SYLLABUS

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

(Effective from Academic Year 2023-24)

2023-24

AN ISO 9001:2015 CERTIFIED FOR QMS

DR. C.V. RAMAN UNIVERSITY

Madhya Pradesh, Khandwa AN AISECT GROUP UNIVERSITY

Approved by : MP. Govt., AICTE, NCTE, MP PARAMEDICAL COUNCIL, PCI Recognized by : UGC Member of : AIU

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CVRU
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DR. C.V.RAMAN UNIVERSITY

Preamble

The objective of any program at Higher Education Institute (HEI) is to prepare future professionals well equipped with attitude – skills and knowledge demanded by the growing society. The CVRUK envisions all its programs in the best interest of its students and in this endeavor, it offers a new vision to all its under graduate courses. It imbibes Learning Outcome - Based Curriculum Framework (LOCF) for all its under graduate programs. The LOCF approach is envisioned to provide focused, outcome – based syllabus at the undergraduate level with an agenda to structure the teaching – learning experiences in a more student - centric manner.

The LOCF approach has been adopted to strengthen students' experience as they engage themselves in the program of their choice. The under graduate programs will prepare the students both for academic pursuit as well as enhance her / his employability.

Each program vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programs also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice also skills for employability. In short, each program prepares students for sustainability and life-long learning.

The new curriculum of B.Sc. Mathematics offers the students to gain the requisite knowledge, skills, and aptitude for the field of Physical Science The efforts are made to measure cognitive as well as applied learning. Students are not only trained on the core components but also in areas which are need based, innovative, and relevant keeping in pace with the fast-growing industry. The course is internationally competitive.

The CVRUK hopes the LOCF approach of the program B.sc Mathematics will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

1. Introduction to B.Sc. Mathematica's

The Physical Science course at the bachelor's level is being offered at CVRUK in its 3rd year of operation and introduced by setting up / or continuing at School of Physical Science. from the academic year 2023- 24. The course is being prepared keeping in view, the unique requirements of region, GOI' new policy initiatives like "One District One Commodity" or start – up policy / skill enhancement policy / new education policy. The policies of GOI and Go MP enshrine the spirit of dealing with the job creation and rapid growth in economy, ceasing the opportunity of setting up of new industries in the region. This necessitates the need of technically trained, educated human resources having knowledge, skills, and attitude to deal with the emergent needs of the "New Sun Shine" industry. The graduate level degree of B.Sc. Mathematics would help develop a cadre of professionals to provide necessary human resource.

The Physical Science (PCM) course in Choice Based Credit System is of 3 - year duration which comprises of 6 semesters, divided into 11 Core papers, 04 Ability Enhancement Course (AEC) 4 Skill Enhancement Elective Courses (SEC) and 3 Inter Discipline Course (IDC)Courses and 02 Value added courses. Each year consists of 2 semesters. This course has been prepared keeping in view, the unique requirements of B.Sc. Mathematics students.

The objectives of the program are:

- Providing a strong foundation in mathematical principles and theories.
- Developing problem-solving and analytical skills through mathematical reasoning.
- Cultivating proficiency in mathematical methods and techniques for various applications.
- Equipping students with the ability to communicate mathematical concepts effectively.
- Preparing students for advanced studies in mathematics or related fields.
- Enhancing computational and quantitative skills relevant to real-world problem-solving.
- Fostering an understanding of mathematical modelling and its Applications in different domains.

2. Learning Outcome Based Curriculum Framework

2.1 Nature and Extent of the Program in B.Sc. Mathematics

B.Sc. Mathematics is an undergraduate degree program focused on the study of mathematics and its applications. It provides a strong foundation in various branches of mathematics, including calculus, algebra, geometry, probability, statistics, and discrete mathematics. The program typically spans over three to four years, depending on the curriculum. During this

time, students will take a combination of core mathematics courses and elective courses in specialized areas like mathematical physics, numerical analysis, operations research, and more.

2.2 Aims of Bachelor Degree Program in B.Sc. Mathematics

The key objectives that underpin curriculum planning and development at the undergraduate level include Program Learning Outcomes, and Course Learning Outcomes. For the B.Sc. Mathematics course, it includes:

- Providing students with a strong foundation in mathematical theories, principles, and methods.
- Developing analytical and problem-solving skills through mathematical reasoning and logical thinking.
- Equipping students with the ability to apply mathematical concepts to real-world problems in various fields.
- Preparing students for further studies in advanced mathematics or related disciplines.
- Enhancing computational and quantitative skills for data analysis and modelling.
- Fostering a deeper understanding of mathematical concepts and their applications in different areas of science and technology.
- Cultivating effective communication skills, both written and oral, to present mathematical ideas and findings.

3. Graduate Attributes in Disciplinary knowledge

Students can demonstrate comprehensive knowledge and understanding of one or more disciplines such as chemistry, biochemistry, Physics, mathematics, regulations with support of different allied subjects of Physical Science.

3.1 Communication Skills

Development of students' communication skills is planned through an AEC paper (English) which is compulsory for each student. Besides that, the students do various assignments that enable them to develop skills in public speaking writing and effective's interpersonal skills. Presentations in each paper enhances their confidence, ability to express themselves; presentation skills.

3.2 Research-related skills

Students develop a scientific temper and a sense of enquiry through various Physical Science papers. They have capabilities in asking relevant questions relating to current issues and themes and state hypothesis and rationale for inquiry. Students can use appropriate research methodology especially for understanding issues in Physical Science and reporting the results in different formats.

3.3 Cooperation/Team work

Students are capable of effective working in diverse contexts and teams in class rooms laboratories, student societies, industry, and the community. They have basic management skills for independently organizing events, resource mobilization and leading community-based projects, initiatives; cultural shows.

3.4 Self-directed learning

Students can work independently and are able to apply the concepts of Physical Science in an original; creative manner to solve and manage real life issues for the customers and industry. Students develop customized processes and or products as per the requirements of society.

3.5 Multicultural competence

Students are confident of working in diverse socio-cultural contexts. They can effectively engage with multicultural groups and teams. They have sensitivities of cross cultural and ethnic diversity which they can apply to different settings. College through a student and faculty exchange program with foreign university helps them to acquire multicultural competency. They are competent to seek higher education in foreign universities.

3.6 Moral and ethical awareness/reasoning

Student has awareness of ethical conduct in different situations (academic and personal). They have skills in understanding and avoiding unethical Behaviour such as misrepresentation, plagiarism and environmental misuse and violence. They are formally taught ethics of research and human interventions.

3.7 Leadership readiness/qualities

Students have leadership qualities in organizing teams and their mobilization for effective problem solving in different Physical Science aspects. Students apply creative leadership for realization of various goals. As a leader, they are trained to have greater customer sensitivity and connect.

3.8 Lifelong learning

Students acquire ability to gain knowledge and skills which are necessary in life for the holistic development for meeting their professional and personal needs in varying environment and changing contexts.

4. Qualification Descriptors for B.Sc. Mathematics

The following descriptors indicate the expectations from Physical Science.

- The students will have a sound knowledge of Physical Science.
- They will understand the science and technologies of Physical Science
- They will understand the type of stimulus in the receptive field and the relative intensity of the stimulus aspects.
- They will understand mathematical safety and standards, both nationally and internationally.
- They will be versant with key principles of mathematical engineering

5. Program Learning Outcome in B.Sc. Mathematics

The learning outcome of the course are-

- Demonstrate a solid understanding of fundamental mathematical concepts and theories across various branches of mathematics.
- Apply mathematical reasoning and problem-solving skills to analyse and solve real-world problems.
- Utilize mathematical techniques and tools to model and interpret data in different contexts.
- Demonstrate proficiency in calculus, linear algebra, discrete mathematics, and other core mathematical topics.
- Develop the ability to communicate mathematical ideas clearly and effectively, both in written and oral forms.
- Utilize technology, such as mathematical software and programming languages, to enhance mathematical analysis and visualization.
- Apply mathematical knowledge to explore and contribute to interdisciplinary fields, such as physics, engineering, economics, and computer science.
- Engage in independent research and investigation of mathematical topics, demonstrating critical thinking and analytical skills.
- Work collaboratively in a team to solve complex mathematical problems and communicate results.
- Demonstrate an awareness of the historical development and current trends in mathematics, fostering a broader appreciation of the field.

6. Structure of B.Sc. Mathematics

The B.Sc. Mathematics program will be of three years' duration. Each year will be called an academic year and will be divided into two semesters, thus there will be a total of six semesters. Each semester will consist of sixteen weeks.

The program will consist of core papers 6 cr. In Sem each semester, and inter discipline electives of 3 credits in each semester. Skill enhancement courses are 2 credits. For theory classes 1 credit indicates a one hr lecture per week while for Practical 1 credit indicates a two-hour session per week.

The program includes Core Courses (CC) and elective courses. The core courses are all compulsory courses. Inter Discipline-Course Elective (IDC), Skill Enhancement Course (SEC). In addition, there are two compulsory Ability Enhancement Courses (AEC), and Value-added courses (VAC).

To acquire a degree in Physical science. A student must study 11 Core Courses are 60 credit and Minor Stream are 28 Credit,3 Inter Discipline-Course Electives, 4 Skill Enhancement Courses and 4 compulsory Ability Enhancement Courses. The Core Courses, credit Inter Discipline-Course Elective and 6 Value – Added Courses (VAC). The Skill Enhancement Courses are 9 credit courses while the Ability Enhancement Courses are 8 credit-courses. A student must earn a minimum of 80 credits to get a degree in B.Sc. Mathematics.

There will be 11 Core Courses which are to be compulsorily studied to complete the requirements for a degree in B.Sc. Mathematics The students will study two Core Courses each in Semesters I II, and III. three Core Courses each in Semesters IV, and V. four Core Courses in Semesters VI. The Core Courses will be of four credits each (four credits theory and two credits Practical).

The program offers 3 Inter Discipline-Course Electives (IDC), of which the student must choose any two in each of the Semester I, II and III will be of 9 credits each. A particular option of AEC course will be offered in Semesters I To IV semesters only if the minimum number of students opting for that course is 8 credits. A particular option of VAC will be offered in semester Ist and II semesters opting for that course in 6 credits.

The students will undertake 4 Skill Enhancement (SE) courses of two credits in I, II, V and 3 credit in III semester, which they can choose from the list of SE courses offered by their respective school or other schools within CVRUK. The Department of Physical science is offering five such courses. The 4 compulsory Ability Enhancement Courses (AECs): AE1 (Hindi language) and AE2 (English language) AE3 (Communication Skill) AE4 (Culture Heritage) will be of 8 credits each (theory only). The student will take one each in Semesters I, II, III and IV.

The teaching learning will involve theory classes of one-hour duration and practical classes. The curriculum will be delivered through various methods including chalk and talk, power point presentation, audio, video tools, e-learning/e-content, field trips/ industry visits, seminars, workshops, projects, and class discussions. The assessment broadly will comprise of internal assessment (40%) and End Semester examination (60%). The internal assessment will be through MCQs, test, assignment, oral presentation, quizzes, and worksheets. Each practical paper will be of 100 marks.

Credit Distribution in B.Sc. (PCM)

Semester	Course Code	Course Name (Major)	Credit L+T+P
I	**3SATC103**	Mathematics – I (Algebra, Trigonometry and Geometry)	6(4+0+2)
	3SMOC103	Physics-I (Mechanics, Oscillations. And Properties of Matter)	6(4+0+2)
	3SPIC103	Chemistry –I (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
II	**3SCDC203**	Mathematics – II (Calculus, Differential Equations and Vector Calculus)	6(4+0+2)
	3SMBC203	Physics-II (Mathematical Background, Electrostatics and Steady-State)	6(4+0+2)
	3SPIC203	Chemistry –II (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
III	**3SCDC303**	Mathematics-III (Calculus, Differential Equation and Mechanics)	6(4+0+2)
	3SKTC303	Physics-III (Kinetic Theory of Gases, Thermo-dynamics and Statistical Mechanics	6(4+0+2)
	3SPIC303	Chemistry –III (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
	3SACC403	Major I-Mathematics-IV (Advanced Calculus, Partial Differential Equations, Complex Analysis and Abstract Algebra)	6(4+0+2)

Semester	Course Code	Course Name (Major)	Credit L+T+P
IV	**3SPSC403**	Major II- Probability and Statistics	6(4+0+2)
	3SGOC403	Physics-IV Major-I (Group. Waves, Acoustics and Optics)	6(4+0+2)
	3STPC403	Major II- Thermal Physics	4(2+0+2)
	3SPIC403	Chemistry-IV Major- I (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
	3SAMC403	Major II -Analytical Methods in Chemistry	4(2+0+2)
V	**3SRAC503**	Major I - Mathematics-V (Real Analysis, Linear Algebra and Discrete Mathematics)	6(4+0+2)
	3SRTC503	Major II- Mathematics-V (Ring Theory and Linear Algebra II)	4(4+0+0)
	3SMCC503	Major I - Multivariable Calculus	4(4+0+0)
	3SQMC503	Major I - Physics-V (Quantum Mechanics, Atomic Molecular and Nuclear Physics)	6(4+0+2)
	3SAPC503	Major II - Physics-V (Astro Physics and Atmospheric Science)	4(2+0+2)
	3SMPC503	Major. III - Physics-V Mathematical Physics	4(2+0+2)
	3SPOC503	Major I -Chemistry –V (Physical, Organic and Inorganic Chemistry)	6(4+0+2)
	3SRMC503	Major II -Research Methodology for Chemistry	4(2+0+2)
	3SGCC503	Major III -Green Chemistry	4(2+0+2)
VI	**3SMSC603**	Major I - Mathematics-VI (Metric Space, Numerical Analysis and Statistics)	6(4+0+2)
	3SFSC603	Major II- Mathematics-VI (Fuzzy Set Theory)	6(6+0+0)
	3SNTC603	Major III - Number Theory	4(4+0+0)
	3SSSC603	Major I- Physics -VI (Solid State Physics, Electronics and Laser)	6(4+0+2)
	3SNTC603	Major II- Physics-VI (Nano Technology and Material Science)	6(4+0+2)
	3SSMC603	Major III - Statistical Mechanics	4(2+0+2)
	3SPIC603	Major I -Chemistry –VI (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
	3SNCC603	Major II -Nano Chemistry	6(4+0+2)

Semester	Course Code	Course Name (Major)	Credit L+T+P
	3SBIC603	Major III-Biochemistry	4(2+0+2)

Semester	Course Code	Course Name (Minor)	Credit L+T+P
I	**3SATM104**	Mathematics – I (Algebra, Trigonometry and Geometry)	4(4+0+0)
	3SMOM104	Physics-I (Mechanics, Oscillations and Properties of Matter)	4(2+0+2)
	3SPIM104	Chemistry –I (Physical, Inorganic and Organic Chemistry)	4(2+0+2)
II	**3SCDM204**	Mathematics – II (Calculus, Differential Equations and Vector Calculus)	4(4+0+0)
	3SMBM204	Physics-II (Mathematical Background, Electrostatics and Steady-State)	4(2+0+2)
	3SPIM204	Chemistry –II (Physical, Inorganic and Organic Chemistry)	4(2+0+2)
III	**3SCDM304**	Mathematics-III (Calculus, Differential Equation and Mechanics)	6(6+0+0)
	3SKTM304	Physics-III (Kinetic Theory of Gases, Thermo-dynamics and Statistical Mechanics	6(4+0+2)
	3SPIM304	Chemistry –III (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
IV	**3SACM404**	Mathematics-IV (Advanced Calculus, Partial Differential Equations, Complex Analysis and Abstract Algebra)	6(6+0+0)
	3SGWM404	Physics-IV (Group Waves, Acoustics and Optics)	6(4+0+2)
	3SPIM404	Chemistry-IV (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
V	**3SRAM504**	Mathematics-V (Real Analysis, Linear Algebra and Discrete Mathematics)	4(4+0+0)
	3SQMM504	Physics-V (Quantum Mechanics, Atomic, Molecular and Nuclear Physics)	4(2+0+2)
	3SPOM504	Chemistry-V (Physical, Organic and Inorganic Chemistry	4(2+0+2)
	3SMSM604	Mathematics-VI (Metric Space, Numerical Analysis and	4(4+0+0)

Semester	Course Code	Course Name (Minor)	Credit L+T+P
VI		Statistics)	
	3SSSM604	Physics-VI (Solid State Physics, Electronics and Laser)	4(2+0+2)
	3SPIM604	Chemistry-VI (Physical, Inorganic and Organic Chemistry)	4(2+0+2)

Value Added Course (VAC)			
Semester	**Code**	**Course Name**	**Credit (L+T+P)**
1st	3IFAV106	Fundamentals of AI	3(3+0+0)
	3SEEV106	Environmental Education	3(3+0+0)
2nd	3ICSV206	Cyber Security	3(3+0+0)
2nd	3HCIV206	Contemporary India	3(3+0+0)
2nd	3HYEV206	Yoga Education	3(0+1+2)

Inter Discipline Course			
Semester	Course Code	Course Name	Credits (L+T+P)
1st	3SPHI102	Public Health and Hygiene	3(3+0+0)
2nd	3SATI202	Analytical Techniques	3(3+0+0)
3rd	3SCSI302	Calculus Single and Multivariable	3(3+0+0)

Skill Enhancement Course (SEC)			
Semester	**Course Code**	**Course Name**	**Credits (L+T+P)**
1st	3SNMS105	Numerical Methods	2(2+0+0)
2nd	3SDES205	Differential Equation	2(2+0+0)
3rd	3SBAS305	Boolean Algebra	3(3+0+0)
5th	3SGTS505	Game Theory	2(0+1+1)

Ability Enhancement Course (AEC)			
Semester	**Course Code**	**Course Name**	**Credited (L+T+P)**
1st	3HHLA101	Hindi language	2(2+0+0)
2nd	3HELA201	English language	2(2+0+0)
3rd	3HCSA301	Communication Skill	2(2+0+0)
4th	3HCHA401	Cultural Heritage	2(2+0+0)

Semester-wise Distribution

Semester	Course Opted	Course Name	Credits
I	Value Added Course	Fundamentals of AI Environmental Education	3
	Ability Enhancement Course	Hindi language	2
	Skill Enhancement Course	Numerical Methods	2
	Inter Discipline Course	Public Health and Hygiene	3
	Major Core	Mathematics/ Physics/ Chemistry	4
	Minor Core	Mathematics/ Physics/ Chemistry	2
	Major Core Practical	Mathematics/ Physics/ Chemistry	2
	Minor Core Practical	Mathematics/ Physics/ Chemistry	2
II	Value Added Course	Cyber Security/ Contemporary India Yoga education	3
	Ability Enhancement Course	English language	2
	Skill Enhancement Course	Differential Equation	2
	Inter Discipline Course	Analytical Techniques	3
	Major Core	Mathematics/ Physics/ Chemistry	4
	Minor Core	Mathematics/ Physics/ Chemistry	2
	Major Core Practical	Mathematics/ Physics/ Chemistry	2
	Minor Core Practical	Mathematics/ Physics/ Chemistry	2
III	Ability Enhancement Course	Communication Skill	2
	Skill Enhancement Course	Boolean Algebra	3
	Inter Discipline Course	Calculus Single and Multivariable	3
	Major Core	Mathematics/ Physics/ Chemistry	4
	Minor Core	Mathematics/ Physics/ Chemistry	4
	Major Core Practical	Mathematics/ Physics/ Chemistry	2
	Minor Core Practical	Mathematics/ Physics/ Chemistry	2
IV	Ability Enhancement Course	Cultural Heritage	2
	Major Core – I	Mathematics/ Physics/ Chemistry	4

Semester	Course Opted	Course Name	Credits
	Major Core – II	Mathematics/ Physics/ Chemistry	4
	Minor Core	Mathematics/ Physics/ Chemistry	4
	Major Core-I Practical	Mathematics/ Physics/ Chemistry	2
	Major Core-II Practical	Mathematics/ Physics/ Chemistry	2
	Minor Core Practical	Mathematics/ Physics/ Chemistry	2
V	Skill Enhancement Course	Game Theory	2
	Major Core – I	Mathematics/ Physics/ Chemistry	4
	Major Core – II	Mathematics/ Physics/ Chemistry	2
	Major Core – III	Mathematics/ Physics/ Chemistry	2
	Minor Core	Mathematics/ Physics/ Chemistry	2
	Major Core-I Practical	Mathematics/ Physics/ Chemistry	2
	Major Core-II Practical	Mathematics/ Physics/ Chemistry	2
	Major Core-III Practical	Mathematics/ Physics/ Chemistry	2
	Minor Core Practical	Mathematics/ Physics/ Chemistry	2
VI	Major Core – I	Mathematics/ Physics/ Chemistry	4
	Major Core – II	Mathematics/ Physics/ Chemistry	4
	Major Core – III	Mathematics/ Physics/ Chemistry	2
	Minor Core	Mathematics/ Physics/ Chemistry	2
	Major Core- I Practical	Mathematics/ Physics/ Chemistry	2
	Major Core-II Practical	Mathematics/ Physics/ Chemistry	2
	Major Core-III Practical	Mathematics/ Physics/ Chemistry	2
	Minor Core- Practical	Mathematics/ Physics/ Chemistry	2
		Total	**120 Credits**

Total Credits: 60 CC + 28 MINORS + 09 IDE + 08 AEC + 09 SEC + 06 VAC = 120 Credits

BACHELOR OF SCIENCE(PCM)

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FIRST SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SATC103	Major Core	Mathematics – I (Algebra, Trigonometry & Geometry)	100	60	20	40	14	4	-	-	4
3SMOC103		Physics-I (Mechanics, Oscillations, and Properties of Matter)									
3SPIC103		Chemistry –I (Physical, Inorganic & Organic Chemistry)									
3SATM104	Minor Core	Mathematics – I (Algebra, Trigonometry & Geometry)	100	60	20	40	14	2	-	-	2
3SMOM104		Physics-I (Mechanics, Oscillations and Properties of Matter)									
3SPIM104		Chemistry –I (Physical, Inorganic & Organic Chemistry)									
3SPHI102	Interdisciplinary Course	Public Health and Hygiene	100	60	20	40	14	3	-	-	3
3HHLA101	Ability Enhancement Course	Hindi language	100	60	20	40	14	2	-	-	2
3SNMS105	Skill Enhancement Course	Numerical methods	100	60	20	40	14	2	-	-	2
3SEEV106 3IFAV106	Value Added Course	Environmental Education/ Fundamentals of AI	100	60	20	40	14	3	-	-	3

BACHELOR OF SCIENCE(PCM)

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FIRST SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Practical Group			Total Marks	Term End Practical Exam		Internal Assessment		Credit Distribution			Allotted Credits
				Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SATC103	Practical Major Core	Mathematics – I (Algebra, Trigonometry & Geometry)	100	60	40	40	14		-	2	2
3SMOC103		Physics-I (Mechanics, Oscillations. And Properties of Matter)									
3SPIC103		Chemistry –I (Physical, Inorganic & Organic Chemistry)									
3SMOM104	Practical Minor Core	Physics-I (Mechanics, Oscillations and Properties of Matter)	100	60	40	40	14	-	-	2	2
3SPIM104		Chemistry –I (Physical, Inorganic & Organic Chemistry)									
	Grand Total		800					16	-	4	20

***For MINOR CORE course credit distribution will be**

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SATM104	MINOR CORE	Mathematics – I (Algebra, Trigonometry & Geometry)	100	60	20	40	14	4	-	-	4

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

BACHELOR OF SCIENCE(PCM)

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF SECOND SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SCDC203	**Major Core**	Mathematics – II (Calculus, Differential Equations & Vector Calculus)	100	60	20	40	14	4	-	-	4
3SMBC203		Physics-II (Mathematical Background, Electrostatics and Steady)									
3SPIC203		Chemistry –II (Physical, Inorganic & Organic Chemistry)									
3SCDM204	**Minor Core**	Mathematics – II (Calculus, Differential Equations & Vector Calculus)	100	60	20	40	14	2	-	-	2
3SMBM204		Physics-II (Mathematical Background, Electrostatics and Steady)									
3SPIM204		Chemistry –II (Physical, Inorganic & Organic Chemistry)									
3SATI202	**Interdisciplinary Course**	Analytical Techniques	100	60	20	40	14	3	-	-	3
3HELA201	**Ability Enhancement Course**	English language	100	60	20	40	14	2	-	-	2
3SDES205	**Skill Enhancement Course**	Differential Equation	100	60	20	40	14	2	-	-	2
3ICSV206/ 3HYEV206/ 3HCIV206	**Value Added Course**	Cyber Security/ Yoga Education/ Contemporary India	100	60	20	40	14	3	-	-	3

BACHELOR OF SCIENCE(PCM)

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF SECOND SEMESTER											
Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Practical Group											
3SCDC203	**Practical Major Core**	Mathematics – II (Calculus, Differential Equations & Vector Calculus)	100	60	20	40	14	-	-	2	2
3SMBC203		Physics-II (Mathematical Background, Electrostatics and Steady)									
3SPIC203		Chemistry –II (Physical, Inorganic and Organic Chemistry)									
3SMBM204	**Practical Minor Core**	Physics-II (Mathematical Background, Electrostatics and Steady)	100	60	20	40	14	-	-	2	2
3SPIM204		Chemistry –II (Physical, Inorganic & Organic Chemistry)									
	Grand Total		**800**					**16**	-	**4**	**20**

BACHELOR OF SCIENCE(PCM)

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF SECOND SEMESTER

***For MINOR CORE Course Credit Distribution Will Be**

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SCDM204	MINOR CORE	Mathematics – II (Calculus, Differential Equations & Vector Calculus)	100	60	20	40	14	4	-	-	4

***For Value Added Course Yoga Education Credit Distribution Will Be**

Practical Group			Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Total Credit
3HYEV206	Value Added Course	Yoga Education	100	60	20	40	14	-	1	2	3

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

After Second Sem
Student exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline/Subject provided they secure 4 credits in work based vocational courses offered during summer term or internship/ apprenticeship in addition to 6 credits from skill- based courses earned during first and second semester.

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF THIRD SEMESTER											
Course Details				**External Assessment**		**Internal Assessment**		**Credit Distribution**			**Allotted Credits**
Course Code	**Course Type**	**Course Title**	**Total Marks**	**Max Marks**	**Min Marks**	**Max Marks**	**Min Marks**	**L**	**T**	**P**	**Subject wise Distribution**
Theory Group											
3SCDC303	**Major Core**	Mathematics-III (Calculus, Differential Equation and Mechanics)	100	60	20	40	14	4	-	-	4
3SKTC303		Physics-III (Kinetic Theory of Gases, Thermo-dynamics and Statistical Mechanics)									
3SPIC303		Chemistry –III (Physical, Inorganic & Organic Chemistry)									
3SCDM304	**Minor Core**	Mathematics-III (Calculus, Differential Equation and Mechanics)	100	60	20	40	14	4	-	-	4
3SKTM304		Physics-III (Kinetic Theory of Gases, Thermo-dynamics and Statistical Mechanics									
3SPIM304		Chemistry –III (Physical, Inorganic & Organic Chemistry)									
3SCSI302	**Interdisciplinary Course**	Calculus single and multivariable	100	60	20	40	14	3	-	-	3
3HCSA301	**Ability Enhancement Course**	Communication Skill	100	60	20	40	14	2	-	-	2
3SBAS305	**Skill Enhancement Course**	Boolean algebra	100	60	20	40	14	3	-	-	3

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF THIRD SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Practical Group											
3SCDC303	Practical Major Core	Mathematics-III (Calculus, Differential Equation and Mechanics)	100	60	20	40	14		-	2	2
3SKTC303		Physics-III (Kinetic Theory of Gases, Thermo-dynamics and Statistical Mechanics									
3SPIC303		Chemistry –III (Physical, Inorganic & Organic Chemistry)									
3SKTM304	Practical Minor Core	Physics-III (Kinetic Theory of Gases, Thermo-dynamics and Statistical Mechanics	100	60	20	40	14	-	-	2	2
3SPIM304		Chemistry –III (Physical, Inorganic & Organic Chemistry)									
	Grand Total		**700**					**16**	**-**	**4**	**20**

***For MINOR CORE course credit distribution will be**

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SCDM304	MINOR CORE	Mathematics-III (Calculus, Differential Equation and Mechanics)	100	60	20	40	14	6	-	-	6

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FOURTH SEMESTER

Course Details					External Assessment	Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SGOC403	**Major Core – I**	Physics-IV (Group Waves, Acoustics and Optics)	100	60	20	40	14	4	-	-	4
3SPIC403		Chemistry- IV (Physical, Inorganic & Organic Chemistry)									
3STPC403	**Major Core – II**	Physics- IV (Thermal Physics)	100	60	20	40	14	4	-	-	4
3SAMC403		Chemistry- IV (Analytical methods in Chemistry)									
3SACM404	**Minor Core**	Mathematics IV (Advanced, Calculus, Partial Differential Equations, Complex Analysis and Abstract Algebra)	100	60	20	40	14	4	-	-	4
3SGWM404		Physics- IV (Group Waves, Acoustics and Optics)									
3SPIM404		Chemistry-IV (Physical, Inorganic & Organic Chemistry)									
3HCHA401	**Ability Enhancement Course**	Cultural Heritage	100	60	20	40	14	2	-	-	2
Practical Group											
3STPC403	**Practical Major Core-I**	Physics-IV (Group Waves, Acoustics and Optics)	100	60	20	40	14		-	2	2
3SPIC403		Chemistry- IV (Physical, Inorganic & Organic Chemistry)									

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FOURTH SEMESTER

Course Code	Course Type	Course Title	Total Marks		External Assessment	Internal Assessment		Credit Distribution			Allotted Credits
				Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Practical Group											
3SPIC403		Chemistry- IV (Physical, Inorganic & Organic Chemistry)									
	Practical Major Core-II	Physics- IV (Thermal Physics)	100	60	20	40	14	-	-	2	2
3SAMC403		Chemistry- IV (Analytical methods in Chemistry)									
3SGWM404	**Practical Minor Core**	Physics- IV (Group Waves, Acoustics and Optics)	100	60	20	40	14	-	-	2	2
3SPIM404		Chemistry-IV (Physical Inorganic & Organic Chemistry)									
	Grand Total		**700**					**14**	**-**	**6**	**20**

***For MINOR CORE course credit distribution will be**

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SACM404	**MINOR CORE**	**Mathematics -IV Advanced, Calculus, Partial Differential Equations, Complex Analysis and Abstract Algebra**	**100**	**60**	**20**	**40**	**14**	**6**	**-**	**-**	**6**

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical

External theory & practical will carry 60 marks.

Internal Assessment (theory & practical will carry total of 40 marks.

Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.

Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

After Second Sem - Student exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline/Subject provided they secure 4 credits in work based vocational courses offered during summer term or internship/ apprenticeship in addition to 6 credits from skill- based courses earned during first and second semester

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FIFTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SQMC503	**Major Core – I**	Physics V- Quantum Mechanics Atomic Molecular and Nuclear Physics	100	60	20	40	14	4	-	-	4
3SPOC503		Chemistry V- (Physical Organic and Inorganic Chemistry)									
3SAPC503	**Major Core – II**	Physics-V Astro Physics and Atmospheric Science	100	60	20	40	14	2	-	-	2
3SRMC503		Chemistry-V Research Methodology for Chemistry									
3SMPC503	**Major Core – III**	Physics-V Mathematical Physics	100	60	20	40	14	2	-	-	2
3SGCC503		Chemistry-V Green Chemistry									
3SRAM504	**Minor Core**	Mathematics V- Real Analysis Linear, Algebra and Discrete Mathematics	100	60	20	40	14	2	-	-	2
3SQMM504		Physics-V Quantum Mechanics Atomic Molecular and Nuclear Physics									
3SPOM504		Chemistry-V (Physical Organic and Inorganic Chemistry)									

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FIFTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Practical Group				Term End Practical Exam		Internal Assessment					
*****	Practical		-	-	-	-	-	-	-	-	-
3SQMC503	Practical Major Core-I	Physics V- Quantum Mechanics Atomic Molecular and Nuclear Physics	100	60	20	40	14		-	2	2
3SPOC503		Chemistry V- (Physical Organic and Inorganic Chemistry)									
3SAPC503	Practical Major Core-II	Physics- V Astro Physics and Atmospheric Science	100	60	20	40	14	-	-	2	2
3SRMC503		Chemistry-V Research Methodology for Chemistry									
3SMPC503	Practical Major Core-III	Physics-V Mathematical Physics	100	60	20	40	14	-	-	2	2
3SGCC503		Chemistry- V Green Chemistry									
3SQMM504	Practical Minor Core	Physics-V Quantum Mechanics Atomic Molecular and Nuclear Physics	100	60	20	40	14	-	-	2	2
3SPOM504		Chemistry-V (Physical Organic and Inorganic Chemistry)									
3SGTS505	Skill Enhancement Course	Game Theory	100	60	20	40	14	-	1	1	2
	Grand Total		900					10	1	9	20

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: 12th Pass (Maths)

COURSE STRUCTURE OF FIFTH SEMESTER												
Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution

*For MINOR CORE course credit distribution will be

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SRAM504	MINOR CORE	Mathematics V- Real Analysis Linear Algebra and Discrete Mathematics	100	60	20	40	14	4	-	-	4

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF FIFTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SRAC503	**Major Core – I**	Mathematics V -Real Analysis, Linear Algebra and Discrete Mathematics	100	60	20	40	14	4	-	-	4
3SRTC503	**Major Core – II**	Mathematics V -Ring Theory and Linear Algebra	100	60	20	40	14	4	-	-	4
3SMCC503	**Major Core – III**	Mathematics V - Multivariable Calculus	100	60	20	40	14	4	-	-	4
3SQMM504	**Minor Core**	Physic V - Quantum Mechanics Atomic Molecular and Nuclear Physics	100	60	20	40	14	2	-	-	2
3SPOM504		Chemistry-V (Physical Organic and Inorganic Chemistry)									

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF FIFTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Practical Group				Term End Practical Exam		Internal Assessment					
*****	**Practical**	Group Elective – I	-	-	-	-	-	-	-	-	-
3SRAC503	**Practical Major Core-I**	Mathematics V -Real Analysis, Linear Algebra and Discrete Mathematics	100	60	20	40	14		-	2	2
3SQMM504	**Practical Minor Core**	Physic -V Quantum Mechanics Atomic Molecular and Nuclear Physics	100	60	20	40	14	-	-	2	2
3SPOM504		Chemistry-V (Physical Organic and Inorganic Chemistry)									
Skill Course											
3SGTS505	**Skill Enhancement Course**	Game Theory	100	60	20	40	14	-	1	1	2
	Grand Total		**700**					**14**	1	**5**	**20**

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF SIXTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SSSC603	**Major Core – I**	Physic-VI Solid State Physics Electronics and LASER	100	60	20	40	14	4	-	-	4
3SPIC603		Chemistry-VI (Physical Inorganic and Organic Chemistry)									
3SNTC603	**Major Core – II**	Physics-VI Nano Technology and Material Science	100	60	20	40	14	4	-	-	4
3SNCC603		Chemistry-VI Nano Chemistry									
3SSMC603	**Major Core – III**	Physics –VI Statistical Mechanics	100	60	20	40	14	2	-	-	2
3SBIC603		Chemistry-VI Bio Chemistry									
3SMSM604	**Minor Core**	Mathematics VI – Matric Space, Numerical Analysis and Statistic	100	60	20	40	14	2	-	-	2
3SSSM604		Physics-VI Solid State Physics Electronics and LASER									
3SPIM604		Chemistry-VI (Physical Inorganic and Organic Chemistry)									

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF SIXTH SEMESTER

Course Details				**External Assessment**		**Internal Assessment**		**Credit Distribution**			**Allotted Credits**
Course Code	**Course Type**	**Course Title**	**Total Marks**	**Max arks**	**Min Marks**	**Max Marks**	**Min Marks**	**L**	**T**	**P**	**Subject wise Distribution**
Practical Group				**Term End Practical Exam**		**Internal Assessment**					
3SSSC603	**Practical Major Core - I**	Physic-VI Solid State Physics Electronics and LASER	100	60	20	40	14	-	-	2	2
3SPIC603		Chemistry-VI (Physical Inorganic and Organic Chemistry)									
3SNTC603	**Practical Major Core- II**	Physics-VI Nano Technology and Material Science	100	60	20	40	14	-	-	2	2
3SNCC603		Chemistry-VI Nano Chemistry									
3SSMC603	**Practical Major Core- III**	Physics –VI Statistical Mechanics	100	60	20	40	14	-	-	2	2
3SBIC603		Chemistry-VI Bio Chemistry									
3SSSM604	**Practical Minor Core-**	Physic-VI Solid State Physics Electronics and LASER	100	60	20	40	14	-	-	2	2
3SPIM604		Chemistry-VI (Physical Inorganic and Organic Chemistry)									
	Grand Total		**800**					**12**	-	**8**	**20**

BACHELOR OF SCIENCE

Duration: 36 Months (3 Years) Eligibility: **12th Pass (Maths)**

COURSE STRUCTURE OF SIXTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max arks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution

***For MINOR CORE course credit distribution will be**

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
3SMSM604	MINOR CORE	Mathematics – Matric Space, Numerical Analysis and Statistic	100	60	20	40	14	4	-	-	4

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

I Semester

MAJOR CORE COURSES

3SATC103: Mathematics-I (Algebra, Trigonometry and Geometry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SATC103	Mathematics-I (Algebra, Trigonometry and Geometry)	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- Apply the concepts of matrices in solving a system of linear equations.
- Be familiar with the theory of equations.
- Expand trigonometric functions and also find the summation of T-series.
- To have knowledge About Cone and Cylinder with coincides.
- Be familiar with group theory, ring, integral domain, and field and make their fundamental strong.

Course Outcomes

- Understanding the ideas of matrices and ability to solve system of linear equations.
- The student will be able to acquire sound knowledge of matrices and techniques in solving equations with the help of theory of equations
  Fluency in solving equations.
- Understanding the concepts of algebra, trigonometry and geometry.

Syllabus — Credit (4-0-2)

UNIT – 1 Rank of a matrix. Eigen values, eigen vectors. Characteristic equation of a matrix. Cayley Hamilton theorem and its use in finding inverse of matrix. Application of matrix to a systemof linear (both homogenous and non - homogenous) equations. Theorems on consistency andinconsistency of a system of linear equations. Solving the linear equations with three unknowns. Relation between the roots and coefficients of a general polynomial equation in one variable. Transformation of equations, Descartes's rule of signs.

UNIT – 2 De Moivre's theorem and its application. Direct and inverse circular and hyperbolic functions, Expansion of trigonometrical function. Gregory's Series, Summation of Series,

UNIT – 3 Definition and basic properties of group. Order of an element of a group. Subgroups, algebra of subgroups. Cyclic groups and their simple properties. Coset decomposition and related theorems. Lagrange's theorem and its consequences, Normal sub groups, quotient groups.

UNIT- 4 Homomorphism and isomorphism of groups, kernel of Homomorphism and fundamental theorem

of Homomorphism of groups Permutation groups (even and odd permutations) Alternating groups An, Cayley's theorem. Introduction to rings, subrings, integral domains and fields, simple properties and examples.

UNIT – 5 General equation of second degree. Tracing of conics. Equation of cone with given base, generators of cone, condition for three mutually perpendicular generators, Right circular cone. Equation of Cylinder and its properties. Right circular cylinder, enveloping cylinder and their properties Central conicoid, Paraboloids. Plane sections of Conicoid.

Practical **Credit-2**

1. Tracing of conics in Cartesian coordinates/polar coordinates.
2. Sketching ellipsoid, hyperboloid of one and two sheets (using Cartesian co-ordinates).

Reference Books

1. Algebra, Trigonometry and Geometry by Dr. H.K. Pathak
2. Complex Analysis by Elias M. Stein and Rami Shakarchi.
3. Linear Algebra by Gilbert Strang.

Text Books

1. Elementary Linear Algebra" by Howard Anton and Chris Rorres
2. Complex Variables and Applications" by James Ward Brown and Ruel Churchill
3. Contemporary Abstract Algebra" by Joseph A. Gallian
4. A First Course in Abstract Algebra" by John B. Fraleigh

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will learn to manipulate matrices, calculate their rank, and understand their properties, enabling them to solve systems of linear equations. They will explore the relationship between the roots and coefficients of polynomial equations, enabling them to analyse and manipulate polynomial expressions.	Start with a lecture explaining what matrices are, their Notation and basic operations like addition, subtraction, and multiplication. Provide examples to illustrate these concepts.	Quiz, and Solve some questions discussion
2.	Students will understand and apply De Moivre's theorem, which deals with complex numbers and powers of complex numbers. They will be able to raise complex numbers to any integer power, making it a fundamental tool in trigonometry and complex analysis.	Teaching will be done through lectures and discussion mode. Real-Life Applications, Practice Problems.	Quiz, and discussion Group Problem Solving, Assessment

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
3.	Students will understand the fundamental definition of a group and its basic properties, including closure, associativity, identity element, and inverses. They will be able to determine the order of an element within a group, which is the smallest positive integer "n" such that raising the element to the power of "n" yields the identity element.	Teaching will be done through lectures and discussion mode.	Quiz, and discussion Group Problem Solving, Assessment
4.	Students will understand the concepts of homomorphism and isomorphism in groups, including the kernel of a homomorphism and the fundamental theorem of homomorphism. They will also explore permutation groups, focusing on even and odd permutations, and gain insights into alternating groups An and Cayley's theorem.	Teaching will do through lectures and discussion mode.	Quiz, and discussion Group Problem Solving, Assessment
5.	This topic covers Conic sections and shapes in geometry. It includes the general equation of a second-degree curve, tracing and properties of conic sections (such as circles, ellipses, parabolas, and hyperbolas), the equation of a cone with its base and generators, conditions for mutually perpendicular generators in a cone, properties of right circular cones, equations and properties of cylinders (right circular, enveloping), central conicoid, and paraboloids.	Teaching will do through lectures and discussion mode.	Quiz, and discussion Group Problem Solving, Assessment

MAJOR CORE COURSES

3SMOC103: Physics-I (Mechanics Oscillations and Properties of Matter)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMOC103	Mechanics, Oscillations and Properties of Matter	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

COURSE OBJECTIVE: -

1. To understands applications of Newton's Laws of Classical System.
2. Understands the concepts of elasticity and viscosity
3. Understands the damped and driven oscillators
4. Gains and appreciations of surface phenomena.

