H	-	M	L	M	M	M	L	M
CO3	L4	H	L	M	M	M	M	-	1	M	L	H	M
CO4	L4	M	H	-	L	L	H	H	M	M	M	L	H
CO5	L2	H	M	L	L	M	L	L	L	L	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO5

BSC 602: Spectroscopy, Heterocyclic Compounds & Carbohydrates

Course Objective:

- To learn and interpretation of Electromagnetic, Infrared (IR), Nuclear Magnetic Resonance Spectrum.
- To develop an understanding of Heterocyclic Compounds.
- To impart the basic knowledge of Carbohydrates.

Course Contents:

Unit-I: **Electromagnetic Spectrum:** An introduction

Absorption Spectroscopy: UV-Visible Spectrometry: AbsorptionLaws (Beer-Lambert'slaw.), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions. Effect of solvents on transitions, effect of conjugation.Concept of chromophore and auxochrome. Bathochromic, hypsochromic , hyperchromic and hypochromic shift. UV spectra of conjugated dienes and enones.

Unit-II: **Infrared (IR) spectroscopy:** Molecular vibrations. Hook's law, selection rules, intensity and position of IR bands,measurement IR spectrum, fingureprint region , characteristics absoption of various functional groups and interpretation of IR spectra of simple organic compounds.

Unit-III: **Nuclear Magnetic Resonance (NMR) Spectroscopy:**

Proton magnetic resonance (1H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals.Interpretation of NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetopheone.Problems pertaining to the structure elucidation of simple organic compounds using NMR data.

Unit-IV: **Heterocyclic Compounds**

Introduction: Molecular orbital diagram and aromatic characteristics of pyrrole, furan, thiopheneand pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution.Mechanism of nucleophilic substitution reactions in pyridine derivatives.Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction of condensed five – and six-membered heterocyles.Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher-indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Unit-V: Carbohydrates

Classification and nomenclature, Monosaccharides, mechanism of osazone formation. Epimers, anomers and mutarotation Interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Erythro and theodiastereomers. Conversion of glucose into mannose. Configuration of monosaccharides. Determination of ring size of monosaccharides. Formation of glycosides, ethers and esters. Cyclic structure of D(+)-glucose and fructose. Structures of ribose and deoxyribose.

Nomenclature and structure of disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose); Glycosidic linkage.

Reference Books:

1 Banwell, C. N. &McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).

2 Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).

3 House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).

4 Lowe, J. P. & Peterson, K. *Quantum Chemistry,* Academic Press (2005).

5 Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).

Course Outcomes:

By the end of the course, the students will be able to:

CO1	Learn and interpretation of Electromagnetic Spectrum.
CO2	Learn and interpretation of Infrared (IR) Spectrum.
C O3	Interpret various types of NMR spectra and know about their application in structure elucidation.
CO4	Understanding of Heterocyclic Compounds.
CO5	Impart the basic knowledge of Carbohydrates.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	M	H	H	H	-	L	M	L	H	M	H
CO2	L2	M	M	H	H	H	-	L	M	L	M	L	M
CO3	L2	M	M	H	L	M	-	L	M	L	M	L	M
CO4	L5	H	H	H	H	H	H	M	M	H	H	M	H
CO5	L2	M	M	M	L	L	-	L	M	L	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC 603: Numerical Analysis and Linear Programming

Course Objective:

- To understand Newton's divided difference, Lagrange's interpolation formula.
- To understandinterpolation formulae and Numerical Differentiation and integration.
- To understandNumerical solution of Algebraic and Transcendental equations.
- To understand the concepts of Iterative methods.
- To understand solutions of ordinary differential equations of first order.

Course Contents:

Unit-I: Differences. Relation between differences and derivatives.Differences of a polynomial.Newton's formulae for forward and backward interpolation.Divided differences. Newton's divided difference, Lagrange's interpolation formula.

Unit-II: Central differences.Gauss's, Stirling's and Bessel's interpolation formulae. Numerical Differentiation.Derivatives from interpolation formulae. Numerical integration, Derivations of general quadrature formulas, Trapezoidal rule. Simpson's one-third, Simpson's three-eighth and Gauss's quadrature formulae.

