St. PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Deemed to be University U/S 3 of the UGC Act,1956)
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# FOUR-YEAR B.Sc. (PHYSICS) DEGREE PROGRAMME

## (Approved by UGC)

(I to VIII SEMESTERS)

**REGULATIONS AND SYLLABI UNDER CHOICE-BASED CREDIT SYSTEM**

## (REGULATIONS – 2023)

## Effective from the Academic Year 2023-2024

# St. Peter's Institute of Higher Education and Research

## B.Sc. (PHYSICS)

## REGULATION 2023

## CHOICE BASED CREDIT SYSTEM

## VISION & MISSION OF THE INSTITUTION

### Vision

To achieve, Academic Excellence in Engineering, Technology and Science through Teaching, Research and Extension to Society

### Mission

By generating, preserving and disseminating knowledge through rigorous academic study, inquisitiveness to understand and explore nature, entrepreneurship with creativity and innovation

# Vision and Mission of the Department

## Vision

To develop the department as a center for studies in materials science and Technology and to encourage the inquisitiveness in a student and make him understand the fundamentals of physics so as to exploit it for research and implementation of technology**.**

## Mission

- To feed the budding Engineers and physicists with finer aspects of science.
- To make them understand, exploit and innovate the aspects of physics.
- To make the students contribute to the technological advancements of tomorrow.
- To develop among students, sensitivity to contribute to the betterment of society through knowledge in Physics.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

After successful completion of three/four year degree program in physics a student should be able to:

**PEO-1** Demonstrate, solve and understand the major concepts in all Disciplines of physics.

**PEO-2** Solve the problem and also think methodically, independently and draw a logical conclusion.

**PEO-3** Employ critical thinking and the scientific knowledge to design, carry out, record and analyse the results of Physics experiments.

**PEO**-4 Use modern techniques, decent equipments and Microprocessor kits.

**PEO-5** Create an awareness of the impact of Physics on the society, and development outside the scientific Community.

## PROGRAM OUTCOMES (POs):

Physics Graduates will be:

**PO1 Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

**PO2 Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

**PO3 Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

**PO4 Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

**PO5 Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

**PO6 Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

**PO7 Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

**PO8 Modern tool usage**: Create data using modern chemical tools and ICT for modelling and analyze the data obtained from sophisticated instruments (like UV-Vis, FTIR, NMR, GCMS, Fluorescence, SEM, TEM, XRD, etc) for chemical analysis.

## PROGRAM SPECIFIC OUTCOMES (PSOS)

**PSO-1** Gain the knowledge of Physics through theory and practicals.

**PSO-2** Understand good laboratory practices and safety.

**PSO-3**.Develop research oriented skills.

**PSO-4** Make aware and handle the sophisticated instruments/equipments

**Contribution 1: Reasonable 2: Significant 3: Strong**

# SYLLABUS

## Credit Distribution

| Four / Three year UG Degree Programs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Total distribution of courses and credits | | | | | | | | | |
| Course Description | I Sem | II Sem | III Sem | IV Sem | V Sem | VI Sem | VII Sem | VIII Sem | Total credits |
| Major 1 (core) - Theory | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 35 |
| Major 1 (core) - Practical | 2 | 2 | 2 | 2 | 2 | 2 | - | - | 12 |
| Major 2 (core) - Theory | - | - | - | 5 | 4 | 4 | 5 | 5 | 23 |
| Major 2 (core) - Practical | - | - | - | 2 | 2 | 2 | - | - | 6 |
| Major 3 (core) - Theory | - | - | - | - | - | 4 | - | - | 4 |
| Minor Steam | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 32 |
| Multidisciplinary | 3 | 3 | 3 | - | - | - | - | - | 9 |
| Ability Enhancement | 2 | 2 | - | - | - | - | - | - | 4 |
| Ability Enhancement | 2 | 2 | - | - | - | - | - | - | 4 |
| Skill Enhancement courses | 3 | 3 | 3 | - | - | - | - | - | 9 |
| Value added courses | - | - | 4 | 2 | 2 | 2 | - | - | 10 |
| Internship | - | - | - | - | 2 | - | - | - | 2 |
| Project | - | - | - | - | - | 3 | 6 | 6 | 12 |
| Total | 20 | 20 | 20 | 20 | 20 | 25 | 20 | 20 | 165 |

**Semester I**

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23PH101 | Major Core-1<br>Basic Physics I | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH102 | Major Core Lab-1<br>Basic Physics Lab1 | 0 | 0 | 4 | 2 | 40 | 60 | 100 |
| 23MA122 | Minor Stream-1<br>Mathematics I | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH180 | Skill Enhancement course – 1<br>Every Day Physics | 4 | 0 | 0 | 3 | 40 | 60 | 100 |
| 23PS121 | Multidisciplinary Course-1<br>Sociology in the context of Political Science | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 23TA121/<br>23HI121/<br>23FR121/<br>23TE121 | Ability Enhancement Course I<br>Language I<br>(Tamil I/Hindi I/ French I /Telugu I) | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23EN123 | Ability Enhancement Course 2<br>English I | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| Total | | 21 | 0 | 4 | 20 | 280 | 420 | 700 |