COURSE OUTCOMES: -

1. To study the fundamentals of mechanics and oscillations
2. Gate the knowledge about forces help the student in their daily life
3. The information will teach the students about the rolling concepts

SYLLABUS CREDIT-(4 -0-2)

UNIT – I Mechanics Laws of motion, centripetal acceleration, Coriolis force and its applications. Kepler's laws. Gravitational law and field. Gauss and Poisson's Equation of Gravitational self- energy System of particles, Center of mass, equation of motion, conservation of linear and angular momentum, conservation of energy, single stage and multistage rockets, Elastic and Inelastic collisions.

UNIT – II Oscillations differential equation and its solution, kinetic and potential energy, simple harmonic oscillations and its examples, spring and mass system, Vibrations of a magnet, moments of inertia and their products, principal moments and axes, Euler's equations simple.

UNIT – III Superposition of harmonic motion ,Superposition of two simple harmonic motions of the same frequency along the same line, Interference, Superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, damped harmonic oscillators, Harmonic oscillator.

UNIT – IV Properties of matter Elasticity, Hook's Law, Elastic constants for an isotropic solid beams supported at both the ends, Cantilever, Torsion of a cylinder bending moments and Shearing forces. Kinematics of moving fluids, Equations of continuity Euler's equation, Bernoulli's Theorem, Viscous fluids, Streamline and Turbulent flow, Poiseuille's law, Capillary tube flow, Reynolds number, Stokes law, Ssurface tension , Ssurface energy and Surface wetting

UNIT – V A brief historical background of mathematics and mechanics in the context of India and Indian culture. A brief biography of Varahamihira and Vikram Sarabhai with their Major contribution to science and society. Frame of references, Galilean transformation, Michelson –Morley experiment. Postulates of Special theory of relativity, Lorentz Transformation, Simultaneity and order of events, Length contractions, Time dilation, Relativistic transformation of velocities, Variation of mass with velocity. Mass-energy equivalence and its experimental verification.

PRACTICAL: - **(CREDIT-2)**

1. To determine the acceleration due to gravity (g) at a place with the help of Bar pendulum. (Compound Pendulum).
2. To determine the acceleration due to gravity (g) at a place with the help of Kater's reversible pendulum.
3. To determine the modulus of rigidity of given wire by Torsional Pendulum.
4. To determine the moment of inertia of a flywheel about its own axis of rotation.
5. To determine the moment of inertia of given body by using inertia table.
6. To determine the moment of inertia of given body by using inertia table with lamp and scale arrangement.
7. To study and prove the perpendicular axis theorem of moment of inertia by using inertia table. Iz = Ix + Iy
8. To determine the surface tension of a liquid by the capillary rise method.
9. To determine the co-efficient of viscosity of glycerine or castor oil by falling sphere method.
10. To determine the density of liquid by using steel balls and Teflon spheres.
11. To determine the fall time of different size spheres of same material.
12. To determine the Young's Modulus of elasticity of the given sample material by bending. (Bending of Beam)

Text Books:

1. Unified physics, R.P. Goyal, Shivalal Agarwal and Company.
2. Satentra Nath Maiti, Revised Second Edition, New age international Publishers.
3. Classical Mechanics, John R. Taylor, University Science Books,2005.
4. Introduction to Mechanic, Kleppner and Kolenkow, Cambridge University Press,2013.
5. University Physics with Modern Physics, Hugh D. Young and Roger A. Freedman, Pearson.

Reference Books:

1. R. Murugeha, S. Chand.
2. Mechanics and Properties of Matter, A.B. Gupta, Fifth Edition
3. University Physics. FW Sears, MW Zemansky and amp; HD Young Addison Wesley,1986.
4. Mechanics Berkeley Physics course, Charles Kittel, Tata Mc Graw-Hill,2007.
5. Physics - Resnick, Halliday and amp, Walker, Wiley.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understanding the fundamental principles of classical mechanics. Ability to apply Newton's laws to solve a variety of physical problems.	Interactive demonstrations of Newton's laws using everyday objects. Classroom experiments to measure forces, mass, and acceleration.	Quiz, and discussion Group Problem Solving,
2.	Students will learn how to interpret the solutions of differential equations in the context of physical systems, including analysing amplitudes, frequencies.	Analyse and solve problems related to SHM, such as	Quiz, and discussion Group Problem Solving,

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
		finding amplitudes, frequencies, and periods.	
3.	Students will learn to analyse and describe the superposition of two mutually perpendicular simple harmonic vibrations of the same frequency and interpret various Lissajous patterns.	Introduce the concept of phase difference between the vibrations. Discuss how this superposition results in elliptical motion.	Quiz, and discussion Group Problem Solving,
4.	These understand the fundamentals of solid mechanics, fluid dynamics, and related concepts. and good understanding of the behaviour of materials under various loads and the principles governing fluid flow.	Lecture to introduce the fundamental concepts of elasticity, including Hooke's Law and elastic constants.	Quiz, and discussion Group Problem Solving,
5.	Understand the concept of electric fields as accelerating agents for charged particles. Describe how electric fields influence the motion of charged particles. Calculate the acceleration of charged particles in an electric field.	Teach students the mathematical relationship between force, charge, and electric field strength using Coulomb's law.	Quiz, and discussion Group Problem Solving,

MAJOR CORE COURSES

3SPIC103: Chemistry –I (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPIC103	Chemistry – I (Physical, Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Mastering math tools for problem-solving in chemistry.
- Understanding gas behavior and critical phenomena.
- Analyzing molecular structures and crystallography.
- Comparing properties and complexation tendencies.
- Grasping bonding, reactions, and stereochemistry principles.

Course Learning Outcomes

- Ability to apply logarithmic relations, differentiate functions, and calculate slopes for chemical applications.
- Understanding of gas laws, critical phenomena, and molecular dynamics.
- Proficiency in analyzing molecular structures, intermolecular forces, and crystallography.
- Competence in comparing properties, understanding complexation tendencies, and identifying key characteristics.
- Profound understanding of bonding, reaction mechanisms, and stereochemical principles in organic compounds.

Syllabus **Credits: 4-0-2**

Physical Chemistry

UNIT - I

Mathematical Concepts

Logarithmic relations, curves stretching, linear graphs, calculation of Slopes. Differentiation of functions like K_x, e^x, x^n, sin x, logx; maxima and minima, partial differentiation. Integration of some useful/relevant functions; Factorials, probability.

Gaseous States

Critical phenomenon: PV isotherms of ideal gases, continuity of states, the isotherms of van der Waals equations, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of states.

Molecular Velocities

Root mean square, average and most probable velocities. Qualitative discussion of the maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter.

UNIT - II

Liquid State

Intermolecular forces, structure of liquids (a qualitative description) liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholesteric phases. Thermography and seven segment cells.

Solid State

Definition of space lattice, unit cell. Laws of crystallography - (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Laws of symmetry, symmetry elements in crystals. Diffraction: X-ray diffraction by crystals, derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method).

Inorganic Chemistry

UNIT – III

s-Block Elements

Comparative study Li and Mg, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

p-Block Elements Part-I

Comparative study Be and Al (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacid and halides of groups 13-16.

p-Block Elements Part-II

Hydrides of boron: diborane and higher boranes, borazine, borohydrides. fullerenes, carbides, fluorocarbons, silicates (structural principle), tetra Sulphur tetranitride, basic properties of halogens, interhalogens.

Organic Chemistry

UNIT - IV

Structure and Bonding

Hybridizations, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, inclusion compounds, clathrates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions

Homolytic and heterolytic bond breaking. Types of Reagents- electrophiles and nucleophiles. Types of organic reactions, energy consideration. Reactive intermediates (carbocations, carbanions, free radicals and carbenes). Methods of determination of reaction mechanism (active intermediate products).

UNIT - V

Stereochemistry of Organic Compounds

Concept of isomerism, types of isomerism. Optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereo genic centers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereo genic centers, diastereomers, mesocompounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configurations, sequence rule, D & L and R & S system of nomenclature. Geometrical isomerism-

determination of configuration of geometric isomers. E and Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Practical Content **Credits: 2**

Physical Chemistry

- Calibration of thermometer.
- Determination of melting point.
- Determination of boiling point.
- Determination of surface tension / percentage composition of given organic mixture using surface tension method.

Inorganic Chemistry

- Separation of cations by paper chromatography.
- Preparation of ferrous alum.

Organic chemistry

- Distillation
- Crystallization
- Decolorization and crystallization using charcoal
- Sublimation

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
- Solid State Chemistry and its Applications by Anthony R. West.

Reference Books

- Physical Chemistry Thermodynamics, Structure, and Change by Peter Atkins and Julio de Paula.
- Inorganic Chemistry by Catherine and Alan G. Sharpe.
- Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Solid State Chemistry an Introduction by Leslie E. Smart and Elaine A. Moore.
- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Developing critical thinking skills and an appreciation for the broader context of mathematics in various fields and basics concept of gaseous states and molecular velocities.	Conduct traditional lectures to introduce fundamental mathematical concepts such as moles, stoichiometry and gas laws. Use visuals, diagrams, and real-world examples to make these concepts relatable.	Homework assignments requiring calculations of slopes, integration of functions, and probability problems.

2	Intermolecular forces (hydrogen bonding, dipole-dipole interactions, London dispersion forces) influence liquid properties.	Begin with traditional lectures to introduce the fundamental concepts of the liquid state, including properties, intermolecular forces, and phase transitions.	Lab report on the determination of molecular velocities and collision parameters.
3	Collision theory and explain how it relates to reaction rates and the role of reactant collisions in chemical reactions.	Provide examples of reactions and guide students through the derivation of rate laws from experimental data, emphasizing the determination of reaction order.	Written exam assessing understanding of liquid crystals, crystallography, and diffraction techniques.
4	The basic structure of an atom, including the nucleus, electrons, protons, and neutrons. Explain the significance of atomic number and mass number.	Begin with interactive lectures that introduce key concepts of atomic structure, electron configuration, and chemical bonding. Use visual aids, models, and demonstrations to engage students.	Class quizzes or short tests that assess your understanding of specific lecture topics.
5	Define stereochemistry as the study of the spatial arrangement of atoms or groups of atoms in molecules and its impact on chemical properties.	Conduct interactive workshops where students practice assigning R and S configurations to stereo centres using the Cahn-Ingold-Prelog rules. Provide practice problems and molecular models.	Lab report on the application of spectroscopic techniques in structural analysis.

MINOR CORE COURSES

3SATM104: Mathematics-I (Algebra, Trigonometry and Geometry)

Chemistry)

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SATM104	Mathematics-I (Algebra, Trigonometry and Geometry)	4(4-0-0)	60	20	20	-	-	100	3hr	-

Course Objectives

- Apply the concepts of matrices in solving a system of linear equations.
- Be familiar with the theory of equations.
- Expand trigonometric functions and also find the summation of T-series.
- To have knowledge about Cone and Cylinder with coincides.
- Be familiar with group theory, ring, integral domain, and field and make their fundamental strong.

Course Outcomes

- Understanding the ideas of matrices and ability to solve system of linear equations.
- The student will be able to acquire sound knowledge of matrices and techniques in solving equations with the help of theory of equations
- Fluency in solving equations.
- Understanding the concepts of algebra, trigonometry and geometry

Syllabus: **Credit-(4-0-0)**

UNIT – I Rank of a matrix. Eigen values, eigen vectors. Characteristic equation of a matrix. Cayley Hamilton theorem and its use in finding inverse of matrix. Application of matrix to a system of linear (both homogenous and non - homogenous) equations.

UNIT – II De Moivre's theorem and its application. Direct and inverse circular and hyperbolic functions, Expansion of trigonometrical function. Gregory's Series, Summation of Series,

UNIT – III Definition and basic properties of group. Order of an element of a group. Subgroups, algebra of subgroups. Cyclic groups and their simple properties. Coset decomposition and related theorems. Lagrange's theorem and its consequences, Normal sub groups, quotient groups.

UNIT- IV Homomorphism and isomorphism of groups, kernel of Homomorphism and fundamental theorem of Homomorphism of groups Permutation groups (even and odd permutations) Alternating groups An, Cayley's theorem.

UNIT – V General equation of second degree. Tracing of conics. Equation of cone with given base, generators of cone, condition for three mutually perpendicular generators, right circular cone. Equation of Cylinder and its properties.

Reference Books

1. Algebra, Trigonometry and Geometry by Dr. H.K. Pathak
2. Complex Analysis by Elias M. Stein and Rami Shakarchi
3. Linear Algebra by Gilbert Strang

Text Books

1. Elementary Linear Algebra" by Howard Anton and Chris Rorres
2. Complex Variables and Applications" by James Ward Brown and Ruel V. Churchill
3. Contemporary Abstract Algebra" by Joseph A. Gallian
4. A First Course in Abstract Algebra" by John B. Fraleigh

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will learn to manipulate matrices, calculate their rank, and understand their properties, enabling them to solve systems of linear equations. They will explore the relationship between the roots and coefficients of polynomial equations, enabling them to analyse and manipulate polynomial expressions.	Start with a lecture explaining what matrices are, their notation, and basic operations like addition, subtraction, and multiplication. Provide examples to illustrate these concepts.	Quiz, and solve some questions discussion
2.	Students will understand and apply De Moivre's theorem, which deals with complex numbers and powers of complex numbers. They will be able to raise complex numbers to any integer power, making it a fundamental tool in trigonometry and complex analysis.	Teaching will be done through lectures and discussion mode. Real-Life Applications, Practice Problems.	Quiz, and discussion Group Problem Solving, Assessment
3.	Students will understand the fundamental definition of a group and its basic properties, including closure, associativity, identity element, and inverses.	Teaching will be done through lectures and discussion mode.	Quiz, and discussion Group Problem Solving, Assessment
4.	Students will understand the concepts of homomorphism and isomorphism in groups, including the kernel of a homomorphism and the fundamental theorem of homomorphism. They will also explore permutation groups, focusing on even and odd permutations, and gain insights into alternating groups An and Cayley's theorem.	Teaching will do through lectures and discussion mode.	Quiz, and discussion Group Problem Solving, Assessment

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
5.	This topic covers conic sections and shapes in geometry. It includes the general equation of a second-degree curve, tracing and properties of conic sections (such as circles, ellip-ses, parabolas, and hyperbolas),	Teaching will do through lectures and discussion mode.	Quiz, and discussion Group Problem Solving, Assessment

MINOR CORE COURSES

3SMOM104: Physics-I (Mechanics, Oscillations and Properties of Matter)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMOM104	Mechanics, Oscillations and Properties of Matter	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- To understands applications of Newton's Laws of Classical System.
- Understands the concepts of elasticity and viscosity
- Understands the damped and driven oscillators
- Gains and appreciations of surface phenomena.

Course Outcomes

- To study the fundamentals of mechanics and oscillations
- Gate the knowledge about forces help the student in their daily life
- The information will teach the students about the rolling concepts

Syllabus Credit-2-0-2

UNIT – I Mechanics Laws of motion, Centripetal acceleration, Coriolis force and its applications. Kepler's laws, Gravitational law and field, Gauss and Poisson's equation of Gravitational self- energy system of particles.

UNIT – II Oscillations differential equation and its solution, kinetic and potential energy, Simple harmonic oscillations and its examples, Spring and mass system.

UNIT –III Lissajous figures, Damped harmonic oscillators, Power dissipation, Quality factor and their examples, Driven harmonic oscillator.

UNIT – IV Properties of matter elasticity, Hook's Law, Equations of continuity, Bernoulli's theorem, Viscous fluids, Streamline and Turbulent flow, Poiseuille's law, Reynolds number.

UNIT - V A brief historical background of mathematics and mechanics in the context of India and Indian culture. A brief biography of Varahamihira and Vikram Sarabhai with their major contribution to science and society.

Practical (Credit-2)

1. To determine the acceleration due to gravity (g) at a place with the help of Bar pendulum.
2. (Compound Pendulum).
3. To determine the modulus of rigidity of given wire by Torsional Pendulum.
4. To determine the moment of inertia of a flywheel about its own axis of rotation.
5. To determine the moment of inertia of given body by using inertia table.
6. To study and prove the perpendicular axis theorem of moment of inertia by using inertia table. Iz = Ix + Iy
7. To determine the surface tension of a liquid by the capillary rise meth

8. To determine the Young's Modulus of elasticity of the given sample material by bending. (Bending of Beam)

Text Books

1. Unified physics, R.P. Goyal, Shivalal Agarwal and Company.
2. Satentra Nath Maiti, Revised Second Edition, New age international Publishers.
3. Classical Mechanics, John R. Taylor, University Science Books,2005.
4. Introduction to Mechanic, Kleppner and Kolenkow, Cambridge University Press,2013.
5. University Physics with Modern Physics, Hugh D. Young and Roger A. Freedman, Pearson.

Reference Books

1. R. Murugeshan, S. Chand.
2. Mechanics and Properties of Matter, A.B. Gupta, Fifth Edition.
3. University Physics. FW Sears, MW Zemansky and amp; HD Young Addison Wesley,1986.
4. Mechanics Berkeley Physics course, Charles Kittel, Tata Mc Graw-Hill,2007.
5. Physics - Resnick, Halliday and amp, Walker, Wiley.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understanding the fundamental principles of classical mechanics. Ability to apply Newton's laws to solve a variety of physical problems.	Interactive demonstrations of Newton's laws using everyday objects. Classroom experiments to measure forces, mass, and acceleration.	Quiz, and discussion Group Problem Solving,
2.	Students will learn how to interpret the solutions of differential equations in the context of physical systems, including analysing amplitudes, frequencies.	Analyse and solve problems related to SHM, such as finding amplitudes, frequencies, and periods.	Quiz, and discussion Group Problem Solving,
3.	Students will learn to analyse and describe the superposition of two mutually perpendicular simple harmonic vibrations of the same frequency and interpret various Lissajous patterns.	Introduce the concept of phase difference between the vibrations. Discuss how this superposition results in elliptical motion.	Quiz, and discussion Group Problem Solving,
4.	These understand the fundamentals of solid mechanics, fluid dynamics, and related concepts. and good understanding of the behaviour of materials under various loads and the principles governing fluid flow.	Lecture to introduce the fundamental concepts of elasticity, including Hooke's Law and elastic constants.	Quiz, and discussion Group Problem Solving,
5.	Understand the concept of electric fields as accelerating agents for charged particles. Describe how electric fields influence the motion of charged particles. Calculate the acceleration of charged particles in an electric field.	Teach students the mathematical relationship between force, charge, and electric field strength using Coulomb's law.	Quiz, and discussion Group Problem Solving,

MINOR CORE COURSES

3SPIM104: Chemistry –I (Physical, Inorganic and Organic Chemistry

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIM104	Chemistry –I (Physical, Inorganic and Organic Chemistry	4(2-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Mastering math tools for problem-solving in chemistry.
- Understanding gas behavior and critical phenomena.
- Analyzing molecular structures and crystallography.
- Comparing properties and complexation tendencies.
- Grasping bonding, reactions, and stereochemistry principles.

Course Learning Outcomes

- Ability to apply logarithmic relations, differentiate functions, and calculate slopes for chemical applications.
- Understanding of gas laws, critical phenomena, and molecular dynamics.
- Proficiency in analyzing molecular structures, intermolecular forces, and crystallography.
- Competence in comparing properties, understanding complexation tendencies, and identifying key characteristics.
- Profound understanding of bonding, reaction mechanisms, and stereochemical principles in organic compounds.

Syllabus Credits 2-0-2

Physical Chemistry

UNIT – I

Gaseous States

Critical phenomenon: PV isotherms of ideal gases, continuity of states, the isotherms of van der Waals equations.

Molecular Velocities

Root mean square, average and most probable velocities. Qualitative discussion of the maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter.

UNIT –II

Liquid State

Intermolecular forces, structure of liquids (a qualitative description). Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholesteric phases.

Inorganic Chemistry

UNIT – III

s-Block Elements

Comparative study Li and Mg, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

p-Block Elements

Comparative study Be and Al (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacid and halides of groups 13-16.

Organic Chemistry

UNIT – IV

Structure and Bonding

Hybridizations, bond lengths and bond angles, bond energy, Localized and delocalized chemical bond, van-der Waals interactions, inclusion compounds, clathrates, charge transfer complexes, resonance, hyper- conjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions

Homolytic and heterolytic bond breaking. Types of Reagents- electrophiles and nucleophiles. Types of organic reactions, energy consideration.

UNIT – V

Stereochemistry of Organic Compounds

Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereo genic centers, optical activity, properties of enantiomers, diastereomers, mesocompounds, resolution of enantiomers, inversion, retention and racemization.

Practical Content **Credits :2**

Physical Chemistry

- Calibration of thermometer.
- Determination of melting point.
- Determination of boiling point

Inorganic Chemistry

- Separation of cations by paper chromatography.
- Preparation of ferrous alum.

Organic Chemistry

- Distillation.
- Crystallization.
- Sublimation.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
- Solid State Chemistry and its Applications by Anthony R. West.

Reference Books

- Physical Chemistry Thermodynamics, Structure, and Change by Peter Atkins and Julio de Paula.
- Inorganic Chemistry by Catherine and Alan G. Sharpe.
- Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Solid State Chemistry an Introduction" by Leslie E. Smart and Elaine A. Moore.
- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Developing critical thinking skills and an appreciation for the broader context of mathematics in various fields and basics concept of gaseous states and molecular velocities.	Conduct traditional lectures to introduce fundamental mathematical concepts such as moles, stoichiometry and gas laws. Use visuals, diagrams, and real-world examples to make these concepts relatable.	Homework assignments requiring calculations of slopes, integration of functions, and probability problems.
2	Intermolecular forces (hydrogen bonding, dipole-dipole interactions, London dispersion forces) influence liquid properties.	Begin with traditional lectures to introduce the fundamental concepts of the liquid state, including properties, intermolecular forces, and phase transitions.	Lab report on the determination of molecular velocities and collision parameters.
3	Collision theory and explain how it relates to reaction rates and the role of reactant collisions in chemical reactions.	Provide examples of reactions and guide students through the derivation of rate laws from experimental data, emphasizing the determination of reaction order.	Written exam assessing understanding of liquid crystals, crystallography, and diffraction techniques.
4	The basic structure of an atom, including the nucleus, electrons, protons, and neutrons. Explain the significance of atomic number and mass number.	Begin with interactive lectures that introduce key concepts of atomic structure, electron configuration, and chemical bonding. Use visual aids, models, and demonstrations to engage students.	Class quizzes or short tests that assess your understanding of specific lecture topics.
5	Define stereochemistry as the study of the spatial arrangement of atoms or groups of atoms in molecules and its impact on chemical properties.	Conduct interactive workshops where students practice assigning R and S configurations to stereo centres using the Cahn-Ingold-Prelog rules. Provide practice problems and molecular models.	Lab report on the application of spectroscopic techniques in structural analysis.

INTER DISCIPLINARY COURSE

3SPHI102: Public Health and Hygiene

(Credits: Theory- 3, Tutorials- 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPHI102	Public Health and Hygiene	3(3-0-0)	60	20	20	-	-	100	3hr	-

Course Objective

- To enlighten the non-major elective students about the general knowledge on their health and hygiene.
- To create general health awareness, the hazardous impacts and remedy.

Course Learning Outcomes

- These outcomes cover a wide range of topics related to public health, nutrition, environmental health, disease prevention, and health education.
- They aim to equip learners with essential knowledge and skills for promoting and maintaining community health.

Syllabus: Credits 3-0-0

Unit 1:

Scope of Public health and Hygiene – nutrition and health – classification of foods bases on nutritional value – Nutritional deficiency diseases Vitamin deficiency diseases.

Unit 2:

Environment and Health hazards: Environmental degradation – Pollution – Air (causes and prevention), Water– Air (causes and prevention), Land– Air (causes and prevention) and Noise associated health hazards.

Unit 3:

Communicable diseases. Measles diseases and their preventive and control measures, Malaria diseases and their preventive and control measures, Hepatitis diseases and their preventive and control measures, Cholera, Filariasis diseases and their preventive and control measures, HIV /AIDS.

Unit 4:

Non-Communicable diseases and their preventive measures. Genetic diseases, Cancer, Cardio vascular diseases, Chronic respiratory disease, Diabetes, Epilepsy,

Unit 5:

Health Education in India – WHO Programs – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on epidemic/sporadic diseases.

Text Book

- Park and Park, 1995: Text Book of Preventive and Social Medicine – Banarsidas Bhanot Publ. Jodhpur – India.
- Text Book of Public Health and hygiene, zoology by Dr. A. P. Ekhande, Dr. N. G. Mahajan, Dr. M. C. Patil, Dr. Manojkumar Chopda, Dr. R. M. Chaudhari, Prashant Publication.
- "Public Health and Community Medicine" by Rajvir Bhalwar (Publisher: CBS Publishers & Distributors Pvt Ltd)

Reference Books

- Verma, S. 1998: Medical Zoology, Rastogi publ. – Meerut – India
- Singh, H.S. and Rastogi, P.: Parasitology, Rastogi Publ. India.
- Dubey, R.C and Maheshwari, D.K. 2007: Text Book of Microbiology S. Chand and Co. Publ. New Delhi – India.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	• Understand the scope and significance of public health and hygiene. • Recognize the role of public health in promoting community wellbeing.	• Explain the relationship between nutrition and health. Scope of Public Health and Hygiene	• Multiple choice questions, quiz, Class test and students' presentation.
2.	• Understand the concept of environmental degradation. Identify factors contributing to environmental degradation.	• Describe the types of pollution, including air, water, land, and noise pollution. • Explain the associated health hazards and their effects on human health.	• Multiple choice questions, quiz, Class test and students' presentation.
3.	• Knowledge of Identify key preventive and control measures for communicable diseases.	• Describe the causes, symptoms, and preventive strategies for diseases like measles, malaria, hepatitis, cholera, filariasis, and HIV/AIDS.	• Multiple choice questions, match
4.	• Understand noncommunicable diseases (NCDs) and their risk factors.	• Describe genetic diseases, cancer, cardiovascular diseases, chronic respiratory diseases, diabetes, and epilepsy. • Explain the importance of early detection and management of NCDs.	• the following, students' presentation, quiz, class test focusing on short notes and definitions.
5.	• Learn about the World Health Organization (WHO) programs and their impact on global health. Explore the methods and channels for effective health education in India.	• Describe the basics of first aid for common health emergencies.	• Class tests, assignments, quiz, student presentations.

SKILL ENHANCEMENT COURSE (SEC)

3SNMS105: Numerical Methods

(Credits: Theory-2 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3SNMS105	Numerical Methods (I st Sem)	2(2+0+0)	60	20	20	-	-	100	2 hr	-

Course Objective

Explore numerical integration techniques, including adaptive quadrature methods and Gaussian integration. Address simultaneous and higher order ODEs. Explore techniques for solving boundary value problems, including the finite difference method and the shooting method.

Course Outcomes

- Students will be able to perform numerical differentiation and integration accurately.
- They will understand the Euler Maclaurin formula and apply adaptive quadrature methods, Gaussian integration, and techniques for handling singular integrals and Fourier integrals. Students will also demonstrate proficiency in numerical double integration.

Syllabus: Credit -2

Unit 1: Numerical Differentiation and Integration Introduction, Numerical Differentiation, Numerical Integration, Euler Maclaurin Formula, Adaptive Quadrature Methods, Gaussian Integration, Singular Integrals, Fourier Integrals, Numerical Double Integration

Unit 2: Numerical Solution of Ordinary Differential Equations Introduction, Solution by Taylor's Picard's Method, Euler's Method, Runge Kutta Methods, Predictor Corrector Methods, the Cubic Spline Method, Simultaneous and Higher Order Equations, Boundary Value Problems: Finite Difference Method, The Shooting Method,

Unit 3: Numerical Solution of Partial Differential Equations Introduction, Finite Difference Approximations, Laplace's Equation: Jacobi's Method, Gauss Seidel Method, SOR Method, ADI Method, Parabolic Equations, Iterative Methods, Hyperbolic Equations.

Unit 4: System of Linear Algebraic Equations Introduction, Solution of Centrosymmetric Equations, Direct Methods, LU Decomposition Methods, Iterative Methods, III conditioned Linear Systems.

Unit 5: The Finite Element Method: Functional Base Function Methods of Approximation the Rayleigh –Ritz Method – The Galerk in Method, Application to two dimensional problems Finite element Method for one- and two-dimensional problems.

Reference Books

- Numerical Analysis" by Richard L. Burden and J. Douglas Faires.
- Introduction to Numerical Analysis" by F. B. Hildebrand.
- Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Tarkovsky, William T. Vetter ling, and Brian P. Flannery.
- Numerical Mathematics and Computing" by Ward Cheney and David Kincaid.

Text Book

- Numerical Methods for Engineers" by Steven C. Chapra and Raymond P. Canale
- "Numerical Analysis" by Richard L. Burden and J. Douglas Faires
- "Introduction to Numerical Analysis" by F. B. Hildebrand

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	• Students will have a strong grasp of the fundamental principles of numerical differentiation and integration, including their significance in solving real world problems.	• In class lectures will provide the theoretical foundations of numerical differentiation and integration and other relevant topics.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions
2.	• Students will gain a deep understanding of ordinary differential equations (ODEs), their types, and their significance in modelling dynamic systems.	• Teaching will be done through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions.
3.	• Students will develop a strong understanding of partial differential equations (PDEs), their types, and their significance in modelling physical and engineering phenomena.	• . Teaching will be done through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions
4.	• Students will develop a solid understanding of linear algebraic equations, their significance in various fields, and their role in solving complex problems.	• Teaching will be done through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions
5.	• Students will develop a solid understanding of the Finite Element Method, its principles, and its significance in solving complex engineering and mathematical problems.	• Teaching will be done through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions

VALUE ADDED COURSE (VAC)

3SEEV106: Environmental Education

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SEEV106	Environmental Education	3(3+0)	60	20	20	-	-	100	3 hr	-

Course Objective

Upon completion of the course, the student – teacher will be able to:

- Understand the concept, significance, scope and terminologies objectives and program of environmental education.
- Develop awareness about the various types of pollution ecological Imbalances and life and contributions of environmental activities.
- Interpret the environmental legislations in conservation and protection of the environment.
- Understand the role of governmental and non-governmental Agencies in environmental education.
- Apply the methods of teaching and evaluation in environmental education.

Course Outcomes

- Environmental education raises awareness about various environmental issues, such as pollution, climate change, habitat destruction, and resource depletion.
- It provides individuals with a deeper understanding of ecosystems, biodiversity, and the interconnections between living organisms and their environment.
- Environmental education can lead to changes in behavior, such as reducing waste, conserving energy and water, and adopting sustainable consumption patterns.
- Individuals become more inclined to take care of their surroundings, leading to increased community involvement in local environmental projects.
- It fosters critical thinking skills by encouraging individuals to analyze complex environmental problems and develop solutions.

Syllabus:

Unit 1: Introduction to Environmental Education-

Environmental Education Concept, Importance and Scope, Objectives and Principles of Environmental Education. Basic Concepts in Environmental Education, Ecology, Eco-System, Food Chain, Natural Resources, Greenhouse Effect, Bio-Diversity.

Unit 2: Environment and Pollution-

Definition and Types of Environmental pollution, Air Pollution- Definition, Causes and Remedial Measures, Water Pollution: Definition, Causes and Remedial Measures, Soil Pollution: Definition, Causes and Remedial Measures, Sound Pollution: Definition, Causes and Remedial Measures, Ecological Imbalances -Deforestation, Soil Erosion.

Unit 3: Environmental Laws and Organization-

The Air Prevention and Control of Pollution Act 1977, The Water Prevention and Control of Pollution Act1974, Forest Conservation Act 1980, Environment Protection Act 1986, United Nations Environment Program (UNEP), International Union for Conservation of Nature and Natural Resources (IUCN), Central pollution control board (CPCB).

Unit 4: Environmental Ethics-

Role of Indian and other religions and cultures in environmental conservation. Green Politics, Earth Hour, Green Option Technologies, Environmental communication and public awareness, EIA Formulations, stages, Merits and demerits.

Unit 5: Methods of Teaching Environmental Education-

Project Work, Intellectual Meets-Seminars, Symposia, Workshops, Conferences, Group Discussions, Debates, Brain Storming Quiz, Poster Making, Models Making and Exhibitions.

Text Book

- Environmental science by Kamal Kant Joshi & Deepak Kumar, TechSar. 2019.
- Basics of Environmental science by Abhijit Mitra & Tanmay Ray Chaudhuri, New central book agency Pvt. Ltd. 2017.
- Essentials of Environmental Education by A.B. Saxena & V.V. Anand, Motilal Banarsidass publishing House, 2012.
- Environmental Studies by Dr. SM Saxena, Dr. Seema Mohan.

Reference Books

- Ecological Literacy: Educating Our Children for a Sustainable World, Michael K. Stone and Zenobia Barlow, Publication: Published by Sierra Club Books in 2005.
- Place-Based Education: Connecting Classrooms and Communities, David Sobel Publication: Published by The Orion Society in 2005.
- The Handbook of Environmental Education, Robert B. Stevenson, Michael Brody, Justin Dillon, and Arjen E.J. Wals, Publication: Published by Routledge in 2019.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course Learning Outcomes	Teaching and LearningActivities	Assessment Tasks
1	● The students about this particular are intended to gain knowledge about the objectives and importance of environmental education. Enabling them to understand the composition of environment, greenhouse effect. Students will improve their understanding towards the factors governing the life on earth	● Lectures ● Group discussion ● Sight Seeing ● The teaching will be done through lectures and group discussion	● Assignment ● Homework
2	● Students will understand about the impacts of our unusual and destructive use of resources and their harmful effects. ● Students will understand about the destruction of environment and its sustainability. Enhance the concern	● Lectures ● Group discussion ● Visit to any industry or manufacturing site ● The teaching will be done through lectures and group discussion.	● Assignment ● Poster making

Unit no.	Course Learning Outcomes	Teaching and LearningActivities	Assessment Tasks
	about this depletion among the students.		
3	● Importance of government laws and agencies their interference to regulate pollution and harming the quality of environment. Methods to improve the quality of habitat and natural resources will be necessary for the students to have its knowledge and concern.	● Lectures ● Group discussion ● Visit to any law governing body ● The teaching will be done ● through lectures and group discussion	● Brain storming Quiz ● Assignment
4	● Students will know their ethics and responsibilities towards the improvement in quality of environment. Innovation, technologies, awareness through communication and various others measures through which a student can involve these practices in their lifestyle.	● Lectures ● Group discussion Sight Seeing ● The teaching will be done through lectures and group discussion	● Seminar ● Conferences
5	● The students will enhance the techniques to prepare a project on any of the issues regarding the environment pollution or the remedial measures. Students will find ways to present the issues through seminars, workshops, poster making, model making.	● Lectures ● Group discussion ● Seminars ● Poster making ● Model making	● Power point presentation Project work ● Debates ● Brain storming Quiz

VALUE ADDED COURSE (VAC)
3IFAV106: Fundamentals of AI
(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3IFAV106	Fundamentals of AI	(3-0-0)	60	20	20	-	-	100	3 hr	-

Course Objective
Student will be able-

- To understanding the importance of AI and puzzle problem.
- To understanding the Search Techniques.
- To understanding the Symbolic and Statistical Reasoning.
- To understanding the frames and Structural Knowledge Representation.
- To understanding the expert system life cycle.

Course Outcomes

Upon completion of the course, students will be able to:

- Understand the fundamental concepts and scope of Artificial Intelligence.
- Describe the essential tools and techniques used in Machine Learning.
- Describe interface mechanisms and their role in knowledge representation.
- Understand the fundamentals of probability theory and its role in AI.

Syllabus:

Theory:

Unit 1: Introduction: Artificial Intelligence, AI Problems, AI Techniques, The Level of the Model, Criteria for Success. Defining the Problem as a State Space Search, Problem Characteristics, Production Systems, Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A*Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.

Unit 2: Introduction to Machine Learning: Applications of ML, Difference between Data Mining and Predictive Analysis, Tools and Techniques of Machine Learning. What is Machine Learning, Basic Terminologies of Machine Learning

Unit 3: Knowledge Representations First order predicate calculus, Skolemization, resolution principle and unification, interface mechanisms, horn's clauses, semantic networks, frame systems and value inheritance, scripts, conceptual dependency.

Unit 4: Natural Language processing Parsing techniques, context free grammar, recursive transitions nets (RNT), augmented transition nets (ATN), case and logic grammars, semantic analysis. Game playing Minimax search procedure, alpha-beta cut offs, additional refinements. Planning Overview an example domain the block word, component of planning systems, goal stack planning, nonlinear planning.

Unit 5: Probabilistic Reasoning and Uncertainty Probability theory, bayes theorem and Bayesian networks, certainty factor. Expert Systems Introduction to expert system and application of expert systems, various expert system shells, vidwan frame work, Knowledge acquisition, case studies, MYCIN. Learning Rote learning, learning by induction, explanation-based learning

Reference Books

- Elaine Rich and Kevin Knight, "Artificial Intelligence," Tata McGraw-Hill. "Artificial Intelligence," 4th Edition, Pearson.
- Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems," Prentice India.
- Nils J. Nilson, "Principles of Artificial Intelligence," Narosa Publishing House. Clocksin and C.S. Melish, "Programming in PROLOG," Narosa Publishing House.
- M. Sasikumar, S. Raman, etc., "Rule-based Expert System," Narosa Publishing House.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1	• Understand the fundamentals of Artificial Intelligence (AI). Identify AI problems and techniques. Learn about the levels of AI models and criteria for success. Explore state space search and production systems. Understand search algorithms such as BFS, DFS, and heuristic search techniques. Learn about problem reduction and constraint satisfaction. Familiarize with means ends analysis.	• Problem solving exercises on state space search. Group discussions on production systems and search algorithms. Handson exercises with BFS, DFS, and heuristic search algorithms. Case studies on problem reduction and constraint satisfaction. Practical demonstrations of means end analysis.	• Quizzes on AI fundamentals and problem-solving techniques. Written assignments on state space search. Group presentation on search algorithms.
2	• Learn about applications of Machine Learning (ML). Differentiate between Data Mining and Predictive Analysis. Explore tools and techniques of Machine Learning. Understand basic ML terminologies.	• Lectures on ML applications and differences from Data Mining. Discussions on ML tools and techniques. Handson experience with ML terminology. Case studies on real world ML applications.	• Written assignments on ML applications and differences from Data Mining. Quizzes on ML tools and terminology. Case study analysis of ML applications. Final examination on unit II content.
3	• Understand knowledge representations in AI. Learn about first order predicate calculus, Skolemization, and resolution principles. Explore interface mechanisms, horn's clauses, semantic networks, frame systems, and value inheritance. Familiarize with scripts and conceptual dependency.	• Practical exercises on resolution principles and interface mechanisms. Group discussions on semantic networks, frame systems, and scripts. Handson sessions with conceptual dependency. Case studies on real world knowledge representation systems.	• Problem solving assignments on predicate calculus and resolution. Quizzes on knowledge representation techniques.
4	• Explore Natural Language Processing (NLP) techniques. Learn about parsing techniques, context free grammar, and semantic analysis. Understand gameplaying strategies and Minimax search procedures. Familiarize with	• Lectures on NLP, parsing techniques, and semantic analysis. Coding practice for parsing and grammar. Problem solving exercises on gameplaying strategies. Practical demonstrations of	• Implementation and testing of parsing and semantic analysis. Problem solving assignments on game playing and planning. Quizzes on NLP and gameplaying

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks
	alpha beta cutoffs and planning components. Apply these concepts to an example domain.	planning components. Hands-on sessions with an example domain.	concepts. GD, Unit Test and Quizzes.
5	• Understand probabilistic reasoning and uncertainty in AI. Learn about probability theory, Bayes' theorem, and Bayesian networks. Explore certainty factors and expert systems. Familiarize with expert system shells, knowledge acquisition, and case studies. Learn about various learning techniques, including rote learning, induction, and explanation-based learning.	• Bayesian networks, and expert systems. Practical exercises on probability theory and Bayes' theorem. Group discussions on expert systems and knowledge acquisition. Handson sessions with learning techniques. Case studies on expert systems and learning methods.	• Problem solving assignments on probability theory and expert systems. Quizzes on probabilistic reasoning and learning techniques. Group presentation on expert system case studies.