Unit-III: Numerical solution of Algebraic and Transcendental equations, Bisection method, Secant method, Regula-Falsi method, Iteration method, Newton- Raphson Method (derivation of formulae and rate of convergence only). Gauss elimination and Iterative methods (Jacobi and Gauss Seidal) for solving system of linear algebraic equations. Partial Pivoting method, ill conditioned systems, Numerical solutions of ordinary differential equations of first order with initial condition using Picard's, Euler and modified Euler's method.

Unit-IV: Numerical solutions of ordinary differential equations of first order with initial condition using Picard's, Euler and modified Euler's method.

Unit-V: The linear programming problem.. Fundamental theorem of L.P.P. Theory of simplex methods. Graphical method, Simplex Method, Transportation problem, assignment problem

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Useinterpolation Techniques
CO2:	Find Numerical Differentiation and integration.
CO3:	Find Numerical solution of Algebraic and Transcendental equations.
CO4:	Apply the concept of Iterative methods to solve system of linear algebraic equations.
CO5:	Find solutions of ordinary differential equations of first order.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	H	H	M	M	M	H	M	H	H	M	H
CO2	L2	H	H	H	H	H	H	H	H	H	M	L	M
CO3	L2	H	H	H	H	H	H	H	H	H	M	L	M
CO4	L2	M	H	H	M	M	M	H	M	H	H	M	H
CO5	L2	M	H	H	H	H	H	H	H	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 604A: NUCLEAR AND PARTICLE PHYSICS

Course Objective:

- To explain nucleus and properties of nuclei.
- To explain and derive the various theoretical formulation of nuclear disintegration.
- To understandnuclear reactions and decays.
- To understandinteraction of various nuclear radiation with matter.
- To develop basic knowledge of elementary particles.

Course Contents:

Unit-I: **Properties of Nucleus:**Discovery of Nucleus, Rutherford Scattering, Constituents of the Nucleus, Mass, Charge, Size, Nuclear Density, Charge Distribution, Hofstadter's experiment, Nuclear Angular momentum, Nuclear Magnetic Dipole Moment, Electric Quadrupole Moment Spin, Isospin.Wave Mechanical Properties: Parity and Statistics, Classification of Nuclei, Mass Defect and Binding Energy, Packing Fraction, Mass Spectrograph. Nuclear Forces: Properties of Nuclear Forces, Yukawa Meson Theory, Nuclear Potential.

Unit-II: **Nuclear Models and Radioactive Decays:**Nuclear Models: Segre Chart, Liquid Drop Model, Semi Empirical Mass Formula, Condition of Stability, Fermi Gas Model, Evidence for Nuclear Shell Structure, Nuclear Magic Numbers and Basic Assumptions of the Shell Model.Radioactive Decays: Alpha Decay: Basics of α-Decay Processes, Theory of β-Emission Spectrum, Gammow Factor, Geiger Nuttal Law, Range of Alpha Particles. Beta Decay: Energy kinematics for β-Decay, β-Decay Spectrum, Positron Emission, Electron Capture, Pauli's Neutrino Hypothesis. Gamma Decay: Gamma Ray Emission and Kinematics, Internal Conversion, Applications of Radioactivity.

Unit-III: **Nuclear Reactions and Interaction of Nuclear Radiation with Matter:**Nuclear Fission and Fusion: Nuclear Fission, Spontaneous Fission and Potential Barrier, its Explanation by Liquid Drop Model, Chain reaction, Controlled chain reaction, Four Factor Formula, Nuclear Reactors, Classification of Nuclear Reactor, Uncontrolled Chain Reaction. Nuclear Fusion, Energy released in Nuclear Fusion, Fusion in stars. Nuclear Reactions: Types of Reactions, Conservation Laws, Kinematics of Reactions, Q-value, Threshold Energy, Reaction Rate, Reaction Cross-Section.Interaction of Nuclear Radiation with Matter: Energy Loss by Heavy Charged Particles in Matter, interaction of Electrons with Matter, Range of Charged Particle, Bremsstrahlung, Cherenkov Radiation, Gamma Ray Interaction with Matter,

Unit-IV: **Radiation detectors and Elementary Particles:**Radiation detectors: Gas filled detector, Avalanche, Geiger Discharge, lionization Chamber, Proportional Counter, Geiger Muller Counter, Current mode and Pulse Mode operation of Detector. Particle Accelerators: Ion source, Van-de-Graff Accelerator (Tandem Accelerator), Linear Accelerator, Cyclotron, Synchrocyclotron, Betatron, Proton Synchrotron.Elementary Particles: Necessity of high energy to discover elementary constituents, historical introduction to discovery of elementary particles (electron, positrons, neutrinos, strange mesons, charm quark, intermediate vector bosons, bottom quark, top quark and Higgs boson), Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.), elementary particles included in the standard model.