**Semester II**

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23PH111 | Major Core-1<br>Basic Physics II | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH112 | Major Core Lab-1<br>Basic Physics Lab II | 0 | 0 | 4 | 2 | 40 | 60 | 100 |
| 23MA132 | Minor Stream-2<br>Mathematics II | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH181 | Skill Enhancement course – 2<br>Basic Instrumentation Skills | 4 | 0 | 0 | 3 | 40 | 60 | 100 |
| 23CA135 | Multidisciplinary Course-2<br>Advanced Excel | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 23TA131/<br>23HI131/<br>23FR131/<br>23TE131 | Ability Enhancement Course3<br>Language II<br>(Tamil II/Hindi II/ French II /Telugu II) | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23EN132 | Ability Enhancement Course 4<br>English II | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| Total | | 21 | 0 | 4 | 20 | 280 | 420 | 700 |

**Semester III**

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23PH205 | Major Core-3<br>Electricity and Electromagnetism | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH206 | Major Core Lab-3<br>Electricity and Electromagnetism Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23CY221 | Minor Stream-3<br>Chemistry - 1 | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23CY222 | Minor Stream-3<br>Chemistry - lab 1 | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23CP225 | Multidisciplinary Course-3 | 4 | 0 | 0 | 3 | 40 | 60 | 100 |
| 23PH282 | Skill Enhancement Course-3<br>Electrical Circuits and Network Skills | 4 | 0 | 0 | 3 | 40 | 60 | 100 |
| 23VA270 | Value Added Courses-1<br>Environmental Science | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| Total | | 21 | 0 | 6 | 20 | 240 | 360 | 600 |

**Semester IV**

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23PH207 | Major Core-4<br>Optics and Spectroscopy | 6 | 0 | 0 | 5 | 40 | 60 | 100 |
| 23PH208 | Major Core Lab-4<br>Optics Laboratory | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23PH209 | Major Core-5<br>Basic Electronics | 6 | 0 | 0 | 5 | 40 | 60 | 100 |
| 23PH210 | Major Core Lab-5<br>Electronics Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23CY231 | Minor Stream-4<br>Chemistry - II | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23CY232 | Minor Stream-4<br>Chemistry lab - II | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23VA271 | Value Added Course<br>Yoga for Human Excellence | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| Total | | 18 | 0 | 9 | 20 | 240 | 360 | 600 |

## Semester V

| Course Code | Course Title | L | T | P | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | EA | Total |
| 23PH301 | Atomic Physics | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH302 | Electronics and Communication Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23PH303 | Fundamentals of Microprocessor | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH304 | Microprocessor Lab | 0 | 0 | 3 | 2 | | | |
| 23PH305 | Minor Stream<br>Physics of Renewable Energy Systems | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23IK301 | Value added course<br>Introduction to Indian Knowledge System | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23PH306 | Internship | 0 | 0 | 0 | 2 | | 100 | 100 |
| Total | | 18 | 0 | 6 | 20 | 200 | 400 | 600 |

## Semester VI

| Code No. | Course Title | L | T | P | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | EA | Total |
| 23PH307 | Solid State Physics | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH308 | Solid State Physics Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23PH309 | Nuclear Physics | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH310 | Electronics lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| 23PH311 | Relativity and Quantum Mechanics | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH312 | Minor Stream<br>Computational Physics | 4 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23VA370 | Value added course<br>Universal Human Values | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23PH313 | Project | 0 | 0 | 4 | 3 | 40 | 60 | 100 |
| Total | | 22 | 0 | 10 | 25 | 320 | 480 | 800 |

## Semester VII

| Code No. | Course Title | L | T | P | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | EA | Total |
| 23PH401 | Mathematical Physics | 6 | 0 | 0 | 5 | 40 | 60 | 100 |
| 23PH402 | Classical Mechanics | 6 | 0 | 0 | 5 | 40 | 60 | 100 |
| 23PH403 | Minor Stream<br>Entrepreneurship for Physicists: From Discovery to Enterprise | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH404 | Project-I | 0 | 0 | 8 | 6 | 40 | 60 | 100 |
| Total | | 17 | 0 | 8 | 20 | 160 | 240 | 400 |

## Semester VIII

| Code No. | Course Title | L | T | P | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | EA | Total |
| 23PH405 | Thermodynamics and Statistical Mechanics | 6 | 0 | 0 | 5 | 40 | 60 | 100 |
| 23PH406 | Introduction to Numerical Methods | 6 | 0 | 0 | 5 | 40 | 60 | 100 |
| 23PH407 | Minor Stream<br>Innovation and Design Thinking in Physical Sciences | 5 | 0 | 0 | 4 | 40 | 60 | 100 |
| 23PH408 | Project-II | 0 | 0 | 8 | 6 | 40 | 60 | 100 |
| Total | | 17 | 0 | 8 | 20 | 160 | 240 | 400 |

## Minor Stream

### Minor Stream 1 (I Semester)

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23MA122 | Mathematics–I | 5 | 1 | 0 | 4 | 40 | 60 | 100 |
| | Statistical Methods–I | 5 | 1 | 0 | 4 | 40 | 60 | 100 |
| | Numerical Methods-I | 5 | 1 | 0 | 4 | 40 | 60 | 100 |