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

II Semester

MAJOR CORE COURSES

3SCDC203: Mathematics – II (Calculus, Differential Equations and Vector Calculus)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SCDC203	Mathematics – II (Calculus, Differential Equations and Vector Calculus)	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- To solve problem using expansion of functions.
- Familiar with curve tracing.
- Apply integral calculus in solving problems.
- To make the student acquire sound knowledge of techniques in solving differential questions.
- Familiar with physical interpretation of divergence and curl of a vector.

Course Outcomes

- Understanding the ideas and concept of calculus and facility in solving standard examples.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Fluency in solving differential equations and facility in solving standard examples.
- Understanding the ideas of vector calculus and facility in solving standard examples.

Syllabus: (Credit-4-0-2)

UNIT – I Concept of Partial differentiation, Successive differentiation, Leibnitz theorem, Maclaurin and Taylor series expansions, Asymptotes and Curvature, Tests for concavity and convexity, Points of inflexion. Multiple points. Tracing of curves in cartesian and polar co-ordinates

UNIT – II Integration of irrational algebraic functions and transcendental functions. Reduction formulae. Definite Integrals. Quadrature, Rectification, Volumes and Surfaces of solids of revolution of curves.

UNIT – III Linear equations and equations reducible to the linear form, Exact differential equation First order higher degree equations for x, y, p, Clairaut's form and singular solutions. Linear differential equations with constant coefficients.

UNIT – IV Homogenous linear ordinary differential equations, linear differential equations of second order. Transformation of the equation by changing the dependent variable and the independent Variable, Method of variation of parameters, Ordinary simultaneous differential equations.

UNIT – V Vector differentiation. Gradient, Divergence and Curl. Vector integration, Theorem of Gauss (without proof) and problems based on it. Theorem of Green (without proof) and problems based on it. Stoke's theorem (without proof) and problems based on it.

Practical **Credits -2**

1. Plotting the graphs of the polynomial of degree 4 and 5.
2. Sketching parametric curves (E.g., Trochoid, cycloid, hypocycloid).

Reference Books

1. Advanced Engineering Mathematics" by C. R. Wylie and Louis C. Barrett
2. Calculus, Differential Equations and Vector Calculus by Dr.H.K. Pathak
3. Vector Calculus" by Susan J. Colley

Text Books

1. Calculus, Differential Equations and Vector Calculus by P.K. Mittal, and S. Chand.
2. Vector Calculus" by Jerrold E. Marsden and Anthony J. Tromba:
3. Higher Engineering Mathematics" by B.S. Grewal:

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will understand the concept of partial differentiation, enabling them to calculate partial derivatives of functions with respect to multiple variables. They will grasp the idea of successive differentiation and apply it to solve problems involving higher-order partial derivatives.	Provide exercises for students to practice partial differentiation, emphasizing both theory and practical applications. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Students will acquire the ability to integrate a wide range of algebraic functions, including those with irrational components, as well as transcendental functions like exponential and trigonometric functions.	Integration Practice Sessions, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Students will develop the ability to solve linear differential equations and equations that can be reduced to linear form, demonstrating a sound understanding of the principals involved.	Real-World Applications Linear Differential Equations with Constant Coefficients Practice, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
4.	Students will be able to identify, classify, and solve homogeneous linear ordinary differential equations, demonstrating a solid understanding of their properties and solutions.	Collaborative Problem-Solving Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
5.	Students will understand the concept of vector differentiation, including gradient, divergence, and curl operators, and how they relate to vector fields and scalar functions.	Computer-Based Simulations. Case Studies, Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions

MAJOR CORE COURSES

3SMBC203: Physics-II (Mathematical Background, Electrostatics and Steady-State)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMBC203	Mathematical Background, Electrostatics and Steady - State	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- The main objective of this subject is introducing the basic concepts of Electrostatics to student and help in developing problem-solving skills.
- Student will study basic ideology of Scalar and Vector product, double and triple integral.
- Introducing the basic concepts of electrostatics to student and help in developing problem-solving skills.

Course Outcomes

1. To study the basics of Mathematical Background and to introduce concepts of Electrostatics and magnetics.
2. Develop the ability to analyze and solve physics problems using mathematical equations and reasoning
3. Understand the scientific method including hypothesis testing experimentation and data analysis

Syllabus: Credit-(4-0-2)

UNIT - I Mathematical Background Scalars and vectors, dot and cross products, triple vector product, flux of a vector field, Gauss's divergence theorem. Green's theorem and Stoke's theorem. Functions of two and three variables, Partial derivatives, definition of a double and triple integral, Evaluation of double and triple integrals as repeated integrals, change of variables of integration, Jacobian applications.

UNIT - II Electrostatics Coulombs law in vacuum expressed in vector forms, calculations of E for simple distributions of charge at rest, dipole and quadrupole fields. Torque on a dipole in a uniform electric field and its energy, Flux of the electric field, Gauss's law and its application. Capacitors, electrostatic field energy, Dielectrics, Dielectric constant, Parallel plate capacitor with a dielectric.

UNIT - III Description of Linear, Circular and Elliptical Polarization. Propagation of e.m. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary and Extraordinary Refractive Indices. Production and Detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light. Claussius- Mossotti equation

UNIT – IV Magneto-statics Force on a moving charge: Lorentz force equation and definition of B, Force on a straight conductor carrying current in a uniform magnetic field, Torque on a current loop, Magnetic dipole moment, Angular momentum and Gyromagnetic ratio, Biot and Savart's Law, Ampere's Law.

Motion of charged particles in electric and magnetic field: Construction and working principle of Cyclotron and Betatron; Thomson's method for the determination of specific charge (e/m) of electron. Introduction to CRO: Block Diagram of CRO; Applications of CRO.

UNIT - V Time Varying Fields Electromagnetic induction, Faraday's Laws, Electromotive force e = E.dl, integral and differential forms of Faraday's laws. Self and Mutual inductance. Transformers, Maxwell Equations. Poynting Theorem and Poynting Vector. Electromagnetic Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

Electric Currents Steady current, Current density J, Non-steady currents and continuity equation, Kirchhoff 's laws, rise and decay of current in LR and CR circuits, decay constants, Transients in LCR circuits. AC circuits, Series and parallel resonance., Q factor, Power consumed by an A.C. circuit, Power factor.

Practical **Credit-2**

1. To draw the B-H curve and determination of Hysteresis loss.
2. Determination of voltage, frequency and phase difference using CRO.
3. Study of sensitivity of CRO.
4. Measurement of self-inductance using Maxwell's bridge.
5. To study of the charging and discharging of condenser through a resistor.
6. Determination of impedance and power factor using LCR circuit.
7. Study of frequency response curve of a series LCR circuit and determination of resonant frequency, Quality factor and Band width.
8. Determination of specific charge e/m by Thomson's method.
9. To study the magnetic field along the axis of a circular coil.
10. Determination of M and H using vibrational magnetometer and deflection magnetometer.

Text Books

1. Mathematical Physics I , S. Chand.
2. Unified physic, R.P. Goyal, Shivlal Agrawal and Company.
3. Introduction to Electrodynamics by A.Z.Capri & P.V.Panat.(New Delhi: Narosa Pub.House, 2002).
4. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata Mc Graw Hill, 2006).
5. David J. Griffiths, Introduction to Electrodynamics, 3rd edition, (Benjamin Cummings 1998).

Reference Books

- Mathematical Physics, PK Chattopadhyay, New Age International Publishers.
- Concepts of Electrostatics and current electricity, Fifth Edition, D.C. Gupta
- Feynman R.P., Leighton R.B. Sands M. .and- Feynman Lectures Vol.2, Peearson Education, 2008.
- Kshetrimayun R.S. - Electromagnetic field theory, Cengage Learning, 2012
- Griffiths D.J. - Electricity and Magnetism, 3rdEdn, Benjamin Cummings, 1998.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Proficiency in vector calculus, including dot and cross products. Understanding of the divergence and curl of vector fields. Skill in changing variables of integration using the Jacobian matrix.	Lectures and examples demonstrating vector operation. Lectures explaining divergence and curl concepts. Workshops and guided problem-solving sessions.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
		Assignments involving theorem applications	
2.	These cover a range of fundamental concepts in electrostatics, including Coulomb's law, electric field calculations, Gauss's law, capacitor behaviour, dielectrics, and their applications in various contexts.	Demonstrations of electric field configurations. Problem-solving sessions for calculating electric fields. Interactive experiments to observe field patterns. Physics labs or simulations for hands-on experience.	Quiz, project presentation and discussion
3.	These cover a range of essential concepts in electric currents, including steady and time-varying currents, circuit analysis, transient responses, AC circuits, and power calculations, providing students with a strong foundation in electrical engineering and physics.	Classroom lectures explaining the differences. Demonstrations with simple circuits. Practice problems differentiating between steady and non-steady currents.	Quiz, project presentation and discussion
4.	These cover a range of essential concepts in magneto-statics, including the behaviour of charged particles in magnetic fields, magnetic forces, torque, magnetic dipole moments.	Classroom lectures on the Lorentz force equation. Demonstrations with charged particles in magnetic fields. Problem sets to calculate magnetic fields and forces Workshops on the gyromagnetic ratio and NMR applications.	Quiz, project presentation and discussion
5.	These cover a wide range of topics related to time-varying electromagnetic fields and waves, providing students with a solid foundation in electromagnetism and its applications in various contexts, including communication and optics.	Laboratory experiments demonstrating polarization. Analyse polarization effects in optical materials. Case studies on applications in optical devices.	Quiz, project presentation and discussion

MAJOR CORE COURSES

3SPIC203: Chemistry –II (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPIC203	Chemistry –II (Physical, Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understanding reaction rates and factors influencing them.
- Grasping atomic properties and periodic trends.
- Exploring bonding theories and molecular shapes.
- Analyzing properties and reactions of alkanes, cycloalkanes, and alkenes.
- Understanding key reactions and synthesis pathways.

Course Learning Outcomes

- Ability to analyze reaction rates and factors affecting them.
- Understanding atomic properties and periodic trends.
- Proficiency in bonding theories and molecular shapes.
- Mastery of properties and reactions of specific organic compounds.
- Competence in understanding and predicting key organic reactions.

Syllabus

Credits 4-0-2

Physical Chemistry

UNIT – I

Chemical Kinetics

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction- concentration, temperature, pressure, solvent, light and catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero order, first order, second order, pseudo-order, half-life and mean life. Determination of the order of reaction, differential method, method of integration, method of half-life period and isolation method. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis).

Inorganic Chemistry

UNIT – II

Atomic Structure

Idea of de Broglie's matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of φ , quantum numbers, radial and angular wave functions and probability distribution curves, effective nuclear charge.

Periodic Properties

Atomic and ionic radii, ionization energy, electron affinity and electronegativity: definition, method of determination, trends in periodic table and applications.

UNIT – III

Chemical Bonding

Covalent Bond: Valence bond theory and its limitations, directional characteristic of covalent bond, various type of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to NH_3, SF_4, ClF_3, and H_2O. Molecular Orbital theory for homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and the bond energy, percentage ionic character of covalent bond.

Organic Chemistry

UNIT – IV

Alkanes and Cycloalkanes

IUPAC nomenclature of alkanes, classification, isomerism in alkanes, sources and methods of preparation, physical properties and chemical reactions of alkanes, mechanism of free radical halogenation of alkanes.

Cycloalkanes

Nomenclature, methods of preparations, chemical reactions. Baeyer's strain theory and its limitations, ring strain in cyclopropane and cyclobutene, theory of strain less rings.

UNIT – V

Cycloalkenes, Dienes, Alkenes

Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions - 1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkenes. Methods of formation. Chemical reactions of alkenes- electrophilic and free radical addition. hydroboration oxidation and polymerization of alkenes.

Alkynes and Alkyl Halides

Nomenclature, structure and bonding in alkynes, method of formation, chemical reaction, acidity of alkynes. Nomenclature and classes of alkyl halides, methods of formation, chemical reactions; mechanism of nucleophilic substitution reaction of alkyl halides, SN^1 and SN^2 reactions with energy profile diagrams, elimination reaction.

Polyhalogeno Compounds

Method of preparation and properties chloroform, carbon tetrachloride.

Practical Content — Credits 2

Physical Chemistry

- Determination of mixed melting point.
- Preparation of solutions of various concentrations, NaOH, HCl, H2SO4.
- Determination of viscosity / percentage composition of given organic mixture using viscosity method.

Inorganic chemistry

- Inorganic mixture analysis.

- Macro/Semi-micro-Analysis- Cation analysis, separation and identification of ions from group I-VI, anion analysis.

Organic Chemistry

- Detection of elements (N, S and Halogens) 2 elements.
- Functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and aniline) in simple organic compounds.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Chemical Kinetics by Keith J. Laidler and John H. Meiser.
- Principles of Physical Chemistry by Peter Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Fundamentals of Molecular Spectroscopy by C.N. Banwell.

Reference Books

- Chemical Kinetics and Reaction Dynamics by Paul L. Houston.
- Advanced Inorganic Chemistry by F. Albert Cotton and Geoffrey Wilkinson.
- Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Physical Chemistry by Robert J. Sibley, Robert A. Alberty, and Moungi G. Bawendi.
- Organic Reaction Mechanisms by V.K. Ahluwalia.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand chemical kinetics and its scope, including factors affecting reaction rates. Analyse the mathematical characteristics of simple chemical reactions and methods to determine reaction orders.	Organize a scavenger hunt where students explore the periodic table to locate and identify s-block elements. This activity helps familiarize them with the elements in this block.	Quiz assessing understanding of chemical kinetics and factors affecting reaction rates.
2	Describe the historical development of atomic models from Dalton's to the modern quantum mechanical model. Explain the limitations and strengths of each atomic model.	Organize a timeline activity where students create a visual representation of the historical development of atomic models, starting from Dalton's model to the modern quantum mechanical model.	Written exam on periodic properties and trends.
3	Define ionic bonding and explain how it differs from covalent bonding. Describe the transfer of electrons between atoms to form ions in ionic compounds.	Provide students with model kits or digital simulations to build and visualize the crystal lattice structures of common ionic compounds.	Presentation on the comparison between Valence Bond and Molecular Orbital theories.
4	Understand and apply Huckell's rule to determine whether a compound is aromatic, antiaromatic, or non-	Assign research projects where students investigate the environmental impact of polycyclic aromatic hydrocarbons (PAHs) and	Class quizzes or short tests that assess your

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
	aromatic based on its number of electrons.	their relevance in air pollution and carcinogenicity.	understanding of specific lecture topics.
5	Describe the general methods for the halogenation of organic compounds, including free-radical halogenation, electrophilic halogenation, and nucleophilic halogenation.	Conduct laboratory experiments where students synthesize alkyl and aryl halides using various methods such as halogenation reactions or substitution reactions. Emphasize safety protocols.	Homework assignments on alkynes and alkyl halides.

MINOR CORE COURSES

3SCDM204 Mathematics-II Calculus, Differential Equations and Vector Calculus
(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SCDM204	Calculus, Differential Equations and Vector Calculus	4(4-0-0)	60	20	20	-	-	100	3hr	-

Course Objectives

- To solve problem using expansion of functions.
- Familiar with curve tracing.
- Apply integral calculus in solving problems.
- To make the student acquire sound knowledge of techniques in solving differential questions.
- Familiar with physical interpretation of divergence and curl of a vector.

Course Outcomes

- Understanding the ideas and concept of calculus and facility in solving standard examples.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Fluency in solving differential equations and facility in solving standard examples.
- Understanding the ideas of vector calculus and facility in solving standard examples.

Syllabus Credit-(4-0-0)

UNIT – I Concept of Partial differentiation, Successive differentiation, Leibnitz theorem, Maclaurin and Taylor series expansions, Asymptotes and Curvature, Tests for concavity and convexity, Points of inflexion. Multiple points. Tracing of curves in cartesian and polar co-ordinates

UNIT – II Integration of irrational algebraic functions and transcendental functions. Reduction formulae. Definite Integrals. Quadrature, Rectification, Volumes and Surfaces of solids of revolution of curves.

UNIT – III Linear equations and equations reducible to the linear form, Exact differential equation First order higher degree equations for x, y, p, Clairaut's form and singular solutions. Linear differential equations with constant coefficients.

UNIT – IV Homogenous linear ordinary differential equations, linear differential equations of second order. Transformation of the equation by changing the dependent variable and the independent Variable, Method of variation of parameters, Ordinary simultaneous differential equations.

UNIT – V Vector differentiation. Gradient, Divergence and Curl. Vector integration, Theorem of Gauss (without proof) and problems based on it. Theorem of Green (without proof) and problems based on it. Stoke's theorem (without proof) and problems based on it.

Text Books

1. Calculus, Differential Equations and Vector Calculus by P.K. Mittal, and S. Chand
2. Vector Calculus" by Jerrold E. Marsden and Anthony J. Tromba:
3. Higher Engineering Mathematics" by B.S. Grewal:

Reference Books:

1. Advanced Engineering Mathematics" by C. R. Wylie and Louis C. Barrett
2. Calculus, Differential Equations and Vector Calculus by Dr.H.K. Pathak
3. Vector Calculus" by Susan J. Colley

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will understand the concept of partial differentiation, enabling them to calculate partial derivatives of functions with respect to multiple variables. They will grasp the idea of successive differentiation and apply it to solve problems involving higher-order partial derivatives.	Practice: Provide exercises for students to practice partial differentiation, emphasizing both theory and practical applications. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Students will acquire the ability to integrate a wide range of algebraic functions, including those with irrational components, as well as transcendental functions like exponential and trigonometric functions.	Integration Practice Sessions, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Students will develop the ability to solve linear differential equations and equations that can be reduced to linear form, demonstrating a sound understanding of the principals involved.	Real-World Applications Linear Differential Equations with Constant Coefficients Practice, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
4.	Students will be able to identify, classify, and solve homogeneous linear ordinary differential equations, demonstrating a solid understanding of their properties and solutions.	Collaborative Problem Solving. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
5.	Students will understand the concept of vector differentiation, including gradient, divergence, and curl operators, and how they relate to vector fields and scalar functions.	Computer-Based Simulations. Case Studies, Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions

MINOR CORE COURSES

3SMBM204: Physics-II (Mathematical Background, Electrostatics and Steady-State)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMBM204	Mathematical Back-ground, Electrostatics and Steady-state	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- The main objective of this subject is introducing the basic concepts of Electrostatics to student and help in developing problem-solving skills.
- Student will study basic ideology of Scalar and Vector product, double and triple integral.
- Introducing the basic concepts of electrostatics to student and help in developing problem-solving skills.

Course Outcomes

- To study the basics of Mathematical Background and to introduce concepts of Electrostatics and magnetics.
- Develop the ability to analyze and solve physics problems using mathematical equations and reasoning
- Understand the scientific method including hypothesis testing experimentation and data analysis

Syllabus: **Credit-2-0-2**

UNIT - I Mathematical Background Scalars and vectors, Dot and cross products, Triple vector product, flux of a vector field, Gauss's Divergence Theorem. Green's Theorem and Stoke's Theorem.

UNIT - II Electrostatics Coulombs law in vacuum expressed in vector forms, calculations of E for simple distributions of charge at rest, dipole and quadrupole fields. Capacitors, electrostatic field energy. Dielectrics, Parallel plate capacitor with a dielectric.

UNIT - III Electric Currents Steady current, current density J, Non-steady currents and Continuity equation. Q factor, power consumed by an A.C. circuit, Power factor, Kirchhoff 's laws and analysis of multi loop circuits, rise and decay of current in LR and CR circuits, decay constants, transients in LCR circuits.

UNIT – IV Magneto-statics Force on a moving charge: Lorentz force equation and definition of B, force on a straight conductor carrying current in a uniform magnetic field, Magnetic dipole moment, angular momentum and gyromagnetic ratio, Biot and Savart's Law, Ampere's Law, $\tilde{N} \times B = \mu 0J$, $\tilde{N}. B=Q$.

UNIT - V Time Varying Fields Electromagnetic induction, Faraday's Laws, electromotive force, Integral and differential forms of Faraday's laws. self and mutual inductance9.transformers, Maxwell's displacement current, Derivations of Maxwell's equations.

Practical **(Credit 2)**

1. To plot graphs showing the variation of magnetic field with distance along the axis of circular coil carrying current and to estimate the radius of the coil.
2. To Determine the Dielectric Constant of different materials.
3. To determine the impedance, phase angle and power factor of R, L and C are connecting in series with the help of LCR Impedance circuit.
4. To determine the resistance per unit length of the Carrey-Foster's bridge wire.
5. To study and verify the Coulomb's law.
6. To determine the radius of a current carrying coil by using current carrying coil measurement unit.
7. To determine the magnetic field with the variation of distance along the axis of current carrying coil.

Text Books

1. Mathematical Physics I, S. Chand.
2. Unified physic, R.P. Goyal, Shivlal Agrawal and Company.
3. Tayal D.C. - Electricity and Magnetism, Himalaya Publishing Co.
4. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata Mc Graw Hill, 2006).
5. David J. Griffiths, Introduction to Electrodynamics, 3rd edition, (Benjamin Cummings 1998).

Reference Books

1. Mathematical Physics, PK Chattopadhyay, New Age International Publishers.
2. Concepts of Electrostatics and current electricity, Fifth Edition, D.C. Gupta
3. Griffiths D.J. – Electricity and Magnetism, 3rd Edn, Benjamin Cummings, 1998

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Proficiency in vector calculus, including dot and cross products. Understanding of the divergence and curl of vector fields. Skill in changing variables of integration using the Jacobian matrix.	Lectures and examples demonstrating vector operation. Lectures explaining divergence and curl concepts. Workshops and guided problem-solving sessions. Assignments involving theorem applications	Quiz, project presentation and discussion
2.	These cover a range of fundamental concepts in electrostatics, including Coulomb's law, electric field calculations, Gauss's law, capacitor behaviour, dielectrics, and their applications in various contexts.	Demonstrations of electric field configurations. Problem-solving sessions for calculating electric fields. Interactive experiments to observe field patterns. Physics labs or simulations for hands-on experience.	Quiz, project presentation and discussion
3.	These cover a range of essential concepts in electric currents, including steady and time-varying currents, circuit analysis, transient responses, AC circuits, and power calculations, providing students with a strong	Classroom lectures explaining the differences. Demonstrations with simple circuits. Practice problems differentiating between steady and non-steady currents.	Quiz, project presentation and discussion

	foundation in electrical engineering and physics.		
4.	These cover a range of essential concepts in magneto-statics, including the behaviour of charged particles in magnetic fields, magnetic forces, torque, magnetic dipole moments.	Classroom lectures on the Lorentz force equation. Demonstrations with charged particles in magnetic fields. Problem sets to calculate magnetic fields and forces Workshops on the gyromagnetic ratio and NMR applications.	Quiz, project presentation and discussion
5.	These cover a wide range of topics related to time-varying electromagnetic fields and waves, providing students with a solid foundation in electromagnetism and its applications in various contexts, including communication and optics.	Laboratory experiments demonstrating polarization. Analyse polarization effects in optical materials. Case studies on applications in optical devices.	Quiz, project presentation and discussion

MINOR CORE COURSES

3SPIM204: Chemistry-II (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIM204	Chemistry-II (Physical, Inorganic and Organic Chemis-try)	4(2-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understanding reaction rates and factors influencing them.
- Grasping atomic properties and periodic trends.
- Exploring bonding theories and molecular shapes.
- Analyzing properties and reactions of alkanes, cycloalkanes, and alkenes.
- Understanding key reactions and synthesis pathways.

Course Learning Outcomes

- Ability to analyze reaction rates and factors affecting them.
- Understanding atomic properties and periodic trends.
- Proficiency in bonding theories and molecular shapes.
- Mastery of properties and reactions of specific organic compounds.
- Competence in understanding and predicting key organic reactions.

Syllabus Credits 2-0-2

Physical Chemistry

UNIT – I

Chemical Kinetics

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction- concentration, temperature, pressure, solvent, light and catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero order, first order, second order, pseudo-order, half-life and mean life. Determination of the order of reaction, differential method, method of integration, method of half-life period and isolation method. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Inorganic Chemistry

UNIT – II

Atomic Structure

Idea of de Broglie's matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of φ , quantum numbers, radial and angular wave functions and probability distribution curves, effective nuclear charge.

UNIT – III

Chemical Bonding

Covalent Bond: Valence bond theory and its limitations, directional characteristic of covalent bond, various type of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to NH_3, SF_4, ClF_3, and H_2O. Molecular Orbital theory for homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and the bond energy, percentage ionic character of covalent bond.

Organic Chemistry

UNIT – IV

Alkanes and Cycloalkanes

IUPAC nomenclature of alkanes, classification, isomerism in alkanes, sources and methods of preparation, physical properties and chemical reactions of alkanes, mechanism of free radical halogenation of alkanes.

Cycloalkanes

Nomenclature, methods of preparations, chemical reactions. Baeyer's strain theory and its limitations, ring strain in cyclopropane and cyclobutene, theory of strain less rings.

UNIT – V

Cycloalkenes, Dienes, Alkenes

Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions - 1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkenes. Methods of formation. Chemical reactions of alkenes- electrophilic and free radical addition. hydroboration oxidation and polymerization of alkenes.

Practical Content **Credits :2**

Physical Chemistry

- Determination of boiling point.
- Preparation of solutions of various concentrations, NaOH, HCl, H2SO4.

Inorganic Chemistry

- Inorganic mixture analysis.
- Macro/Semi-micro-Analysis- Cation analysis, separation and identification of ions from group I-VI, anion analysis.

Organic Chemistry

- Detection of elements (N, S and Halogens) 2 elements.
- Functional groups (phenolic, carboxylic, carbohydrates, amines, and aniline) in simple organic compounds.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Chemical Kinetics by Keith J. Laidler and John H. Meiser.
- Principles of Physical Chemistry by Peter Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.

- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Fundamentals of Molecular Spectroscopy by C.N. Banwell

Reference Books

- Chemical Kinetics and Reaction Dynamics by Paul L. Houston.
- Advanced Inorganic Chemistry by F. Albert Cotton and Geoffrey Wilkinson.
- Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Physical Chemistry by Robert J. Silbey, Robert A. Alberty, and Moungi G. Bawendi.
- Organic Reaction Mechanisms by V.K. Ahluwalia.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand chemical kinetics and its scope, including factors affecting reaction rates. Analyse the mathematical characteristics of simple chemical reactions and methods to determine reaction orders.	Organize a scavenger hunt where students explore the periodic table to locate and identify s-block elements. This activity helps familiarize them with the elements in this block.	Quiz assessing understanding of chemical kinetics and factors affecting reaction rates.
2	Describe the historical development of atomic models from Dalton's to the modern quantum mechanical model. Explain the limitations and strengths of each atomic model.	Organize a timeline activity where students create a visual representation of the historical development of atomic models, starting from Dalton's model to the modern quantum mechanical model.	Written exam on periodic properties and trends.
3	Define ionic bonding and explain how it differs from covalent bonding. Describe the transfer of electrons between atoms to form ions in ionic compounds.	Provide students with model kits or digital simulations to build and visualize the crystal lattice structures of common ionic compounds.	Presentation on the comparison between Valence Bond and Molecular Orbital theories.
4	Understand and apply Huckell's rule to determine whether a compound is aromatic, antiaromatic, or non-aromatic based on its number of electrons.	Assign research projects where students investigate the environmental impact of polycyclic aromatic hydrocarbons (PAHs) and their relevance in air pollution and carcinogenicity.	Class quizzes or short tests that assess your understanding of specific lecture topics.
5	Describe the general methods for the halogenation of organic compounds, including free-radical halogenation, electrophilic halogenation, and nucleophilic halogenation.	Conduct laboratory experiments where students synthesize alkyl and aryl halides using various methods such as halogenation reactions or substitution reactions. Emphasize safety protocols.	Homework assignments on alkynes and alkyl halides.

INTER DISCIPLINARY COURSE

3SATI202: Analytical Techniques

(Credits: Theory-3 Practical-0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SATI202	Analytical Techniques	3(3-0-0)	60	20	20	-	-	100	3hr	-

Course Objective

- Gain a comprehensive understanding of various analytical techniques used in scientific research, industry, or specific fields such as chemistry, biology, environmental science, or materials science.
- Develop skills in collecting, processing, and interpreting analytical data. Emphasize the importance of accuracy, precision, and reliability in analytical measurements.
- Explore qualitative analysis methods, including the identification of unknown substances and the interpretation of spectra or chromatograms.
- Stay updated on the latest developments in analytical techniques and technologies. Explore emerging trends in the field and their potential applications.

Course Learning Outcomes

- Students will be able to apply a variety of analytical techniques to solve scientific problems in their respective fields.
- Students will demonstrate the ability to operate and troubleshoot common analytical instruments with precision and accuracy.
- Students will implement and adhere to quality assurance and quality control practices to ensure the reliability and validity of analytical results.
- Students will adhere to laboratory safety protocols, recognizing and mitigating potential hazards associated with analytical techniques.

Syllabus: **Credits: 3(3-0-0)**

Unit 1: Introduction to Analytical Techniques

Chemical Measurements and Analytical tools, Experimental Error, Statistics and Quality Assurance, Chemical Equilibrium, Sample Preparation, Importance of analytical techniques in various fields, Classification of analytical methods

Unit 2: Spectroscopic Techniques

Introduction to spectroscopy, UV Visible Spectroscopy and applications, Infrared Spectroscopy (IR) and applications, Nuclear Magnetic Resonance Spectroscopy (NMR) and applications, Mass Spectrometry (MS) applications

Unit 3: Chromatographic Techniques

Introduction to chromatography (Principle, Instrumentation, working and Application), Gas Chromatography (Principle, Instrumentation, working and Application), Liquid Chromatography (Principle, Instrumentation, working and Application), High-performance Liquid Chromatography (Principle, Instrumentation, working and Application), Thin Layer Chromatography (Principle, Instrumentation, working and Application)

Unit 4: Electrochemical Techniques

Introduction to electrochemistry, Potentiometry (Principle, theory and types) Voltammetry (Principle, Instrumentation, working and Application), Conductometry (Principle, Instrumentation, working and Application), Applications in environmental analysis

Unit 5: Microscopy and Imaging Techniques

Introduction to microscopy, Optical microscopy, Electron microscopy (SEM and TEM), Scanning Probe Microscopy (SPM), Imaging techniques in biological and materials analysis, Applications and advancements.

Text Book

- Quantitative Chemical Analysis" by Daniel C. Harris.
- Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
- Fundamentals of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, and F. James Holler
- Instrumental Methods of Analysis" by Willard, Merritt, Dean, and Settle.

Reference Books

- Handbook of Analytical Techniques" by D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch.
- Analytical Chemistry: A Modern Approach to Analytical Science" by Robert Kellner, JeanMichel Mermet, Matthias Otto, and Miguel Valcárcel.
- Comprehensive Analytical Chemistry" Series.
- Modern Methods of Chemical Analysis" by Arthur I. Vogel.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	• Students will understand the principles of chemical measurements and demonstrate proficiency in using various analytical tools.	• Organize discussions on the principles behind the classification of analytical methods. • Students work in groups to categorize and present different analytical methods, highlighting their principles and applications.	• Presentation, Exam and quiz
2	• Understand the principles and techniques of various spectroscopic methods.	• Provide an overview of spectroscopy, its principles, and the different types.	• Presentation, Exam and quiz
3	• Understand various chromatographic techniques, emphasizing the importance of understanding molecular interactions and their impact on separation.	• Provide lectures and interactive workshops.	• Presentation, Exam and quiz
4	• Provides students with a foundational understanding of the principles governing the interaction between chemical systems and electricity	• Introduce students to the basic principles of electrochemistry and its significance in chemical analysis.	• Presentation, Exam and quiz

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
5	• Providing students with a comprehensive introduction to the principles and techniques of microscopy. It covers the fundamental concepts behind microscopy, highlighting its pivotal role in observing and analysing structures at various scales.	• Theoretical lectures cover the basics of microscopy, including historical developments and key concepts	• Presentation, Exam and quiz

ABILITY ENHANCEMENT COURSE

3HELA201: English Language

(Credit: Theory -2 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HELA201	English Language	2(2+0)	60	20	20	-	-	100	2 hr	-

Course Objective

- To Study the basic concept and Language Skills of English Language.
- Comprehensive study of different kinds of vocabulary in English Language
- To Study the different era in every story and moos in poems.

Course Outcomes

- Students will be able to understand the basic concept and Language Skills of English Language.
- Students will be able to understand the different use of vocabulary in their sentences.
- Students will be able to understand the varieties of stories on different issues and on different format.

Syllabus:

Unit 1:

- Amalkanti: Nirendranth Chakrabarti
- Sita: Toru Dutt
- Preface to the Mahabharata: C. Rajagopalachari
- Satyagraha: M.K. Gandhi
- Toasted English: R.K. Narayan
- The Portrait of a lady: Khushwant Singh

Unit 2: Comprehension (unseen passages, summary, note making)

Unit 3: Composition and Paragraph Writing (Based on expansion of an idea)

Unit 4: Basic Language Skills: Vocabulary – Synonyms, Antonyms, Word Formation. Prefixes and Suffixes, Words likely to be confused and Misused, Words similar in Meaning or Form, Distinction between Similar Expressions, Speech Skill.

Unit 5: Basic Language Skills: Grammar and usage – The Tense Forms, Propositions, Determiners and Countable/Un-countable Nouns, Verb, Articles Adverbs.

Reference Books

- English language & Indian Culture – Dr. Pankaj Kumar Singh, Dr. Ashwin Joshi - Thakur Publication, Bhopal.
- Indian Art & Culture – Dr. Manish Rannian (IAS) – Prabhat Prakashn
- Indian Culture & Heritage – Romila Thapar – Kindle Unlimited

Facilitating the Achievement of Course Learning Objectives

Unit	Learning Outcome	Teaching-Learning Activities	Assessment Tasks
1	● Understand the historical context of English in India and its impact on Indian culture.	● Lecture on the history of English in India. ● Group discussions on the cultural influences of English. ● Readings and analysis of relevant texts.	● Research paper on the historical development of English in India. ● Group presentation on cultural assimilation.
2	● Analyze the influence of literature in English on Indian culture and identity.	● Close reading of select literary works by Indian authors writing in English. ● Comparative analysis of Indian and Western literary traditions. ● Guest lectures by Indian authors.	● Essay on the impact of Indian English literature on cultural identity. ● In-class quizzes on literary analysis.
3	● Explore the role of English in contemporary Indian society and media.	● Case studies on the use of English in Indian media. ● Group projects on language in advertising. ● Guest speakers from the media industry.	● Media analysis report on the use of English in Indian news outlets. ● Group presentation on language in advertising campaigns.
4	● Investigate the intersection of English and Indian languages and their cultural significance.	● Language workshops on common Indian languages and their influence on English. ● Interviews with bilingual/multilingual individuals. ● Analysis of code-switching in communication.	● Research paper on language convergence and divergence in bilingualism. ● Oral presentations on code-switching in real-life contexts.
5	● Reflect on the challenges and opportunities of bilingualism and multiculturalism in India.	● Group discussions on identity and language choices. ● Debates on language policy and diversity in India. ● Field visits to multilingual communities.	● Final reflective essay on personal experiences and insights regarding bilingualism and multiculturalism in India. ● Participation in debates and discussions.

Credit-2

Unit 1: Elementary Concepts: Linear equations of second order, Transformation of the equation to the normal form, Transformation of the equation by changing the independent variable, Method of variation of parameters.

Unit 2: Ordinary simultaneous differential equations, Differential equations in different form, Total differential equation.

Unit 3: Integration in series. Roots of indicial equation equal, Roots of indicial equation unequal and differing by a quantity not an integer, Roots of indicial equation equal differing by an integer making coefficient of yinfinity.

Unit 4: Roots of indicial equation differing by an integer; making a coefficient of y indeterminate, some cases where the method fails, The particular integral, Method of differentiation.

Unit 5: Picard's iteration method, The Lipschitz condition, Existence theorem, Uniqueness theorem, Existence and Uniqueness theorem (The general case).

Reference Books

- "Differential Equations with Boundary Value Problems" by Dennis G. Zill
- Ordinary Differential Equations" by Morris Tenenbaum and Harry Pollard
- Partial Differential Equations for Scientists and Engineers" by Stanley J. Farlow

Text Book

- Elementary Differential Equations and Boundary Value Problems" by William E. Boyce and Richard C. DiPrima
- Differential Equations and Linear Algebra" by Gilbert Strang

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	• Understanding and solving linear differential equations of second order. Identifying different types of solutions (homogeneous and particular solutions).	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
2.	• Students will learn to solve systems of ordinary differential equations using various methods, such as elimination and substitution.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
3.	• Students will comprehend the concept of integrating power series and understand the convergence criteria for these series. They will develop skills in manipulating power series to facilitate integration.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
4.	• Students will learn specialized solution techniques for differential equations with roots of the indicial equation differing by an integer. They will analyse the	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	behavior of solutions in such cases and understand the significance of integer differences in roots.		
5.	• They will develop skills in implementing Picard's iteration method to find numerical solutions. They will learn to identify functions that satisfy the Lipschitz condition.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session

SKILL ENHANCEMENT COURSE

3SDES205: Differential Equation

(Credits: Theory-2 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3SDES205	Differential Equation	2(2+0+0)	60	20	20	-	-	100	2 hr	-

Course Objective

- This course helps the students to study elementary concepts.
- To introduce the concept of simultaneous differential equations.
- Understanding the concept of integration in series.
- To understand the Existence and Uniqueness theorem.

Course Outcomes

- The student will be able to define the elementary concept of differential equations.
- The student will be able to define and work with the concept of simultaneous differential equations.
- The student will be able to define and work with the concept of integration in series.
- The student will be able to apply the iteration method.

Syllabus: Credit-2

Unit 1: Elementary Concepts: Linear equations of second order, Transformation of the equation to the normal form, Transformation of the equation by changing the independent variable, Method of variation of parameters.

Unit 2: Ordinary simultaneous differential equations, Differential equations in different form, Total differential equation.

Unit 3: Integration in series. Roots of indicial equation equal, Roots of indicial equation unequal and differing by a quantity not an integer, Roots of indicial equation equal differing by an integer making coefficient of yinfinity.

Unit 4: Roots of indicial equation differing by an integer; making a coefficient of y indeterminate, some cases where the method fails, The particular integral, Method of differentiation.

Unit 5: Picard's iteration method, The Lipschitz condition, Existence theorem, Uniqueness theorem, Existence and Uniqueness theorem (The general case).

Reference Books

- "Differential Equations with Boundary Value Problems" by Dennis G. Zill
- Ordinary Differential Equations" by Morris Tenenbaum and Harry Pollard
- Partial Differential Equations for Scientists and Engineers" by Stanley J. Farlow

Text Book

- Elementary Differential Equations and Boundary Value Problems" by William E. Boyce and Richard C. DiPrima
- Differential Equations and Linear Algebra" by Gilbert Strang

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	• Understanding and solving linear differential equations of second order. Identifying different types of solutions (homogeneous and particular solutions).	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
2.	• Students will learn to solve systems of ordinary differential equations using various methods, such as elimination and substitution.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
3.	• Students will comprehend the concept of integrating power series and understand the convergence criteria for these series. They will develop skills in manipulating power series to facilitate integration.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
4.	• Students will learn specialized solution techniques for differential equations with roots of the indicial equation differing by an integer. They will analyse the behavior of solutions in such cases and understand the significance of integer differences in roots.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session
5.	• They will develop skills in implementing Picard's iteration method to find numerical solutions. They will learn to identify functions that satisfy the Lipschitz condition.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Session

VALUE ADDED COURSE

3ICSV206 Cyber Security

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3ICSV206	Cyber Security	3-0-0	60	20	20	-	-	100	3 hr	-

Course Objective

- Learn to analyze the security of in-built cryptosystems.
- Know the fundamental mathematical concepts related to
- security.
- Develop cryptographic algorithms for information security.
- Understand cybercrimes and cyber security.

Course Outcomes

Understand the fundamentals of networks security, security architecture, threats and vulnerabilities. Apply the different cryptographic operations of symmetric cryptographic algorithms. Apply the different cryptographic operations of public key cryptography. Apply the various Authentication schemes to simulate different applications. Understand various cyber-crimes and cyber security.

Syllabus:

Theory:

Unit 1: Introduction to Cyber Security Introduction,

Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography. Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. Network Vulnerabilities: Overview of vulnerability scanning, Open, Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning (Netcat, Socat), Network Sniffers and Injection tools.

Unit 2: Network Défense tools Firewalls and Packet Filters:

Firewall Basics, Packet Filter Vs Firewall, how a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding. VPN: the basic of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System.

Unit 3: Web Application Tools Scanning for web vulnerabilities tools:

Nikto, W3af, HTTP utilities - Curl, OpenSSL and S-tunnel. Application Inspection tools – Zed Attack Proxy, Sql-map, DVWA, Web goat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, PW dump, HTC-Hydra.