Unit-V: **Fundamental Interactions and Quark Model:**Fundamental Interactions: Four types of fundamental forces, Symmetries and Conservation Laws, Discrete symmetries, C, P, and T invariance, Application of symmetry, arguments to particle reactions, Parity non-conservation in weak interaction, CP violation.Quark Model: Flavor symmetries, Gellmann-Nishijima formula, the eightfold way, Quark model, Octet Diagram for Mesons and Baryons, Concept of Quark model, the November Revolution, Baryon Decuplet, Color Quantum Number and Gluons.

Reference book:

1. Nuclear and Particle Physics, W. E. Burcham and M. Jobes, Addison Wesley Longman Inc.
2. Nuclear and Particle Physics, Brian R. Martin, John Wiley & Sons.
3. Introduction to Nuclear and Particle Physics, Das and Ferbal, World Scientific.
4. Elements of Nuclear Physics, Walter E. Meyerhof, McGraw-Hill Book Company.
5. Introductory Nuclear Physics, Kenneth S. Krane, John Wiley & Sons.
6. Introduction to Elementary Particles, David J. Griffiths, John Wiley & Sons.
7. Radiation Detection and Measurement G. F. Knoll, John Wiley & Sons.
8. Introduction to Nuclear and Particle Physics, V. K. Mittal, R. C. Verma, S. C. Gupta, PHI
9. Concepts of Modem Physics, A. Beiser, McGraw-Hill Book Company.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1	Understand properties of nucleus.
CO2	Analysis nuclear models and radioactive decays.
CO3	Analysis nuclear reactions and interaction of nuclear radiation with matter
CO4	Understand radiation detectors and elementary particles
CO5	Understand fundamental interactions and quark model.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	H	H	L	M	L	M	L	-	-M	M	L
CO2	L4	M	-	L	L	M	L	L	-	L	L	L	M
CO3	L4	L	H	L	M	-	M	M	M	-	M	L	L
CO4	L2	M	-	L	L	M	M	L	M	M	M	-M	M
CO5	L2	L	M	L	L	M	L	L	L	L	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO4

BSC 604B: COMMUNICATION SYSTEM

Course Objective:

- To understand the basic concepts of communication.
- To learn the techniques of different types of modulation of electromagnetic signals.
- To learn basics of satellite communication.
- To learn concepts and application of mobile telephony system.
- To review the applications of communication in daily life.

Course Contents:

Unit-I: **Electronic communication:** Introduction to communication– means and modes, Need for modulation, Block diagram of an electronic communication system, Brief idea of frequency allocation for radio communication system in India (TRAI), Electromagnetic communication spectrum, band designations and usage, Channels and base-band signals, Concept of Noise, signal-to-noise (S/N) ratio.

Unit-II: **Analog Modulation**: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection, Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver.

Unit-III: **Pulse Modulation**:Analog Pulse Modulation: Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.Digital Pulse Modulation: Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

Unit-IV: **Satellite Communication**– Introduction, need, Geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites, Satellite visibility, transponders (C-Band), path loss, ground station, simplified block diagram of earth station, Uplink and downlink, GPS navigation system (qualitative idea only)

Unit-V: **Mobile Telephony System** – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only).