### Minor Stream 2 (II Semester)

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23MA132 | Mathematics–II | 5 | 1 | 0 | 4 | 40 | 60 | 100 |
| | Statistical Methods–II | 5 | 1 | 0 | 4 | 40 | 60 | 100 |
| | Numerical Methods-II | 5 | 1 | 0 | 4 | 40 | 60 | 100 |

### Minor Stream 1 (III Semester)

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23CY221 | Chemistry–I | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23CY222 | Chemistry–I Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| | Python Programming | 5 | 0 | 2 | 4 | 40 | 60 | 100 |

### Minor Stream 2 (IV Semester)

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23CY231 | Chemistry–II | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23CY232 | Chemistry-II Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| | Python Programming | 5 | 0 | 2 | 4 | 40 | 60 | 100 |

### Ability Enhancement course L1-Language I (I Semester)

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23TA121 | Tamil -I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23FR121 | French- I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23HI121 | Hindi -I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23TE121 | Telugu- I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |

### Ability Enhancement course L2-Language II (II Semester)

| Course Code | Course Title | Hours/Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | CIA | ESE | Total |
| 23TA131 | Tamil-II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23FR131 | French-II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23HI131 | Hindi-II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| 23TE131 | Telugu-II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |

## Multidisciplinary Course-1& 2

Students can choose basic courses from disciplines such as Natural Science, for example, Biology, Botany, Zoology, Biotechnology, Biochemistry, Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Sciences, etc., Students are not allowed to choose or repeat courses already undergone at the Higher Secondary Level ($12^{th}$ class).

# SYLLABUS

| Course code 23TA121 | Ability Enhancement Course -1 | L | T | P | C |
|---|---|---|---|---|---|
| | ப□ொFத் தமிம் | 3 | 0 | 0 | 2 |

**அ□கு - 1 கவிதத இ□க்கினந்**

அ. □ா□ம்டு□ம்பு□ இ□க்கிதண், ண□புக் கவிதட, பு□க்கவிதட ஆ.

டா□ா□ம்டு □ா□□ம், ஒ□ம்□ா□ி (□ாக்கு□F □க்கா□ண்)

இ. □ா□திதா□ம் – □ா□ட தடசண்(1,5,9,10,12,13)

ஈ. □ா□திடாச□ம் – டமின்க் காட□ம் (2 □ா□□ம்கந்)

உ. □□ம்டுக்தகா□ம்த□ – சசத்யுண் சடாழித ஆன

ஊ.திரு□ங்தக குஞபதி – சமூக□ம் □ா□ம்தப

**அ□கு - 2 சி□ம்றி□க்கினந்**

அ. சி□ம்றி□க்கித ப□□ாறு

ஆ. □□ம்திக்க□ண்□கண் – (□ா□ம்டுத□ட் டத□ப□ம் வீ□ச்சி□□ம்பு, தக வீடுFா, தகதறு□ித□)

இ. கு□ம்□ா□க் கு□பஜ்சி – கு□ட்தி ணத□ பநண் கூறுட□ம் (2 ஆ.

இததசுபி□ா□ம் பிந்தநட்டமின் – (2 □ா□□ம்கந்)

**அ□கு - 3 சிறுகதத இ□க்கினந்**

அ. உத□□த□ இ□க்கித ப□□ாறு ஆ.

கு.□.□ா□தகா□ா□□ம் – விடியுணா!

இ. குநட்டங்கத□ அ□சண□ண் – ப.தப.சு

**அ□கு - 4 □ொடகந்**

□ண்ண□ம் சண்□□ம்ட முடலிதா□ம் –

**சி□ஹி அ□கு - 5 பநொழி□ம் □ன□ம்சி**

அ. அலுப□ம் கடிடமுண் விஞ்ஞ□ம்□முண்

ஆ. த□□ம்காஞ□ம்

இ. த□ச்சுக்கத□

| CO NO | COURSE OUTCOME | RBT |
|---|---|---|
| CO1 | சணாழி பழிதத கவிட்தி□த□யுண், □த□□ம்□ா□ம்□□ம் திதுண் பந□ட்ட□ம் | K3, K6 |
| CO2 | கா□ ணா□ம்□ட்தி□ம் சபப்தபறு படிங்கதந□ம் ஆண் இ□க்கிதங்கதந அறிடலுண் அப்பாறு தடா□ம்றித இ கூறுகதந ஆத்வுசசத்டலுண் | K4 |
| CO3 | புத□வு இ□க்கித பந□ம்ச்சிம□□ம் ஆதமா□ம் தி விநங்கிசகாஞ்டு அ□ம்□த□□ம்□ா□ம்□□ம் தி□த□□ம் □த□ம்□டுட்Fட□ம் | K2, K3 |
| CO4 | □ஞ்த□த கா□ □ா□க இ□க்கிதண் இ சடாழி□ம்த□□ம்□ட்தி□ம் மூ□ண் அத□□ம்ட புனித ணதி□ம்பிடுட□ம் ண□ம்றுண் அதி□ம் ட□ிட்தி□த□ பந□ட்ட□ம் | K6 |
| CO5 | சணாழிம□□ம் □த□ம்□ாடுகதநயுண் இ□க்கிதட் இன விநங்க சசத்ட□ம் | K5 |