Unit 4: Introduction to Cyber Crime, law and Investigation:

Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. Internet crime and Act: A Brief History of the Internet, Recognizing.

Unit 5: Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT Page 3 of 23 2000. Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks.

Reference Books

- Behrouz A. Ferouzan, Deb deep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, 2015.
- Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
1	• Understand the fundamentals of Cyber Security • Explore Computer Security and its importance • Learn about authentication, access control, and cryptography • Understand various web attacks and how to protect against them • Explore network vulnerabilities and scanning techniques	• Lecture on the introduction to Cyber Security • Explanation of computer security, threats, vulnerabilities, and controls • Practical exercises on authentication, access control, and cryptography • Explanation of web attacks, browser attacks, and email attacks • Introduction to vulnerability scanning, network sniffers, and injection tools	• Quiz on Cyber Security basics • Writing a short essay on the importance of Cyber Security • Implementing authentication and access control measures • Identifying and mitigating web vulnerabilities • Conducting network vulnerability scans
2	• Learn about network defense tools and techniques • Understand the role of firewalls and packet filters • Explore VPNs and their basic concepts • Learn about intrusion detection systems (IDS) • Explore web application scanning and security tools • Learn about scanning tools like Nikto and W3af	• Lecture on firewalls, packet filters, and VPNs • Practical exercises on configuring firewalls and packet filters • Explanation of Virtual Private Networks (VPNs) • Introduction to intrusion detection systems (IDS) • Lecture on web application security, scanning tools, and password cracking • Practical exercises with Nikto, W3af, and HTTP utilities	• Configuring firewalls and VPNs • Implementing packet filtering rules • Setting up a VPN for secure communication • Configuring and using Snort IDS • Conducting web vulnerability scans • Identifying and addressing web vulnerabilities

Unit no.	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
3	• Understand application inspection tools like ZAP and Sqlmap • Learn about password cracking and brute-force tools	• Explanation and hands on practice with Zed Attack Proxy (ZAP) • Introduction to password cracking tools and techniques	• Conducting application security assessments • Cracking passwords and evaluating password security
4	• Gain insights into Cyber Crime, laws, and investigation • Understand the types of Cybercrime and attack vectors • Learn about cyber laws and regulations	• Lecture on Cyber Crime, types, and incident response • Explanation of hacking, attack vectors, and digital forensics • Practical exercises on Indian IT Act 2000 and cyber laws	• Quiz on Cyber Crime and laws • Investigating a simulated cybercrime incident • Analyzing legal aspects of Cyber Security incidents
5	• Explore various contemporary Cyber Security threats and attacks • Understand the risks associated with different types of attacks Learn about SQL injection, buffer overflow, and wireless network attacks	• Introduction to contemporary Cyber Security threats and attacks • Explanation of password cracking, keyloggers, viruses, and malware • Practical exercises on SQL injection, buffer overflow, and wireless attacks	• Identifying and mitigating Cyber Security threats and attacks • Evaluating and mitigating security risks associated with attacks Conducting simulated attacks and defending against them

VALUE ADDED COURSE

3HYEV206: Yoga Education

(Credit: Practical -2 Tutorial - 1)

Scheme of Examination

Course Details				End Term Practical Exam		Lab Performance		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor Sessional ***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks				
Practical Group											
3HYEV206	Value added course	Yoga Education	100	60	20	40	14	-	1	2	3

Objectives:

- To provide an understanding of the meaning and definition of Yoga.
- To identify the aims and objectives of Yoga.
- To analyze the role of Yoga in Early Upanishads.
- To understand the Yoga Sutra: General Consideration.
- To recognize the need and importance of Yoga in Physical Education and Sports.

Outcomes:

- Understand the definitions and concepts of Yoga.
- Describe the historical development of Yoga in India.
- Know the major schools of Yoga.
- Demonstrate the different stages of the Surya Namaskar.
- Name the different types of Asanas.
- Analyze the preventive and curative effects of Yoga.

Syllabus:

Unit 1: Introduction

- Meaning, History and Development of Yoga.
- Aims and Objectives of Yoga, Time and food.
- The Yoga Sutra: General Consideration.
- Need and Importance of Yoga.

Unit 2: Foundation of Yoga

- Various kind of Yoga (Bhakti yoga, karma yoga, hatha yoga, and Ashtang yoga).
- General guidelines for yoga practice.
- Yoga practice for health and wellness.

Unit 3: Asanas

- Effect of Asanas and Pranayama on various system of the body Classification of asanas.
- Influences of relatives, meditative posture on various system of the body.
- Types of Bandhas, mudras and kriyas.

Unit 4: Yoga Education

- Basic, applied and action research in Yoga.
- Difference between yogic practices and physical exercises.
- Yoga education centers in India and abroad.

Unit 5: Yoga and Holistic Health

- Holistic Health and Yoga- Explore the concept of holistic health and how yoga contributes to overall well-being, including physical, mental, and emotional health.
- Yoga for Stress Management - Examine the role of yoga in managing stress and promoting relaxation, with a focus on specific techniques and practices.
- Yoga and Nutrition - Discuss the connection between yoga and nutrition, emphasizing the importance of a balanced diet for a healthy lifestyle.
- Yoga Philosophy and Ethics - Delve into the ethical and philosophical aspects of yoga, including concepts like Ahinsa (non-violence) and Dharma (duty), and how they can be applied in daily life.

Practical:

- Prayer: Concept and recitation of pranava.
- Surya Nasmaskar
- Aasana- (Uttanpadasan, Halasan, Pawanmuktasan, Makrasan, Bhujangasan Shaslabhasan, Dhanurasan, Ardha-Mastsyendrasan, Janushirasan, Supta-Vajrasan, Chakrasan, Tadasa, Uktatasan, Padamsan, Gomukhasan, Vajrasan, Pashchimottasan, Sarvangasan, Matsyasan.)
- Chalana kriya/ Loosening Practice
  - Neck Movement
  - Shoulder movement
  - Bhuja Valli shakti vikasaka
  - Purna Bhuja shakti vikasaka
  - Knee Movement
- Yogasana Standing Posture – Tadasana, vrikshasana, Ardha Chakrasana, sarwangasana, trikonasana Sitting posture – Bhadrasana, vajrasana, Ardha- ushtrasana, shashankasana, vakrasana Prone Posture- Makarasana, bhujangasana, Shalabhasana Supine posture- Ardhasana, Setubandhasana, pawanmuktasana, shavasana.
- Pranayam (Anulom-vilom, Nadi-Shodhan, Surya, Bhedi Ujjayi, Shitkari, Sheetali, Bhastrika, Bhramri.)
- Shat-Karma (Cleansing process) (Jal-Neti, Sutra Neti, Kunjal, Trataka, Kapalbhati)
- Mudra (Mahamudra, Mahabandha, Viparitkarani, Shambhri, Kaki)
- Dhyan (Meditation): "OM" recitation, Body Awareness, Breath Awareness, yoga nidra.
- Viva
- Practical work

Reference Books

- Gupta S.N. Dass Yoga Philosophy Dr. Bhardwaj Ishwar Upnishdhik & Adhyatmik Yigyan.
- Swami Kuvalayananda Hathyog Preedipika Mukherjee, Wishvananth Bharat Ke Mahaan Yogies.
- Swami Tirth, Omanand Patanjali Yog Pradeep Swami Kuvalayananda Pranayam.
- Swami Saraswati Sataya Nand Asan Pranayam and Mudra Bandh Bharamchari, Swami Dhirender Yogic Suksham Vigyan.
- Dr. Nagendra H.R. Pranayama the Arts & Science.
- Swami Kuvalayananda Yogic Chikitisa Ananda Swamy Shankaradev Yogic management & Common.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Learning Outcome	Teaching and Learning Activities	Achievements
1	Understand the meaning and definition of yoga.	Lecture and discussion on the concept and definition of yoga. - Reading assignments on the history and evolution of yoga.	Define yoga and its historical context.
2	Identify the aims and objectives of yoga practice.	Group discussions on the purposes of practicing yoga. - Research projects on the benefits of yoga in various aspects of life.	List the aims and objectives of yoga.
3	Trace the presence of yoga in early Upanishads.	Analysis of select Upanishadic texts with references to yoga. Group presentations on the historical development of yoga.	Summarize the influence of Upanishads on yoga.
4	Summarize the Yoga Sutra and its general considerations.	In depth study of Patanjali's Yoga Sutras and their significance. Group debates on the key principles in the Yoga Sutra.	Explain the fundamental concepts in the Yoga Sutra.
5	Recognize the need and importance of yoga in physical education and sports.	Guest lectures by yoga experts in sports and physical education. Practical sessions of yoga for athletes and physical education students.	Identify the benefits and relevance of yoga in sports and physical education.

VALUE ADDED COURSE

3HCIV206: Contemporary India

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HCIV206	Contemporary India	3(3+0)	60	20	20	-	-	100	3 hr	-

Course Objective

- Develop a clear and comprehensive understanding of the definition and scope of Contemporary India.
- Identify and critically analyze the key elements that define the contemporary period.
- Trace and summarize the post-independence historical background, highlighting major events and their significance.
- Evaluate the impact of historical developments on the current socio-political and economic landscape.
- Examine India's demographic profile, including population distribution, age structure, and regional diversity.
- Analyze the cultural and linguistic diversity within India and its implications for national identity.
- Understand the trajectory of economic growth in India, including key sectors and challenges.
- Analyze the role of economic policies in shaping India's growth and development.
- Evaluate social indicators such as education, health, and poverty, understanding their significance in measuring societal well-being.
- Examine the interconnections between social indicators and their impact on the overall quality of life.

Course Outcome

- Students will articulate a precise definition of Contemporary India, demonstrating an understanding of its multi-dimensional nature.
- Students will categorize and interpret key aspects defining the scope of Contemporary India.
- Students will construct a chronological timeline of post-independence events, demonstrating an understanding of their historical context.
- Students will assess the significance of historical events in shaping the contemporary landscape.
- Students will analyze India's demographic landscape, producing insights into population distribution and diversity.
- Students will recognize and appreciate the cultural diversity within India, linking it to the nation's identity.
- Students will explain the trajectory of economic growth in India, illustrating their understanding of key economic sectors.
- Students will critically assess economic challenges, demonstrating an understanding of their complexities.
- Students will interpret social indicators, showcasing their ability to evaluate education, health, and poverty metrics.
- Students will demonstrate an understanding of the interconnectedness of social indicators and their implications for societal well-being.

Syllabus:

Unit 1: Introduction to Contemporary India

- Definition and scope of Contemporary India
- Historical background: post-independence period
- Demographic profile and diversity
- Economic overview: Growth, sectors, and challenges
- Social indicators: Education, health, and poverty

Unit 2: Political Landscape

- Constitution of India: Features and amendments
- Political institutions: Parliament, President, Prime Minister, Judiciary
- Electoral system: Elections, political parties, and regional dynamics
- Major political issues and challenges

Unit 3: Economic Development

- Economic planning and policies
- Agriculture: Green Revolution, challenges, and reforms
- Industry and services sector
- Infrastructure development
- Economic inequality and inclusive growth

Unit 4: Social Issues and Cultural Dynamics

- Social diversity: Caste, religion, ethnicity, and language
- Gender issues: Women empowerment, equality, and challenges
- Cultural heritage: Art, literature, music, and cinema
- Urbanization and changing lifestyles

Unit 5: Contemporary Challenges and Future Prospects

- Environmental challenges: Climate change, pollution, and conservation
- Technological advancements and their impact
- Globalization and India's role in the international community
- Future prospects: Opportunities and challenges

Recommended Texts:

- "India After Gandhi" by Ramachandra Guha
- "India Unbound" by Gurcharan Das
- "The Argumentative Indian" by Amartya Sen
- "Pax Indica" by Shashi Tharoor
- Articles and research papers on contemporary issues

Reference Books

- Author: Ramachandra Guha, Book Title: "India After Gandhi: The History of the World's Largest Democracy", Publication Year: 2007
- Author: Bipan Chandra, Mridula Mukherjee, Aditya Mukherjee, and Sucheta Mahajan, Book Title: "India Since Independence", Edition: 1st Edition Publication Year: 2008
- Author: Amartya Sen, Book Title: "The Argumentative Indian: Writings on Indian History, Culture and Identity", Edition: 1st Edition, Publication Year: 2005
- Author: Shashi Tharoor, Book Title: "Pax Indica: India and the World of the 21st Century", Edition: 1st Edition, Publication Year: 2012
- Author: Arvind Panagariya, Book Title: "India: The Emerging Giant", Edition: Updated and Expanded Edition Publication Year: 2011

Facilitating the Achievement of Course Learning Objectives

Unit no.	Learning Outcome	Teaching and Learning Activities	Achievements
1	● Introduction to Contemporary India ● Definition and scope of Contemporary India ● Historical background: post-independence period ● Demographic profile and diversity ● Economic overview Growth, sectors, and challenges ● Social indicators Education, health, and poverty	● Lectures and discussions Case studies on demographic trends Analysis of economic indicators Research projects on social issues	● Increased understanding of Contemporary India Enhanced analytical skills
2	● Political Landscape ● Constitution of India: Features and amendments ● Political institutions: Parliament, President, Prime Minister, Judiciary Electoral system: Elections, political parties, and regional dynamics ● Major political issues and challenges	● Interactive sessions on constitutional features Role-playing exercises on political processes Debates on major political issues	● Improved understanding of India's political landscape Enhanced debating and critical thinking skills ●
3	● Economic Development ● Economic planning and policies ● Agriculture: Green Revolution, challenges, and reforms ● Industry and services sector ● Infrastructure development ● Economic inequality and inclusive growth	● Guest lectures from economists Case studies on economic policies Field visits to industries and farms	● Increased awareness of economic policies Practical insights into economic sectors
4	● Social Issues and Cultural Dynamics ● Social diversity: Caste, religion, ethnicity, and language ● Gender issues: Women empowerment, equality, and challenges ● Cultural heritage: Art, literature, music, and cinema ● Urbanization and changing lifestyles	● Group discussions on social diversity Workshops on gender equality Cultural events and presentations	● Improved sensitivity to social issues Enhanced understanding of cultural diversity
5	● Contemporary Challenges and Future Prospects	● Seminars on environmental challenges Analysis of technological impacts	● Heightened awareness of global issues

Unit no.	Learning Outcome	Teaching and Learning Activities	Achievements
	● Environmental challenges: Climate change, pollution, and conservation Technological advancements and their impact ● Globalization and India's role in the international community ● Future prospects: Opportunities and challenges	Model United Nations (MUN) simulations	Improved diplomatic and negotiation skills

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

III Semester

MAJOR CORE COURSES

3SCDC303: Mathematics-III (Calculus, Differential Equations and Mechanics)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SCDC303	Calculus, Differential Equations and Mechanics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- The goal of this course is for students to gain proficiency in calculus computations.
- sequences, series and their convergence.
- To familiarize the student with Laplace and inverse Laplace transforms as well as applications of Laplace transformation in solving linear differential equations.
- To acquaint the student with mechanics.

Course Outcomes

- Understanding the ideas of sequences and series and ability to find their convergence. Understanding of the ideas of limit and continuity.
- Calculate with them and apply them for function of one and two variables.
- Understanding of the ideas of differential equation and facility in solving standard examples.
- Understanding the ideas of Laplace and inverse Laplace transforms facility in solving standard examples and apply them.
- Understanding of the ideas of Mechanics and facility in solving simple standard examples.

Syllabus Credit-(4-0-2)

UNIT – I Definition of a sequence. Theorems on limits of sequences. Bounded and monotonic sequences. Cauchy's convergence criterion. Series of non-negative terms. Comparison test, Cauchy's integral test, Ratio test. Raabe's test, logarithmic test. Leibnitz's theorem. Absolute and conditional convergence.

UNIT – II Continuity of functions of one variable, sequential continuity. Properties of continuous functions. Uniform continuity. Chain rule of differentiability. Mean value theorems and their geometrical interpretations. Darboux's intermediate value theorem for derivatives. Limit and continuity of functions of two variables.

UNIT – III Series Solution of Differential Equations-Power series Method, Bessel's Equation Bessel's function and its properties, recurrence and generating relations. Legendre's

UNIT – IV Laplace transformations, Linearity of the Laplace transformation, Existence theorem of Laplace transforms, Laplace transforms of derivatives and integrals. Shifting theorem. Differentiation and integration of transforms. Inverse Laplace transforms, Convolution theorem. Applications of Laplace transformation in solving linear differential equations with constant coefficients.

UNIT - V Analytical conditions of equilibrium of Coplanar forces. Catenary. Forces in three dimensions. Velocities and accelerations along Radial and transverse direction.

Practical

1. Solve that initial value problem for Cauchy's test.
2. Find general solution of Laplace transformations
3. Find the Power Series Method by the method of characteristics.

Reference Books

1. Calculus, Differential Equation and Mechanics Equations by Dr.H.K. Pathak
2. Principles of Mathematical Analysis" by Walter Rudin:
3. Differential Equations with Applications and Historical Notes" by George F. Simmons
4. A Course in Ordinary Differential Equations" by Stephen A. Wirkus and Randall J. Swift

Text Books

1. Calculus, Differential Equation and Mechanics Dr. P.K. Mitt
2. Calculus: Early Transcendentals" by James Stewart
3. Classical Mechanics" by Herbert Goldstein, Charles P. Poole, and John L. Safko

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will understand the theorems and principles related to the limits of sequences.	Definition and Theorems Practice Series Evaluation Workshops, Practical Applications, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Students will comprehend the concept of continuity for functions of one variable and be able to identify continuous functions and their properties.	Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Students will master the power series method for solving differential equations and understand its application in finding series solutions for a wide range of problems.	Begin with exercises and problems that allow students to practice the power series method for solving differential equations, gradually increasing complexity. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
4.	Students will develop a deep understanding of the Laplace transformation process and its role in solving complex linear differential equations.	Start with exercises that help students practice Laplace transformations for basic functions and simple differential equations. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
5.	Students will understand the analytical conditions required for an object to be in equilibrium under the influence of coplanar forces, including the concepts of force balance and torque balance.	Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions

MAJOR CORE COURSES

3SKTC303: Physics-III (Kinetic theory of Gases, Thermodynamics and Statistical Mechanics)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SKTC303	Kinetic Theory of Gases, Thermo dynamics and Statistical Me-chanics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

1. To express the basic assumption of the kinetic theory of gases.
2. Students learns the different laws of Thermodynamics.
3. To learn Thermodynamically function and their relations.

Course Outcomes

1. Understand the concept of Thermodynamics and their laus.
2. Describe the Thermodynamics function and their relations.
3. Student learn about the concepts of Quantum Statics.

Syllabus

Credit-(4-0-2)

UNIT – I Kinetic Theory of Gases: Ideal Gas Kinetic model, Deduction of Boyle's law, Interpretation of temperature, Estimation of rms speeds of molecules. Brownian motion, Estimation of the Avogadro number. Law of Equipartition of energy, specific heat of monatomic gas, extension to di- and tri- atomic gases, behavior at low temperatures. Adiabatic expansion of an ideal gas, Applications to atmospheric physics. Real Gas: Van der Waals gas, Equation of state, nature of Vander Waals forces, comparison with experimental P-V curves. Boyle temperature and inversion temperature. Refrigeration cycle.

UNIT – II Thermodynamics: Zeroth and First Law of Thermodynamics: - Thermodynamical Equilibrium. Zeroth Law of Thermodynamics and Concept of Temperature. Work and Heat Energy. State Functions. First Law of Thermodynamics. Differential form of First Law. Internal Energy. First Law and Various Processes. Applications of First Law: General Relation between Cp and Cv. Work Done during Isothermal and Adiabatic Processes. Compressibility and Expansion Coefficient. Atmosphere and Adiabatic Lapse Rate.

UNIT – III Statistical Physics: - The statistical basis of thermodynamics: Probability and thermodynamic probability, principle of equal a priori probabilities. Constrains, accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states. Some Universal laws. Equilibrium between two systems in thermal contact. Probability and entropy, Boltzmann entropy relation. Boltzmann canonical distribution law.

UNIT – IV Quantum Theory of Radiation: - Stefan-Boltzmann Law: Thermodynamic Proof. Radiation Pressure. Spectral Distribution of Black Body Radiation. Wien's Distribution Law and Displacement Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law and (4) Wien's Displacement Law from Planck's Law.

UNIT - V Quantum Statistics Transition to quantum statistics; "h" as a natural constant and its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator., Bose- Einstein and Fermi-Dirac conditions, estimates of molecular diameter and mean free path. Transport of mass, Momentum and Energy and Interrelationship, Dependence on temperature and pressure.

Practical **Credit-2**

1. Determination of efficiency of electrical Kettle with variable voltages.
2. Determination of electromotive force of a thermocouple.
3. Determination of thermal conductivity of a bad conductor by Lee's disc method.
4. Verification of Newton's law of cooling.
5. Determination of specific heat of a liquid with the help of Newton's law of cooling.
6. Determination of the coefficient of thermal conductivity of a metal by Searl's method.
7. Determination of Stefan's constant using thermocouple.
8. Study of statistical distribution and determination of standard deviation with the help of black and white dice.

Text Books

1. 1.An Introduction of Thermodynamics, YVC Rao, Revised Edition.
2. Kinetic Theory and Thermodynamics, R.k. Agrawal.
3. Zemansky M. W. and Dittman R. - "Heat and Thermodynamics", Tata McGraw-Hill Publishing.
4. Sears and Salinger - "Thermodynamics, Kinetic Theory and Statistical Thermodynamics", Narosa Publishing.

Reference Books

1. Kinetic Theory and Thermodynamics, J.P. Agrawal.
2. Thermodynamics and the Kinetic Theory of Gases, Wolfgang Pauli, volume
3. Garg S. C. and Ghosh C. K. - "Thermal Physics", Tata McGraw-Hill Publishing.
4. Subrahmanyam N., BrijLal and - " Heat Thermodynamics and statistical", S. Chand, 2012. Hemne P.S. Publishing

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	This unit is comprehensive understanding of gas behaviour, from ideal gases to real gases, and its applications in various fields, including thermodynamics, physics.	Classroom discussions and debates to foster critical thinking and deeper understanding. Assign projects where students simulate real gas behaviour under various conditions.	Quiz, project presentation and discussion
2.	This unit is equipping students with a deep understanding of the laws and principles of thermodynamics, enabling them to analyse and solve real-world problems related to energy, heat, and temperature, and	Conduct lectures to introduce fundamental concepts and laws of thermodynamics.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	apply their knowledge in various scientific and engineering applications.	Use visual aids and real-world examples to illustrate principles. Encourage active participation through discussions and questions.	
3.	This unit equips students with the statistical tools and concepts necessary to understand the behaviour of complex physical systems at the microscopic level, connecting statistical physics with the macroscopic laws of thermodynamics and providing a foundation for advanced studies in physics and related fields.	Conduct lectures to introduce fundamental concepts in statistical physics. Begin with an overview of microscopic vs. macroscopic behaviour. Present statistical ensembles, probability distributions, and basic statistical mechanics.	Quiz, project presentation and discussion
4.	This unit equips students with a deep understanding of statistical mechanics, thermal physics, and the quantum nature of matter and radiation. It provides a foundation for understanding the behaviour of particles and radiation at different energy levels and temperatures, with applications in fields such as physics, astronomy, and engineering.	Organize problem-solving sessions where students apply concepts from statistical mechanics, thermal physics, and quantum mechanics to solve problems. Provide problem sets with varying levels of difficulty. Discuss solution strategies and techniques.	Quiz, project presentation and discussion
5.	This unit equips students with the quantum mechanical tools and principles necessary to understand the behaviour of particles and radiation at the quantum level. It also provides a foundation for exploring the transport of mass, momentum, and energy in various physical systems, making it relevant in fields such as physics, materials science, and engineering.	Conduct lectures to introduce the fundamental principles of quantum mechanics. Cover topics such as wave-particle duality, Schrödinger's equation, quantum states, and operators. Explain the relevance of quantum mechanics in understanding the behaviour of particles and radiation.	Quiz, project presentation and discussion

MAJOR CORE COURS

3SPIC303: Chemistry –III (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIC303	Chemistry –III (Physical, Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Grasp fundamental concepts and laws, understand entropy and its role in spontaneity and equilibrium.
- Learn enthalpy changes, Hess's law, and enthalpy of formation and neutralization reactions.
- Understand adsorption, catalysis, and surface area determination.
- Learn properties, compounds, complexes, and comparative treatment of transition elements.
- Understand coordination compounds, oxidation-reduction principles, and reactions of alcohols and phenols.

Course Learning Outcome

- Ability to apply thermodynamic principles to understand spontaneity and equilibrium in chemical systems.
- Proficiency in calculating enthalpy changes and understanding their applications in various reactions.
- Understanding adsorption phenomena, catalysis, and methods for determining surface area.
- Grasping the properties, compounds, and complexes of transition elements.
- Mastery of coordination compounds, oxidation-reduction principles, and reactions of alcohols and phenols.

Syllabus Credits :4-0-2

Physical Chemistry

UNIT – I

Thermodynamics

Basic concepts of thermodynamics. first law, 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 function of P & T and T and T & V, entropy change in physical change. Clausius inequality, entropy as criteria of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases. 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 (H) as thermodynamic quantities. A and G as a criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change.

Thermochemistry

Standard state, standard enthalpy of formation: Hess's law of heat summation and its application. Enthalpy of neutralization.

UNIT – II

Surface Chemistry

Adsorption: Adsorption and absorption, type of adsorption, adsorption of gases and liquids in solid adsorption, Freundlich and Langmuir adsorption isotherms. Surface area and determination of surface area.

Catalysis: Characteristics of catalyzed reactions, classification of catalysis, application of catalysts, miscellaneous examples.

Inorganic Chemistry

UNIT – III

Chemistry of Elements of First Transition Series

Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds such as carbides, oxides and sulphides. Complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Chemistry of Elements of Second and Third Transition Series

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

UNIT – IV

Coordination Compounds

Werner's co-ordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, VBT of transition metal complexes.

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 elements.

Organic Chemistry

UNIT – V

Alcohols

Classification and nomenclature. Monohydric alcohols: nomenclature, methods of formation, acidic nature and reactions of alcohols. Dihydric alcohols: Nomenclature, methods of formation, chemical reactions. Trihydric alcohols: Nomenclature and methods of formation, chemical reactions.

Phenols

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols- Electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Hauben- Hoesche reaction, Lederer-Manasse reaction and Riemer- Tiemann reaction.

Practical Content — Credits :2

Physical Chemistry

- Determination of transition temperature of give substance by thermometric method.
- Verification of beer's lambert law.
- To determine the strength of HCl with NaOH using potentiometer.

Inorganic Chemistry

- Determination of acetic acid in commercial vinegar using NaOH.
- Determination of alkali content- antacid tablet using HCl.

- Estimation of calcium content in chalk as calcium oxalate by permagnometry.
- Estimation of hardness of water by EDTA.

Organic Chemistry

- Thin layer chromatography Determination of Rf values and identification of organic compounds.
  a. Separation of green leaf pigments (spinach leaves may be used).
  b. Preparation and separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone, hexane-2 and 3-one using toluene and light petroleum (40:6).
  c. Separation of a mixture of dyes using cyclohexane and ethyl acetate (8:5:1.5).
- Paper chromatography: Ascending and Circular Determination of Rf values and identification of organic compounds.
  a. Separation of a mixture of phenylalanine and glycine, alanine and aspartic acid, leucine and glutamic acid. Spray reagent ninhydrin.
  b. Separation of a mixture of DL-alanine, glycine and L-Lucine using n butanol, acetic acid: water (4:1:5). Spray reagent ninhydrin.
  c. Separation of monosaccharides- a mixture of D-galactose and D fructose using n-butanol: acetone: water (4:1:5). Spray reagent-aniline hydrogen phthalate.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Surface Chemistry by Arne Östlund.
- Transition Metal Chemistry the Valence Shell in d-Block Chemistry by Malcolm S. Cresser.

Reference Books

- Chemical Kinetics and Reaction Dynamics by Paul L. Houston.
- Thermodynamics, Statistical Thermodynamics, and Kinetics by Thomas Engel and Philip Reid.
- Introduction to Catalysis by Robert J. Farrauto and Lucas Dorazio.
- Principles of Inorganic Chemistry by Brian W. Pfennig and Kimberly A. Pfennig.
- Advanced Organic Chemistry Reactions, Mechanisms, and Structure by Jerry March.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	The laws of thermodynamics, including the zeroth law, first law (conservation of energy), second law (entropy and the direction of processes), and third law (absolute zero and entropy).	Traditional lectures can be used to introduce and explain key thermodynamic concepts, laws, and principles. Visual aids, diagrams, and animations can enhance understanding.	Quiz assessing understanding of basic thermodynamic concepts.
2	Understanding the fundamental principles of surface chemistry, including surface tension , adsorption and interface phenomena.	Covering fundamental concept, theories and principles of surface chemistry. Showing surface phenomena using visual aids or experiments.	Homework assignments on catalytic mechanisms and examples.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
3	Describe and compare the fundamental physical and chemical properties of the elements in the first transition series, including atomic and ionic radii, ionization energy, electron affinity, and magnetic properties.	Assign each student or group of students an element from the first transition series. Have them create profiles that include key information like electron configuration, physical properties, and common uses. Present these profiles to the class.	Written exam on the characteristic properties of transition elements.
4	Coordination compounds and describe their distinctive features, including the central metal ion or atom, ligands, and coordination number.	Provide students with molecular modelling software or kits to build and visualize coordination complexes. This hands-on approach helps students understand three-dimensional structures.	Quiz on Werner's coordination theory and effective atomic number concept.
5	Classification and nomenclature and Chemical reaction of Alcohols and Phenols.	Begin with traditional lectures to introduce the basic concepts of Alcohols and Phenols.	Class test focusing on long questions.

MINOR CORE COURSES

3SCDM304: Mathematics-III (Calculus, Differential Equation and Mechanics)

(Credits: Theory-6 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SCDM304	Calculus, Differential Equations and Mechanics	6(6-0-0)	60	20	20	-	-	100	3hr	-

Course Objectives

- The goal of this course is for students to gain proficiency in calculus computations.
- sequences, series and their convergence.
- To familiarize the student with Laplace and inverse Laplace transforms
- well as applications of Laplace transformation in solving linear differential equations.
- To acquaint the student with mechanics.

Course Outcomes

- Understanding the ideas of sequences and series and ability to find their convergence. Understanding of the ideas of limit and continuity.
- Calculate with them and apply them for function of one and two variables.
- Understanding of the ideas of differential equation and facility in solving standard examples.
- Understanding the ideas of Laplace and inverse Laplace transforms facility in solving standard examples and apply them.
- Understanding of the ideas of Mechanics and facility in solving simple standard examples.

Syllabus: Credit (6-0-0)

UNIT – I Definition of a sequence. Theorems on limits of sequences. Bounded and monotonic sequences. Cauchy's convergence criterion. Series of non-negative terms. Comparison test, Cauchy's integral test, Ratio test. Raabe's test, logarithmic test. Leibnitz's theorem. Absolute and conditional convergence.

UNIT – II Continuity of functions of one variable, sequential continuity. Properties of continuous functions. Uniform continuity. Chain rule of differentiability. Mean value theorems and their geometrical interpretations. Darboux's intermediate value theorem for derivatives. Limit and continuity of functions of two variables.

UNIT – III Series Solution of Differential Equations-Power series Method, Bessel's Equation Bessel's function and its properties, recurrence and generating relations. Legendre's

UNIT – IV Laplace transformations, Linearity of the Laplace transformation, Existence theorem of Laplace transforms, Laplace transforms of derivatives and integrals. Shifting theorem. Differentiation and integration of transforms. Inverse Laplace transforms, Convolution theorem. Applications of Laplace transformation in solving linear differential equations with constant coefficients.

UNIT - V Analytical conditions of equilibrium of Coplanar forces. Catenary. Forces in three dimensions. Velocities and accelerations along Radial and transverse direction.

Reference Books

1. Calculus, Differential Equation and Mechanics Equations by Dr. H.K. Pathak
2. Principles of Mathematical Analysis" by Walter Rudin:
3. Differential Equations with Applications and Historical Notes" by George F. Simmons
4. A Course in Ordinary Differential Equations" by Stephen A. Wirkus and Randall J. Swift

Text Books

1. Calculus, Differential Equation and Mechanics Dr. P.K. Mitt
2. Calculus: Early Transcendentals" by James Stewart
3. Classical Mechanics" by Herbert Goldstein, Charles P. Poole, and John L. Safko

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will also understand the theorems and principles related to the limits of sequences.	Definition and Theorems Practice Series Evaluation Workshops, Practical Applications, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Students will comprehend the concept of continuity for functions of one variable and be able to identify continuous functions and their properties.	Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Students will master the power series method for solving differential equations and understand its application in finding series solutions for a wide range of problems.	Begin with exercises and problems that allow students to practice the power series method for solving differential equations, gradually increasing complexity. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
4.	Students will develop a deep understanding of the Laplace transformation process and its role in solving complex linear differential equations.	Start with exercises that help students practice Laplace transformations for basic functions and simple differential equations. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions.
5.	Students will understand the analytical conditions required for an object to be in equilibrium under the influence of coplanar forces, including the concepts of force balance and torque balance.	Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions

MINOR CORE COURSES

3SKTM304: Physics-III (Kinetic Theory of Gases, Thermodynamics and Statistical Mechanics
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SKTM304	Kinetic theory of Gases. Thermodynamics and Statistical Mechanics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

1. To express the basic assumption of the kinetic theory of gases.
2. Students learns the different laws of Thermodynamics.
3. To learn Thermodynamically function and their relations.

Course Outcomes

1. Understand the concept of Thermodynamics and their laws.
2. Describe the Thermodynamics function and their relations.
3. Student learn about the concepts of Quantum Statics.

Syllabus Credit-(4-0-2)

UNIT – I Kinetic Theory of Gases: Ideal Gas Kinetic model, deduction of Boyle's law, interpretation of temperature, estimation of rms speeds of molecules. Brownian motion, estimation of the Avogadro number. Law of Equipartition of energy, specific heat of monatomic gas, extension to di- and tri- atomic gases, behavior at low temperatures. Adiabatic expansion of an ideal gas, applications to atmospheric physics. Real Gas: Van der Waals gas, Equation of state, nature of Vander Waals forces, comparison with experimental P-V curves. Boyle temperature and inversion temperature. Refrigeration cycle.

UNIT – II Thermodynamics : Zeroth and First Law of Thermodynamics :- Thermodynamical Equilibrium. Zeroth Law of Thermodynamics and Concept of Temperature. Work and Heat Energy. State Functions. First Law of Thermodynamics. Differential form of First Law. Internal Energy. First Law and Various Processes. Applications of First Law: General Relation between Cp and Cv. Work Done during Isothermal and Adiabatic Processes. Compressibility and Expansion Coefficient. Atmosphere and Adiabatic Lapse Rate.

UNIT – III Statistical Physics The statistical basis of thermodynamics: Probability and thermodynamic probability, principle of equal a priori probabilities. Constrains, accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states. Some universal laws. Equilibrium between two systems in thermal contact. Probability and entropy, Boltzmann entropy relation. Boltzmann canonical distribution law.

UNIT – IV Quantum Theory of Radiation: - Stefan-Boltzmann Law: Thermodynamic Proof. Radiation Pressure. Spectral Distribution of Black Body Radiation. Wien's Distribution Law and Displacement Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody

Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law and (4) Wien's Displacement Law from Planck's Law.

UNIT - V Quantum Statistics Transition to quantum statistics; "h" as a natural constant and its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator., Bose- Einstein and Fermi-Dirac conditions, estimates of molecular diameter and mean free path. Transport of mass, Momentum and Energy and Interrelationship, Dependence on temperature and pressure.

Practical (Credit-2)

1. Determination of efficiency of electrical Kettle with variable voltages.
2. Determination of electromotive force of a thermocouple.
3. Determination of thermal conductivity of a bad conductor by Lee's disc method.
4. Verification of Newton's law of cooling.
5. Determination of specific heat of a liquid with the help of Newton's law of cooling.
6. Determination of the coefficient of thermal conductivity of a metal by Searl's method.
7. Determination of Stefan's constant using thermocouple.
8. Study of statistical distribution and determination of standard deviation with the help of black and white dice.

Text Books

1. An Introduction of Thermodynamics, YVC Rao, Revised Edition.
2. Kinetic Theory and Thermodynamics R.K. Agrawal.
3. Zemansky M. W. and Dittman R. - "Heat and Thermodynamics", Tata McGraw-Hill Publishing.
4. Sears and Salinger - "Thermodynamics, Kinetic Theory Statistical Thermodynamics", Narosa Publishing.

Reference Books:

1. 1.Kinectic Theory and Thermodynamics, J.P. Agrawal.
2. 2.Thermodynamics and the Kinetic Theory of Gases, Wolfgang Pauli, volume 3.
3. Garg S. C. and Ghosh C. K. - "Thermal Physics", Tata McGraw-Hill Publishing.
4. Subrahmanyam N., BrijLal, and - " Heat Thermodynamics and statistical", S. Chand, 2012. Hemne P.S. Publishing

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	This unit is comprehensive understanding of gas behaviour, from ideal gases to real gases, and its applications in various fields, including thermodynamics, physics.	Classroom discussions and debates to foster critical thinking and deeper understanding. Assign projects where students simulate real gas behaviour under various conditions.	Quiz, project presentation and discussion
2.	This unit is equipping students with a deep understanding of the laws and principles of thermodynamics, enabling them to analyse and solve real-world problems related to energy, heat, and temperature, and apply their knowledge in various scientific and engineering applications.	Conduct lectures to introduce fundamental concepts and laws of thermodynamics. Use visual aids and real-world examples to illustrate principles. Encourage active participation through discussions and questions.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
3.	This unit equips students with the statistical tools and concepts necessary to understand the behaviour of complex physical systems at the microscopic level, connecting statistical physics with the macroscopic Laws of thermodynamics and providing a foundation for advanced studies in physics and related fields.	Conduct lectures to introduce fundamental concepts in statistical physics. Begin with an overview of microscopic vs. macroscopic behaviour. Present statistical ensembles, probability distributions, and basic statistical mechanics.	Quiz, project presentation and discussion
4.	This unit equips students with a deep understanding of statistical mechanics, thermal physics, and the quantum nature of matter and radiation. It provides a foundation for understanding the behaviour of particles and radiation at different energy levels and temperatures, with applications in fields such as physics, astronomy, and engineering.	Organize problem-solving sessions where students apply concepts from statistical mechanics, thermal physics, and quantum mechanics to solve problems. Provide problem sets with varying levels of difficulty. Discuss solution strategies and techniques.	Quiz, project presentation and discussion
5.	This unit equips students with the quantum mechanical tools and principles necessary to understand the behaviour of particles and radiation at the quantum level. It also provides a foundation for exploring the transport of mass, momentum, and energy in various physical systems, making it relevant in fields such as physics, materials science, and engineering.	Conduct lectures to introduce the fundamental principles of quantum mechanics. Cover topics such as wave-particle duality, Schrödinger's equation, quantum states, and operators. Explain the relevance of quantum mechanics in understanding the behaviour of particles and radiation.	Quiz, project presentation and discussion

MINOR CORE COURS

3SPIM304: Chemistry –III (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIM304	Chemistry –III (Physical, Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Grasp fundamental concepts and laws, understand entropy and its role in spontaneity and equilibrium.
- Learn enthalpy changes, Hess's law, and enthalpy of formation and neutralization reactions.
- Understand adsorption, catalysis, and surface area determination.
- Learn properties, compounds, complexes, and comparative treatment of transition elements.
- Understand coordination compounds, oxidation-reduction principles, and reactions of alcohols and phenols.

Course Learning Outcome

- Ability to apply thermodynamic principles to understand spontaneity and equilibrium in chemical systems.
- Proficiency in calculating enthalpy changes and understanding their applications in various reactions.
- Understanding adsorption phenomena, catalysis, and methods for determining surface area.
- Grasping the properties, compounds, and complexes of transition elements.
- Mastery of coordination compounds, oxidation-reduction principles, and reactions of alcohols and phenols.

Syllabus Credits: 4-0-2

Physical Chemistry

UNIT – I

Thermodynamics

Basic concepts of thermodynamics. first law, 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 function of P & T and T and T & V, entropy change in physical change. Clausius inequality, entropy as criteria of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases. 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 (H) as thermodynamic quantities. A and G as a criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change.

UNIT – II

Surface Chemistry

Adsorption: Adsorption and absorption, type of adsorption, adsorption of gases and liquids in solid adsorption, Freundlich and Langmuir adsorption isotherms. Surface area and determination of surface area.

Catalysis: Characteristics of catalyzed reactions, classification of catalysis, application of catalysts, miscellaneous examples.

Inorganic Chemistry

UNIT – III

Chemistry of Elements of First Transition Series

Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds such as carbides, oxides and sulphides. Complexes illustrating relative stability of their oxidation states, coordination number and geometry.

UNIT – IV

Coordination Compounds

Werner's co-ordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, VBT of transition metal complexes.

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 elements.