Reference Books:

1. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
2. Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
3. Electronic Communication systems, G. Kennedy, 3rdEdn., 1999, Tata McGraw Hill.
4. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill.
5. Communication Systems, S. Haykin, 2006, Wiley India.
6. Electronic Communication system, Blake, Cengage, 5th edition.
7. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1	Understand frequency allocation for radio communication system.
CO2	Understand analog modulation.
CO3	Understand pulse modulation
CO4	Analysis GPS navigation system.
CO5	Analysis mobile telephony system.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3
CO1	L2	H	H	H	L	M	L	M	L	L	-M	M	L
CO2	L2	M	-	L	L	M	L	L	-	-	L	L	M
CO3	L2	L	H	L	M	-	M	M	M	-	M	L	L
CO4	L4	M	-	L	L	M	M	L	M	M	M	-M	M
CO5	L4	L	M	L	L	M	L	L	L	L	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO3, CO4

BSC 605A: Spectroscopy, Chemical & Ionic Equilibrium

Course Objective:

- To get the knowledge of various types of spectrum
- To impart the knowledge of Chemical and ionic Equilibrium

Course Contents:

Unit-I: Spectroscopy

Introduction: Electromagnetic radiation, spectrum, basic features of different spectrometers, statement of the Born-Openheimer approximation, degrees of freedom.

Rotational Spectrum: Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotator, isotope effect.

Unit-II: **Vibrational Spectrum:** Infrared spectrum: Energy level of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the pectrum, idea of vibrational frequencies of different functional groups.

Unit-III: **Raman Spectrum:** Basic principles and applications, concept of polarizability, pure rotational and pure vibrational Raman Spectra of diatomic molecules, selection rules.

Electronic Spectrum: Concept of Potential Energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Frank Condon principle. Qualitative description of σ, π and n M.O. their energy levels and the respective transitions.

Unit-IV: **Chemical Equilibrium:** Equilibrium constant and free energy. Thermodynamic derivation of law of Mass Action.Le Chaterlier's principle.Reaction Isotherm and reaction isochore.Clapeyron equation and Clausius Clapeyron equation, applications.

Unit-V: **Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect.Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.Buffer solutions.Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Reference Books:

1 Shriver & Atkins. *Inorganic Chemistry*, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
2 Adam, D.M. *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons, 1974.
3 Poole, C.P. & Owens, F.J. *Introduction to Nanotechnology* John Wiley & Sons, 2003.
4 Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Understand the Rotational Spectrum
CO2:	Explain the concept of Vibrational Spectrum
CO3:	Gain knowledge of Raman Spectrum
CO4:	Learn the information of Chemical Equilibrium.
CO5:	Explain basics of ionic Equilibrium.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**Bloom Level**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**
CO1	L3	M	M	H	-	M	-	L	M	H	M	H	H
CO2	L5	M	M	M	M	M	-	L	M	H	M	M	H
CO3	L2	M	M	M	-	-	-	L	M	-	M	H	H
CO4	L2	M	M	M	-	-	-	L	M	-	M	H	H
CO5	L2	M	L	-	-	-	-	L	M	-	M	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5
CD5	Industrial visit	CO5

BSC605B: Chemistry of Cosmetics & Perfumes

Course Objective:

- To serve the knowledge of hair enrichment items.
- To make the students understand about face glowing objects.
- To understand preparation and uses of creams, antiperspirants and artificial flavours.
- To get the facts of essential oils and their importance in cosmetic industries.

Course Contents:

Unit-I: A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions.

Unit-II: A general study including preparation and uses of the following: face powder, lipsticks, talcum powder, nail enamel.

Unit-III: A general study including preparation and uses of the following: creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Unit-IV: Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandal wood oil,

Unit-V: Essential oils and their importance in cosmetic industries with reference to eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Reference Books:

1 E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.

2 P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

3 Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Summarize the hair enrichment items.
CO2:	Understand the face glowing objects.
CO3:	Understand the preparation and uses of creams, antiperspirants and artificial flavours.
CO4:	Understand the essential oils and their importance in cosmetic industries.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	H	H	M	-	-	-		H	L	H	M	H
CO2	L2	H	H	M	-	-	-		H	L	H	M	H
CO3	L3	H	H	M	M	M	-	L	H	L	H	M	H
CO4	L2	M	M	M	-	-	-		M	L	H	M	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4
CD3	Experiments, Seminars	CO1, CO2, CO3, CO4
CD4	Self- learning advice using internets	CO4
CD5	Industrial visit	CO1, CO2, CO3, CO4

BSC 606 A: Mechanics

Course Objective:

- To understand the Velocity and acceleration and simple harmonic motion
- To understandMotion in resisting medium and projectile
- To understand moment of inertia
- To understandEquilibrium of coplanar force
- To understandVirtual work

Course Contents:

Unit-I: Velocity and acceleration – along radial and transverse directions, along tangential and normal directions. S.H.M., Hooke's law, motion along horizontal and vertical elastic string.