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | 2 | - | - | 2 | - | - | 3 | 3 |
| **CO2** | - | - | - | 2 | - | - | - | - | 2 | 3 |
| **CO3** | - | 2 | 2 | - | - | - | - | - | 3 | 3 |
| **CO4** | - | - | - | - | - | 2 | - | - | 3 | 3 |
| **CO5** | - | - | - | - | 2 | - | - | - | 2 | 3 |
| **CO** | - | 2 | 2 | 2 | 2 | 2 | - | - | 3 | 3 |

| Course Code: 23EN123 | Ability Enhancement Course E1 | L | T | P | C |
|---|---|---|---|---|---|
| | ENGLISH -I | 3 | 0 | 0 | 2 |

**Prerequisites:** None

**COURSE OBJECTIVES:**

This course is designed to equip students with a comprehensive understanding of effective communication and interpersonal skills, essential for professional growth.

**UNIT – I: Vocabulary:** **No.of.Hours:06**

- Synonyms and Antonyms
- One word substitution
- Word Formation (prefixes & suffixes)
- Homonyms, Homophones and Homographs
- Discourse Markers
- Cause & Effect Expressions

**UNIT – II: Language and Communication:** **No.of.Hours:06**

- Definition of Language
- Importance of Language
- Definition of Communication
- Barriers of Communication
- Importance of Communication
- Principles of Communication

**UNIT – III: Communication Strategies:** **No.of.Hours:06**

- Verbal Communication
- Tone, Audibility, Fluency
- Types of Verbal Communication
- Non- verbal Communication
- Posture, Gestures, Facial expression, Eye contact
- Advantages and Disadvantages of Verbal and Non-Communication

**UNIT – IV: Self-management Skills** **No.of.Hours:06**

- Self-awareness and Self-confidence
- Time management
- Stress management
- Perseverance and Resilience
- Mind mapping

**UNIT-V: Social skills:** **No.of.Hours:06**

- Negotiation & persuasion
- Networking
- Problem solving and Empathy
- Decision making
- Presentation skills
- Leadership skills and Team work
- Social responsibility

**Total No. of Hours: 30**

**Book Recommended**


1. Krishna Mohan & Meera Banerji. *Developing Communication Skills*.Macmillan
2. SasiKumar. V and P.V. Dharmija. 1993. *Spoken English*: A Self-Learning Guide Conversation Practice. 34th reprint. Tata McGraw – Hill. New Delhi.
3. Suresh Kumar, E. & Sreehari, P. *Communicative English*. New Delhi: Orient BlackSwan, 2007.Print.
4. Yardi, V.V *English Conversation for Indian Students*. NewDelhi: Orient BlackSwan, 2002.Print.
5. Chandra, Joseph, Xavier Alphonse, Antony Jeyadoss and Mary Thomas. *Power Communication In English*. Chennai, Loyola Publication, 2003.
6. Cole, Kris. *Crystal clear Communication*. Chennai, East West Books Pvt.Ltd.,2001. McKay,Mathew,Martha Davis and Patrick Fanning. *Communication Skills*. New Delhi,B.Jain Pub.(P) Ltd;2003.


**COURSE OUTCOMES:**

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

**CO1:** develop an enriched vocabulary and recognize the importance of discourse markers in effective communication.

**CO2:** recognize the barriers that can hinder effective communication and explore methods to overcome them.

**CO3:** analyze verbal communication and utilize non-verbal cues.

**CO4:** cultivate perseverance, resilience, and effective mind mapping for problem-solving and goal achievement.

**CO5:** demonstrate negotiation and persuasion skills for effective communication in various contexts.

**CO's- PO's & PSO's MAPPING.**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 0 | 1 | 2 | 2 | 1 | 2 | 0 | 2 | 3 | 3 |
| **CO2** | 0 | 1 | 2 | 1 | 1 | 2 | 0 | 1 | 2 | 3 |
| **CO3** | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 0 | 3 | 3 |
| **CO4** | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |
| **CO5** | 2 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 3 |
| **CO** | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 | 1 | 1.2 | 3 | 3 |

**1.low 2- medium 3- high 0 - no correlation**

| 23MA122 | MATHEMATICS-I | L | T | P | C | Total Marks |
|---|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 | 100 |

**PREREQUISITES: NIL**

**COURSE OBJECTIVES:**

The main objectives of this course are to:

| | |
|---|---|
| 1 | This course introduces the concepts of approximation values. |
| 2 | To learn the basic concepts of matrices. |
| 3 | To form algebraic equations finding roots. |
| 4 | To gain general knowledge of trigonometry. |
| 5 | To train the students to learn basic calculus |

| UNIT 1: | NUMERICAL METHODS | 12 |
|---|---|---|

Numerical Methods: Operators E,Δ,A, difference tables - Newton -Raphson method-Newton‟s forward and backward interpolation formulae for equal intervals.

| UNIT 2: | MATRICES | 12 |
|---|---|---|

Symmetric-Skew-Symmetric-Orthogonal-Hermetian-Skew-Hermetian-Unitary Matrices-Eigen values and Eigen-vectors-Cayley-Hamilton theorem (without proof)-verification.