Organic Chemistry

UNIT – V

Alcohols

Classification and nomenclature. Monohydric alcohols: nomenclature, methods of formation, acidic nature and reactions of alcohols. Dihydric alcohols: Nomenclature, methods of formation, chemical reactions. Trihydric alcohols: Nomenclature and methods of formation, chemical reactions.

Practical Content — Credits: 2

Physical Chemistry

- Determination of transition temperature of give substance by thermometric method.
- Verification of beer's lambert law.

Inorganic Chemistry

- Calibration of the fractional weights, pipettes and burettes.
- Quantitative analysis -Volumetric analysis

a. Determination of acetic acid in commercial vinegar using NaOH.
b. Estimation of hardness of water by EDTA

- Gravimetric analysis: Barium as barium sulphate Organic Chemistry Laboratory Techniques.

Organic Chemistry

- Thin layer chromatography Determination of Rf values and identification of organic compounds.
  a. Separation of green leaf pigments (spinach leaves may be used).
- Paper chromatography: Ascending and Circular Determination of Rf values and identification of organic compounds.
  a. Separation of a mixture of phenylalanine and glycine, alanine and aspartic acid, leucine and glutamic acid. Spray reagent ninhydrin.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Surface Chemistry by Arne Östlund.
- Transition Metal Chemistry the Valence Shell in d-Block Chemistry by Malcolm S. Cresser.

Reference Books

- Chemical Kinetics and Reaction Dynamics by Paul L. Houston.
- Thermodynamics, Statistical Thermodynamics, and Kinetics by Thomas Engel and Philip Reid.
- Introduction to Catalysis by Robert J. Farrauto and Lucas Dorazio.
- Principles of Inorganic Chemistry by Brian W. Pfennig and Kimberly A. Pfennig.
- Advanced Organic Chemistry Reactions, Mechanisms, and Structure" by Jerry March.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	The laws of thermodynamics, including the zeroth law, first law (conservation of energy), second law (entropy and the direction of processes), and third law (absolute zero and entropy).	Traditional lectures can be used to introduce and explain key thermodynamic concepts, laws, and principles. Visual aids, diagrams, and animations can enhance understanding.	Quiz assessing understanding of basic thermodynamic concepts.
2	Understanding the fundamental principles of surface chemistry, including surface tension, adsorption and interface phenomena.	Covering fundamental concept, theories and principles of surface chemistry. Showing surface phenomena using visual aids or experiments.	Homework assignments on catalytic mechanisms and examples.
3	Describe and compare the fundamental physical and chemical properties of the elements in the first transition series, including atomic and ionic radii, ionization energy, electron affinity, and magnetic properties.	Assign each student or group of students an element from the first transition series. Have them create profiles that include key information like electron configuration, physical properties, and common uses. Present these profiles to the class.	Written exam on the characteristic properties of transition elements.
4	Coordination compounds and describe their distinctive features, including the central metal ion or atom, ligands, and coordination number.	Provide students with molecular modelling software or kits to build and visualize coordination complexes. This hands-on approach helps students understand three-dimensional structures.	Quiz on Werner's coordination theory and effective atomic number concept.
5	Classification and nomenclature and Chemical reaction of Alcohols and Phenols.	Begin with traditional lectures to introduce the basic concepts of Alcohols and Phenols.	Class test focusing on long questions.

INTER DISCIPLINARY COURSE

3SCSI302: Calculus Single and Multivariable

(Credits: Theory-3 Practical-0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SCSI302	Calculus single and multivariable	3(3-0-0)	60	20	20	-	-	100	3hr	-

Course Objective

- Apply fundamental concepts of limits, continuity, and differentiation in single variable calculus.
- Utilize differentiation techniques and rules to solve a variety of mathematical and real-world problems.
- Demonstrate proficiency in integration, including integration techniques and applications.
- Apply calculus to solve differential equations and analyses infinite sequences and series.
- Develop a deep understanding of the fundamental theorem of calculus and integration techniques.

Course Outcomes

- Compute limits and assess continuity in various functions.
- Determine derivatives of functions using differentiation rules and apply them to solve problems involving rates of change.
- Apply integration techniques, such as integration by parts and trigonometric integrals, to find areas, volumes, and other quantities.
- Calculate double and triple integrals and understand their applications.

Syllabus: Credits: 3(3-0-0)

Unit 1: Introduction to Single Variable Calculus Limits and Continuity Differentiation and Rules Applications of Differentiation Integration and Rules.

Unit 2: Advanced Single Variable Topics Techniques of Integration Applications of Integration Differential Equations Infinite Sequences and Series.

Unit 3: Introduction to Multivariable Calculus Functions of Several Variables Partial Differentiation Multiple Integrals.

Unit 4: Vector Fields and Line Integrals Surface Integrals Stokes' and Divergence Theorems Applications in 3D Space.

Unit 5: Integrals Riemann sums and definite integrals Fundamental theorem of calculus Integration techniques.

Reference Books

- Calculus by Dr. H.K Pathak.
- Colin Adams. Calculus" by Michael Spivak
- Calculus For Dummies" by Mark Ryan

Text Book

- Calculus: “Early Transcendental" by James Stewart (for Multivariable Calculus)
- Multivariable Calculus" by James Stewart

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	• Students will be able to evaluate limits of functions and identify points of continuity, demonstrating a solid foundation in the fundamental principles of calculus.	• Reading text books. Attending lectures, workshops, Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions.
2.	• Students will be able to apply integration to calculate areas, volumes, arc length, and solve practical problems in physics, engineering, economics, and other fields, showcasing their ability to use calculus in diverse contexts.	• Reading textbooks, attending lectures, workshops, Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions.
3.	• Students will have a solid understanding of functions of two or more variables, including their domain and range, and will be able to interpret and graph these functions. Students will become proficient in taking partial derivatives of multivariable functions and will understand the geometric interpretation of partial derivatives in terms of slopes and rates of change.	• Reading textbooks, attending lectures, workshops, Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions
4.	• students will have a deep understanding of vector fields, including concepts of vector functions and their graphical representations.	• Reading textbooks, • Attending lectures, workshops, Teaching will do through lectures and discussion mode. Reading textbooks,	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions
5.	• students will have a solid understanding of integrals, including the concept of accumulation of quantities and the geometric interpretation of integration.	• Reading textbooks, attending lectures, workshops, Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis, Group Projects, Problem Solving Sessions

ABILITY ENHANCEMENT COURSE (AEC)

3HCSA301: Communication Skill

(Credit: Theory - 2 Tutorial -0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HCSA301	Communication Skill	2(2-0-0)	60	20	20	-	-	100	2 hr	-

Course Objective

- Develop Effective Communication Skills Spoken and written.
- Develop Effective Presentation Skills.
- Conduct Effective business Correspondence, business reports, team management and all-round personality Development.

Course Outcomes

- Projects Role plays, quizzes and Various other participatory sessions. The emphasis will be on learning by doing.
- The student will learn the skills and attributes but also internalize them over a period of time.
- Internalization ensures that the skills and attributes become part of the student's nature. Thus, the changes will be genuine and positive.

Syllabus:

Unit 1: Introduction

General Introduction of self by students, Importance of the Training sessions, Importance of Presentation Skills, Public Speaking

Unit 2: Basic English Grammar

Vocabulary, Kinds of Sentences, Verb, Adverb, Tenses, Preposition, Conjunction, Formation of Sentences, Sentence Making, Translation

Unit 3: Communication Skills

Communication meaning, Function, Process, Types of communication, Guidelines for effective communication, Purpose of Good communication, Importance of right Pronunciation

Unit 4: Listening and Writing Skills

Importance of effective listening, Importance of effective writing skills, Conversation Practice, Guidelines for Effective writing

Unit 5: Body Language

Gestures, Voice Modulation, Eye Contact, Facial Expression, Posture, Dressing Sense, Attire, Hand, movements, General Etiquette, Mannerism, Smiling Gestures, Confidence building. Email Etiquette, Email Drafting

Reference Books

- English Communicative skill by Pramod Singla.
- English Language skill a Practical.
- Communicative skill by Sanjay Kumar & Pushpalata.

Facilitating the Achievement of Course Learning Objectives

Unit	Course Learning Outcome	Teaching-Learning Activities	Assessment Tasks
1	● Understand the basics of communication.	● Lecture on communication fundamentals ● Group discussion on the importance of effective communication ● Role-play exercises demonstrating different communication styles	● Quiz on communication basics Individual reflection on group discussion performance
2	● Develop active listening skills.	● Listening comprehension exercises Class debates with active listening requirements Peer feedback sessions	● Listening comprehension test Debate participation and assessment by peers
3	● Improve verbal communication skills.	● Public speaking workshops ● Mock interviews and feedback sessions. ● Impromptu speech exercises	● Public speaking assessment with feedback ● Mock interview performance evaluation
4	● Enhance non-verbal communication skills.	● Body language analysis and practice activities Group activities emphasizing non-verbal cues Video analysis of non-verbal communication	● Non-verbal communication assessment with peer feedback Written reflection on video analysis
5	● Develop effective written communication skills.	● Writing workshops on emails, reports, and proposals Collaborative document editing exercises Writing assignments on various topics	● Written assignments on emails, reports, and proposals with rubric assessment Peer review of collaborative document editing

SKILL ENHANCEMENT COURSE

3SBAS305: Boolean Algebra

(Credits: Theory-3 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3SBAS305	Boolean Algebra	3(3-0-0)	60	20	20	-	-	100	3 hr	-

Course Objective

- Demonstrate a solid understanding of the foundational concepts of Boolean algebra, including Boolean variables, logic gates, and binary logic.
- Appreciate the historical development of Boolean algebra and its significance in mathematics and computer science.

Course Outcomes

- Recognizing, defining, and working with groups, subgroups, abelian groups, cyclic groups, and understanding Lagrange's theorem.
- Dealing with normal subgroups, quotient groups, homomorphisms, isomorphisms, and applying Cauchy's theorem for abelian groups.
- Understanding Euclidean rings, greatest common divisors, prime and irreducible elements, and the concept of a unique factorization domain, along with the unique factorization theorem.

Syllabus: Credit: 3(3-0-0)

Unit 1: Groups: Definition and examples of groups, Subgroups, abelian groups, cyclic groups, Lagrange's theorem, normal subgroups and quotient groups, homomorphism, isomorphism, Cauchy's theorem for abelian groups, application of Cauchy's theorem, automorphism, inner and outer atropism.

Unit 2: Permutation Groups: Examples, orbit, cycle, transposition, alternating groups, Cayley's Theorem, Conjugate class, class equation, Cauchy theorem for finite groups,

Unit 3: Sylow's Theorem and Problems: solvable groups, direct products, Fundamental Theorem on finite abelian groups

Unit 4: Rings: Definition and examples of Rings, Integral domain, Field, Characteristic of a Ring, Homomorphism, Kernal, isomorphism, ideals and quotient rings, maximal Ideal, pri Demonstrate a solid understanding of the foundational concepts of Boolean Algebra, including Boolean variables, logic gates, and binary logic. me ideal, principal ideal ring

Unit 5: Euclidean Ring: Definition and examples, greatest common divisor, prime and Irreducible elements, unique factorization domain, unique factorization theorem

Reference Books

- "Boolean Algebra and Its Applications" by J. Eldon Whitesitt:
- "Boolean Algebra" by R.L. Goodstein and Judith R. Goodstein:

Text Book

- Digital Design" by M. Morris Mano and Michael D. Cilett.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	• Students will develop a strong understanding of the fundamental concepts of groups, including definitions and examples of groups, subgroups, and their properties. Students will explore the concepts of auto morphisms, inner auto morphisms, and outer auto morphisms, demonstrating their understanding of group transformations.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions
2.	• Students will develop a solid understanding of permutation groups, their definitions, and their significance in group theory and combinatory. Students will apply Cauchy's theorem to recognize and analyse finite groups, demonstrating their understanding of the theorem's significance in group theory.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions
3.	• Students will develop a strong understanding of Sylow's Theorem, its various forms, and its significance in group theory. Students will be able to apply the Fundamental Theorem on finite abelian groups, recognizing and classifying abelian groups of finite order.	• . Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions
4.	• Students will develop a strong understanding of rings, their definitions, and their significance in abstract algebra, including examples of rings. Students will apply the concept of principal ideal rings, recognizing and working with these special types of rings.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode. Reading textbooks,	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions
5.	• Students will develop a strong understanding of Euclidean rings, their definitions, and their significance in number theory and abstract algebra. Students will understand and apply the unique factorization theorem, recognizing its significance in number theory and algebra.	• Reading textbooks. • Attending lectures, workshops, • Teaching will do through lectures and discussion mode.	• Class Discussions and Analysis. Group Projects, Problem Solving Sessions

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

IV Semester

MAJOR CORE COURSES –I

3SGOC403: Physics-IV (Group Waves, Acoustics and Optics)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SGOC403	Group Waves, Acoustics and Optics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

1. To aware the students about various phenomena of Waves, Acoustics and Optics.
2. Describe the phenomena like Interference, Diffraction.

Course Outcomes

1. Understand the Physics behind various optical phenomena.
2. Understand various natural phenomena which is happening in their surroundings.
3. Explain the relationship in between various optical phenomena

Syllabus Credit4-0-2

UNIT - I Waves: Waves in Media Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, gravity waves and ripples. Group velocity and phase velocity; their measurements. Superposition of waves: Linear homogeneous equations and the superposition principle, Standing waves harmonics and the quality of sound, examples. Chladni's figures and vibrations of a drum. Production and detection of ultrasonic and infrasonic waves and applications.

UNIT – II Acoustics Noise and Music; The human ear and its responses, Limits of human audibility, Intensity and loudness, bel and decibel, The musical scales, Temperament and musical instrument. Reflection, refraction and diffraction of sound; Acoustic impedance of a medium, Percentage reflection and refraction at a boundary, Impedance matching for transducers, Diffraction of sound, Principle of a sonar system, Sound Ranging. Applied acoustics: Transducers and their characteristics. Recording and reproduction of sound various systems, Measurements of frequency, Waveform, Iintensity and velocity. The acoustics of halls, Reverberation period, Sabine's formula.

UNIT – III Geometrical Optics Fermat's Principle of extremum path, Aplanatic points of a sphere and other applications. General theory of image formation: cardinal points of an optical system, General relationships for thick lens and lens combinations, Optical instruments: Entrance and exit pupils, Need for a multiple lens eyepiece, Common types of eyepieces.

UNIT – IV Interference of light; The principle of superposition, Two slit Interference, Coherence requirement for the sources, thin films, Interference by a film with two non-parallel reflecting surfaces, Newton’s rings. Haidinger fringes (Fringes of equal inclination). Michelson interferometer, its application for precision determination of wavelength, Intensity distribution in multiple beam interference, Fabry -Perot interferometer and etalon.

UNIT- V Diffraction: Fresnel diffraction: - Fresnel’s Assumptions. Fresnel’s Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate.

Comparison of a Zone plate with a convex lens. Diffraction due to (1) a Straight Edge and (2) a Rectangular Aperture (Slit), (3) a Small Circular Aperture and (4) an Opaque Circular Disc. Fresnel's Integrals, Cornu's Spiral: Fresnel Diffraction Pattern due to (1) a Straight Edge, (2) a Slit, and (3) a Wire (Qualitatively using Cornu's Spiral.

Fraunhofer diffraction: Diffraction due to (1) a Single Slit, (2) a Double Slit and (3) a Plane Transmission Grating. Rayleigh's criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves

Practical **Credit-2**

1. To determine the frequency of A.C. Mains by using sonometer.
2. To determine the frequency of A.C. Mains by Melde's Experiment in transverse arrangement.
3. To Study and analysis of human ear (on the basis of physical concepts).
4. To determine the wavelength of sodium light by Newton's rings method.
5. To determine the wavelength of prominent lines of mercury light by plane diffraction grating.
6. To determine the refractive index of the material of the prism using spectrometer.
7. To determine the resolving power of the Telescope.
8. To determine the resolving power of the Prism.
9. To determine the resolving power of the Diffraction Grating.

Text Books

1. Wave motion and Optics, Dr. Mangala Gowri M, Himalaya P.
2. A Textbook of Oscillations, Waves and Acoustics, Dr. M. Ghosh, Dr. D. Bhattacharya, S. Chand.
3. 3.Light and Optics: Principles and Practices by Abdul Al-Azzawi (CRC Press, 2007
4. Contemporary Optics by A. K. Ghatak & K. Thyagarajan. (Plenum Press,1978).
5. Introduction to Optics by Khanna and Gulat

Reference Books

1. Oscillations, Wave and Acoustics, P.K. Mittal.
2. Fundamental of Wave, Oscillations and Acoustics, K. U. INGARD.
3. Oscillations and Wave, Second Edition, RICHARD FITZPATRICK.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students should have a comprehensive understanding of wave behaviour, their propagation in different media, and their practical applications in various industries and scientific disciplines. They should also be able to apply mathematical and physical principles to analyse and solve problems related to waves and wave phenomena.	Conduct traditional lectures to introduce theoretical concepts related to waves. Use visual aids, animations, and demonstrations to illustrate wave phenomena and properties	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
2.	Students should have a strong foundation in acoustics, noise, music, and related topics, enabling them to apply their knowledge in fields such as audio engineering, architectural acoustics, and musical instrument design, and to understand the principles behind human perception of sound and its practical applications.	. Enhance lectures with multimedia presentations, audio-visual materials. Organize live acoustic demonstrations to illustrate concepts such as sound reflection, refraction, diffraction, and resonance.	Quiz, project presentation and discussion
3.	Students understand Fermat's Principle and its application in optics, which states that light follows the path of least time when traveling between two points. Learn about aplanatic points, where spherical aberrations are minimized, and explore other practical applications of this concept in optical systems.	Present practical examples where Fermat's Principle is applied, such as in the design of optical lenses, mirrors, and fibre optics. Discuss how optimizing the path of light can lead to improved optical systems.	Quiz, project presentation and discussion
4.	Students should have a comprehensive understanding of interference of light, be able to apply the principles to solve complex problems, and appreciate the wide range of applications of interference in various fields of science and technology.	Explore the historical development of interference theory, highlighting key figures and experiments. Organize field trips to research labs, optical manufacturing facilities, or observatories where students can see interference principles applied in real-world settings.	Quiz, project presentation and discussion
5.	Understand the factors that determine the resolving power of optical instruments. Learn how to calculate the resolving power of a diffraction grating and appreciate its significance in spectral analysis.	Conduct lectures that explain the concept of resolving power, its importance in optical instruments, and the factors that affect it, such as wavelength of light and aperture size. Engage students in discussions to ensure they grasp the theoretical foundations.	Quiz, project presentation and discussion

MAJOR CORE COURS-I

3SPIC403: Chemistry-IV (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIC403	Chemistry-IV (Physical, Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understand phase compositions and eutectic systems.
- Grasp ideal and non-ideal liquid behavior.
- Learn electrical transport and concentration cells.
- Understand electronic structure and chemistry.
- Learn about aldehydes, ketones, and nitrogen compounds.

Course Learning Outcomes

- Identify phases and understand eutectic systems.
- Comprehend ideal and non-ideal behavior.
- Understand conductivity and concentration cells.
- Recognize electronic structures and chemistry.
- Learn synthesis and reactions of functional groups.

Syllabus Credits :4-0-2

Physical Chemistry

UNIT – I

Phase Equilibrium

Statement and the meaning of the terms: Phase component and the degree of freedom, derivation of the Gibbs phase rule. Simple eutectic System: Bi-Cd, Pb-Ag system. Desiliverisation of lead. One component system: Water, CO_2 and S system. Two component system: Solid liquid equilibria.

Solid Solutions

Systems in which compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H_2O) and ($CuSO_4$-H_2O) system. Freezing mixtures: Acetone-dry ice.

Liquid-Liquid Mixtures

Ideal liquid mixtures, Raoult's and Henry's law, non-ideal system. Azeotropes: HCl-H_2O and ethanol- Water systems.

Partial Miscible Liquids

Phenol-water, trimethylamine–water and nicotine-water systems. Lower and upper consulate temperature. Immiscible liquids, steam distillation. Nernst distribution law: Thermodynamic derivation, applications.

UNIT – II

Electrochemistry-I

Electrical transport, conduction in metals and in electrolyte solutions. Specific conductance and equivalent conductivity, Measurement of equivalent conductance, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Theory of strong electrolytes, Transport number: Definition and determination by Hittorf method and moving boundary method.

Electrochemistry-II

Types of reversible electrodes: Gas-metal ion, metal-metal ion, metal- insoluble salt-anion and redox electrodes. Concentration cell with and without transport. Liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titration. Definition of pH and pK, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods.

Inorganic Chemistry

UNIT – III

Chemistry of Lanthanides Elements

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

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 later lanthanides.

Organic Chemistry

UNIT – IV

Aldehydes and ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids, physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, Aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villager oxidation of ketones, Cannizzaro reaction. Meer Wine-Pondrof -Verlay (MPV), Clemmensen, Wolf- Kischner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. An introduction of alpha, beta unsaturated aldehydes and ketones.

UNIT – V

Organic Compounds of Nitrogen

Preparation of nitro alkanes and nitroarenes. Chemical reaction of nitro alkanes. Mechanism of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media.

Halo nitroarenes

Reactivity, structure and nomenclature of amines, physical properties, stereochemistry of amines, separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Amine salt as phase transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-Phthalimide reaction, Hoffmann bromamide reaction. Reactions of amines. Electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid. Synthetic transformation of aryl diazonium salts, Azo coupling.

Practical Content — Credits: 2

Physical Chemistry

- To study the effect of solute (e.g., NaCl, succinic acid) on the critical solution temperature of two partially miscible liquid (e.g., phenol water system) and to determine the concentration of that soluble in phenol water system.
- To construct the phase diagram of two component (e.g., diphenyl amine benzophenone) by cooling curve method.
- To determine the enthalpy of neutralization of weak acid/weak base versus strong acid/ strong base and determine the enthalpy of ionization of the weak acid/ base.

Inorganic chemistry-

- Estimation of ferrous and ferric by dichromate method.
- Estimation of copper using thiosulphate.

Organic Chemistry

- Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Text Books

- Unified Chemistry by Tandon, Rathore &Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Electrochemistry by Philip N. Bartlett.
- Phase Equilibria in Chemical Engineering by Stanley M. Walas.

Reference Books

- Electrochemical Methods: Fundamentals and Applications by Allen J. Bard and Larry R. Faulkner.
- Principles of Phase Equilibria and Phase Diagrams by C. H. P. Lupis.
- Inorganic Chemistry by Catherine Housecraft and Alan G. Sharpe.
- Organic Synthesis by Michael B. Smith.
- Handbook of Lanthanide and Actinide Chemistry by Simon Cotton.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment tasks
1	Define and differentiate between phases, such as solid, liquid, and gas, and explain the fundamental principles governing phase transitions.	Provide foundational knowledge through lectures on topics like phase diagrams, phase transitions, Gibbs phase rule, chemical potential, and thermodynamic equilibrium.	Class test focusing and short questions.
2	The fundamental principles of electrochemistry, including the laws governing electrical transport, Faraday's laws, and the Nernst equation.	Conduct laboratory sessions where students perform electrochemical experiments, such as measuring cell potentials, conducting cyclic voltammetry, or investigating corrosion processes.	Class test focusing on definitions and short questions.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment tasks
3	The reactions specific to aldehydes and ketones, including nucleophilic addition reactions, reduction, oxidation, and formation of hemiacetals and acetals.	Conduct lectures to introduce key concepts related to aldehydes and ketones, including nomenclature, reactivity, and synthesis.	Class test focusing on and short and long questions.
4	Analyse and identify alkanes and nitroarenes. Synthetic transformation of aryl diazonium salts, Azo coupling.	Traditional lectures can introduce students to the fundamental concepts of alkanes and nitroarenes, including their structures, nomenclature, and basic properties.	Class test focusing on and long questions.
5	Identification and differentiate between lanthanide elements in the periodic table, recognizing their atomic numbers and electron configurations.	Encourage active participation through Q. and Ans sessions and open discussions on lanthanide properties and trends.	Class test focusing on definitions and short and long questions.

CORE COURSES - II

3STPC403: Physics-IV (Thermal Physics)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3STPC403	Physics-IV (Thermal Physics)	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- Explore properties and applications of these thermodynamic potentials.
- Classify and provide examples of first and second-order phase transitions.
- Understand the Clausius-Clapeyron equation and its application.
- Derive and apply Maxwell's thermodynamic relations.

Course Outcome

- Define and comprehend entropy and its significance.
- Understand Clausius Theorem and Inequality.
- Analyze entropy changes in reversible and irreversible processes with practical examples.
- Interpret Temperature-Entropy diagrams for Carnot's Cycle.
- Grasp the Third Law and the unattainability of absolute zero.

Syllabus Credit-(4-0-2)

UNIT-I Introduction to Thermodynamics Recapitulation of Zeroth and First law of thermodynamics,

Second Law of Thermodynamics: Reversible and Irreversible process with examples, Kelvin-Planck and Claudius Statements and their Equivalence, Carnot's Theorem, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

UNIT- II **Entropy**: Change in Entropy. Entropy of a State. Clausius Theorem. Clausius Inequality. Second Law of Thermodynamics in terms of Entropy. Entropy of a Perfect Gas. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Impossibility of Attainability of Absolute Zero: Third Law of Thermodynamics. Temperature-Entropy Diagrams. First and second order Phase Transitions.

UNIT-III **Thermodynamic Potentials**: Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials U, H, F and G: Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work. Cooling due to Adiabatic magnetization. Approach to Absolute Zero.

Maxwells Thermodynamic Relations: Derivations and applications of Maxwells Relations, Maxwells Relations: Clausius Clapeyron equation Relation between Cp and Cv TdS Equations, Joule-Kelvin coefficient for Ideal and Van der Waal Gases Energy equations, Change of Temperature during Adiabatic Process.

UNIT-IV **Kinetic Theory of Gases Distribution of Velocities**: - Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific Heats of Gases. Molecular Collisions: - Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

UNIT-V **Real gases**: Behavior of Real Gases: - Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. p-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.

Practicals **Credit-2**

1. To determine the frequency of A.C. Mains by using sonometer.
2. To determine the frequency of A.C. Mains by Melde's Experiment in transverse arrangement.
3. To verify Stefans law.
4. To verify Newtons law of cooling.
5. To verify Planks content.
6. To study of Thermocouple.

Text Books

1. Thermal Physics, A. B. Gupta (Books and allied Ltd)
2. Heat and Thermodynamics, M.W. Zemanski, Richard Dittman (McGraw- Hill).
3. Heat and Thermodynamics: An Intermediate Textbook By Mark Waldo Zemansky, Richard Dittman (McGraw-Hill, 1981).
4. Thermal Physics by Garg, Bansal and Ghosh (Tata McGra-Hill, 1993)

Reference Books

1. Theory and experiments on thermal Physics, P.K. Chakrabarty (New central book agency limited):
2. Thermal Physics" by Charles Kittel and Herbert Kroemer.
3. Statistical Mechanics: A Set of Lectures" by Richard P. Feynman
4. "An Introduction to Thermal Physics" by Daniel V. Schroeder:

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will grasp the concept of thermodynamic equilibrium and its application in determining whether two systems are at the same temperature.	Assign laboratory experiments where students measure temperature changes and observe how different materials reach thermal equilibrium. Have students collect data and analyse it to determine when equilibrium is achieved.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
2.	Students will be understanding the behaviour of thermodynamic systems and are crucial in the study of heat engines, refrigeration, and other thermodynamic processes. They have wide-ranging applications in various fields of science and engineering, including the design of efficient engines and refrigeration systems.	Use thought experiments to help students visualize and understand abstract concepts Assign group projects that require students to design and analyse thermodynamic systems or processes.	Quiz, project presentation and discussion
3.	These aim to equip students with a strong foundation in statistical mechanics and the behaviour of gases at the molecular level, which is essential for understanding various physical and chemical processes in thermodynamics and kinetic theory.	Teach students how to calculate critical constants (critical temperature, critical pressure, and critical volume) for various gases using experimental data or equations of state. Discuss real-world applications of critical constants, such as in the design of supercritical fluid extraction processes or the behaviour of gases at high pressures.	Quiz, project presentation and discussion
4.	Students should develop a deep understanding of how real gases deviate from the ideal gas equation and the factors that contribute to these deviations. Students should grasp the concept of continuity between the liquid and gaseous states and how it relates to phase transitions Students should know the critical constants for various gases and their significance in phase transitions.	Teach students how to calculate critical constants (critical temperature, critical pressure, and critical volume) for various gases using experimental data or equations of state. Assign group projects where students investigate specific substances, their phase diagrams,	Quiz, project presentation and discussion
5.	Students should develop a clear understanding of the concept of entropy, its significance in thermodynamics and how it relates to the behaviour of energy and matter. Students should be able to calculate and analyse the entropy of an ideal or perfect gas under different conditions and processes.	Present real-world case studies where students can apply the concepts of entropy and the second law to understand natural processes, heat engines, and refrigeration systems. Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

MAJOR CORE COURS-II

3SAMC403: Analytical Methods in Chemistry

(Credits: Theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SAMC403	Chemistry-IV Analytical Methods in Chemistry	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Learn sampling, data evaluation, and error analysis.
- Understand UV-Visible and Infrared Spectrometry basics.
- Grasp principles and techniques of atomic absorption and emission.
- Learn thermogravimetry theory and its application.
- Understand pH metric, potentiometric titrations, and chromatography principles.

Course Learning Outcomes

- Understand the fundamentals of analytical chemistry, including sampling and error analysis.
- Learn the principles and instrumentation of UV-Visible and Infrared Spectrometry.
- Grasp the techniques and applications of Flame Atomic Absorption and Emission Spectrometry.
- Master the theory and practice of thermogravimetry for quantitative analysis.
- Gain proficiency in electroanalytical methods such as pH metric and potentiometric titrations, as well as the basics of chromatography.

Syllabus **Credits :4-0-2**

UNIT-I

Qualitative and Quantitative Aspects of Analysis

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of them expression, normal law of distribution if indeterminate errors.

UNIT-II

Optical Methods of Analysis

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; sampling techniques.

UNIT-III

Flame Atomic Absorption and Emission Spectrometry

Basic principles of instrumentation (Choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction.)

UNIT-IV

Thermal Methods of Analysis

Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

UNIT-V

Electroanalytical Methods

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition and ion exchange. Development of chromatograms: frontal, elution and displacement methods.

Practical Content — Credits :2

- Spectrophotometric determination of Fe in water sample using standard addition method.
- Determination of complex Lon composition by job's method of continuous variation.
- Determination of Fe in copper metal by flame atomic absorption spectrometry (FAAS).
- Determination of trace metals (Fe, Cu, Cr and in environmental water samples by atomic absorption spectrometry (FAAS).
- Determination of cadmium(cd) in biological reference material using graphite furnace atomic absorption spectrometry (GFAAS).
- Determination of Cu and Zn in soil by ICP-OES.

Text Book

- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch.
- Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch.
- Instrumental Methods of Analysis by Hobart H. Willard, Lynne L. Merritt, John A. Dean, Jr., and Frederick A. Settle Jr.
- Quantitative Chemical Analysis by Daniel C. Harris.
- Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan.

Reference Books

- Modern Spectroscopy by J. Michael Hollas.
- Atomic Absorption Spectrometry by Bernhard Welz and Michael Sperling.
- Introduction to Thermal Analysis: Techniques and Applications by Michael E. Brown.
- Electrochemical Methods: Fundamentals and Applications by Allen J. Bard and Larry R. Faulkner.
- Chromatographic Methods by A. Braithwaite and F. J. Smith.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Collecting qualitative data through surveys or feedback forms from students can provide insights into their experiences with the course. Open-ended questions can help identify strengths	Qualitative content analysis involves examining course materials, assignments, and learning activities to ensure alignment with course objectives. It can also assess	Assignments on expressing accuracy and precision.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
	and weaknesses, as well as areas for improvement.	whether activities promote critical thinking, collaboration, and other desired skills.	
2	Spectroscopic methods like UV-visible spectroscopy or infrared spectroscopy can be employed to qualitatively analyse the chemical composition of substances. Students can learn how to interpret spectra to identify functional groups or chemical compounds.	Provide students with microscopes and prepared slides of various specimens or materials. Instruct them to observe and identify different structures or components using optical microscopy.	Assignments on Beer-Lambert's law, and a project on the validity of spectroscopic laws.
3	Explain the fundamental principles of atomic absorption and emission spectroscopy, including absorption and emission processes, energy levels, and the role of flames in atomization.	Guide students through the process of instrument calibration. Provide samples of known concentrations and instruct them on how to create calibration curves and determine unknown concentrations.	Class test focusing on definitions, short and long questions.
4	Explain the fundamental principles underlying thermal analysis techniques, including thermogravimetry, differential scanning calorimetry, and thermal conductivity measurements.	Conduct lectures to introduce and explain the theoretical principles and concepts of thermal analysis methods. Engage students in discussions to ensure they understand the underlying physics and chemistry.	Assignments on TG instrument components, and a practical exam on TG analysis.
5	Understand the fundamental principles of electrochemistry, including electrode reactions, redox reactions, and Faraday's laws.	Organize laboratory sessions where students perform electroanalytical experiments. These may include cyclic voltammetry, spectroscopy.	Lab reports on electroanalytical techniques.

MAJOR CORE COURSES –I

3SACC403: Mathematics-IV Advanced Calculus, Partial Differential Equations Complex Analysis and Abstract Algebra
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SACC403	Mathematics-IV Advanced Calculus, Partial Differential Equations Complex Analysis and Abstract Algebra)	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- The goal of this course is for students to gain proficiency in computations of advanced calculus.
- To make the student acquire sound knowledge of techniques in solving partial differential equations.
- To familiarize the student with complex analysis.
- To acquaint the student with Abstract Algebra.

Course Outcomes

- Understanding the ideas of advanced calculus and series and an ability to calculate with them and apply them.
- Understanding of the ideas of partial differential equations and facility in solving standard examples.
- Understanding of the ideas of complex analysis and ability to calculate with them.
- Improved facility in abstract algebra.

Syllabus Credit (4-0-2)

UNIT – I Partial differentiation. Change of variables. Euler's Theorem on homogeneous function, Taylor's theorem for functions of two variables. Jacobians, Envelopes, Evolutes.

UNIT – II Maxima, minima and saddle points of functions of two variables. Beta and Gamma functions. Double and triple integrals. Dirichlet's integrals.

UNIT – III Partial Differential equations of the first order. Lagrange's solution. Some special types of equations which can be solved easily by methods other than general methods. Char pit's general method of solution, Partial differential equations of second and higher orders. Homogeneous and non- Homogeneous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficients.

UNIT – IV Complex numbers as ordered pairs. Geometric representation of Complex numbers, Continuity and differentiability of Complex functions. Analytical function, Cauchy Riemann equation, Harmonic function, Mobius transformations, fixed point, cross ratio.

UNIT – V Group-Automorphisms, inner automorphism. Group of Automorphism, Conjugacy relation and centralizer. Normalizers. Counting principle and the class equation of a finite group. Cauchy's theorem for finite abelian groups and non-abelian groups. Ring homomorphism. Ideals and Quotient Rings.

Practical Credit-2

1. Limit continuity and derivatives of functions of complex variables.
2. Stereographic projection, Analytic function, finding harmonic conjugate.
3. Contour Integral, Cauchy Integral formula Mobins Transformations.

Reference Books

1. Advanced Calculus, Partial Differential Equations Complex Analysis and Abstract Algebra by Dr. H.K. Pathak
2. Advanced Calculus" by Lynn H. Loomis and Shlomo Sternberg
3. Advanced Calculus" by Patrick M. Fitzpatrick
4. A Course in Advanced Calculus" by Robert S. Borden and Jerry B. Weinstein

Text Books

1. Partial Differential Equations: An Introduction" by Walter A. Strauss
2. A First Course in Abstract Algebra" by John B. Fraleigh

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	After studying partial differentiation, students should be able to compute partial derivatives of multivariable functions, understand the geometric interpretation of partial derivatives, and apply them to various scientific and engineering problems.	Attending lectures, workshops, or online courses. Participating in group discussions and study groups. Solving practice problems and exercises. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
2.	After studying this topic, students should be able to identify critical points, classify them as maxima, minima, or saddle points using the second derivative test, and apply these concepts to optimization problems.	. Reading textbooks, Attending lectures, workshops, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
3.	After studying first-order PDEs, students should be able to classify and solve them using various methods, including Lagrange's solution. Students should be proficient in classifying, solving, and understanding PDEs of second and higher orders, both homogeneous and non-homogeneous, with constant coefficients.	Reading textbooks. Attending lectures, workshops, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
4.	After studying complex numbers as ordered pairs, students should be able to represent complex numbers in Cartesian and polar forms and perform arithmetic operations with them. Students should be able to define and identify analytic (holomorphic) functions, understand their properties, and apply them in complex analysis.	Reading textbooks. Attending lectures, workshops, Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
5.	After studying group auto morphisms and inner auto morphisms, students should understand the concepts and be able to identify and work with auto morphisms in a group.	Reading textbooks. Attending lectures, workshops, Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions

MAJOR CORE COURSES –II

3SPSC403: Mathematics-IV (Probability and Statistics)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPSC403	Probability and Statistics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

The objective of the course is to expertise the student to the extensive role of statistics in everyday life and computation, which has made this course a core course in all branches of mathematical and engineering sciences.

Course Outcome

The students shall learn probability and statistics for various random variables, multivariate distributions, correlations and relations. He shall learn law of large numbers and shall be able to do basic numerical calculations.

Syllabus — Credit (4-0-2)

UNIT-I Probability: Introduction, Sample spaces, Events, probability of events, rules of probability, conditional Probability independent events, Boyes's theorem, Probability distributions and probability densities.

UNIT-II Probability distributions, continuous random variables, probability density functions, Multivariate distributions, joint distribution function, joint probability density function, marginal distributions, conditional distributions, conditional density,

UNIT-III Mathematical Expectation: Introduction, expected value of random variable, moments, Chebyshev's theorem, moment generating functions, product moments, moments of linear combinations of random variables, conditional expectations, the theory in practice, measures of location, dispersion

UNIT-VI Special probability distributions: Discrete Uniform distribution, binomial distribution, Negative binomial, geometric, hypergeometric, poison, multinomial distribution, multinomial. Special probability densities; Uniform distribution, gamma, exponential, gamma, chi-square, beta distribution, normal, normal approximation to binomial, bivariate normal, Functions of random variables, distribution function technique, transformation technique-one variable, several variables, moment generating function technique,

UNIT-V Sampling distributions: population distribution, random sample, sampling distribution of mean, Central Limit theorem, Sampling distribution of the mean: finite populations, chi-square, t, F distributions, regression and correlation: Bivariate regression, regression equation, Linear regression, method of least squares.

Practical — Credit-2

1. Chi-Square Test: Compare the chi-square statistic to the chi-square distribution with the calculated degrees of freedom to find the p-value.

2. Use the Central Limit Theorem to explain how the distribution of the sample mean daily spending will behave as the sample size increases.

Reference Books

1. A First Course in Probability" by Sheldon Ross
2. Statistical Inference" by George Casella and Roger L. Berger
3. Mathematical Statistics and Data Analysis" by John A. Rice:
4. Statistical Inference" by George Casella and Roger L. Berger
5. Irwin Miller and Marilee's Miller, John E. Freund's Mathematical Statistics with Application (8thEdition), Pearson, Asia, 2001.

Text Books

1. Probability and Statistics for Engineering and the Sciences" by Jay L. Devore
2. Probability and Statistics" by Morris H. DeGroot and Mark J. Schervish
3. Probability and Statistical Inference" by Robert V. Hogg and Elliot Tanis

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	After studying probability basics, students should understand the concepts of sample spaces, events, and how to calculate probabilities.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Session
2.	Students will understand the concept of probability distributions and their applications in modelling random phenomena. They will analyse continuous random variables, recognizing their characteristics and behaviour.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Session
3.	After studying mathematical expectation, students should understand the concept of expected value and its importance in probability theory.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Session
4.	After studying these special probability distributions, students should be able to understand their characteristics, apply them to real-world problems, and calculate probabilities associated with them.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Session
5.	After studying population distributions and random sampling, students should be able to understand the characteristics of populations and the process of obtaining random samples	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Session

MINOR CORE COURSES

3SGWM404: Physics-IV (Group Waves, Acoustic and Optics)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SGWM404	Group Waves, Acoustic and Optics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- To aware the students about various phenomena of Waves, Acoustics and Optics.
- Describe the phenomena like Interference, Diffraction.

Course Outcomes

- Understand the Physics behind various optical phenomena.
- Understand various natural phenomena which is happening in their surroundings.
- Explain the relationship in between various optical phenomena.

Syllabus — Credit (4-0-2)

UNIT – I Waves: Waves in Media Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, gravity waves and ripples. Group velocity and phase velocity, their measurements. Superposition of waves: Linear homogeneous equations and the superposition principle.

UNIT – II Acoustics Noise and Music, The human ear and its responses, limits of human audibility, intensity and loudness, bel and decibel, the musical scales, temperament and musical instrument. Reflection, refraction and diffraction of sound; Acoustic impedance of a medium, percentage reflection and refraction at a boundary, impedance matching for transducers, diffraction of sound, principle of a sonar system, sound ranging. Applied acoustics: Transducers and their characteristics. Recording and reproduction of sound, various systems, measurements of frequency, waveform, intensity and velocity.