Unit-II: Motion in resisting medium- Resistance varies as velocity and square of velocity. Work and Energy.Motion on a smooth curve in a vertical plane.Motion on the inside and outside of a smooth vertical circle, Projectile.

Unit-III: Central orbits- p-r equations, Apses, Time in an orbit. Kepler's law of planetary motion.Moment of inertia- M.I. of rods.Circular rings, Circular disks, Solid and Hollow spheres.Rectangular lamina, Ellipse and Triangle.Theorem of parallel axis.Product of inertia.

Unit-IV: Equilibrium of coplanar force, Moments and friction.

Unit-V: Virtual work and Catenary.

Reference Books:

1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics (4^{th} Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
2. R.C. Hibbeler and Ashok Gupta Engineering Mechanics: Statics and Dynamics (11^{th} Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
3. S.L. Loney – An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1	Use concept of Velocity and acceleration and simple harmonic motion
CO2	Learn about Motion in resisting medium and projectile.
CO3	use the concept ofmoment of inertia.
CO4	Learn basic concepts of Equilibrium of coplanar force.
CO5	Learn about the Virtual work.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	M	H	H	M	M	M	H	M	H	H	M	H
CO2	L3	M	H	H	H	M	M	H	M	H	M	L	M
CO3	L2	M	H	H	H	M	M	H	M	H	M	L	M
CO4	L2	M	H	H	H	M	M	H	M	H	H	M	H
CO5	L2	M	H	H	M	M	M	H	M	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSc 606B :Theory of Equations and Number Theory

Course Objective:

- To explainGeneral properties of polynomials.
- To explain and derive the Descarte's rule.
- To develop basic understanding of Symmetric functions.
- To develop basic understanding of thedefinition and properties of the Dirichlet product.
- To develop basic knowledge of Number theoretic functions.

Course Contents:

Unit-I: General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials, General properties of equations,

Unit-II: Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Unit-III: Symmetric functions, Applications symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations.Algebraic solutions of the cubic and biquadratic. Properties of the derived functions

Unit-IV: Division algorithm, Lame's theorem, linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem, Goldbach conjecture, binary and decimal representation of integers, linear congruences, complete set of residues.

Unit-V: Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function.

Books Recommended:

1. W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
2. C. C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954
3. David M. Burton, Elementary Number Theory 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.
3. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, Applications of Abstract Algebra with Maple, CRC Press, Boca Raton, 2000.
4. Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1	Learn the General properties of polynomials.
CO2	Learn about the Descarte's rule.
CO3	Learn the concept of Symmetric functions.
CO4	Learn basic concepts of definition and properties of the Dirichlet product.
CO5	Learn about the Number theoretic functions.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments, Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L3	M	H	H	M	M	M	H	M	H	H	M	H
CO2	L3	H	H	H	H	H	H	H	H	H	M	L	M
CO3	L2	H	H	H	M	M	M	H	M	H	M	L	M
CO4	L2	M	H	H	M	M	M	H	M	H	H	M	H
CO5	L2	M	H	H	H	H	H	H	H	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiments, Seminars	CO2, CO3, CO5
CD4	Self- learning advice using internets	CO4, CO5

BSC 607: PHYSICS LAB-VI

Course Objective:

- To understand working of P-N junction diode.
- To observing reverse photoelectric effect.
- To study of zener diode.
- To understand characteristics of Photo diode.
- To study B-H curve.

List of experiments:

1. Determination of band gap using a P-N junction diode.
2. To determine Planck's constant using LED by observing reverse photoelectric effect.
3. Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
4. Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
5. Draw the V-I characteristics of a Gunn diode, and determine the output power and frequency as a function of voltage.
6. To find the characteristics impedance, input impedance, losses, standing waves, phase shifting in transmission line.
7. To perform impact test on a given material and to determine its resilience.
8. To study and plot the characteristics of Photo diode.
9. To determine the dispersive power of material of a prism with the help of spectrometer.
10. To study B-H curve and to find out the values of coercivity, retentivity and saturation magnetisation of experimental material.