| UNIT 3: | THEORY OF EQUATIONS | 12 |
|---|---|---|

Polynomial equations with real coefficients-irrational roots-complex roots-symmetric functions of roots-reciprocal equation-Newton‘s method to find a root approximately - simple problems.

| UNIT 4: | TRIGONOMETRY | 12 |
|---|---|---|

Expansions of $\sin(n\theta)$ and $\cos(n\theta)$ in a series of powers of $\sin\theta$ and $\cos\theta$ - Expansions of $\sin^n\theta$, $\cos^n\theta$, $\tan^n\theta$ in a series of sines, cosines and tangents of multiples of —θ‖ - Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in a series of powers of —θ‖.

| UNIT 5: | DIFFERENTIAL CALCULUS | 12 |
|---|---|---|

Successive differentiation-$n^{th}$ derivatives-partial differentiations (simple problems)-Jacobians-maxima and minima of functions of two variables-Lagrange's multipliers - Simple problems.

**60 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| **CO1** | Solve algebraic series and solve equations numerically |
| **CO2** | Get knowledge of matrices to find eigen values and eigen vectors. |
| **CO3** | Find roots of equations. |
| **CO4** | Solve all kinds of trigonometric functions. |
| **CO5** | Get the knowledge of basic differential calculus. |

**TEXT /REFERENCES BOOKS**


1. Allied Mathematics Volume I and II by P. Duraipandian and S. Udayabaskaran, Published byS. Chand-2016 Edition (Reprint)
2. S. Narayanan and T.K. Manickavasagam Pillai – Ancillary Mathematics, S. Viswanathan Printers, 2009, Chennai.
3. Dr. A.Singaravelu-Allied Mathematics, Published by Meenakshi Agency 2017 .

## CO'S-PO'S & PSO'S MAPPING

| CO's\PO's\PSO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 1 |
| CO2 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| CO4 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 2 |
| CO5 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 2 |

**1 – Low, 2 - Medium, 3 - High**

| 23PH101 | BASIC PHYSICS I | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 4 | 100 |

**Pre-Requisites: Nil**

**COURSE OBJECTIVES:**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Explain the fundamental principles of elasticity, including stress-strain relationships, elastic constants, and methods for determining rigidity modulus. |
| **2** | Analyze diffraction phenomena and their applications in determining optical properties such as resolving and dispersive power. |
| **3** | Explain atomic models, quantum numbers, and coupling schemes that explain atomic behavior and spectral characteristics. |
| **4** | Interpret the principles of acoustics and ultrasonics and their applications in engineering and technology. |
| **5** | Use the principles of heat conduction and radiation laws and their applications in thermal measurements. |

| **UNIT 1:** | **ELASTICITY** | **12** |
|---|---|---|

Hooke‘s Law – Stress – Strain - Elastic constants – Expressions for Poisson‘s ratio in terms of elastic constants – work done in stretching and twisting a wire – twisting couple on a cylinder – rigidity modulus by static torsion – torsional pendulum – rigidity modulus and moment of inertia.

| **UNIT 2:** | **DIFFRACTION** | **12** |
|---|---|---|

Fresnel diffraction - diffraction at a circular aperture and narrow wire. Fraunhoffer diffraction - single slit - double slit - (simple theory). Plane diffraction grating - missing order - overlapping spectra - maximum number of orders - Determination of wavelengths using grating - normal incidence - oblique incidence (theory). Dispersive power of a grating. Rayleigh's criterion for resolution - limit of resolution of the eye - resolving power of Telescope and microscope - resolving power of prism and grating - Difference between resolving power and Dispersive power.

| **UNIT 3:** | **Atomic Structure** | **12** |
|---|---|---|

Bohr and Sommerfield atom models - Vector atom model - Pauli's exclusion principle - explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - coupling schemes - LS and JJ coupling - special quantisation - Bohr magnetron - Stern and Gerlach experiments.

| **UNIT 4:** | **Acoustics and Ultrasonics** | **12** |
|---|---|---|

Ultrasonics – production – piezo electric crystal method – magnetostriction method – applications Acoustics of buildings – reverberation – Absorption coefficient – Sabine‘s formula – Acoustics aspects of halls and auditoriums

| **UNIT 5:** | **Conduction and Radiation** | **12** |
|---|---|---|

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe‘s method – thermal conductivity of a bad conductor – Lee‘s disc method – radiation – blackbody radiation – Wien‘s law – Stefan‘s law – Newton‘s law of cooling from Stefan‘s law – Solar constant – Pyrometer – Pyrheliometer.