UNIT – III Geometrical Optics Fermat's Principle of extremum path, the aplanatic points of a sphere and other applications. General theory of image formation: cardinal points of an optical system, general relationships for thick lens and lens combinations, Optical instruments: Entrance and exit pupils, need for a multiple lens eyepiece, common types of eyepieces.

UNIT – IV Interference of light; The principle of superposition, Two slit interference, coherence requirement for the sources, Thin films, Interference by a film with two non-parallel reflecting surfaces, Newton's rings. Haidinger fringes (Fringes of equal inclination). Michelson interferometer, its application for precision determination of wavelength, Intensity distribution in multiple beam interference, Fabry-Perot interferometer and etalon.

UNIT – V Fresnel Diffraction Fresnel half period zones, plates, straight edge, rectilinear propagation. Fraunhoffer Diffraction: Diffraction at a slit, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, Rayleigh criterion resolving power of telescope and

microscope. Diffraction and Polarization: Diffraction gratings: Diffraction at N parallel slits, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating. Double refraction and optical rotation: Refraction in uniaxial crystals. Phase retardation plates.

Practical Credit-2

1. To determine the frequency of A.C. Mains by using sonometer.
2. To determine the frequency of A.C. Mains by Melde's Experiment in transverse arrangement.
3. To Study and analysis of human ear (on the basis of physical concepts).
4. To determine the wavelength of sodium light by Newton's rings method.
5. To determine the wavelength of prominent lines of mercury light by plane diffraction grating.
6. To determine the refractive index of the material of the prism using spectrometer.
7. To determine the resolving power of the Telescope.
8. To determine the resolving power of the Prism.
9. To determine the resolving power of the Diffraction Grating.

Text Books

1. 1.Wave motion and Optics, Dr. Mangala Gowri M, Himalaya P.
2. 2.A Textbook of Oscillations, Waves and Asoustics, Dr. M. Ghosh, Dr. D. Bhattacharya, S. Chand.
3. Wave, Oscillations and Asoustics for B. Sc. and BTech students, SL Kakani, C Hemrajani, CBS Publishers.

Reference Books

1. Oscillations, Wave and Asoustics, P.K. Mittal.
2. Fundamental of Wave, Oscillations and Asoustics, K.U. INGARD.
3. Oscillations and Wave, Second Edition, RICHARD FITZPATRICK.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students should have a comprehensive understanding of wave behaviour, their propagation in different media, and their practical applications in various industries and scientific disciplines. They should also be able to apply mathematical and physical principles to analyse and solve problems related to waves and wave phenomena.	Conduct traditional lectures to introduce theoretical concepts related to waves. Use visual aids, animations, and demonstrations to illustrate wave phenomena and properties	Quiz, project presentation and discussion
2.	Students should have a strong foundation in acoustics, noise, music, and related topics, enabling them to apply their knowledge in fields such as audio engineering, architectural acoustics, and musical instrument design, and to understand the principles behind human perception of sound and its practical applications.	. Enhance lectures with multimedia presentations, audiovisual materials. Organize live acoustic demonstrations to illustrate concepts such as sound reflection, refraction, diffraction, and resonance.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
3.	Students understand Fermat's Principle and its application in optics, which states that light follows the path of least time when traveling between two points. Learn about aplanatic points, where spherical aberrations are minimized, and explore other practical applications of this concept in optical systems.	Present practical examples where Fermat's Principle is applied, such as in the design of optical lenses, mirrors, and fiber optics. Discuss how optimizing the path of light can lead to improved optical systems.	Quiz, project presentation and discussion
4.	Students should have a comprehensive understanding of interference of light, be able to apply the principles to solve complex problems, and appreciate the wide range of applications of interference in various fields of science and technology.	Explore the historical development of interference theory, highlighting key figures and experiments. Organize field trips to research labs, optical manufacturing facilities, or observatories where students can see interference principles applied in real-world settings.	Quiz, project presentation and discussion
5.	Understand the factors that determine the resolving power of optical instruments. Learn how to calculate the resolving power of a diffraction grating and appreciate its significance in spectral analysis.	Conduct lectures that explain the concept of resolving power, its importance in optical instruments, and the factors that affect it, such as wavelength of light and aperture size. Engage students in discussions to ensure they grasp the theoretical foundations.	Quiz, project presentation and discussion

MINOR CORE COURS

3SPIM404: Chemistry-IV (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPIM404	Chemistry-IV (Physical Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understand phase compositions and eutectic systems.
- Grasp ideal and non-ideal liquid behavior.
- Learn electrical transport and concentration cells.
- Understand electronic structure and chemistry.
- Learn about aldehydes, ketones, and nitrogen compounds.

Course Learning Outcomes

- Identify phases and understand eutectic systems.
- Comprehend ideal and non-ideal behavior.
- Understand conductivity and concentration cells.
- Recognize electronic structures and chemistry.
- Learn synthesis and reactions of functional groups.

Syllabus Credits 4-0-2

Physical Chemistry

UNIT – I

Phase Equilibrium

Statement and the meaning of the terms: Phase component and the degree of freedom, derivation of the Gibbs phase rule. Simple eutectic System: Bi-Cd, Pb-Ag system. Desiliverisation of lead. One component system: Water, CO_2 and S system. Two component system: Solid liquid equilibria.

Solid Solutions

Systems in which compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H_2O) and ($CuSO_4$-H_2O) system. Freezing mixtures: Acetone-dry ice.

UNIT – II

Electrochemistry

Electrical transport, conduction in metals and in electrolyte solutions. Specific conductance and equivalent conductivity, measurement of equivalent conductance, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Theory of strong electrolytes. Transport number: Definition and determination by Hittorf method and moving boundary method.

Inorganic Chemistry

UNIT – III

Chemistry of Lanthanides Elements

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

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 later lanthanides.

Organic Chemistry

UNIT – IV

Aldehydes and ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids, physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, Aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villager oxidation of ketones, Cannizzaro reaction.

UNIT – V

Organic Compounds of Nitrogen

Preparation of nitro alkanes and nitroarenes. Chemical reaction of nitro alkanes. Mechanism of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media.

Halo nitroarenes

Reactivity, structure and nomenclature of amines, physical properties, stereochemistry of amines, separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Amine salt as phase transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-Phthalimide reaction, Hoffmann bromamide reaction.

Practical Content — Credits: 2

Physical Chemistry

- To study the effect of solute (e.g., NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g., phenol water system) and to determine the concentration of that soluble in phenol water system.
- To construct the phase diagram of two components (e.g., diphenyl amine benzophenone) by cooling curve method.
- To determine the enthalpy of neutralization of weak acid/weak base versus strong acid/ strong base and determine the enthalpy of ionization of the weak acid/ base.

Inorganic chemistry

- Estimation of ferrous and ferric by dichromate method.
- Estimation of copper using thiosulphate.

Organic Chemistry

- Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Text Books

- Unified Chemistry by Tandon, Rathore & Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Electrochemistry by Philip N. Bartlett.
- Phase Equilibria in Chemical Engineering by Stanley M. Walas.

Reference Books

- Electrochemical Methods: Fundamentals and Applications by Allen J. Bard and Larry R. Faulkner.
- Principles of Phase Equilibria and Phase Diagrams by C. H. P. Lupis.
- Inorganic Chemistry by Catherine Housecraft and Alan G. Sharpe.
- Organic Synthesis by Michael B. Smith.
- Handbook of Lanthanide and Actinide Chemistry by Simon Cotton.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Define and differentiate between phases, such as solid, liquid, and gas, and explain the fundamental principles governing phase transitions.	Provide foundational knowledge through lectures on topics like phase diagrams, phase transitions, Gibbs phase rule, chemical potential, and thermodynamic equilibrium.	Class test focusing on short questions.
2	The fundamental principles of electrochemistry, including the laws governing electrical transport, Faraday's laws, and the Nernst equation.	Conduct laboratory sessions where students perform electrochemical experiments, such as measuring cell potentials, conducting cyclic voltammetry, or investigating corrosion processes.	Class test focusing on definitions and short questions.
3	Analyse and identify alkanes and nitroarenes. Synthetic transformation of aryl diazonium salts, Azo coupling.	Traditional lectures can introduce students to the fundamental concepts of alkanes and nitroarenes, including their structures, nomenclature, and basic properties.	Class test focusing on long questions.
4	Identification and differentiate between lanthanide elements in the periodic table, recognizing their atomic numbers and electron configurations.	Encourage active participation through Qand A sessions and open discussions on lanthanide properties and trends.	Class test focusing on definitions and short and long questions.
5	The reactions specific to aldehydes and ketones, including nucleophilic addition reactions, reduction, oxidation, and formation of hemiacetals and acetals.	Conduct lectures to introduce key concepts related to aldehydes and ketones, including nomenclature, reactivity, and synthesis.	Class test focusing on and short and long questions.

ABILITY ENHANCEMENT COURSE (AEC)

3HCHA401: Cultural Heritage

(Credit: Theory -2 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HCHA401	Cultural Heritage	2(2-0-0)	60	20	20	-	-	100	2 hr	-

Course Objective

- The primary objective of this course is to explore the significance, evolution, and preservation of culture and heritage across different societies and time periods.
- Students will gain a deeper understanding of how culture and heritage shape identities, influence societies, and contribute to a sense of belonging.

Course Outcomes

- Upon completion of this course, students will have a comprehensive understanding of culture and heritage, their significance in society, and the various challenges and methods associated with their preservation.
- They will develop critical thinking skills to evaluate cultural issues and contribute to the sustainable management of cultural heritage.

Syllabus: **Duration 30 hrs (Credit – 2)**

Unit 1: Introduction to Culture and Heritage

- Definition of culture and heritage
- Importance of studying culture and heritage
- Overview of key concepts and terms (e.g., cultural diversity, cultural identity, intangible cultural heritage)

Unit 2: Cultural Expressions and Artifacts

- Exploration of various forms of cultural expressions (e.g., music, dance, visual arts, literature, traditional crafts)
- Analysis of the role of cultural expressions in preserving and transmitting heritage
- Case studies of significant cultural artifacts and their historical and cultural significance

Unit 3: UNESCO World Heritage Sites

- Introduction to UNESCO and its World Heritage program
- Study of selected UNESCO World Heritage Sites from different regions
- Analysis of the criteria for selection and the challenges faced in preserving and protecting these sites

Unit 4: Cultural Identity and Cultural Heritage

- Examination of the relationship between cultural identity and cultural heritage
- Discussion on the ways in which cultural heritage shapes individual and collective identities
- Impact of globalization and cultural assimilation on cultural identity and heritage preservation

Unit 5: UNESCO World Heritage Sites

- Introduction to UNESCO and its World Heritage program
- Study of selected UNESCO World Heritage Sites from different regions
- Analysis of the criteria for selection and the challenges faced in preserving and protecting these sites

Reference Books

- Bhartiya Kala avm Sanskriti - Nitin Singhania- ISBN -13:978-9354601842
- Bharti Sanskriti Kala avm virast – devdat patnayak –- ISBN. -13:978-935440095
- Madhukar Kumar Bhagat –II Adition, ISBN-13:9789389310382
- Bhartiya Kala avm Sanskriti awam virasat – ISBN-13:978-9388182577 Minakshi Kant
- Vishy vikhyat bhartiya kala or sanskriti virasat – ISBN- 9789381395462, Rama shyal

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course Learning Objectives	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
Unit 1: Introduction to Culture and Heritage	● Define culture and heritage. ● Explain the importance of studying culture and heritage. ● Familiarize students with key concepts and terms related to culture and heritage (e.g., cultural diversity, cultural identity, intangible cultural heritage).	● Students will be able to define culture and heritage. ● Students will understand the significance of studying culture and heritage. ● Students will demonstrate knowledge of key concepts related to culture and heritage.	● Lectures and discussions on the definition and importance of culture and heritage. ● Reading assignments and case studies to explore key concepts. ● Group discussions and presentations on cultural diversity and identity.	● Class participation and engagement in discussions. ● Written assignments or quizzes on key concepts. ● Group presentations on cultural diversity and identity.
Unit 2: Cultural Expressions and Artifacts	● Explore various forms of cultural expressions such as music, dance, visual arts, literature, and literature, and traditional crafts. Analyze the role of cultural expressions in preserving and transmitting heritage	● Students will be able to identify different forms of cultural expressions. ● Students will understand the importance of cultural expressions in heritage preservation. Students will analyze the historical and cultural significance of selected artifacts.	● Practical sessions or workshops on various cultural expressions (e.g., music and dance workshops, art exhibitions). ● Case study analysis and group discussions on the role of cultural expressions in heritage preservation. ● Research assignments on selected cultural artifacts and their significance.	● Presentation or demonstration of a chosen cultural expression. ● Written analysis of the role of cultural expressions in heritage preservation. ● Research paper or presentation on a selected cultural artifact and its significance

Unit no.	Course Learning Objectives	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
Unit 3: UNESCO World Heritage Sites	● Introduce students to UNESCO and its World Heritage program. ● Study selected UNESCO World Heritage Sites from different regions. ● Analyze the criteria for selection and the challenges faced in preserving and protecting these sites.	● Students will understand the role of UNESCO in preserving cultural and natural heritage. ● Students will gain knowledge of specific UNESCO World Heritage Sites and their cultural importance ● Students will analyze the criteria used for selecting World Heritage Sites and the preservation challenges they face.	● Lectures and presentations on UNESCO and the World Heritage program. ● Virtual or physical tours of selected UNESCO World Heritage Sites. ● Discussions on the criteria for World Heritage Site selection and the preservation challenges they pose.	● Research project or presentation on a specific UNESCO World Heritage Site. ● Essay or report on the criteria for selecting World Heritage Sites and the challenges they face in preservation
Unit 4 Cultural Identity and Cultural Heritage	● Examination of the relationship between cultural identity and cultural heritage Discussion on the ways in which cultural heritage shapes individual and collective identities Impact of globalization and cultural assimilation on cultural identity and heritage preservation	● Students will be able to: Analyze the relationship between cultural identity and cultural heritage Evaluate the impact of cultural heritage on individual and collective identities Assess the impact of globalization and cultural assimilation on cultural identity and heritage preservation	● Lectures and presentations on cultural identity and cultural heritage Group discussions and debates on the impact of cultural heritage on individual and collective identities Case studies on the impact of globalization and cultural assimilation on cultural identity and heritage preservation	● Written assignments on the analysis of the relationship between cultural identity and cultural heritage Oral presentations on the impact of cultural heritage on individual and collective identities Case study analysis on the impact of globalization and cultural assimilation on cultural identity and heritage preservation
Unit 5 Cultural Identity and Cultural Heritage	● Introduction to UNESCO and its World Heritage program Study of selected UNESCO World Heritage Sites from different regions Analysis of the criteria for selection and the challenges faced in preserving and protecting these sites	● Students will be able to: Understand the importance of UNESCO World Heritage sites Analyze the criteria for selection of World Heritage sites Evaluate the challenges faced in preserving and protecting World Heritage sites	● Lectures and presentations on UNESCO and World Heritage sites Group discussions and debates on the criteria for selection and challenges faced in preserving and protecting World Heritage sites Field trips to selected World Heritage sites	● Written assignments on the analysis of the criteria for selection and challenges faced in preserving and protecting World Heritage sites Oral presentations on the importance of UNESCO World Heritage sites Group projects on the preservation and protection of World Heritage site.

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

V Semester

MAJOR CORE COURSES - I

3SRAC503: Mathematics -V (Real Analysis linear Analysis. Algebra and Discrete Mathematics)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SRAC503	Real Analysis Linear Analysis. Algebra and Discrete Mathematics)	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- The goal of this course is for students to gain proficiency in computation of real analysis.
- To make the student acquire sound knowledge of linear algebra.
- To familiarize the student with discrete mathematics.

Course Outcomes

- Understanding the ideas of real analysis and series and an ability to calculate with them.
- Understanding of the ideas of linear algebra and facility in solving standard examples.
- Understanding of the ideas of discrete mathematics. and facility in solving standard examples.

Syllabus (Credit 4-0-2)

UNIT - I Riemann integral, Internality of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorems of integral calculus, Partial derivatives and differentiability of real-valued functions of two variables.

UNIT – II Schwarz and Young's theorem, Implicit function theorem, Fourier series of half and full intervals, Improper integrals and their convergence, Comparison test, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter.

UNIT – III Definition and examples of vector spaces, subspaces, Sum and direct sum of subspaces. Linear span, Linear dependence, independence and their basic properties. Basis, Finite dimensional vector spaces, Existence theorem for basis, Invariance of the number of elements of a basis set, Dimension, Dimension of sums of vector subspaces.

UNIT - IV Linear transformations and their representation as matrices, The Algebra of linear transformations, The rank- nullity theorem, Eigen values and eigen vectors of a linear transformation, Diagonalization. Quotient space and its dimension.

UNIT – V Binary Relations, Equivalence Relations, Partitions and Partial Order Relation. Graphs, Multigraphs, Weighted Graphs, Paths and Circuits, Shortest Paths. Trees and their properties.

Practical Credit-2

1. Trees, Cayley Formula
2. Hamiltonian Graphs,
3. Miscellaneous Problems,
4. Miscellaneous theory questions.

Reference Books

1. Real and Complex Analysis" by Walter Rudin
2. Real Analysis, Linear Algebra and Discrete Mathematics by Dr.H.K. Pathak
3. Introduction to Linear Algebra" by Gilbert Strang
4. "Abstract Algebra" by David S. Dummit and Richard M. Foote

Text Books

1. Real Mathematical Analysis" by Charles C. Pugh
2. Linear Algebra Done Right" by Sheldon Axler

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	After studying the Riemann integral, students should understand the concept of integration, how to compute integrals, and the properties of integrable functions.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
2.	After studying Schwarz and Young's theorem, students should understand its statement, implications, and how it can be applied in various mathematical contexts.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
3.	Understand the properties and axioms that define vector spaces. Identify subspaces and determine whether they are subspaces of a given vector space. Calculate linear spans and determine linear dependence or independence of sets of vectors.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
4.	After studying linear transformations, students should understand how to represent them as matrices, recognize their properties, and apply them to solve problems.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
5.	After studying binary relations, students should understand the concept of relations between sets, represent them using matrices and digraphs, and apply them in various mathematical contexts.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions

MAJOR CORE COURSES-II

3SRTC503: Mathematics -V (Ring Theory and Linear Algebra)

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SRTC503	Ring Theory and Linear Algebra)	4(4-0-0)	60	20	20	-	-	100	3hr	-

Course objectives

- Courses aim to enhance your ability to analyze and solve mathematical problems, both in theoretical and real-world contexts.
- Courses focus on ensuring you understand fundamental mathematical concepts, theorems, and formulas.
- They provide a strong foundation in mathematical principles, which is important for further studies in advanced math and other related disciplines.
- Math courses help develop your critical thinking skills by encouraging you to think logically and apply mathematical reasoning to different situations.

Course Outcome

a) Describe the fundamental concepts in ring theory such as of the ideals, quotient rings, integral domains, and fields.
b) Demonstrate the concepts of vector spaces, subspaces, bases, dimension and them
c) Properties with examples. Identify matrices with linear transformations.
d) Compute eigenvalues and eigenvectors of linear transformations.

Syllabus Credit (4-0-0)

UNIT- I Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms.

UNIT – II Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials

UNIT - III Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

UNIT – IV Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits,

UNIT – V Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-War shall algorithm.

Reference Books

1. Ring Theory and Linear Algebra by Dr.H.K.Pathak
2. Real and Complex Analysis" by Walter Rudin
3. "Introduction to Linear Algebra" by Gilbert Strang
4. "Linear Algebra" by Serge Lang

Text Books

1. 1 Ring Theory and Linear Algebra II by Ravindra Kumar Dr. Shiv Kumar Verma
2. "Linear Algebra and Its Applications" by David C. Lay

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students should develop a clear understanding of ordered sets, including their definition, properties, and examples from various mathematical contexts. Students will be able to identify complete lattices and understand their role in providing suprema and infima for arbitrary subsets.	Begin with lectures that provide clear definitions and examples of ordered sets, emphasizing their order relations and basic properties. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Students should have a clear understanding of what modular and distributive lattices are, including their definitions, properties, and differences. Students will learn about Boolean polynomials, their representation, operations, and how they are used to express logical statements and functions.	Begin with lectures that provide clear definitions of modular and distributive lattices, Boolean algebras, Boolean polynomials, and minimal forms. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Students should be able to understand and apply the Quinn-McCluskey method to simplify Boolean expressions and minimize logic circuits. Students will understand the practical applications of switching circuits in digital systems, including logic gates, multiplexers, and flip-flops.	Begin with lectures that introduce the Quinn-McCluskey method, Karnaugh diagrams, and switching circuits. Provide step-by-step examples to illustrate the processes. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
4.	Students should have a clear understanding of the basic definition of graphs, including vertices and edges, and recognize different types of graphs. Students will learn about paths and circuits within graphs and recognize their significance in graph theory.	Start with lectures that introduce the fundamental definitions of graphs, pseudographs, complete graphs, bipartite graphs, and isomorphism. Emphasize the basic properties of these structures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
5.	Students should understand the concepts of Eulerian circuits and Hamiltonian cycles, recognizing the conditions under which these cycles exist in graphs. Students should understand the Floyd-	Start with lectures that introduce the fundamental definitions and concepts related to Eulerian circuits, Hamiltonian cycles, adjacency matrices,	Class Discussions and Analysis, Group Projects,

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	War shall algorithm, which finds the shortest paths between all pairs of vertices in a weighted graph.	weighted graphs, TSP, and shortest path problems. Teaching will done through lectures and discussion mode.	Problem-Solving Sessions

MAJOR CORE COURSES-III

3SMCC503: Mathematics -V Multivariable calculus

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMCC503	Multivariable calculus	4(4-0-0)	20	20	10	-	-	100	3hr	-

Course Objective

1. The objective of this course to introduce functions of several variable to a student after he has taken a course in one variable calculus.
2. The course will introduce partial derivatives and several of its consequences and will introduce double and triple integrals along with line integrals which are fundamental to all streams where calculus can be used.

Course Outcomes

1. After reading this course a student will be able to calculate partial derivatives, directional derivatives, extremum values and can calculate double, triple and line integrals.
2. Ideas of basic vector calculus including green's theorem, divergence theorem. and stokes theorem.
3. He can take courses in calculus on manifolds, Differential geometry and can help in numerical computations involving several variables.

Syllabus Credit (4-0-0)

UNIT-I Functions of several variables, limit and continuity of functions of two variables. Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

UNIT-II Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems. Definition of vector field, divergence and curl, Double integration over rectangular region, double integration over nonrectangular region. Double integrals in polar co-ordinates,

UNIT-III Three-dimensional coordinate systems Vectors in space Vector operations (addition, scalar multiplication, dot product, cross product) Lines and planes in space.

UNIT-IV Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stokes' theorem, The Divergence theorem.

UNIT-V Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co- ordinates. Change of variables in double integrals and triple integrals.

Reference Books

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.

2. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE). Indian reprint, 2005.
3. James Stewart, Multivariable Calculus, Concepts and Contexts,2nd Ed., Brooks/Cole, Thomson Learning, USA, 2001.
4. S Ghorpade, B V Limaye, Multivariable calculus, Springer international edition

Text Books

1. . M. J, Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. S C Mallik and S Arora: Mathematical Analysis, New Age International Publications

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students should have a solid understanding of functions of two or more variables and how they differ from single-variable functions. Students should be able to find tangent planes to surfaces defined by functions of two variables.	Begin with lectures that introduce the definitions and concepts related to functions of several variables, limits, continuity, and partial differentiation. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
2.	Students should be able to find local and global extrema of functions of two variables. Understand the role of critical points in optimization. Learn how to express double integrals in polar coordinates. Apply polar coordinates to solve problems involving circular and radial symmetry.	Start with lectures that introduce the definitions and concepts related to extrema of functions, Lagrange multipliers, vector fields, divergence, curl, and double integration. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
3.	Understand Spatial Representation: Students should be able to visualize and work comfortably in a three-dimensional coordinate system. Definition and Representation: Define vectors and represent them geometrically and algebraically.	Reading textbooks. Attending lectures, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
4.	Students should understand the concept of line integrals and how to compute them along curves. Recognize the importance of line integrals in various applications. Understand the Divergence theorem and its relationship between surface integrals and volume integrals. Apply the Divergence theorem to calculate flux through closed surfaces and volume integrals.	Reading textbooks. Attending lectures, Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
5	Students should understand the concept of triple integrals and their application in calculating volume and mass.	Reading textbooks.	Class Discussions and Analysis. Group

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	Learn how to set up and evaluate triple integrals. Learn the change of variables technique in both double and triple integrals	Attending lectures, Teaching will be done through lectures and discussion mode.	Projects, Problem-Solving Sessions

MAJOR CORE COURSES - I

3SQMC503: Physics -V (Quantum, Mechanics, Atomic Molecular and Nuclear Physics)
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SQMC503	Quantum Mechanics, Atomic Molecular and Nuclear Physics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- To introduce student to the Quantum Mechanics and application to physical sciences.
- To express the basic postulates of Quantum Mechanics and Atomic Physics.

Course Outcomes

- Explain the nature of Quantum Mechanics
- Develop the practical knowledge about quantum, atomic and molecular Physics.
- Describe theories explaining the structure of atoms and the origin of the observed spectra

Syllabus Credit (4-0-2)

UNIT - I Origin of Quantum Theory: photoelectric effect, Ritz combination principle in spectra. stability of an atom, Planck's radiation law, Einstein's explanation of photoelectric effect. Quantum Mechanics Wave-particle duality and uncertainty principle; De Broglie's hypothesis for matter wave. The concept of wave and group velocities, Evidence for diffraction and interference of particles, Experimental demonstrations of matter waves. Consequence of de Broglie's concepts, Postulates of quantum mechanics.

UNIT - II Quantization in hydrogen atom; Energies of a particle in a box, wave packets, Heisenberg's uncertainty relation for p and x, its extension to energy and time. Consequence of the uncertainty relation; Gamma ray microscope, Diffraction at a slit, Particle in a box, Position of an electron in a Bohr's orbit, Operators, Expectation values Schrödinger's equation. Application of Schrodinger equation: Free particle, Particle in one-dimensional box, Rectangular potential barrier, Tunnel effect, Applications of tunnel effect in barrier penetration; One dimensional Harmonic Oscillator and concept of zero-point energy.

UNIT - III Atomic Physics natural occurrence of quantum numbers-n, l and m, the related physical quantities. Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure. Screening constants for alkali spectra for s,p,d and f states, Selection rules, Singlet and triplet fine structure in alkaline earth spectra. L-S and J-J couplings. Weak Spectra: Continuous X-ray spectrum and its dependence on voltage, Duane and Hundt's law. Characteristic X-rays. Moseley's law; Doublet structure of X-ray spectra. X-ray absorption spectra.

UNIT – IV Molecular Spectra Quantization of vibrational and rotational energies, Pure, rotational and vibration spectra Dissociation limit for the ground and other electronic states, Transition rules for pure vibration and electronic vibration spectra. Spectroscopy: Raman Effect, Stokes and anti-stokes lines, experimental arrangements for Raman Spectroscopy. Spectroscopic techniques: Sources of excitation, Prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, Double beam instruments, Different recording systems

UNIT - V Nuclear Physics Working of nuclear detectors, G-M counter, proportional counter, Scintillation counter, Cloud chamber, Spark chamber and Emulsions technique. Structure of nuclei, basic properties (I, μ, Q and binding energy), energy, p-p and n-p scattering and general concepts of nuclear forces. Beta decay, range of alpha particle, Geiger- Nuttal law. Gamow's explanation of alpha decay, beta decay, nuclear reactions, compound nucleus,). Shell model, Liquid drop model, nuclear fission and fusion (concepts), energy production in stars by p-p and carbon - nitrogen cycles (concepts).

Practical **Credit 2**

1. Determination of plank's constant
2. Determination of e by Millikan's method
3. Absorption spectrum of iodine vapour.
4. Study of half wave and full wave rectification
5. Study of Raman Spectrum using laser as an excitation source

Text Books

1. Atomic and Nuclear Physics, Rd. Subrahmanyam, Brij Lal, S. Chand.
2. Quantum Physics, Second Edition, H.C. Verma.
3. Quantum Mechanics Atomic and Molecular Physics, Vimal Saraswat.
4. Quantum Mechanics: Foundations and Applications by Arno Bohm. --3rd ed.— (New York: Springer-Verlag, 2003)

Reference Books

1. Element of Quantum Mechanics, Kamal Singh, S.P. Singh, S. Chand.
2. Quantum Mechanics, Concepts and Application, Noureddine Zettili, WILEY.
3. Introduction to Quantum Mechanics, Third Edition, David Griffiths, Darrellf. Schroet.
4. 3. J.L. Powell & B. Crasemann, Quantum Mechanics, (Addison-Wesley Pubs.Co.,1965).
5. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India, 2004).

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	These unit topics are foundational in modern physics and have revolutionized our understanding of the universe at both the macroscopic and microscopic scales. They continue to be essential components of physics education and research.	Introduce students to simple quantum mechanics Present case studies on the historical development of quantum theory, highlighting the contributions of scientists like Max Planck, Niels Bohr, and Albert Einstein.	Quiz, project presentation and discussion
2.	Understand the fundamental principles of wave-particle duality and the uncertainty principle. Explain the concept of matter waves and de Broglie's hypothesis	Use animations or visualization tools to illustrate the concept of matter waves.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	Introduce the idea of wave packets, which describe the localization of particles in space and time as a result of the superposition of multiple matter waves.		
3.	These topics explain how quantum numbers arise naturally from the Schrödinger equation and their significance in describing electron states in atoms. These topics provide a fundamental understanding of atomic behaviour and spectroscopic techniques	Provide students with spectra of hydrogen, deuteron, and alkali atoms. Provide practice problems involving selection rules for atomic transitions. Provide students with X-ray absorption spectra data for various elements	Quiz, project presentation and discussion
4.	These unit aim to equip students with a strong foundation in molecular spectroscopy Explain the Raman effect, including the concepts of Stokes and anti-Stokes lines, molecular vibrations.	Provide examples of different spectrographic instruments. Conduct a Raman spectroscopy demonstration in the lab. Show students how Raman scattering occurs, how to identify Stokes and anti-Stokes lines.	Quiz, project presentation and discussion
5.	These topics understand the operation and principles of various nuclear detectors. Describe the structure of atomic nuclei and their basic properties. Analyse the behaviour of particles in nuclear scattering experiments. Explain the process of nuclear decay, including alpha decay, beta decay, and gam	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

MAJOR CORE COURSES-III

3SAPC503: Physics--V Astro Physics and Atmospheric Science

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total		
			End Sem	Mid Sem	Assign	End Sem	Term Sem		Theory	Practical
3SAPC503	Astro Physics and Atmospheric Science)	4(2-0-2)	20	20	10	60	40	200	3hr	2hr

Course Objective

- To gain knowledge of modern techniques, theory and observation results in astrophysics and cosmology.
- Introduce the physics of planetary atmospheres with special emphasis on the atmosphere of the earth.

Course Outcomes

- To understand binary stars as well as our solar system and the
- To understand processes occurring in the Milky Way and other galaxies.
- To describe the basic structure of an atmosphere and the climate system.
- The concept of potential temperature and how it relates to static stability.
- Know the components of the earth radiation balance and understand optical depth and transmission function.

Syllabus Credit (2-0-2)

UNIT – I Our Universe Introduction, Constituents of the universe, Atmosphere, Planets, Stars, Solar energy, Asteroids, Meteors or Meteoroids, Comets, Pole Star, Galaxies.

UNIT – II Solar System and Stars Celestial mechanics, Elliptical orbits, Kepler's laws, Earth - Moon system, Tidal forces, Terrestrial Planets, Solar activity, Helioseismology, Binary stars, White dwarfs, Neutron stars, Formation of proto stars, Degenerate remnants of stars, Chandrasekhar Limit, pulsars.

UNIT – III Physical Meteorology and Radar Meteorology Atmosphere; atmospheric composition; Law of thermodynamics of the atmosphere; Adiabatic process; Law of black body radiation; solar and terrestrial radiation; albedo; Greenhouse effect; heat balance of earth-atmosphere system. Basic meteorology-radar principles; use of weather radar in aviation.

UNIT – IV Dynamic Meteorology and Monsoon Dynamics Fundamental forces; Structure of static atmosphere; Momentum; Thermodynamics of dry atmosphere; Voracity; Potential vorticity. Wind; Temperature and pressure distribution over India in the lower, Middle, and upper atmosphere during pre/ post/and mid-monsoon season. Energy cycle of monsoon; dynamics of monsoon; Depressions and easterly waves.

UNIT – V Atmospheric Pollution and Instrumentation System Role of meteorology on atmospheric pollution; Atmospheric boundary layer; Air stability; Wind structure; Ekman spiral; turbulence boundary layer scaling. Residence time and reaction rates of pollutants; Sulphur compounds; nitrogen compounds; Organic

compounds; Aerosol; Radioactive particles. Ground based instruments for the measurement of temperature, Pressure, Humidity, Wind and rainfall rate.

Practical Credit 2

1. To determine the value of specific charge e/m of an electron by Thomson's Method.
2. To study and verify the Inverse Square Law by using photo cell.
3. To study and analysis, the properties of photo cell.
4. To study of colour thin film of given Sample.
5. To study and analysis of long form of the periodic table
6. To study of the time dilation by the concept of twin paradox.

Text Books

1. A Textbook of Astronomy and Astrophysics, Mohit Kumar Sharma, Suresh Chandra, WILEY.
2. Astrophysics and Space Science, Dr. Sham S Atmospheric Science nigh.
3. Basic of Atmospheric Science, A. Chandrasekar.
4. Atmospheric Science, An Introductory Survey, JOHNM. WALLACE.

Reference Books

1. Atmospheric Science an Introduction, ELA DEAN.
2. Principles of Atmospheric Science, JOHN E. FREDERICK.
3. Astronomy, Astrophysics and Planetary Science, CAMBRIDGE UNIVERSITY.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	These unit identify and describe the major constituents of the universe, including matter and classify the planets in our solar system. Describe the Sun's structure and its energy generation through nuclear fusion.	Use multimedia presentations to introduce students to the vastness of the universe, its constituents, and historical developments in astronomy. Explore various galaxy.	Quiz, project presentation and discussion
2.	These topics understand the principles of celestial mechanics. Apply Kepler's laws to describe the motion of celestial bodies within the solar system. Discuss Subrahmanyan	Discuss Chandrasekhar's groundbreaking work on the structure and evolution of star. lectures that provide a historical overview of celestial mechanics	Quiz, project presentation and discussion
3.	Explain the fundamental laws of thermodynamics as they apply to the atmosphere. Explain the principles of radar operation and its use in meteorology. Describe the major components of Earth's atmosphere and their variations	Assign readings from textbooks and research articles to supplement lectures. students give presentations on radar, class discussions on topics such as climate change and the role of radar technology in monitoring	Quiz, project presentation and discussion
4.	Students understand the complex interactions between meteorological conditions and pollution.	Organize field trips to observe and measure atmospheric conditions near the Earth's surface.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	Learn to use instrumentation to collect meteorological data for pollution monitoring and prediction. Gain insights into air quality modelling and environmental impact assessments. Develop skills in analysing and interpreting atmospheric data for pollution control and mitigation.	Assign research projects where students investigate pollution events and their meteorological causes.	
5.	These unit explain how meteorological factors such as temperature, humidity, wind, and atmospheric stability influence the dispersion, concentration, and chemical reactions of pollutants.	Conduct lectures on each course topic, supported by readings from textbooks.	Quiz, project presentation and discussion

MAJOR CORE COURSES - III

3SMPC503: Physics-V Mathematical Physics

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMPC503	Mathematical Physics	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- The emphasis of course is on applications in solving problems of interest to physicists.
- The students are to be examined entirely on the basis of problems, seen and unseen.

Course Outcome

- Understanding the scientific method, hypothesis testing, and the iterative nature of scientific inquiry.
- Enhancing skills in presenting scientific ideas and results effectively, both orally and in writing.
- Recognizing how physics connects with other scientific disciplines and real-world applications.
- Understanding the ethical implications of research and applications in physics.

Syllabus **Credit 2-0-2**

UNIT-I Plotting of functions, Intuitive ideas of continuous, Differentiable functions and plotting of curves, Approximation: Taylor and binomial series (statements only), First Order Differential Equations and Integrating Factor, Second Order Differential equations: Homogeneous Equations with constant coefficients, Wronskian and general solution, Statement of existence and Uniqueness, Particular Integral.

UNIT-II Calculus of functions of more than one variable: Partial derivatives, Exact and Inexact differentials. Integrating factor, with simple illustration, Constrained Maximization using Lagrange Multipliers,

Vector algebra: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar tripleproductandtheirinterpretationintermsofareaandvolumerespectively, Scalar and Vector fields.

UNIT-III Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems, Comparison of velocity and accelerate ion in cylindrical and spherical coordinate system Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular Function, Properties of Dirac delta function.

UNIT-IV Vector Differentiation: Directional derivatives and normal derivative, Gradient of as Clearfield and its geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities

UNIT-V Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Practical

1. Write a program that take Matrices and perform their Algebraic operations.
2. Solve first order ODE using built-in function.
3. Solve Second ODE using built-in function
4. Write the program to solve linear equation using Gauss Elimination Method.
5. Write the program to solve linear equation using Jacobi method.
6. Solve a partial differential equation like Heat Equation and wave equation.
7. Write the program to solve linear equation using Gauss-Seidel method
8. Write the program to solve wave equation for vibrational mode of stretched string.
9. Write the program to solve Laplace's equation

Text Books

1. Mathematical Physics C. Harper (Prentice Hall India)
2. Mathematical Physics–H.K. Dass, Dr. Rama Verma (S. Chand Publishing)

Reference books

1. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition, Mc- Graw Hill Education)
2. Complex variables and applications, J. W. Brown and R.V. Churchill.
3. Mathematical Physics, Satya Prakash (Sultan Chand).
4. Mathematical Physics, B. D. Gupta (4th edition, Vikas Publication).
5. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and Bikash (Srikrishna Prakashan).

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Develop the ability to plot various types of functions accurately and interpret graphical representations of mathematical functions. Visualize and understand the behaviour of functions through graphical representations.	Plotting functions and analysing their behaviour to enhance understanding of continuous and differentiable functions.	Quiz, project presentation and discussion
2.	Calculate partial derivatives of multivariable functions with respect to each variable and understand their geometric interpretations. Solve practical problems involving constrained maximization using Lagrange multipliers	. Providing step-by-step illustrations and examples of integrating factor applications.	Quiz, project presentation and discussion
3.	Develop a deep understanding of orthogonal curvilinear coordinate systems, including Cartesian, spherical, and cylindrical coordinate systems. Learn how to perform coordinate transformations between these coordinate systems	Provide lectures and discussions to introduce and derive equations for gradient Conduct exercises and problem-solving sessions to practice coordinate transformations between different coordinate systems.	Quiz, project presentation and discussion
4.	These unit understand of directional derivatives, including their geometric interpretation and how they measure the rate	Provide lectures and discussions to introduce and derive equations for directional	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	of change of a scalar field in a specific direction	derivatives, gradient, divergence, curl, del, Laplacian, and vector identities.	
5.	Understand the concept of normal derivatives and their application in boundary value problems and the study of surfaces.	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

MAJOR CORE COURSE-I

3SPOC503: Chemistry-V (Physical, Organic and Inorganic Chemistry)

(Credits: Theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPIC503	Chemistry-V (Physical Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understand spectroscopy's principles and applications.
- Learn about carbohydrates, fats, oils, detergents, and synthetic dyes.
- Explore the role of essential elements in biological processes.
- Grasp the concepts of hard and soft acids and bases.

Course Learning Outcomes

- Interpret various spectra to determine molecular structures.
- Differentiate and analyze carbohydrates.
- Apply lipid chemistry knowledge to understand industrial applications.
- Evaluate the biological significance of metal ions.
- Apply HSAB concept to predict reactivity.

Syllabus

Credits 4-0-2

Physical Chemistry

UNIT- I

Spectroscopy: An Introduction

Introduction, electromagnetic radiation, regions of electromagnetic spectrum, basic features of different spectrometers, Born-Oppenheimer approximation, degrees of freedom.

Spectroscopy: Rotational spectrum

Introduction; Rotational spectrum of diatomic molecules. energy levels of a rigid rotator (Semi Classical Principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann Distribution), determination of bond length, qualitative description of non-rigid rotator, isotope effect.

Organic Chemistry

UNIT – II

Carbohydrates

Introduction, classification of carbohydrates; Monosaccharides- general properties, mutual transformations (interconversion), stereoisomerism and configuration of monosaccharides; Threo and erythro diasterioisomers, epimerization, determination of ring size in monosaccharides. Glucose- physical and chemical properties, uses, tests and constitution. Fructose-

properties, uses, test; Structure of ribose and deoxyribose. Disaccharides: Glycoside linkage, reducing and non-reducing sugars. Maltose-properties, uses and structure. Sucrose preparation, properties, uses, tests. Polysaccharides: Starch- manufacture, properties, uses and structure. Cellulose-preparation, properties, industrial applications of cellulose, structure, Exercises.