Reference Books:

1. B. L. Flint and H. T. Worsnop, Advanced Practical Physics for students, Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, 4th Edition, reprinted, Heinemann Educational Publishers, 1985.
3. S. Panigrahi&B.Mallick, Engineering Practical Physics, Cengage Learning India Pvt. Ltd., 2015.
4. InduPrakash and Ramakrishna, A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi, 2011.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Understand characteristic ofP-N junction diode.
CO2:	Analysis zener diode as voltage regulator
CO3:	Analysis impact test on a given material.
CO4:	Analysis dispersive power of material of prism.
CO5:	Analysis B-H curve and find values of coercivity, retentivity and saturation magnetisation.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	-	L	-	M	M	M	H	M	H	M	L	L
CO2	L4	M	H	L	L	L	L	L	M	H	H	M	M
CO3	L4	L	L	M	-	M	L	H	L	L	M	L	L
CO4	L4	M	L	-	L	L	M	L	M	L	M	M	M
CO5	L4	L	H	H	L	H	L	H	M	M	L	M	L

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 608: Chemistry Lab-VI

(Select any one group)

Course Objective:

- To get the skills of organic compound testing and synthesis of Cosmetics & Perfumes material
- To obtain basics of Transition Temperature and Distribution Law.

Group – A

Organic Chemistry

(a) Detection of Elements

(b) Tests of Functional Groups

(c) Determination of important organic compounds and their specification

(d) Formation of Derivatives

Physical Chemistry

(a) Transition Temperature

(b) Distribution Law and distribution Coefficient

Group – B

Chemistry of Cosmetics & Perfumes

S. No.	Experiments
1	Preparation of talcum powder.
2	Preparation of shampoo.
3	Preparation of enamels.
4	Preparation of hair remover.
5	Preparation of face cream.
6	Preparation of nail polish and nail polish remover.

Reference Books:

1 Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

2 Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

3 Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).

4 Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

Course Outcomes:

At the end of the course, the student will be able to:

CO1:	Get the skills of organic compound testing and synthesis of Cosmetics & Perfumes material
CO2:	Obtain basics of Transition Temperature and Distribution Law.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiments
CD4	Self- learning advice using internets
CD5	Industrial visit

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	**Blooms Level**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**
CO1	L5	H	M	M	M	L	H	L	H	H	H	H	H
CO2	L5	H	M	M	M	L	H	L	H	L	H	H	H

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD

CD	**Course Delivery methods**	**Course Outcomes**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Tutorials/Assignments	
CD3	Experiments	CO1, CO2
CD4	Self- learning advice using internets	
CD5	Industrial visit	

BSC 609: MATHEMATICS LAB-VI

Course Objective:

- To studythe absolute value of an integer.
- To measuresolution of algebraic and transcendental equations.
- To understand the concept ofNumerical integration.
- To solve problems by mathematical tools.
- To understand the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.

List of experiments

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Solution of algebraic and transcendental equations by Bisection Method.
(v) Solution of algebraic and transcendental equations by Newton Raphson Method.
(vi) Solution of algebraic and transcendental equations by Secant Method.
(vii) Solution of algebraic and transcendental equations by Regulai Falsi Method.
(viii) Solution of Initial value problems by Euler's methods and Runga-Kutta (third and fourth order) method.
(ix) Numerical integration using Trapezoidal, Simpson's 1/3, 3/8 and Waddle rules.

Course outcomes:

At the end of the course, the student will be able to:

COs	Statements
CO1:	Know about the absolute value of an integer.
CO2:	Know algebraic and transcendental equations.
CO3:	Understand the concept ofNumerical integration.
CO4:	Understand the mathematical tools.
CO5:	Understand the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.