**60 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| **CO1:** | Describe Hooke’s Law and the relationship between stress, strain, and elastic constants. |
| **CO2:** | Explain Fresnel and Fraunhofer diffraction patterns and their significance in optics. |
| **CO3:** | Compare Bohr, Sommerfeld, and vector atom models in explaining atomic structure. |

| | |
|---|---|
| **CO4:** | Evaluate the acoustics of buildings by calculating reverberation time and absorption coefficient using Sabine's formula. |
| **CO5:** | Explain radiation laws, including Wien's law and Stefan's law, and their applications in measuring solar radiation using pyrometers and pyrheliometers. |

| TEXT BOOKS | |
|---|---|
| 1. | Mechanics, D.S.Mathur, S.Chand & Co., 2nd Edition (2001). |
| 2. | A Text book of Optics, Subrahmanyam N., Brijlal and M.N. Avadhanulu,S.Chand & Co., New Delhi(2018). |
| 3. | Atomic Physics, J.B. Rajam, S. Chand & Co., 20th Edition, New Delhi (2004). |
| 4. | Text book of Sound, Ghosh, S.Chand & Co, New Delhi (1996). |
| **REFERENCES** | |
| 1. | Mechanics and General Properties of Matter, P.K. Chakrabarthy, Books and Allied (P) Ltd. (2001). |
| 2. | Optics, Ajay Ghatak, Tata Mc Graw-Hill publishing Co. Ltd., New Delhi(1998). |
| 3. | Modern Physics, Kenneth S.Krane, John Willey & sons, Canada (1998). |

**CO's-PO's & PSO's MAPPING**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1:** | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 2 | 2 |
| **CO2:** | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CO3:** | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 1 |
| **CO4:** | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO5:** | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO** | 2.6 | 2 | 2.6 | 2.6 | 2 | 1 | 2 | 3 | 2.6 | 2.8 | 2.6 | 2.2 |

**1 - Low, 2 - Medium, 3 - High**

| 23PH102 | BASIC PHYSICS LAB I | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Determine the Young's modulus of a material using the uniform and non-uniform bending method with a pin and microscope. |
| **2** | Evaluate the rigidity modulus of a given material using a torsional pendulum. |
| **3** | Determine the number of lines per unit length (N) and wavelength (λ) using a diffraction grating at normal incidence. |
| **4** | Measure the thickness of a thin wire using the air wedge interference method. |
| **5** | Verify the fundamental laws of vibrating strings using a sonometer. |

**PRACTICAL EXERCISES: 30 PERIODS**

| | |
|---|---|
| **1.** | Young's modulus – Non-uniform bending – Pin & microscope |
| **2.** | Young's modulus – Uniform bending – Pin & microscope |
| **3.** | Rigidity modulus – Torsional pendulum |
| **4.** | Spectrometer - Grating N and λ - normal incidence method |
| **5.** | Air wedge - Thickness of a wire |
| **6.** | Sonometer – Verification of Law |
| **7.** | Spectrometer – angle and refractive index of a prism using Minimum deviation |
| **8.** | Newton's law of cooling specific heat of liquid |

**COURSE OUTCOMES**

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

| | |
|---|---|
| **CO1:** | Measure the Young's modulus using uniform and non-uniform bending method. |
| **CO2:** | Determine the rigidity modulus by measuring the time period of oscillations. |
| **CO3:** | Calculate the wavelength of light using diffraction equations from the observed spectral orders. |
| **CO4:** | Compute the thickness of the wire by measuring the fringe width and applying interference equations. |
| **CO5:** | Compare the experimental values with theoretical predictions of the laws of vibrating strings. |

**REFERENCES**


| | |
|---|---|
| **1.** | Practical Engineering Physics Laboratory Manual., Dr. S. Stella Mary, RK Publication (2019) |


**CO's-PO's & PSO's MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |

**1 - Low, 2 - Medium, 3 - High**

| 23PH180 | EVERY DAY PHYSICS | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES:**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Explain the working principles and applications of electronic components, along with basic multimeter operations. |
| **2** | Demonstrate the working principles of commonly used mechanical and electronic devices. |
| **3** | Construct simple electrical circuits and perform wiring tasks. |
| **4** | Analyze the working of household electrical appliances. |
| **5** | Perform basic servicing and repairs on household electrical appliances. |

| | | |
|---|---|---|
| **UNIT 1:** | **Study of electronic components** | **9** |

Study of resistors, chokes, Capacitors and Transformers – multimeter – Basic principles – Measurement of resistance, Voltage AC & DC.

| | | |
|---|---|---|
| **UNIT 2:** | **How things work** | **9** |

Basic principles – Tape recorder – Taps – Lifts – Submarines – Jet planes – Helicopters – Rockets – fax machines – Pagers – Cellular phones

| | | |
|---|---|---|
| **UNIT 3:** | **Demonstration** | **9** |

Making a switch board with multiple points – wiring – one lamp controlled by one switch/Two switches – fixing a fuse – soldering – P.C.B Preparation

| | | |
|---|---|---|
| **UNIT 4:** | **Home electricity** | **9** |

Physics behind Home appliances – Light bulb – Fan – Hair drier – Television – Air Conditioners – microwave ovens – Vacuum cleaners – Dishwasher – Washing machines

| | | |
|---|---|---|
| **UNIT 5:** | **Servicing of domestic appliances** | **9** |

Servicing of iron box – mixie – grinder – motor – emergency lamp.