UNIT – III

Fats, Oils and Detergents

Introduction; Edible and industrial oil of vegetable origin, glycerides occurrence and extraction, properties. Hydrogenation of unsaturated oils, analysis of oils and fats: Soaps manufacture of soap. Kinds of soluble soap, cleansing action of soap: Synthetic detergents, additive of detergents, comparison between soap and synthetic detergents, Alkyl and aryl sulphonates, cleansing action of alkyl-aryl benzene sulphonates.

Inorganic Chemistry

UNIT – IV

Bioinorganic Chemistry

Introduction, Essential and trace elements in biological processes, biological function of the bio elements, availability of bio-metals and bio-son-metals; Metalloporphyrin's Hemoglobin, structure of hemoglobin, biological functions of hemoglobin in animals; Myoglobin, mechanism of oxygen transfer through hemoglobin and myoglobin, relation between chlorophyll and hemoglobin, chemical reactions of hemoglobin and myoglobin, biological role of alkali and alkaline earth metal ion, biochemistry of potassium and sodium. Biochemistry of magnesium and calcium; Nitrogen fixation, mechanism of nitrogenase, iron-Sulphur protein and nitrogen fixation, Exercises.

UNIT – V

Hard and Soft Acids and Bases (HSAB)

Introduction, Lewis's concept of acids and bases, classification of Lewis acids and bases, utility and limitations, classification of hard and soft acid-base-soft acid, hard acids, soft base, and hard base; Hard-soft acid-base concept of Pearson, applications of hard and soft acid-base theory. Symbiosis; Acid-base strength and hardness and softness; Theoretical basis of hardness and softness: Electronic theory, pi-bonding theory, Drago-Wayland theory, Electronegativity and hardness and softness, limitation of hard and soft acid-base concept; Exercises.

Practical Content — Credits 2

Physical Chemistry

- Effluent Analysis: Identification of cations and anions in different water samples.
- Water Analysis: To determine the amount of dissolved oxygen in water samples in ppm units.

Organic Chemistry

Preparation:

- Acetylation
- Benzoylation
- meta-Dinitrobenzene
- Picric acid

Inorganic Chemistry

- Analysis of inorganic mixture containing five radicals with at least one interfering radical (phosphate, borate, oxalate or fluoride).

Text Book

- Spectroscopy: An Introduction by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James A. Vyvyan.
- Organic Chemistry by Robert T. Morrison and Robert N. Boyd.
- Fats and Oils by Clyde E. Stauffer.

- Bioinorganic Chemistry by Rosette M. Roat-Malone.
- Hard and Soft Acids and Bases (HSAB) by Ralph G. Pearson.

Reference Book

- Introduction to Spectroscopy by Donald L. Pavia.
- Advanced Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Fats and Oils Handbook by Michael Bockisch.
- Bioinorganic Chemistry: A Short Course by Rosette M. Roat-Malone.
- Theoretical Principles of Inorganic Chemistry by James E. House.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	The fundamental principles underlying spectroscopic techniques, including the interaction of electromagnetic radiation with matter and the concept of energy levels.	Teach students how to prepare samples for spectroscopic analysis, including proper techniques for dilution, dissolution, or extraction.	Assignments on the electromagnetic spectrum.
2	The principles of metal ion coordination chemistry, including coordination number, ligands, and bonding modes.	Teach students how to analyse metal concentrations in biological samples using techniques like atomic absorption spectroscopy or inductively coupled plasma mass spectrometry.	Presentation on carbohydrate uses and tests.
3	The basic structure of an atom, including the nucleus, electrons, protons, and neutrons, and how they contribute to the overall properties of elements.	Introduce students to different types of matter (solids, liquids, gases) and have them observe and classify common objects and substances in their environment. Use simple sorting activities to help students differentiate between various materials based on properties like colour, texture, and state.	Class test focusing on long questions.
4	Classify carbohydrates into various categories, including monosaccharides, disaccharides, and polysaccharides, and differentiate between aldoses and ketoses.	Begin with informative lectures that introduce the basic concepts of carbohydrates, their classification, and their importance in chemistry and biology.	assignments on metalloporphyrin structure and function
5	The hard and soft acid-base theory, including the concept of hard and soft acids and bases and their interactions.	Provide students with a set of chemical species and ask them to classify each as hard or soft acids and bases based on HSAB principles. Discuss their reasoning and findings as a class.	Class test focusing on long questions.

MAJOR CORE COURSE-II

3SRMC503: Chemistry-V (Research Methodology for Chemistry)

(Credits: Theory-2, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SRMC503	Chemistry-V (Research Methodology for chemistry)	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

The objective of this paper is to formulate the research problems and connect the research outcomes to the society. Student should be able to assess the local resources and opportunities in public domains. It further helps in gaining the knowledge of safety and ethical handlings of chemicals in lab and households.

Course Learning Outcomes

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

- Learn how to identify research problems.
- Evaluate local resources and need for addressing the research problem
- Find out local solution.
- Know how to communicate the research findings.

Syllabus Credits: 2-0-2

UNIT-I

Literature Survey

Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, Chem. Industry, Wiki- Databases, Chem. Spider, Science Direct, Scopus.

Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information. Open-source Lead lectures. Open-source chemistry designing sources, Essentials of Problem formulation and communication with society.

UNIT-II

Methods of Scientific Research and Writing Scientific Papers

Reporting practical and project work. Idea about public funding agencies of research, Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific

contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism. Assessment of locally available resources.

UNIT-III

Chemical Safety and Ethical Handling of Chemicals

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric level. Safe storage and disposal of waste chemicals. Recovery, recycling and reuse of laboratory chemicals. Procedure for laboratory disposal of explosives. Identification, verification and segregation of laboratory waste. Disposal of chemicals in the sanitary sewer system. Incineration and transportation of hazardous chemicals.

UNIT-IV

Data Analysis

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.

Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.

Biostatistics: brief introduction and data handling

UNIT-V

Electronics

Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers for electrochemical instruments. Elementary aspects of digital electronics.

Practical Credits :2

- Ethical handlings of chemicals in the lab and households.
- Methods of Scientific Research and Writing Scientific Papers: Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display.
- Chemical Safety and Ethical Handling of Chemicals: Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation.
- Data Analysis the Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.

Reference Books

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. and Jones, A. (2011) Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
- Hibbert, D. B. and Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
- Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.
- Harris, D. C. Quantitative chemical analysis. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, how to use Excel in analytical chemistry and in general scientific data analysis. Cambridge Univ. Press (2001) 487 pages.
- Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.

Text Book

- Research Methodology in Chemical Sciences: Experimental and Theoretical Approaches by Tanmoy Chakraborty and Shounak Roy.
- Chemical Research: A Practical Guide for Undergraduates by Robert J. Ouellette and J. David Rawn.
- Research Methodology in Chemistry and Chemical Engineering by H. Panda.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1.	The distinctions between primary, secondary, and tertiary sources of information in the context of scientific research.	Theory class on Navigate and utilize digital resources including e-journals, databases, search engines, and academic websites.	Compile a comprehensive report summarizing the findings, including references from various sources such as databases, and textbooks.
2.	Importance of ethical considerations in scientific writing and avoid plagiarism.	Teaching will be done through lectures and discussion mode. Demonstrate the ability to justify the scientific contributions of their work and follow appropriate publication styles.	Write a scientific paper on a laboratory experiment or research project.
3.	Laboratory ventilation and storage requirements for hazardous substances. Apply procedures for working with gases at varying pressures and dispose of waste chemicals properly.	Implement safe working procedures and maintain a protective environment in a laboratory setting.	Class test focusing short and questions.
4.	Recognize the importance of data analysis in drawing meaningful conclusions from experiments.	Teaching will do through lectures and discussion mode. Make accurate measurements and record data effectively.	Analyse a set of experimental data using appropriate statistical methods.
5.	Identify and analyse typical circuits involving operational amplifiers used in electrochemical instruments.	Teaching will do through lectures and discussion mode. Apply electronic principles to enhance their understanding of scientific instrumentation	Document the circuit design, components used, and testing procedures.

MAJOR CORE COURSE-III

3SGCC503: Chemistry-V (Green Chemistry)

(Credits: Theory-2, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SGCC503	Chemistry-V Green Chemis-try	4(2-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

With the environmental concern and shrinking resources acquiring enormous proportions, it has become imperative to devise safer alternative materials and technology that would ensure the human sustenance. This course intends to take the students through the newer, environment friendly products and procedures and incite them to take a more holistic view of different chemical processes.

Course Learning Outcomes

- Explain the field of green chemistry.
- Acquire knowledge of the 12 principles of green chemistry.
- Develop an understanding of cleaner production and green synthesis methods.
- Acquire the knowledge catalysis, and microwave theory.
- Appreciate the Principle of Photochemical.

Syllabus Credits 2-0-2

Unit I

Definition and concepts: green chemistry; sustainable consumption of resources; individual and community level participation such as small-scale composting pits for biodegradable waste.

Unit II

Principles of Green Chemistry and Designing a Chemical synthesis. Twelve principles of Green Chemistry with their explanations and examples; 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).

Unit III

The Cleaner Production Concept, Difference with End of Pipe Concept, Cleaner Production and Sustainable Development, Implementation of Cleaner Production, Change of Raw Material, Technology Change, Good Operating Practice, Product Change, On Site Reuse and Recycling, Who Is Responsible For Cleaner Production, Government Rules, Green Synthesis of Nano Particles.

Unit IV

Green Chemical Strategies for Sustainable Development Areas of green chemistry, Reaction mass Balance-Atom Economy, Evaluation for Chemical Reaction Efficiency, Green Solvents/ reaction Media, Catalysis and Bio catalysis. Microwave oven as a reactor, Theory of Microwave Heating.

Unit V

Photochemical Degradation: An Eco-friendly Approach of Waste Treatment Photochemical Principles, Heterogeneous Photo-catalysis, Homogeneous Photo-degradation, photo oxidation, Direct Photo-degradation, Gas phase Detoxification, Equipments and applications.

Practical Credits 2

- Preparation of biodiesel from vegetable oil.
- Use of enzymes as catalysts Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide Alternative Green solvents
- Diels Alder reaction in water Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.
- Extraction of D-limonene from orange peel using liquid CO2 prepared form drive.
- Mechanochemical solvent free synthesis of azomethines
- Co-crystal controlled solid state synthesis (C2S3) of N-organ phthalimide using phthalic anhydride and 3-amino-benzoic acid. Alternative sources of energy
- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photo reduction of benzophenone to benzo pinacol in the presence of sunlight.

Reference Books

- Anastas, P. T., Warner, J. Green Chemistry: Theory and Practice; Oxford University Press: London, 1998.
- Mukesh Doble, Anil Kumar Kruthiventi, in Green Chemistry and Engineering, 2007
- V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
- P.T. Anastes & J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (1998).
- A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).

Text Book

- Green Chemistry: Theory and Practice by Paul T. Anastas and John C. Warner.
- Introduction to Green Chemistry by Albert Matlack.
- Green Chemistry: An Introductory Text by Mike Lancaster.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand the foundational concepts of green chemistry, sustainable resource consumption, and the importance of individual and community participation.	Lectures introducing the concepts of green chemistry and sustainable resource consumption.	Quizzes or short answer questions to assess understanding of key concepts.
2	Demonstrate knowledge of the twelve principles of green chemistry and their application in designing environmentally friendly chemical synthesis.	In-depth lectures on each principle of green chemistry, with real-world examples.	Design projects or case studies where students apply green chemistry principles to develop environmentally friendly synthesis pathways.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
3	Understand the concepts of cleaner production, its relationship with sustainable development, and implementation strategies.	Interactive discussions on the differences between cleaner production and end-of-pipe approaches.	Research projects or presentations exploring cleaner production implementation in specific industries or contexts.
4	Gain knowledge of green chemical strategies and their role in sustainable development.	Hands-on laboratory experiments or simulations demonstrating green chemistry principles.	Written assignments or presentations on the role of green chemistry in specific sustainability challenges.
5	Understand the principles and applications of photochemical degradation in eco-friendly waste treatment	Lectures on photochemical degradation principles and various approaches to waste treatment.	Class test focusing on and long questions.

MINOR CORE COURSES

3SRAM504: Mathematics-V (Real Analysis, Linear Algebra and Discrete Mathematics)

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SRAM504	Real Analysis, Linear Algebra and Discrete Mathematics	4(4-0-0)	60	20	20	-	-	100	3hr	-

Course Objectives

- The goal of this course is for students to gain proficiency in computation of real analysis.
- To make the student acquire sound knowledge of linear algebra.
- To familiarize the student with discrete mathematics.

Course Outcomes

- Understanding the ideas of real analysis and series and an ability to calculate with them.
- Understanding of the ideas of linear algebra and facility in solving standard examples.
- Understanding of the ideas of discrete mathematics. and facility in solving standard examples.

Syllabus

Credit (4-0-0)

UNIT - I Riemann integral, Internality of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorems of integral calculus, Partial derivatives and differentiability of real-valued functions of two variables.

UNIT – II Schwarz and Young's theorem, Implicit function theorem, Fourier series of half and full intervals, Improper integrals and their convergence, Comparison test, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter.

UNIT – III Definition and examples of vector spaces, subspaces, Sum and direct sum of subspaces. Linear span, Linear dependence, independence and their basic properties. Basis, Finite dimensional vector spaces, Existence theorem for basis, Invariance of the number of elements of a basis set, Dimension, Dimension of sums of vector subspaces.

UNIT - IV Linear transformations and their representation as matrices, The Algebra of linear transformations, The rank- nullity theorem, Eigen values and eigen vectors of a linear transformation, Diagonalization. Quotient space and its dimension.

UNIT – V Binary Relations, Equivalence Relations, Partitions and Partial Order Relation. Graphs, Multigraphs, Weighted Graphs, Paths and Circuits, Shortest Paths. Trees and their properties.

Reference Books

1. Ring Theory and Linear Algebra by Dr. H.K. Pathak

2. Real and Complex Analysis" by Walter Rudin
3. "Introduction to Linear Algebra" by Gilbert Strang
4. "Linear Algebra" by Serge Lang

Text Books

1. Ring Theory and Linear Algebra II by Ravindra Kumar Dr. Shiv Kumar Verma
2. "Linear Algebra and Its Applications" by David C. Lay

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	After studying the Riemann integral, students should understand the concept of integration, how to compute integrals, and the properties of integrable functions.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
2.	After studying Schwarz and Young's theorem, students should understand its statement, implications, and how it can be applied in various mathematical contexts.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
3.	Understand the properties and axioms that define vector spaces. Identify subspaces and determine whether they are subspaces of a given vector space. Calculate linear spans and determine linear dependence or independence of sets of vectors.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
4.	After studying linear transformations, students should understand how to represent them as matrices, recognize their properties, and apply them to solve problems.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions
5.	After studying binary relations, students should understand the concept of relations between sets, represent them using matrices and digraphs, and apply them in various mathematical contexts.	Reading textbooks. Attending lectures. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis. Group Projects, Problem-Solving Sessions

MINOR CORE COURSES

3SQMM504: Physics—V (Quantum Mechanics, Atomic Molecular and Nuclear Physics)
(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SQMM504	Quantum Mechanics, Atomic Molecular and Nuclear Physics	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Explain the quantized energy levels in the hydrogen atom.
- To express the basic postulates of Quantum Mechanics and Atomic Physics.
- The concept that particles, such as electrons, can exhibit both wave-like and particle-like behavior.

Course Outcomes

- Students should comprehend the experimental observations and significance of the photoelectric effect, recognizing its role in challenging classical physics.
- Application of quantum concepts to the hydrogen atom, leading to an understanding of quantized energy levels.
- Describe theories explaining the structure of atoms and the origin of the observed spectra.

Syllabus — Credit (2-0-2)

UNIT - I Origin of Quantum Theory: photoelectric effect, Ritz combination principle in spectra. Stability of an atom, Planck's radiation law, Einstein's explanation of photoelectric effect.

UNIT - II Quantum Mechanics Wave-particle duality and uncertainty principle; de Broglie's hypothesis for matter waves; The concept of wave and group velocities, Evidence for diffraction and interference of particles, Experimental demonstrations of matter waves. Consequence of De Broglie's concepts; quantization in hydrogen atom; Energies of a particle in a box, wave packets, Heisenberg's uncertainty relation for p and x, its extension to energy and time.

UNIT - III Atomic Physics natural occurrence of quantum numbers-n, l and m, the related physical quantities. Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure. screening constants for alkali spectra for s,p,d and f states, selection rules, Singlet and triplet fine structure in alkaline earth spectra. L-S and J-J couplings. Weak Spectra: Continuous X-ray spectrum and its dependence on voltage, Duane and Hundt's law. Characteristic X-rays. Moseley's law.

UNIT – IV Molecular Spectra Quantization of vibrational and rotational energies, pure, rotational and vibration spectra. Spectroscopy: Raman Effect, Stokes and anti-stokes lines, experimental arrangements for Raman Spectroscopy. Spectroscopic techniques: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy.

UNIT - V Nuclear Physics Working of nuclear detectors, G-M counter, proportional counter, scintillation counter, cloud chamber, Spark chamber and Emulsions technique. Structure of nuclei, Basic properties (I, μ, Q and binding energy), Beta decay, Range of alpha particle, Geiger- Nuttal law. Gamow's explanation of alpha decay, Beta decay, Nuclear reactions, compound nucleus,). Shell model, Liquid drop model,

nuclear fission and fusion (concepts), Energy production in stars by p-p and carbon - nitrogen cycles (concepts).

Practical Credit 2

1. Determination of plank's constant.
2. Determination of e/m using Thomson's method.
3. Determination of e by Millikan's method.
4. Absorption spectrum of iodine vapor.
5. Study of half wave and full wave rectification.
6. Study of Raman Spectrum using laser as an excitation source.

Text Books

1. Atomic and Nuclear Physics, Dr.N. Subrahmanyam, Brij Lal, S. Chand.
2. Quantum Physics, Second Edition, H.C. Verma.
3. Quantum Mechanics Atomic and Molecular Physics, Vimal Saraswat.

Reference Books

1. Element of Quantum Mechanics, Kamal Singh, S.P. Singh, S. Chand.
2. Quantum Mechanics, Concepts and Application, Noureddine Zettili, WILEY
3. Introduction to Quantum Mechanics, Third Edition, DAVID GRIFFITHS, DARRELLF.S

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	These unit topics are foundational in modern physics and have revolutionized our understanding of the universe at both the macroscopic and microscopic scales. They continue to be essential components of physics education and research.	Introduce students to simple quantum mechanics Present case studies on the historical development of quantum theory, highlighting the contributions of scientists like Max Planck, Niels Bohr, and Albert Einstein.	Quiz, project presentation and discussion
2.	Understand the fundamental principles of wave-particle duality and the uncertainty principle. Explain the concept of matter waves and de Broglie's hypothesis Introduce the idea of wave packets, which describe the localization of particles in space and time as a result of the superposition of multiple matter waves.	Use animations or visualization tools to illustrate the concept of matter waves.	Quiz, project presentation and discussion
3.	These topics explain how quantum numbers arise naturally from the Schrödinger equation and their significance in describing electron states in atoms. These topics provide a fundamental understanding of atomic behaviour and spectroscopic techniques	Provide students with spectra of hydrogen, deuteron, and alkali atoms. Provide practice problems involving selection rules for atomic transitions. Provide students with X-ray absorption spectra data for various elements	Quiz, project presentation and discussion
4.	These unit aim to equip students with a strong foundation in molecular spectroscopy Explain the Raman effect, including the concepts of Stokes and anti-Stokes lines, molecular vibrations.	Provide examples of different spectrographic instruments. Conduct a Raman spectroscopy demonstration in the lab. Show students how Raman scattering occurs, how to identify Stokes and anti-Stokes lines.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
5.	These topics understand the operation and principles of various nuclear detectors. Describe the structure of atomic nuclei and their basic properties. Analyse the behaviour of particles in nuclear scattering experiments. Explain the process of nuclear decay, including alpha decay, beta decay, and gam	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

MINOR CORE COURSES

3SPOM504: Chemistry-V (Physical Organic and Inorganic Chemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPOM504	Chemistry-V (Physical Organic and Inorganic Chemistry)	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- Understand spectroscopy's principles and applications.
- Learn about carbohydrates, fats, oils, detergents, and synthetic dyes.
- Explore the role of essential elements in biological processes.
- Grasp the concepts of hard and soft acids and bases.

Course Learning Outcomes

- Interpret various spectra to determine molecular structures.
- Differentiate and analyze carbohydrates.
- Apply lipid chemistry knowledge to understand industrial applications.
- Evaluate the biological significance of metal ions.
- Apply HSAB concept to predict reactivity.

Syllabus Credits 4-0-2

Physical Chemistry

UNIT- I

Spectroscopy: An Introduction

Introduction, electromagnetic radiation, regions of electromagnetic spectrum, basic features of different spectrometers, Born-Oppenheimer approximation, degrees of freedom.

Spectroscopy: Rotational spectrum

Introduction; Rotational spectrum of diatomic molecules. energy levels of a rigid rotator (Semi Classical Principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann Distribution), determination of bond length, qualitative description of non-rigid rotator, isotope effect.

Organic Chemistry

UNIT – II

Carbohydrates

Introduction, classification of carbohydrates; Monosaccharides- general properties, mutual transformations (interconversion), stereoisomerism and configuration of monosaccharides; Threo and erythro diasterioisomers, epimerization, determination of ring size in monosaccharides. Glucose- physical and chemical properties, uses, tests and constitution. Fructose-properties, uses, test; Structure of ribose and deoxyribose. Disaccharides: Glycoside linkage, reducing and non-reducing sugars. Maltose-properties, uses and structure. Sucrose preparation, properties, uses, tests. Polysaccharides: Starch-

manufacture, properties, uses and structure. Cellulose-preparation, properties, industrial applications of cellulose, structure, Exercises.

UNIT – III

Fats, Oils and Detergents

Introduction; Edible and industrial oil of vegetable origin, glycerides occurrence and extraction, properties. Hydrogenation of unsaturated oils, analysis of oils and fats: Soaps manufacture of soap. Kinds of soluble soap, cleansing action of soap: Synthetic detergents, additive of detergents, comparison between soap and synthetic detergents, Alkyl and aryl sulphonates, cleansing action of alkyl-aryl benzene sulphonates.

Inorganic Chemistry

UNIT – IV

Bioinorganic Chemistry

Introduction, Essential and trace elements in biological processes, biological function of the bio elements, availability of bio-metals and bio-son-metals; Metalloporphyrin's Hemoglobin, structure of hemoglobin, biological functions of hemoglobin in animals; Myoglobin, mechanism of oxygen transfer through hemoglobin and myoglobin, relation between chlorophyll and hemoglobin, chemical reactions of hemoglobin and myoglobin, biological role of alkali and alkaline earth metal ion, biochemistry of potassium and sodium. Biochemistry of magnesium and calcium; Nitrogen fixation, mechanism of nitrogenase, iron-Sulphur protein and nitrogen fixation, Exercises.

UNIT – V

Hard and Soft Acids and Bases (HSAB)

Introduction, Lewis's concept of acids and bases, classification of Lewis acids and bases, utility and limitations, classification of hard and soft acid-base-soft acid, hard acids, soft base, and hard base; Hard-soft acid-base concept of Pearson, applications of hard and soft acid-base theory. Symbiosis; Acid-base strength and hardness and softness; Theoretical basis of hardness and softness: Electronic theory, pi-bonding theory, Drago-Wayland theory, Electronegativity and hardness and softness, limitation of hard and soft acid-base concept; Exercises.

Practical Content — Credits 2

Physical Chemistry

- Effluent Analysis: Identification of cations and anions in different water samples.
- Water Analysis: To determine the amount of dissolved oxygen in water samples in ppm units.

Organic Chemistry

Preparation:

- Acetylation
- Benzoylation
- meta-Dinitrobenzene
- Picric acid

Inorganic Chemistry

- Analysis of inorganic mixture containing five radicals with at least one interfering radical (phosphate, borate, oxalate or fluoride).

Text Book

- Spectroscopy: An Introduction by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James A. Vyvyan.
- Organic Chemistry by Robert T. Morrison and Robert N. Boyd.
- Fats and Oils by Clyde E. Stauffer.
- Bioinorganic Chemistry by Rosette M. Roat-Malone.
- Hard and Soft Acids and Bases (HSAB) by Ralph G. Pearson.

Reference Book

- Introduction to Spectroscopy by Donald L. Pavia.
- Advanced Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Fats and Oils Handbook by Michael Bockisch.
- Bioinorganic Chemistry: A Short Course by Rosette M. Roat-Malone.
- Theoretical Principles of Inorganic Chemistry by James E. House.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	The fundamental principles underlying spectroscopic techniques, including the interaction of electromagnetic radiation with matter and the concept of energy levels.	Teach students how to prepare samples for spectroscopic analysis, including proper techniques for dilution, dissolution, or extraction.	Assignments on the electromagnetic spectrum.
2	The principles of metal ion coordination chemistry, including coordination number, ligands, and bonding modes.	Teach students how to analyse metal concentrations in biological samples using techniques like atomic absorption spectroscopy or inductively coupled plasma mass spectrometry.	Presentation on carbohydrate uses and tests.
3	The basic structure of an atom, including the nucleus, electrons, protons, and neutrons, and how they contribute to the overall properties of elements.	Introduce students to different types of matter (solids, liquids, gases) and have them observe and classify common objects and substances in their environment. Use simple sorting activities to help students differentiate between various materials based on properties like colour, texture, and state.	Class test focusing on long questions.
4	Classify carbohydrates into various categories, including monosaccharides, disaccharides, and polysaccharides, and differentiate between aldoses and ketoses.	Begin with informative lectures that introduce the basic concepts of carbohydrates, their classification, and their importance in chemistry and biology.	assignments on metalloporphyrin structure and function
5	The hard and soft acid-base theory, including the concept of hard and soft acids and bases and their interactions.	Provide students with a set of chemical species and ask them to classify each as hard or soft acids and bases based on HSAB principles. Discuss their reasoning and findings as a class.	Class test focusing on long questions.

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Physics, Chemistry, Maths)

(B.Sc. (PCM) – CKUG04A03)

VI Semester

MAJOR CORE COURSES – I

3SMSC603: Mathematics-VI Metric Space, Numerical Analysis and Statistics

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMSC603	Metric Space, Numerical Analysis and Statistics	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- To introduce the concept of metric space to the students and to make them understand various familiar concept of real analysis with the help of metric space.
- To introduce the concept of compactness and connectedness w.r.t. metric space and to study some useful properties of continuous function.
- To introduce various numerical techniques to the students of solving equation and also introduce the concept of numerical differentiation and integration.

Course Outcomes

- The concept of metric space would help them to generalize this notion on some other spaces.
- The idea of compactness and connectedness would help them to work on some other useful properties of sets and continuous function.
- The techniques of numerical solution of equation of different kind (algebraic/differential/integral) would help them to find the solution of practical problems.

Syllabus Credit (4-0-2)

UNIT – I Definition and examples of metric spaces, Neighborhoods, Limit points, Interior points, Open and closed sets, Closure and interior, Boundary points, Subspace of a metric space, Cauchy sequences, Completeness, Cantor's intersection theorem, Contraction principle, Real numbers as a complete ordered field, Dense subsets, Baire Category theorem, Separable, first and second countable spaces.

UNIT – II Continuous functions, Extension theorem, Uniform continuity, Compactness, Sequential compactness, totally bounded spaces, Finite intersection property, Continuous functions and compact sets, Connectedness.

UNIT – III Solution of Equations: Bisection method, Secant method, Regula-Falsi method, Newton- Raphson method, Roots of second-degree Polynomials, Interpolation, Lagrange's interpolation formula, Divided Differences method, Interpolation formulae using Differences, Newton-Cote's Quadrature Formulae.

UNIT – IV Linear Equations: Direct Methods for Solving Systems of Linear Equations (Gauss elimination method, LU Decomposition), Iterative methods (Jacobi, Gauss - Seidel iteration method), Ordinary Differential Equations: Euler's method, Euler's Modified method, Runge-Kutta method, Milne's method, Methods based on Numerical Integration, Methods based on numerical Differentiation.

UNIT – V Introduction of Numerical solution of P.D.E., Classification of P.D.E., Solution of Elliptic equation, Solution of Laplace equation, Solution of Poisson's equation, Solution of Elliptic equations by Relaxation method, Solution of one- and two-dimensional heat equations, Hyperbolic equation, Solution of wave equations.

Practical **Credit 2**

1. Continuous functions and compact sets based Practical
2. Neighborhoods, Limit points based Practical.
3. First and second countable spaces based Practical.
4. Miscellaneous theory questions.

Reference book

1. "Topology" by James R. Munkres:
2. "Introduction to Topology" by Bert Mendelson:

Text Book

1. Principles of Mathematical Analysis" by Walter Rudin:
2. Numerical Analysis" by Richard L. Burden and J. Douglas Faires

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understand the fundamental concepts of metric spaces and their properties. Apply the definitions of neighbourhoods, limit points, interior points, open and closed sets, closure, boundary points, and more. Work with Cauchy sequences and grasp the notion of completeness.	Solve problems and exercises related to metric spaces and their properties. Prove theorems and propositions related to metric spaces. Attend lectures, Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions.
2.	Understand the concept of continuity and its implications in real analysis and topology. Learn how the Extension Theorem allows for extending functions from closed subsets to the entire space. Comprehend how continuous functions interact with compact sets. Learn the definition and importance of connectedness in topology	Work through examples of continuous and discontinuous functions. Prove results related to continuity and uniform continuity. Study the Extension Theorem and practice extending functions Teaching will be done through lectures and discussion mode	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions.
3.	Understand the concept of root-finding through interval halving and convergence properties of the bisection method. Understand how linear interpolation can be used to approximate roots and the conditions for convergence. Learn to apply the quadratic formula to find roots of second-degree	Solve various quadratic equations and explore real and complex roots. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions.

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	polynomials. Learn to apply the quadratic formula to find roots of second-degree polynomials.		
4.	Understand the process of transforming a system of linear equations into row echelon form and solving for the unknowns. Learn the LU factorization method for solving linear systems, which separates the matrix into lower and upper triangular matrices.: Learn an advanced numerical method for solving ODEs using Milne's predictor-corrector approach.	Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions.
5.	Understand the basics of numerical methods for solving partial differential equations (PDEs), including their classifications and applications in various scientific and engineering fields.	Study the mathematical definitions and properties of elliptic, parabolic, and hyperbolic PDEs. Solve example PDEs and classify them into appropriate categories. Explore real-world problems described by each PDE type Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions.

MAJOR CORE COURSES - II

3SFSC603: Mathematics-VI Fuzzy Set Theory

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SFSC603	Fuzzy Set Theory	6(6-0-0)	60	20	20	-	-	100	3hr	-

Course Objectives

- To introduce the basic types and concepts of fuzzy sets.
- To introduce different operations on fuzzy sets.
- To introduce the concept of fuzzy arithmetic.
- To introduce the concept of fuzzy relation.
- To introduce the concept of fuzzy relation equations.

Course Outcomes

- Understand the basic concept of Fuzzy sets.
- Apply the operations on Fuzzy Sets.
- Solve the Fuzzy arithmetic.
- Understand the Fuzzy relations and Fuzzy relation equations

Syllabus Credit 4-0-0

UNIT – I Classical Sets vs Fuzzy Sets, Basic types and concepts of fuzzy sets, Additional properties of α-cuts, Representations of fuzzy sets, Extension principle for fuzzy sets.

UNIT – II Operations on Fuzzy Sets Types of operations, Fuzzy complements, Fuzzy intersections; t- norms, Fuzzy unions; t-co-norms, Combinations of operations.

UNIT – III Fuzzy Arithmetic Fuzzy numbers, Linguistic variables, Arithmetic operations on intervals, Arithmetic operations on fuzzy numbers, fuzzy Measures.

UNIT – IV Fuzzy Relations Crisp and fuzzy relations, Binary fuzzy relations, Binary relations on a single set, Fuzzy equivalence relations, Fuzzy compatibility relations, Fuzzy ordering relations.

UNIT – V Fuzzy Relation Equations Partition, Solution method, Fuzzy relation equations based on sup-i compositions and inf-wi compositions, Fuzzy Equivalence relations.

Reference Book

1. Fuzzy Logic with Engineering Applications" by Timothy J. Ross:
E P Klement, R Mesiar and E. Pap, Triangular norms, Kluwer academic press, Dordrecht, 2000

Text Book

1. Fuzzy Sets and Fuzzy Logic: Theory and Applications" by George J. Klir and Bo Yuan.
2. Timothy J. Ross, “Fuzzy Logic with Engineering application” 3rd Edition, Willey.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understand the fundamental concepts of fuzzy sets, such as membership functions and the concept of vagueness. Learn about the relationships between α-cuts and the membership function. Understand how different α-cuts represent different levels of vagueness. Learn to express fuzzy sets through mathematical notation Learn how the extension principle enables operations on fuzzy sets.	Work through examples of the extension principle to see how it is applied to fuzzy sets. Explore how the extension principle can be used for fuzzy set operations like union and intersection. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Understand the fundamental operations on fuzzy sets, including union, intersection, and complement. Learn the concept of a fuzzy complement as an operation that represents the degree of non-membership.	Calculate fuzzy complements for different fuzzy sets and membership functions. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Understand the principles of fuzzy arithmetic and its significance in modelling uncertainty. Learn how to represent fuzzy numbers and linguistic variables.	Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
4.	Understand the concepts of crisp and fuzzy relations, their significance in modelling relationships and uncertainty. 3Learn to represent and manipulate binary fuzzy relations.	Provide examples to illustrate the difference between crisp and fuzzy relations. Create binary fuzzy relation matrices for different datasets. Ask students to present their findings and insights to the class. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
5.	Understand fuzzy relation equations and their significance in modelling complex relationships with uncertainty.	Provide an overview of fuzzy relation equations, their applications, and relevance. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions

MAJOR CORE COURSE - III

3SNTC603: Mathematics-IV Number theory Project

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SNTC603	Number theory	4(-4-0-0)	60	20	20	-	-	100	3hr	-

Course Objective

The main objective of this course is to build up the basic theory of the integers, prime numbers and their primitive roots, the theory of congruence, quadratic reciprocity law and number theoretic functions, Fermat's last theorem, to acquire knowledge in cryptography specially in RSA encryption and decryption.

Course Outcomes

Upon successful completion of this course students will able to know the basic definitions and theorems in number theory, to identify order of an integer, primitive roots, Euler's criterion, the Legendre symbol, Jacobi symbol and their properties, to understand modular arithmetic number-theoretic functions and apply them to cryptography.

Syllabus — Credit (4-0-0)

UNIT- I Linear Diophantine equation, prime counting function, statement of prime number theorem, gold Bach conjecture, linear congruence's, complete set of residues, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem.

UNIT-II Number functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

UNIT-III Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol, Jacobi symbol and their properties, quadratic reciprocity, quadratic congruence's with composite moduli.

UNIT-IV Affine ciphers, Hill ciphers, p unlucky cryptography, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last Theorem.

UNIT-V- Fermat's Little Theorem Statement and applications. Chinese Remainder Theorem, Statement and applications. Pell's Equation Solutions to Pell's equation. Analytic Number Theory (Advanced Topics) Prime number theorem. Riemann zeta function.

Text books

1. David M. Burton, Elementary Number Theory (6thEdition), Tata McGraw-Hill Edition, Indian reprint, 2007.

References Book

1. Thomas Koshy, Elementary Number Theory with Applications (2nd Edition), Academic Press, 2007.
2. Neville Robins, Beginning Number Theory (2ndEdition), Narosa Publishing House Pvt. Limited, Delhi,2007.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understand what linear Diophantine equations are and their applications. Learn methods for finding solutions to linear Diophantine equations. Grasp the significance of linear Diophantine equations in number theory and beyond.	Explain the concept using simple examples and show how to find integer solutions using methods like the extended Euclidean algorithm. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Students will develop a strong foundation in number theory concepts and their applications. Students will be able to perform calculations involving divisors, functions, and modular arithmetic. Students will gain problem-solving skills and the ability to apply these mathematical concepts to various scenarios.	Lectures with clear explanations and examples. In-class discussions and problem-solving sessions. Provide opportunities for group projects or presentations on real-world applications of number theory concepts. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Students will gain a deep understanding of advanced number theory concepts. Students will develop problem-solving skills related to modular arithmetic and quadratic congruences. Students will be able to apply these concepts to cryptography, number theory research, and other areas.	Lectures with theoretical explanations. In-class discussions and problem-solving sessions encourage students to explore open problems in number theory and related research. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
4.	Students will gain knowledge of various cryptographic techniques and their applications in secure communication. Students will understand mathematical concepts behind encryption and decryption algorithms. Students will learn about famous mathematical problems like Fermat's Last Theorem.	Lectures and demonstrations on cryptographic techniques. Encourage students to explore advanced topics in cryptography and number theory, such as elliptic curve cryptography and primality testing. Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
5.	Understanding and applying Fermat's Little Theorem in checking whether a number is likely to be prime. Understanding methods for	Assign students to small groups to solve Chinese Remainder Theorem problems collaboratively.	Class Discussions and Analysis, Group

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	solving Pell's Equation, such as continued fractions and recursive formulas.	Encourage discussion and sharing of different solution approaches.	Projects, Problem-Solving Sessions

MAJOR CORE COURSE - I

3SSSC603: Physic VI Solid State Physics, Electronics and Laser

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SSSC603	Solid State Physics, Electronics and Laser	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

1. Describe the difference between crystalline and non-crystalline materials.
2. Describe the arrangements of atoms and ions in crystalline structure,
3. Explain basic Laser principal, Laser behavior properties of Laser radiations, different types of Lasers and Laser applications.

Course Outcomes

1. Demonstrate an understanding of the crystal lattice and how the main lattice types or described.
2. Explain different laser used and make a comparison between them.

Syllabus Credit (4-0- 2)

UNIT - I Overview Crystalline and glassy forms, Liquid crystals, glass transition. Crystal structure: Periodicity, Lattices and bases, Unit cell, Wigner-Seitz cell, Lattice types, Lattice planes. Common crystal structures. Laue's theory of X-ray diffraction, Bragg's law, Laue patterns. Bonding: Potential between a pair of atoms; Lennard-Jones potential, concept of cohesive energy, covalent, Vander Waal, ionic and metallic crystals Magnetism: Atomic magnetic moment, magnetic susceptibility, Dia, Para and Ferromagnetism, Ferro magnetic domains

UNIT - II Thermal properties Lattice vibrations, Simple harmonic oscillator, Concept of phonons, density of modes (1-D). Debye model; Lattice specific heat low temperature limit, extension (conceptual) to 3-D. Band Structure: Electrons in periodic potential; nearly free electron model (qualitative), Energy band, Energy gap, Metals, Insulators, Semiconductors. Motion of electrons: Free electrons, conduction electrons, Electron collisions, Mean free path, Conductivity and Ohm's law. Fermi energy, Fermi velocity, Fermi-Dirac distribution.

UNIT - III Semiconductors electrons and holes, Fermi Level, Temperature dependence of electron and hole concentrations. Doping: Conductivity, Mobility, Hall Effect, Hall Coefficient. Semiconductor devices: Metal-semiconductor junction, p-n junction, Majority and minority carriers, Diode, Zener and tunnel diodes, Light Emitting Diode, Transistor, Solar cell. Power supply: Diode as a circuit element, Load line concept, Rectification, Ripple factor, Zener diode, Voltage stabilization, Transistors: Characteristics of a transistor in CB, CE and CC mode, thermal runaway. FETs: Field effect transistors, JFET volt-ampere curves, biasing JFETMOSFET, biasing MOSFET.

UNIT - IV Amplifiers- I Small signal amplifiers; General Principle of operation, Classification, Distortion, RC coupled amplifier, input and output impedance, Multistage amplifiers. Amplifier- II: Transformer coupled amplifiers, Noise in electronic circuits. Oscillators Hartley, Colpitts and Wein bridge oscillators.

UNIT – V Laser system: Purity of a spectral line, Coherence length and coherence time, Spatial coherence of a source, Einstein's A and B coefficients. Spontaneous and induced emissions, conditions for laser action, population inversion. Types of Lasers (gas and solid state), Pulsed lasers and tunable lasers, spatial coherence and directionality, Estimates of beam intensity, Temporal coherence and Spectral Energy Density.

Practical Credit - 2

1. 1.Determine the wavelength of laser light with transmission grating
2. To determine the Hall coefficient (RH).
3. 3.To verify Norton's theorem.
4. 4.To verify maximum power transfer theorem
5. 5.To draw X-I characteristic of PN junction diode
6. 6.To verify Thevenin's Theorem.
7. To study characteristics curve of a Zener diode
8. To study characteristics curve of a light emitting diode (LED).
9. To study unregulated and regulated power supply.
10. To study characteristics curves of PNP/ NPN transistor in common base mode configuration.
11. To study characteristics curves of PNP/ NPN transistor in common emitter mode configuration

Text Books

1. 1.Solid State Physics and Electronics, R.K. PURI, V.K. BABBAR, S. CHAND.
2. Solid State Physics and Electronics, A.B. GUPTA.
3. 3.Lasers, Second Edition, Ajoy Ghtak, springer.