Course Delivery Methods (CD)	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Experiment/Seminars
CD4	Self- learning advice using internets

Table: Mapping of Course Outcomes with Program Learning Outcomes

CO	Blooms Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3
CO1	L2	M	H	H	M	M	M	H	M	H	H	M	H
CO2	L2	M	H	H	H	H	H	H	H	H	M	L	M
CO3	L2	H	H	H	M	M	M	H	M	H	M	L	M
CO4	L2	M	H	H	H	H	H	H	H	H	H	M	H
CO5	L4	M	H	H	M	M	M	H	M	H	M	L	M

H- High, M- Moderate, L- Low, '-' for No correlation

Mapping between CO and CD:

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO1, CO2, CO3, CO4, CO5
CD3	Experiment/Seminars	CO1, CO2, CO3, CO4, CO5
CD4	Self- learning advice using internets	CO1, CO2, CO3, CO4, CO5

BSC 610: ANANDAM-VI

Objectives:

- To instil the joy of giving in young people, turning them into responsible citizens to build up a better society.
- To inculcate the habit of service in students across the University.
- A compulsory course of 2 credits per semester to be included in each program of University.
- Students to be excepted to engage in individual and group acts of service and goodness.

Action Plan: Students will be expected to

1. Do at least one act of individual service each day
2. Record this act of service in a dedicated Register / Personal Diary
3. Share this Register / Personal Diary day in the Anandam Class scheduled per week. The class interaction will include Personal Diary check, Showing of Community based motivation videos, Community based presentations by students, Role playing etc.
4. Undertake one group service project for 64 hours every semester (outside college hours)
5. Upload the report on the group project on the Anandam platform
6. Participate in a sharing and presentation on the group service in the discussion sessions held once in week
7. There will be some suggested projects and organizations that students can work with. Students can also suggest their own projects which others can join

Each student will finish the year with a portfolio of giving. This will include their Register / Personal Diaries and their reports on group service projects.

11. TEACHING-LEARNING PROCESS/ METHODOLOGY (TLM):

The teaching-learning process should be aimed at systematic exposition of basic concepts soas to acquire knowledge of physical sciences in a canonical manner. In this context, applications of physical science and linkage with the theory constitute a vital aspect of the teaching-learningprocess. The course offers many modes of learning and assessment methods. Students have great freedom of choice of course which they can study. The various components of teachinglearningprocess are summarized in the following heads.

a. **Class room Lectures:** The most common method of imparting knowledge is through lectures. Thereare diverse modes of delivering lectures such as through blackboard, power pointpresentation and other technology aided means. A judicious mix of these means is a keyaspect of teaching-learning process.

b. **Tutorials:** To reinforce learning, to monitor progress, and to provide a regular pattern of study, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with. Tutorials are also aimed at solving problems associated with the concepts discussed during the lectures.

c. **Practical:** To provide scientific visualization and obtaining results of Physical sciences in practicalsessions. These sessions provide vital insights into scientific concepts and draw learner'sattention towards limitations of scientific computations. During practical, scientific models arising in real life problems can also be simulated.

d. **Choice based learning/Open elective:** LOCF in this undergraduate programme provides great flexibility both in terms of varietyof courses and range of references in each course.

e. **Field based learning:** Students may enhance their knowledge through field based learning while understanding the practical importance.

f. **Textbooks learning:** A large number of books are included in the list of references ofeach course for enrichment and enhancement of knowledge.

g. **E-learning:** Learner may also access electronic resources and educationalwebsites for better understanding and updating the concepts.

h. **Self-study materials:** Self-study material provided by the teachers is anintegral part of learning. It helps in bridging the gaps in the classroom teaching.It also provides scope for teachers to give additional information beyond classroom learning.

i. **Assignment/Problem solving:** Assignments at regular intervals involvingapplications of theory are necessary to assimilate basic concepts of courses. Hence, it isincumbent on the part of a learner to complete open-ended projects assigned by the teacher.

j. **Internships:** The teaching-learning process needs to be further supported by other activities devoted to subject-specific and interdisciplinary skills, summer and winter internships. During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.

k. **Institute visits:** Institute visit by a learner is also a part of learning process. During such visits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.

l. **Industrial visits:** Industrial visits offer an opportunity to observe applications of scientific concepts. These visits also give an opportunity to realize the power ofmathematical ideas and their translation in problem solving.

m. **Training programmes:** Training programmes organized by various agencies/institutes provide an opportunity to learn various dimensions of courses.