**45 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| **CO1:** | Describe electronic components and measure resistance and voltage using a multimeter. |
| **CO2:** | Explain the functioning of tape recorders, lifts, submarines, helicopters, rockets, and communication devices. |
| **CO3:** | Illustrate switchboard wiring, fuse fixing, and PCB preparation. |
| **CO4:** | Explain the principles behind fans, televisions, air conditioners, and kitchen appliances. |
| **CO5:** | Describe troubleshooting and maintenance of iron boxes, mixers, grinders, and motors. |

**TEXT BOOKS**

| | |
|---|---|
| **1.** | The Learner's series – Everyday science – Published by INFINITY BOOKS, New Delhi |
| **2.** | The Hindu speaks on Science, Vol I & II, Kasturi Ranga Publishers, Chennai |

**REFERENCES**

| | |
|---|---|
| **1.** | Fundamentals of Physics by D. Halliday, R.Rensick and J. Walker, 6th edition, Wiley,NY (2001). |
| **2.** | Physics, Vols I, II, III by D.Halliday, R.Resnick and K.S.Krane, 4th Edition, Wiley, New York (1994). |
| **3.** | The Feymann Lectures on Physics Vols I, II, III by R.P. Feynmann, R.B. Leighton &M. Sands, Narosa, New Delhi (1998). |

**CO's-PO's & PSO's MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

**1 - Low, 2 - Medium, 3 - High**

| 23PS121 | SOCIOLOGY IN THE CONTEXT OF POLITICAL SCIENCE | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES:**

The main objectives of this course are to:

1. Introduce students to and provide an overview of major perspectives, problems, and approaches in **Political Science.**
2. Learn the various theories of origin of state.
3. Familiarize with the basic concepts like Liberty, Equality, Rights and Law.

| UNIT 1: | INTRODUCTION TO SOCIOLOGY | 15 |
|---|---|---|

Meaning, Nature and Scope of Sociology –Relationship of Sociology with Other Social Sciences – Approaches to the study of sociology – Uses of Sociology.

| UNIT 2: | BASIC CONCEPTS AND INSTITUTIONS IN SOCIOLOGY | 15 |
|---|---|---|

Meaning, Nature and Scope of Sociology –Relationship of Sociology with Other Social Sciences – Approaches to the study of sociology – Uses of Sociology.

| UNIT 3: | URBAN AND RURAL SOCIETIES | 15 |
|---|---|---|

Urban Society: Meaning & Definition – Nature - Importance of Urban Society - Impacts on Urban Society - Urbanization – Factors of Urbanisation - Problems of Urbanisation in India.

Rural Society: Meaning & Definition – Nature – Importance of Rural Society - Impacts on Rural Society: Industrialization – Modernization – Globalization.

| UNIT 4: | SOCIAL STRATIFICATION | 15 |
|---|---|---|

Social Class: Meaning and Development of Social Class – Caste System – Meaning – Features-Merits and Demerits.

| UNIT 5: | SOCIAL PROBLEMS | 15 |
|---|---|---|

Unemployment – Alcoholism - Illiteracy – Juvenile Delinquency - Drug Abuse.

**TEXT BOOKS**


| | |
|---|---|
| **1.** | Vidhya Bhusan and Sachdeva, 1992, ―Introduction to Sociology‖, KitabMahal, Allahabad. |
| **2.** | Gisbert, Pascal (1973), ―Fundamentals of Sociology‖, Orient Longman, New Delhi. |


**REFERENCES**


| | |
|---|---|
| **1.** | Ram Ahuja, 1969, ―Social Problems in India‖, Rawat Publications, New Delhi. |
| **2.** | R.K. Meston, 1990, ―Social Structure‖, Sterling Press, New Delhi. |

| **COURSE OUTCOMES:** Upon successful completion of the course, students will be able to: | | |
|---|---|---|
| **CO** | **COURSE OUTCOME** | **KNOWLEDGE LEVEL** |
| CO1 | Define Political Science and discuss the various methods of Studying political science. | K1,K2 |
| CO2 | Classify the various theory of Origin of State. | K4 |
| CO3 | Locate the underlying problems in Sovereignty and divide the types of sovereignty. | K1,K4 |
| CO4 | Classify the different types of Law and distinguish between Law and Morality | K2, K4 |
| CO5 | Tabulate the fundamental Rights and associate its application in day-to-day life. | K1,K2 |
| **K1-Knowledge, K2-Understand, K3-Apply, K4-Analyze** | | |

**COPO MAPPING**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 0 | 3 | 0 | 3 | 3 |
| **CO2** | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **AVERAGE** | 3 | 2.4 | 2.4 | 1.6 | 2.6 | 1.6 | 3 | 3 |

**1 - Low, 2 - Medium, 3 – High**

| Course code 23TA131 | Ability Enhancement Course -2 | L | T | P | C |
|---|---|---|---|---|---|
| | ப□ொFத் தமிம் | 3 | 0 | 0 | 2 |

**அ□கு – 1 பெய்வின□் இ□க்கினந்**

**அ. தமிம்ெ் பெய்வி□க்கின யப□ொறு (41 நூ□்க□்**
**அறிமுகந்) ஆ. பு□□ொனூறு – கபி□ப் □ொட□்க□் (8,105,106,)**
**ஈ. முத்பதொ□்□ொயிபந்**