Reference Books

1. Advances in Laser and optics, William T. Arkin.
2. An Introduction Solid State Physics, R.J. Elliott and A.F. Gibson.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will understand of crystallography, material bonding, and magnetism, students should have the knowledge and skills to analyse and work with crystalline materials, including their structures, bonding.	Use physical models, Arrange field trips to laboratories, research facilities, or industries involved in crystallography.	Quiz, project presentation and discussion.
2.	Students will develop a deep understanding of how lattice vibrations and phonons contribute to the thermal properties of solids, able to apply the Debye model to describe these properties in both one and three dimensions.	Provide students with problem sets that require them to apply the concepts learned to solve real-world problems related to thermal properties, electronic properties, and electron motion.	Quiz, project presentation and discussion.

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
3.	Understanding of semiconductor physics, including carrier behaviour, doping, and mobility, as well as the operation and applications of various semiconductor devices in electronic circuits	Encourage students to analyse circuits involving semiconductor devices, including the calculation of voltage drops, current flows, and device characteristics.	Quiz, project presentation and discussion.
4.	Students will have a foundational understanding of the principles that underlie electronic amplifiers and oscillators, providing them with the necessary knowledge to analyse and design these circuits.	Teaching will do through lectures and discussion mode.	Quiz, project presentation and discussion.
5.	Students will have a strong foundational knowledge of the theoretical principles behind laser operation, enabling them to analyse and design laser systems.	Problem-solving questions related to laser design and operation.	Quiz, project presentation and discussion.

MAJOR CORE COURSE - II

3SNTC603: Physics-VI Nano Technology and Material Science

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SNTC603	Nano Technology and Material Science	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

1. To give comprehensive exposures to the students regarding various materials, crystalline, non – crystalline materials, crystal structure and their defects the concept of phase and different type of phase diagram.
2. Experimental and computational characterization of nano materials.

Course Outcomes

Students will have understanding of:

1. Different type of materials and their structure.
2. Structure dependence of various thermal, optical and mechanical properties.
3. Explain the fundamental principles of nano technology and their application in science.

Syllabus (Credit 4-0-2)

UNIT – I Core Concept of Nanotechnology, Nanotech Generation, Nano science, Nano composites, Nano materials, carbon Nano tubes, Nano horns, Inorganic nanotubes, Nanowires. Nano-Structures: Definition and Properties of Nano structured material, Different method of preparation of Nano-materials Zone) Electronic, Mechanical, Thermal and Phonon properties.

UNIT – II Impact of Nanotechnology and its Applications Privacy, Social denied, Communication, Risk, Social and Ethical impacts, Health and environmental impacts, Negative impacts. Types of application, Nanotechnology for energy.

UNIT – III Properties of Nanomaterials: Optical properties, Mechanical properties, Magnetic properties, Electrical properties, Thermal properties, Quantum effects etc.

UNIT – IV Classification of Materials Crystalline, Polycrystalline, Amorphous (Introduction and their structure), Elementary idea of polymers (Structure and properties, Methods of polymerization), Glasses: Structure and properties, Type of Glasses, Fracture in glasses, Composite Materials: Introduction, their types and properties, Different types of bonding.

UNIT – V Super Conductivity: Concept of Superconducting state, Persistent current, Critical temperature, Meissner effect, Thermodynamics of the super conducting transitions, Type I and Type II superconductors, AC and DC Josephson effects, Josephson Tunneling.

Transport Properties of Solids Electrical conductivity of metals and alloys, Extrinsic, Intrinsic semiconductors and amorphous semiconductors, Scattering of electrons by phonons, Impurity, Carrier mobility and its temperature dependence, Matthiessen's rule for resistivity, Temperature dependence of metallic resistivity.

Practical Credit 2

1. To study and verify the De-Morgan's Theorem.
2. To study and prove the Laws of Boolean Algebra.
3. To study and verify the truth table of Compound logic gates.
4. To study and draw the characteristics curve of P-N Junction diode.
5. To study and draw the characteristics curve of Zener diode.
6. To study and draw the characteristics curve of Tunnel diode.
7. To determine the energy band gap of a semiconductor by using P-N Junction diode.
8. To study and draw the characteristics curve of transistor in CB/CC/CE mode.

Text books

1. B.S. Murthy, P Shankar, Baldev Raj, Springer.
2. Robert W. Kelsall, Wiley.
3. Nanostructures and Nanotechnology, Douglas Natelson, Cambridge University Press.

Reference Books

1. Introduction to Nano Technology, Chales P. Poole, Wiley.
2. Nano Technology, S. Shanmugam.
3. Principles of Condened Matter physics, P.M Chaikin and T.C. Lubensky, Cambridge University Press

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understand the fundamental principles and concepts of nanotechnology, including the manipulation of materials at the nanoscale. Recognize the unique properties and behaviours of nanoscale materials and structures.	Use regular assessments, quizzes, and projects to evaluate students' understanding and application of nanotechnology concepts.	Quiz, project presentation and discussion
2.	Recognize and analyse the societal impact of nanotechnology, including its potential to revolutionize various industries and everyday life and effects of nanotechnology on economic, technological, and social aspects of society.	Invite experts in nanotechnology or professionals working in industries.	Quiz, project presentation and discussion
3.	Students will be able to identify and classify materials based on their structural characteristics, distinguishing between crystalline, polycrystalline, and amorphous materials.	Teaching will be done through lectures and discussion mode.	Quiz, project presentation and discussion
4.	Develop a deep understanding of electrical conductivity in metals based on the behaviour of electrons in the metal lattice. Study the concepts of free electron theory and Fermi-Dirac statistics.	Use interactive demonstrations and animations to illustrate concepts like electron motion, electron energy bands, and the Fermi-Dirac distribution.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
5.	Develop a deep understanding of Super conductivity in metals and alloys based on the behaviour of electrons in the crystal lattice. Top of Form	Teaching will do through lectures and discussion mode.	Quiz, project presentation and discussion

MAJOR CORE COURSE - III

3SSMC603: Physics-VI Statistical Mechanics

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SSMC603	Statistical Mechanics	4(2-0-2)	60	30	10	60	40	200	3hr	2hr

Course Objectives

- Understanding the thermodynamic properties of an ideal gas in the context of statistical mechanics.
- Build the ability to use mathematics effectively in solving physics problems.
- Explanation and interpretation of the partition function in statistical mechanics.

Course Outcome

- Understand the concept of the partition function and its interpretation in statistical mechanics.
- Gain a solid understanding of the ensemble concept, recognizing its role in describing systems with similar macroscopic properties.
- Students should be able to differentiate between microstates and microstates, and comprehend their significance in statistical mechanics.
- Understand and navigate the concept of phase space, recognizing its importance in describing the possible states of a system.

Syllabus (Credit 2-0-2)

UNIT- I Classical Statistics-I: Microstate and Microstate, Elementary Concept of Ensemble, Micro canonical, Canonical and Grand Canonical ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function.

Probability, Distribution of N particles in two identical boxes, Probability of occurrence of either event, Probability of composite events, Expression for average properties, Constraints, Accessible and non-accessible microstates, Principle of equal a prior probability

UNIT- II Classical Statistics-II : Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Boltzmann Canonical distribution law: Application: average energy of one dimensional harmonic oscillator, Derivation of law of equipartition of energy from statistics, Equilibrium between two system in thermal contact and B parameter, Statistical interpretation of entropy and relation S=k log W, Boltzmann partition function and derivation of expression for Internal energy, Helmholtz free energy, Enthalpy and Gibbs free energy.

UNIT-III Quantum Statistics: Identical particles, microstates and microstates.

Indistinguishability of particles and its consequences, Maxwell - Boltzmann statistics (Classical statistics): Maxwell- Boltzmann distribution law of velocity and speed, Maxwell - Boltzmann statistics and its distribution law.

UNIT-IV Quantum statistics: Bose-Einstein statistics and distribution law, Derivation of Planck's radiation law from B-E statistics, Rayleigh - Jeans law, Wein's displacement law and Stefan's law. Fermi Dirac

statistics and its distribution law, Explanation of free electron theory, Fermi level and Fermi energy. Comparison between the Maxwell Boltzmann and Fermi - Dirac statistics. Einstein Statistics, Bose

UNIT-V Radiation: Properties of Thermal Radiation, Blackbody Radiation, Pure Temperature dependence, Kirchhoff's law, Stefan Boltzmann law: Thermodynamic proof, Radiation Pressure, Weins Displacement law, Wiens distribution Law, Rayleigh Jeans Law, Ultra Violet catastrophe.

Planck's Law of Black body Radiation: Experimental verification.

Wiens Distribution Law, Rayleigh Jeans Law, Stefan Boltzmann Law, Weins Displacement Law from Planck's Law.

Practical **Credit: 2**

1. Determination of thermal conductivity of a bad conductor by Lee's disc method.
2. Study of statistical distribution and determination of standard deviation with the help of black and white dice.
3. Determination of the coefficient of thermal conductivity of a metal by Searl's method.
4. Determination of electromotive force of a thermocouple.
5. Determination of Stefan's constant using thermocouple.

Text Books

1. Introduction to Statistical Physics by Kerson Huang (Wiley).
2. Statistical Physics, Berkeley Physics Course, F. Reif (Tata Mc Graw -Hill)

Reference Books

1. Statistical Mechanics, B.K. Agarwal and Melvin Eisner (New Age Inter- national
2. Statistical Mechanics: R.K. Parthia and Paul D. Beale (Academic Press)

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students should understand the canonical ensemble and how it relates to systems at constant temperature. They should be able to calculate the probability distribution of energy levels for a canonical ensemble using the Boltzmann factor.	Start with a lecture explaining microstates and their connection to the microscopic configuration of a system. Engage in class discussions to explore the concept further, emphasizing that each microstate has equal probability in the microcanonical ensemble.	Quiz, project presentation and discussion
2.	Students should be able to derive and explain the relationships between pressure, volume, temperature, and the number of moles for an ideal gas using the ideal gas law. They should understand the concepts of internal energy and enthalpy for ideal gases.	Provide a historical overview of how the concept of entropy evolved from Carnot to Clausius to Boltzmann. Discuss the motivations and challenges faced by early thermodynamics. Top of Form	Quiz, project presentation and discussion
3.	Differentiate between microstates (macroscopic properties) and microstates	Start with a thought experiment involving particles with different properties (e.g.,	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	(individual quantum states) in statistical mechanics and explain how they are related through statistical ensembles.	electrons with different spins) and ask students to identify whether they are distinguishable or identical.	
4.	Understand the fundamental properties and characteristics of thermal radiation and its importance in various physical phenomena.	Ask students to research and present real-world applications of thermal radiation, such as infrared thermography in building inspections or thermal imaging in medicine.	Quiz, project presentation and discussion
5.	Understand the properties of thermal radiation. Comprehend blackbody radiation and its characteristics. Understand radiation pressure and its significance. Understand Wien's Distribution Law, Rayleigh-Jeans Law, and the Ultraviolet Catastrophe.	Lectures on thermal radiation properties. Numerical problem-solving sessions for temperature dependence.	Quiz, project presentation and discussion

MAJOR CORE COURSE-I

3SPIC603: Chemistry-VI (Physical Inorganic and Organic Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIC603	Chemistry-VI (Physical Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understand photochemical processes, including radiation-matter interaction and laws such as Grotthus-Draper and Stark-Einstein.
- Analyze quantum efficiency and deviations from Stark-Einstein law using Jablonski diagrams.
- Explore molecular properties like optical activity, polarization, and magnetic behavior, relating them to structure.
- Study organometallic compounds, their preparation, properties, and synthetic applications.
- Examine organosulphur compounds, including preparation methods, properties, and industrial uses.

Course Learning Outcome

- Understand the principles of photochemistry and its laws, including Grotthus-Draper and Stark-Einstein.
- Analyze quantum efficiency and deviations from Stark-Einstein law using Jablonski diagrams.
- Apply knowledge of molecular properties to predict optical activity, polarization, and magnetic behavior.
- Demonstrate proficiency in preparing and utilizing organometallic compounds in synthetic applications.
- Evaluate the properties and uses of Organosulphur compounds in industrial contexts.

Syllabus Credits 4-0-2

Physical Chemistry

UNIT – I

Photochemistry

Introduction, interaction of radiation with matter, thermal and photochemical processes and difference between thermal and photo- chemical processes, Laws of photochemistry: Grotthus-Draper law. Stark-Einstein law of photochemical equivalence, quantum efficiency or yield, deviation from law of photochemical equivalence and its explanation, experimental verification of Stark-Einstein law or determination of quantum efficiency, Jablonski diagram depicting various processes occurring in the excited state. Non-radiative process, radiative process, photosensitized reactions energy transfers processes, photosensitization in solution, Exercise.

UNIT – II

Physical Properties and Molecular Structures

Introduction, optical activity, measurement of optical activity, optical activity and molecular structure. Polarization: polarization of molecules in an electrical field, Mossotti-Clausius equation, permanent dipole, dipole moment and orientation of dipole in an electric field, determination of dipole moment, dipole moment and molecular structure; Magnetic properties-diamagnetism, Paramagnetism, and ferromagnetism; Exercises.

Organic Chemistry

UNIT – III

Organometallic Compounds

Introduction; Organomagnesium compound (Grignard reagent)- preparation, structure of Grignard reagent, properties, synthetic applications, technical applications. Organozinc compound (zinc alkyls) - preparation, properties, chemical reactions. Organolithium compounds- preparation, properties, chemical reactions, differentiating reactions from Grignard reagent, uses, Exercises.

Organosulphur Compounds

Introduction; Structural features; Thioalcohols or Mercaptans or alkyl hydrogen sulphides - nomenclature, general methods of preparation, physical properties, chemical properties, important members; Thioethers (dialkyl sulphides)-general method of preparation, physical properties, chemical properties, individual members. Sulphonic acids- methods of preparation, physical properties, chemical reactions and uses; Sulphonamides, sulphaguanidine; Exercises.

Inorganic Chemistry

UNIT – IV

Inorganic Polymers

Introduction and scope of inorganic polymers, special characteristics, classification, homo and hetero atomic polymers and their applications. Silicones and phosphorene's as examples of inorganic polymers, nature of bonding in triphosphazenes.

UNIT – V

Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds, preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti. A brief account of metal-ethylene complexes and homogeneous hydrogenation; mononuclear carbonyls and the nature of bonding in metal carbonyls. Transition metal organometallic compounds with bonds to hydrogen and boron.

Practical Content — Credits: 2

Physical Chemistry

Physical Instrumentation

- Job's method
- Mole-ratio method

Organic Chemistry

- Binary mixture analysis containing two solids: Separation, identification and preparation of derivatives.

Inorganic Chemistry

Complex Compound Preparation:

- Diaquabis (methyl acetoacetate) nickel (II)
- Diaquabis (ethyl acetoacetate) cobalt (II)
- Bis (methyl acetoacetate) copper (II) monohydrate
- Potassium chlorochromate (IV)
- Tetra ammine copper (II) sulphate monohydrate
- Mercury (II) tetra thio cyanate cobaltate (II)
- Hexamine nickel (II) chloride

Textbooks

- Physical Chemistry by P. W. Atkins and J. de Paula.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Inorganic Chemistry by Catherine and Alan G. Sharpe.
- Organometallic Chemistry by Gary O. Spessard and Gary L. Miessler.
- Photochemistry by V. Ramamurthy and Kirk S. Schanze.

Reference Books

- Physical Chemistry: A Molecular Approach by Donald A. McQuarrie and John D. Simon.
- Organometallics by Christoph Elschenbroich.
- Inorganic Chemistry by James E. Huheey, Ellen A. Keiter, and Richard L. Keiter.
- Photochemistry and Photo physics: Concepts, Research, Applications" by Virender K. Sharma.
- Organic Chemistry by Paula Y. Bruice.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Define photochemistry and its importance in chemistry. Explain how photochemical reactions differ from thermal reactions.	Conduct lectures to introduce the fundamental concepts of photochemistry. Use discussions to encourage students to ask questions and clarify doubts.	Assignments on the laws of photochemistry,
2	Understand optical activity and its correlation with molecular structure, and analyse magnetic properties in materials.	Hands-on laboratory experiments to measure optical activity and investigate magnetic properties, followed by discussions to reinforce understanding.	Lab reports on measuring optical activity and dipole moments.
3	Understand the basic principles of organ magnesium compounds, including the nature of the metal-carbon bond in Grignard reagents.	Conduct lectures to introduce the fundamental concepts and theories related to organ magnesium compounds. Use classroom discussions to engage students, encourage questions, and clarify doubts.	Presentation on the uses of organosulphur compounds.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
4	Basic concepts and definitions related to inorganic polymers, including the differences between inorganic and organic polymers.	Conduct lectures to introduce key concepts related to inorganic polymers, their classification, and properties. Engage students in discussions to explore the differences between inorganic and organic polymers.	Assignments on bonding in silicones and phosphorene's.
5	Principles and definitions related to organometallic chemistry, including the nature of metal-carbon bonds.	Conduct lectures to introduce key concepts, principles, and reactions in organometallic chemistry. Use classroom discussions to engage students, encourage questions, and explore practical applications.	Assignments on the preparation and properties of organometallic compounds.

MAJOR CORE COURSE-II

3SNCC603: Chemistry-VI (Nano Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SNCC603	Chemistry-VI (Nano Chemistry)	6(4-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Understand nanoscale science's interdisciplinary implications and its applications in various fields.
- Explore synthesis methods for nanostructured materials and their unique properties.
- Investigate diverse nano porous materials and their applications.
- Examine organic nanoparticles and their roles in drug delivery systems.
- Assess nanotechnology's potential in environmental protection and energy efficiency.

Course Learning Outcome

- Explain the interdisciplinary significance of nanoscale science and its applications.
- Identify nanostructured materials and understand their synthesis methods and properties.
- Analyze the applications of Nano porous materials in different fields.
- Evaluate the properties and applications of organic nanoparticles, particularly in drug delivery.
- Assess nanotechnology's contributions to environmental protection and energy efficiency.

SYLLABUS **CREDITS 4-0-2**

UNIT - I

Introduction; Nanoscale Science and Technology-Implications for Physics, Chemistry, Biology and Engineering; Classifications of Nanostructured Materials, Nano Particles; Nanowires, Ultra-Thin Films-Multi-Layered Materials.

UNIT – II

Methods Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy.

UNIT – III

Nano porous materials Zeolites, mesoporous materials, Nano membranes. Carbon Nanotubes and Graphene - Core shell and hybrid Nano composites.

UNIT – IV

Organic Nanoparticles: Introduction, Definition, Structure, Analytical Methods (Extraction and isolation, Separation, Characterization and Imaging), General Method of Preparation, Properties, Detection, and Characterization of Organic Nanoparticles: Hydrophobic Drugs, Protein, Peptide, Lipid, Cyclodextrine, Polysaccharides. Nano Cochleates, Prospects and Future Challenges.

UNIT - V

Nanomaterials for Environmental Protection: Nano technology processes – Nano Engineering materials for Pollution Prevention, Green Chemistry, Energy Efficient Resources and Materials, Nano Technology Products- Nanomaterials (Nanostructures) Nano devices and Nano systems.

Practical Content — Credits 2

- Synthesize nanoparticles using various methods.
- Characterize nanoparticles using techniques like TEM, SEM, DLS, and XRD.
- Functionalize nanoparticles for specific applications.
- Investigate the stability of nanoparticles in different environments.
- Design and evaluate nanoparticle-based drug delivery systems.
- Assess the toxicity and biocompatibility of nanoparticles.
- Explore environmental applications of nanoparticles.
- Fabricate nanostructures through self-assembly or template-assisted methods.

Reference Book

- Introduction to Nanoscience and Nanotechnology by Chris Binns, Edward L. Wolf, and Simon B. Walker.
- Principles of Nanotechnology: Molecular-Based Study of Condensed Matter in Small Systems by G. Ali Mansoori.
- Nanomaterials: Synthesis, Properties and Applications by A. S. Edelstein and R. C. Cammarata.
- Nanotechnology: Basic Science and Emerging Technologies by Mick Wilson, Geoff Smith.

Text Book

- Nano chemistry: A Chemical Approach to Nanomaterials by Geoffrey A. O zin and André C. Arsenault.
- Nano chemistry: Synthesis and Applications by Kenneth J. Klabunde.
- Nano chemistry: A Chemical Approach to Nanomaterials by Kenneth J. Shea and Akira Suzuki.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Describe the unique properties and behaviours of nanomaterials, including size-dependent properties such as quantum confinement, surface Plasmon resonance, and increased reactivity.	Conduct lectures to introduce key concepts, theories, and principles related to nanoscale science and technology.	Assignments on the classification of nanostructured materials.
2	Analyse chemical reactions and mechanisms involved in bottom-up synthesis, including nucleophilic and electrophilic reactions, coordination chemistry, and catalysis.	Organize laboratory sessions where students perform bottom-up synthesis reactions.	Presentation on recent advancements in nanomaterial synthesis.
3	Fundamental understanding of nanomaterials, their unique properties, and	Traditional lectures can be used to introduce key concepts, theories, and principles related to nanomaterials.	Quizzes on carbon nanotubes and graphene.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
	the principles that govern their behaviour at the nanoscale.		
4	Solid understanding of nanoparticles, their unique properties at the nanoscale, and the differences between bulk materials and nanoparticles.	Use lectures to introduce key concepts, theories, and principles related to organic nanoparticles chemistry.	Class test focusing on long and short questions.
5	Develop a solid understanding of nanomaterials, their unique properties, and how these properties can be harnessed for environmental protection.	Use lectures to introduce key concepts, principles, and case studies related to nanomaterials in environmental protection.	Project on the design of nanomaterials for environmental applications.

MAJOR CORE COURSE-III

3SBIC603: Chemistry-VI (Biochemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SBIC603	Chemistry-VI (Biochemistry)	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Understand biochemistry fundamentals, focusing on vitamins and their roles in health and disease prevention.
- Explore water's unique properties and its significance in biological systems.
- Study carbohydrates, lipids, amino acids, and nucleic acids, emphasizing their structures and functions.

Course Learning Outcomes

- Identify key vitamins, deficiency diseases, and their preventive measures.
- Explain water's role as a solvent, reactant, and pH regulator in biological processes.
- Recognize the structural diversity and biological functions of carbohydrates, lipids, amino acids, and nucleic acids.
- To study the biological phenomenon at cellular and molecular level is studied to gain knowledge about the principle that govern complex biological systems.

Course Learning Outcomes

- It is helpful to get knowledge of preparation of some complex compound.
- Separation and identification of binary organic mixture, prepare derivatives and know about physical instrumentation techniques

Syllabus Credits 2-0-2

UNIT- I

The foundations of biochemistry and Vitamins Cellular and chemical foundations of life. Structure and active forms of water soluble and fat-soluble vitamins, deficiency diseases and symptoms, hypervitaminosis.

UNIT- II

Water Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

UNIT-III

Carbohydrates and Glycobiology Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo and

heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lip polysaccharides). Carbohydrates as informational molecules, working with carbohydrates.

UNIT-IV

Lipids Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids -triacylglycerol and waxes. Structural lipids in membranes –glycerophospholipids, galactolipids and sulpolipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments.

UNIT-V

Amino acids structure and classification, physical, chemical and optical properties of amino acids nucleic acids. Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA – m RNA, t RNA and r RNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Practical **Credits: 2**

- Buffer solution preparation and pH measurement.
- Test of amino acids.
- Separation of amino acids by TLC.
- Estimation of DNA by diphenylamine method.
- Identification of lipids by TLC.
- Separation of sugar by paper Chromatography.

Reference Book

- Harper's Illustrated Biochemistry by Victor W. Rodwell, David A. Bender, and Kathleen M. Botham.
- Water: A Matrix of Life by Felix Franks.
- Principles of Carbohydrate Chemistry by R. W. Harding and T. J. L. Simeons.
- Lipidomics: Comprehensive Mass Spectrometry of Lipids edited by Xianlin Han.
- Amino Acids, Peptides and Proteins in Organic Chemistry by Andrew B. Hughes.

Text book

- Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox.
- Biochemistry by Lubert Stryer, Jeremy M. Berg, and John L. Tymoczko.
- Water: A Comprehensive Guide for Brewers by John Palmer and Colin Kaminski.
- Carbohydrates: The Essential Molecules of Life by Robert V. Stick
- Lipid Biochemistry: An Introduction by Michael I. Gurr, John L. Harwood, and Keith N. Frayn.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Grasp fundamental chemical concepts and principles, such as bonding, chemical reactions, and thermodynamics, as they apply to biochemistry.	Traditional lectures are often used to deliver essential content and introduce key biochemical concepts. Instructors may use multimedia presentations, slides, and diagrams to aid in understanding.	Class test focusing on short questions.
2	Describe the molecular structure of water, including its	Use molecular model kits or interactive software to allow students to construct	Laboratory report on the unique properties of water

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
	bent shape, covalent bonds, and polar nature. Explain how hydrogen bonding contributes to water's unique properties.	water molecules and explore the polarity of water and hydrogen bonding.	and its significance in biological systems.
3	Students should categorize monosaccharides based on the number of carbon atoms they contain (e.g., triose, pentose, hexose) and distinguish between aldoses and ketoses.	Provide students with samples of different monosaccharides and have them use chemical tests (e.g., Benedict's test, Fehling's test) to identify and differentiate between reducing and non-reducing sugars.	Presentation on the structure, properties, and biological significance of carbohydrates.
4	Define what lipids are and explain their role as essential biomolecules in living organisms.	Provide students with various fatty acids and ask them to identify and classify them based on chain length, degree of saturation, and the presence of functional groups.	Case study on the role of lipids in cellular structure and function.
5	Define what nucleic acids are and explain their role as essential biomolecules that store and transmit genetic information.	Provide students with molecular model kits to build physical models of DNA molecules. This hands-on activity helps students understand the double helix structure and complementary base pairing.	Essay on the structure, classification, and properties of amino acids and nucleic acids.

MINOR CORE COURSES

3SMSM604: Mathematics-VI (Metric Space, Numerical Analysis and Statistics

(Credits: Theory-4 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMSM604	Metric Space, Numerical Analysis and Statistics	4(4-0-0)	60	20	20	-	-	100	3hr	-

Course Objectives

- To introduce the concept of metric space to the students and to make them understand various familiar concept of real analysis with the help of metric space.
- To introduce the concept of compactness and connectedness w.r.t. metric space and to study some useful properties of continuous function.
- To introduce various numerical techniques to the students of solving equation and also introduce the concept of numerical differentiation and integration.

Course Outcomes

- The concept of metric space would help them to generalize this notion on some other spaces.
- The idea of compactness and connectedness would help them to work on some other useful properties of sets and continuous function.
- The techniques of numerical solution of equation of different kind (algebraic/differential/integral) would help them to find the solution of practical problems.

Syllabus Credit (4-0-0)

UNIT – I Definition and examples of metric spaces, Neighborhoods, Limit points, Interior points, Open and closed sets, Closure and interior, Boundary points, Subspace of a metric space, Cauchy sequences, Completeness, Cantor's intersection theorem, Contraction principle, Real numbers as a complete ordered field, Dense subsets, Baire Category theorem, Separable, first and second countable spaces.

UNIT – II Continuous functions, Extension theorem, Uniform continuity, Compactness, Sequential compactness, totally bounded spaces, Finite intersection property, Continuous functions and compact sets, Connectedness.

UNIT – III Solution of Equations: Bisection method, Secant method, Regula-Falsi method, Newton- Raphson method, Roots of second-degree Polynomials, Interpolation, Lagrange's interpolation formula, Divided Differences method, Interpolation formulae using Differences, Newton-Cote's Quadrature Formulae.

UNIT – IV Linear Equations: Direct Methods for Solving Systems of Linear Equations (Guass elimination method, LU Decomposition), Iterative methods (Jacobi, Gauss - Seidel iteration method), Ordinary Differential Equations: Euler's method, Euler's Modified method, Runge-Kutta method, Milne's method, Methods based on Numerical Integration, Methods based on numerical Differentiation.

UNIT – V Introduction of Numerical solution of P.D.E., Classification of P.D.E., Solution of Elliptic equation, Solution of Laplace equation, Solution of Poisson's equation, Solution of Elliptic equations by Relaxation

method, Solution of one- and two-dimensional heat equations, Hyperbolic equation, Solution of wave equations.

Text Book

1. Principles of Mathematical Analysis" by Walter Rudin:

2. Numerical Analysis" by Richard L. Burden and J. Douglas Faires:

Reference Book

1. Topology" by James R. Munkres:

2."Introduction to Topology" by Bert Mendelson:

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Understand the fundamental concepts of metric spaces and their properties. Apply the definitions of neighbourhoods, limit points, interior points, open and closed sets, closure, boundary points, and more. Work with Cauchy sequences and grasp the notion of completeness.	Solve problems and exercises related to metric spaces and their properties. Prove theorems and propositions related to metric spaces. Attend lectures, Teaching will be done through lectures and discussion mode	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
2.	Understand the concept of continuity and its implications in real analysis and topology. Learn how the Extension Theorem allows for extending functions from closed subsets to the entire space.	Work through examples of continuous and discontinuous functions. Prove results related to continuity and uniform continuity. Study the Extension Theorem and practice extending functions Teaching will be done through lectures and discussion mode	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
3.	Understand the concept of root-finding through interval halving and convergence properties of the bisection method. Understand how linear interpolation can be used to approximate roots and the conditions for convergence.	Solve various quadratic equations and explore real and complex roots. Teaching will be done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
4.	Understand the process of transforming a system of linear equations into row echelon form and solving for the unknowns.	Teaching will done through lectures and discussion mode.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions
5.	Understand the basics of numerical methods for solving partial differential equations (PDEs), including their classifications and applications in various scientific and engineering fields.	Study the mathematical definitions and properties of elliptic, parabolic, and hyperbolic PDEs. Solve example PDEs and classify them into appropriate categories.	Class Discussions and Analysis, Group Projects, Problem-Solving Sessions

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
		Explore real-world problems described by each PDE type Teaching will done through lectures and discussion mode.	

MINOR CORE COURSES

3SSSM604: Physic VI Solid State Physics, Electronics and Laser
(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SSSM604	Solid State Physics, Electronics and Laser)	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

1. Describe the difference between crystalline and non-crystalline materials.
2. Describe the arrangements of atoms and ions in crystalline structure,
3. Explain basic Laser principal Laser behavior properties of Laser radiations, different types of Lasers and Laser applications.

Course Outcomes

1. Demonstrate an understanding of the crystal lattice and how the main lattice types or described
2. Explain different laser used and make a comparison between them.

Syllabus Credit (2-0- 2)

UNIT - I Overview Crystalline and glassy forms, liquid crystals, glass transition. Crystal structure: Periodicity, lattices and bases, unit cell, Wigner-Seitz cell, lattice types, lattice planes. Common crystal structures. Laue's theory of X-ray diffraction, Bragg's law, Laue patterns. Bonding: Potential between a pair of atoms; Lennard-Jones potential, concept of cohesive energy, covalent, Vander Waal, ionic and metallic crystals Magnetism: Atomic magnetic moment, magnetic susceptibility, Dia, Para and Ferromagnetism, Ferro magnetic domains

UNIT - II Thermal properties Lattice vibrations, simple harmonic oscillator, Concept of phonons, density of modes (1-D). Debye model; Lattice specific heat low temperature limit, extension (conceptual) to 3-D. Band Structure: Electrons in periodic potential; nearly free electron model (qualitative), energy band, energy gap, metals, insulators, semiconductors. Motion of electrons: Free electrons, conduction electrons, electron collisions, mean free path, conductivity and Ohm's law. Fermi energy, Fermi velocity, Fermi-Dirac distribution.

UNIT - III Semiconductors electrons and holes, Fermi Level, Temperature dependence of electron and hole concentrations. Doping: conductivity, mobility, Hall Effect, Hall Coefficient. Semiconductor devices: Metal-semiconductor junction, p-n junction, majority and minority carriers, diode, Zener and tunnel diodes, light emitting diode, transistor, solar cell. Power supply: Diode as a circuit element, load line concept, rectification, ripple factor, Zener diode, voltage stabilization, Transistors: Characteristics of a transistor in CB, CE and CC mode, thermal runaway. FETs: Field effect transistors, JFET volt-ampere curves, biasing JFETMOSFET, biasing MOSFET.

UNIT - IV Amplifiers- I Small signal amplifiers; General Principle of operation, classification, distortion, RC coupled amplifier, input and output impedance, multistage amplifiers. Amplifier- II: Transformer coupled amplifiers, Noise in electronic circuits. Oscillators Hartley, Colpitt and Wein bridge oscillators.

UNIT – V Laser system: Purity of a spectral line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients. Spontaneous and induced emissions, conditions for laser action, population inversion. Types of Lasers (gas and solid state), Pulsed lasers and tunable lasers, spatial coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density.

Practical (Credit 2)

- Determine the wavelength of laser light with transmission grating
- To determine the resolving lower of telescope
- To verify Norton's theorem
- To verify maximum power transfer theorem
- To draw X-I characteristic of PN junction diode

Text Books

1. 1.Solid State Physics and Electronics, R.K. PURI, V.K. BABBAR, S. CHAND.
2. Solid State Physics and Electronics, A.B. GUPTA.
3. Lasers, Second Edition, Ajoy Ghtak, springer.

Reference Books

1. 1.Advances in Laser and optics, William T. Arkin.
2. An Introduction Solid State Physics, R.J. Elliott and A.F. Gibson.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will understand of crystallography, material bonding, and magnetism, students should have the knowledge and skills to analyse and work with crystalline materials, including their structures, bonding.	Use physical models, Arrange field trips to laboratories, research facilities, or industries involved in crystallography	Quiz, project presentation and discussion
2.	Students will develop a deep understanding of how lattice vibrations and phonons contribute to the thermal properties of solids, able to apply the Debye model to describe these properties in both one and three dimensions.	Provide students with problem sets that require them to apply the concepts learned to solve real-world problems related to thermal properties, electronic properties, and electron motion.	Quiz, project presentation and discussion
3.	Understanding of semiconductor physics, including carrier behaviour, doping, and mobility, as well as the operation and applications of various semiconductor devices in electronic circuits	Encourage students to analyse circuits involving semiconductor devices, including the calculation of voltage drops, current flows, and device characteristics.	Quiz, project presentation and discussion
4.	Students will have a foundational understanding of the principles that underlie electronic amplifiers and oscillators, providing them with the	Teaching will done through lectures and discussion mode.	Quiz, project presentation and discussion

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
	necessary knowledge to analyze and design these circuits.		
5.	Students will have a strong foundational knowledge of the theoretical principles behind laser operation, enabling them to analyze and design laser systems.	Problem-solving questions related to laser design and operation.	Quiz, project presentation and discussion

MINOR CORE COURSES

3SPIM604: Chemistry-VI (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIM604	(Physical Inorganic and Organic Chemistry	4(2-0-2)	20	20	10	60	40	200	3hr.	2hr

Course Objectives

- Understand photochemical processes, including radiation-matter interaction and laws such as Grotthus-Draper and Stark-Einstein.
- Analyze quantum efficiency and deviations from Stark-Einstein law using Jablonski diagrams.
- Explore molecular properties like optical activity, polarization, and magnetic behavior, relating them to structure.
- Study organometallic compounds, their preparation, properties, and synthetic applications.
- Examine organosulphur compounds, including preparation methods, properties, and industrial uses.

Course Learning Outcome

- Understand the principles of photochemistry and its laws, including Grotthus-Draper and Stark-Einstein.
- Analyze quantum efficiency and deviations from Stark-Einstein law using Jablonski diagrams.
- Apply knowledge of molecular properties to predict optical activity, polarization, and magnetic behavior.
- Demonstrate proficiency in preparing and utilizing organometallic compounds in synthetic applications.
- Evaluate the properties and uses of Organosulphur compounds in industrial contexts.

Syllabus Credits 4-0-2

Physical Chemistry

UNIT – I

Photochemistry

Introduction, interaction of radiation with matter, thermal and photochemical processes and difference between thermal and photo- chemical processes, Laws of photochemistry: Grotthus-Draper law. Stark-Einstein law of photochemical equivalence, quantum efficiency or yield, deviation from law of photochemical equivalence and its explanation, experimental verification of Stark-Einstein law or determination of quantum efficiency, Jablonski diagram depicting various processes occurring in the excited state. Non-radiative process, radiative process, photosensitized reactions energy transfers processes, photosensitization in solution, Exercise.

UNIT – II

Physical Properties and Molecular Structures

Introduction, optical activity, measurement of optical activity, optical activity and molecular structure. Polarization: polarization of molecules in an electrical field, Mossotti-Clausius equation, permanent dipole, dipole moment and orientation

of dipole in an electric field, determination of dipole moment, dipole moment and molecular structure; Magnetic properties- diamagnetism, Paramagnetism, and ferromagnetism; Exercises.

Organic Chemistry

UNIT – III

Organometallic Compounds

Introduction; Organomagnesium compound (Grignard reagent)- preparation, structure of Grignard reagent, properties, synthetic applications, technical applications. Organozinc compound (zinc alkyls) - preparation, properties, chemical reactions. Organolithium compounds- preparation, properties, chemical reactions, differentiating reactions from Grignard reagent, uses, Exercises.

Organosulphur Compounds

Introduction; Structural features; Thioalcohols or Mercaptans or alkyl hydrogen sulphides - nomenclature, general methods of preparation, physical properties, chemical properties, important members; Thioethers (dialkyl sulphides)-general method of preparation, physical properties, chemical properties, individual members. Sulphonic acids- methods of preparation, physical properties, chemical reactions and uses; Sulphonamides, sulphaguanidine; Exercises.

Inorganic Chemistry

UNIT – IV

Inorganic Polymers

Introduction and scope of inorganic polymers, special characteristics, classification, homo and hetero atomic polymers and their applications. Silicones and phosphorene's as examples of inorganic polymers, nature of bonding in triphosphazenes.

UNIT – V

Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds, preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti. A brief account of metal-ethylene complexes and homogeneous hydrogenation; mononuclear carbonyls and the nature of bonding in metal carbonyls. Transition metal organometallic compounds with bonds to hydrogen and boron.

Practical Content **Credits: 2**

Physical Chemistry

Physical Instrumentation

- Job's method
- Mole-ratio method

Organic Chemistry

- Binary mixture analysis containing two solids: Separation, identification and preparation of derivatives.

Inorganic Chemistry

Complex Compound Preparation:

- Diaquabis (methyl acetoacetate) nickel (II)
- Diaquabis (ethyl acetoacetate) cobalt (II)
- Bis (methyl acetoacetate) copper (II) monohydrate
- Potassium chlorochromate (IV)
- Tetra ammine copper (II) sulphate monohydrate
- Mercury (II) tetra thio cyanate cobaltate (II)
- Hexamine nickel (II) chloride

Textbooks

- Physical Chemistry by P. W. Atkins and J. de Paula.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Inorganic Chemistry by Catherine and Alan G. Sharpe.
- Organometallic Chemistry by Gary O. Spessard and Gary L. Miessler.
- Photochemistry by V. Ramamurthy and Kirk S. Schanze.

Reference Books

- Physical Chemistry: A Molecular Approach by Donald A. McQuarrie and John D. Simon.
- Organometallics by Christoph Elschenbroich.
- Inorganic Chemistry by James E. Huheey, Ellen A. Keiter, and Richard L. Keiter.
- Photochemistry and Photo physics: Concepts, Research, Applications" by Virender K. Sharma.
- Organic Chemistry by Paula Y. Bruice.

Facilitating the achievement of course learning objectives

Unit	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Define photochemistry and its importance in chemistry. Explain how photochemical reactions differ from thermal reactions.	Conduct lectures to introduce the fundamental concepts of photochemistry. Use discussions to encourage students to ask questions and clarify doubts.	Assignments on the laws of photochemistry,
2	Understand optical activity and its correlation with molecular structure, and analyse magnetic properties in materials.	Hands-on laboratory experiments to measure optical activity and investigate magnetic properties, followed by discussions to reinforce understanding.	Lab reports on measuring optical activity and dipole moments.
3	Understand the basic principles of organ magnesium compounds, including the nature of the metal-carbon bond in Grignard reagents.	Conduct lectures to introduce the fundamental concepts and theories related to organ magnesium compounds. Use classroom discussions to engage students, encourage questions, and clarify doubts.	Presentation on the uses of organosulphur compounds.
4	Basic concepts and definitions related to inorganic polymers, including the differences between inorganic and organic polymers.	Conduct lectures to introduce key concepts related to inorganic polymers, their classification, and properties. Engage students in discussions to explore the differences between inorganic and organic polymers.	Assignments on bonding in silicones and phosphorene's.
5	Principles and definitions related to organometallic chemistry, including the nature of metal-carbon bonds.	Conduct lectures to introduce key concepts, principles, and reactions in organometallic chemistry. Use classroom discussions to engage students, encourage questions, and explore practical applications.	Assignments on the preparation and properties of organometallic compounds.

CVRU
विद्या परं देवता
DR. C.V.RAMAN UNIVERSITY