12. ASSESSMENT AND OUTCOME MESUAREMENT METHODS (AOMM):

A range of assessment methods which are appropriate to test the understanding of variousconcepts of courses will be used. Variouslearning outcomes will be assessed using time-bound examinations, problem solving, assignments and viva-voce examination. For various courses in this programme, the following assessment methods shall be adopted:

i. Scheduled/unscheduled tests

ii. Problem solving sessions aligned with classroom lectures

iii. Practical assignments

iv. Regular chamber consultation with faculty members

v. Mid semester examination and semester end comprehensiveexamination

Examination and Evaluation:

I. The medium of instructions and examination shall be Bilingual.

II. Candidates shall be examined according to the scheme of examination and syllabus as approved by the BOS and Academic Council from time to time.

III. To pass each semester examination, a candidate must obtain at least 40% marks in each written paper, practical work semester examination.

IV. Each theory paper for the respective semester examination shall be set and evaluation of the answer books shall be done as per the University rules.

V. The assessment of External Evaluation i.e. End Term Semester Examination will be made out of 70 (Seventy) marks in theory Papers and Internal Evaluation of 30 (Thirty) marks.

Criterion for awarding Grading System:

Criterion for Awarding SGPA and CGPA: The criterion for awarding the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) for B.Sc.-PCM programme shall be as follows:

a) The criterion for passing in a subject is that a student should secure minimum 40% marks in individual paper.

b) A student obtaining less than pass marks as specified above, in each subject (sum of internal and End-Term examinations) he will be declared fail in that subject and will have to re-appear in a End-Term examination of the course in subsequent odd / even semester end term examination, subject to maximum permissible period of n+4 semestersto complete the course.

c) The University has adopted Absolute Grading System for converting marks into grades. The formula of 10- point grading system for conversion of marks obtained into Letter Grades and converting Letter Grades to Grade Point is given below:

Table: Marks, Letter Grades and Grade Points

Marks	Letter Grade	Grade Points
91-100	O (Outstanding)	10
81-90	A+(Excellent)	9
71-80	A(Very Good)	8
61-70	B+(Good)	7
51-60	B(Above Average)	6
46-50	C(Average)	5
40-45	P (Pass)*	4
0-39	F(Fail)	0
-	AB (Absent)	0

***Pass Mark: 40% in individual paper**

d) While converting the marks into Letter Grade, the rounding off marks must be considered.

e) A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

f) For noncredit courses "Satisfactory" or Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

Computation of SGPA and CGPA:

The university has adopted UGC recommended procedure for computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

a) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the papers/ courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = Σ (Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course. The university shall issue Semester Grade Card to the student.

b) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = Σ (Ci x Si) / Σ Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

c) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration of Computation of SGPA and CGPA and Format for Transcripts:

a) Computation of SGPA and CGPA

Illustration for SGPA

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course/Paper 1	3	A	8	3x8=24
Course/Paper 2	4	B+	7	4x7=28
Course/Paper 3	3	B	6	3x6=18
Course/Paper 4	3	O	10	3x10=30
Course/Paper 5	3	C	5	3x5=15
Course/Paper 6	4	B	6	4x6=24
	20			**139**

Thus, SGPA= 139/20= 6.95

b) Illustration for CGPA

Semester-1	Semester-2	Semester-3	Semester-4	Semester-5	Semester-6
Credit: 20 SGPA:6.9	Credit: 22 SGPA:7.8	Credit: 25 SGPA:5.6	Credit: 26 SGPA:6.0	Credit: 26 SGPA:6.3	Credit: 25 SGPA:8.0

Thus, CGPA= $\frac{20x6.9+22x7.8+25x5.6+26x6.0+26x6.3+25x8.0}{144} = \mathbf{6.73}$

13. TEACHERS TRAINING (TT):

Learning Outcomes Based Curriculum Framework (LOCF) Quality initiative of UGC based on Outcome Based Education (OBE) is being implemented by the University Grants Commission to enhance the Quality of Higher Education and that of Higher Education Learners and Teachers. Therefore, university arrange following activities for teachers training:

1. Workshops for LOCF implementation.
2. Seminar for LOCF implementation.
3. FDP on LOCF.
4. Outcome based higher education and understanding the learning objectives, learning outcomes, new approaches in the area of outcome measurement, preparing future ready teachers and students.
5. Developing a battery of quality speakers/educators to become resource persons to play role for Training of Trainers (TOT).

14. KEYWORDS:

LOCF, CBCS, Course Learning Outcomes, Employability, Graduate Attributes Communication Skills, Critical Thinking, and Descriptors.

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