**அ□கு - 2 அ□ இ□க்கினந்**

**அ. அ□ இ□க்கின யப□ொறு**
**ஆ. திருக்கு□□் – □ட்பு, உமவு**
**இ. □ொ□டினொப் – க□்வி**
**ஈ. இ□ினதய □ொ□்□F – (1,2,9,16,28)**

**அ□கு - 3 கொ□்பினந்**

**அ. தமிம்க் கொ□்பினந் இ□க்கின யப□ொறு**
**ஆ. சி□□்□திகொபந் – யமக்குதபக் கொதத**
**இ. ப□பினபுபொணந் – கண்ண□்□ □ொன□ொப் புபொணந் ஈ.**
**நணிமநகத□ – ந□ப்ய□ந் புக்க கொதத**

**அ□கு – 4 ெநனக் கொ□்பினந்**

**அ. இஸ்□ொந் , கிறிஸ்Fய இ□க்கின யப□ொறு**
**ஆ.சீ□ொ□்புபொணந் – நொனுக்கு பிதண □ி□்□ □ட□ந் இ.**
**மதந்□ொயணி – ய□□் ெ□ித்த□் □ட□ந்**

**அ□கு - 5 பநொழி□் □யி□்சி**

**அ.ெ□்தி□் பிதம**
**□ீக்குத□் ஆ நதி□்புதப**
**எழுFத□் இ.பநொழி**
**ப□னப்□்பு**

| CO NO | COURSE OUTCOME | RBT |
|---|---|---|
| CO1 | சசப்வித□் டமின் இ□க்கிதங்கதந அறி□்F த□ா□்றுட□் | K2 |
| CO2 | டமின்க் கா□்பிதங்கதநயுண் அ□ இ□க்கிதங்கதநயுண் ஆி □த□்சகாந்ளுட□் | K6 |
| CO3 | சமூக □ஞ்□ா□்டு பான்வித□் விழுமிதங்கதந□் ச□றுட□் | K5 |
| CO4 | சணதங்கந் டமின் இ□க்கிதட்தி□்கு அநிட்ட சகாத□ம□த□ பு□ி□்Fசகாந்ளுட□் | K2 |
| CO5 | அடி□்□த□ சணாழிட்தி□த□யுண் □த□□்□ா□்□த□யுண் தணண்□டுட்Fட□் | K3 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | - | 2 | - | - | - | - | - | - |
| CO2 | - | - | - | - | - | 2 | - | - |
| CO3 | - | - | - | - | 2 | - | - | - |
| CO4 | - | 2 | - | - | - | - | - | - |
| CO5 | - | - | 2 | - | - | - | - | - |
| AVERAGE | - | 2 | 2 | - | 2 | 2 | - | - |

| Course Code: 23EN132 | Ability Enhancement Course E2 | L | T | P | C |
|---|---|---|---|---|---|
| | ENGLISH -II | 3 | 0 | 0 | 2 |

**Prerequisites:** None

**COURSE OBECTIVES:**

The objective of this course is to enhance students; communication abilities and equip them with the necessary skills to excel in various communication contexts.

**UNIT – I: Listening Skills:** **No.of.Hours:06**

- Importance of Listening
- Process of Listening
- Types of Listening
- Listening to stories/event narration; documentaries and interviews
- Listen to a classroom lecture

**UNIT – II: Speaking Skills:** **No.of.Hours:06**

- Self Introduction
- Process and Types of Speaking
- Extempore topics
- Public Speech
- Conducting and Organizing seminars and conferences

**UNIT – III: Reading Skills:** **No.of.Hours:06**

- Process of Reading
- Importance of Reading
- Components of Readings
- Types of Readings
- Reading Stories, Essays, biographies, News paper articles

**UNIT – IV: Writing Skills**: **No.of.Hours:06**

- Process of Writing
- Dialogue Writing
- Paragraph Writing
- Note Taking/Note Making
- Letter Writing and Hints development

**UNIT – V: Interview Skills** **No.of.Hours:06**

- Face to face conversation
- Telephonic conversation

- Formal and Informal Conversation
- Interviews for Placement - Mock Interviews Job/Internship application–Cover letter& Resume
- Group Discussions and Debates

**Total No. of Hours: 30**

**Book Recommended**

1. Krishna Mohan & Meera Banerji. *Developing Communication Skills*.Macmillan

2. SasiKumar. V and P.V. Dharmija. 1993. *Spoken English*: A Self-Learning Guide Conversation Practice. 34th reprint. Tata McGraw – Hill. New Delhi.

3. Suresh Kumar, E. & Sreehari, P. *Communicative English*. New Delhi: Orient BlackSwan, 2007.Print.

4.Yardi, V.V *English Conversation for Indian Students*. NewDelhi: Orient BlackSwan, 2002.Print.

5. Chandra, Joseph, Xavier Alphonse, Antony Jeyadoss and Mary Thomas. *Power Communication In English*. Chennai, Loyola Publication, 2003.

6. Cole, Kris. *Crystal clear Communication*. Chennai, East West Books Pvt.Ltd.,2001.

7. McKay,Mathew,Martha Davis and Patrick Fanning. *Communication Skills*. New Delhi,B.Jain Pub.(P) Ltd;2003.

**COURSE OUTCOMES:**

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

**CO1:** understand the sequential process of listening & its impact and identify various types of listening.

**CO2:** demonstrate effective public speaking skills, utilizing appropriate body language, tone, and content.

**CO3:** understand the process of reading by engaging with diverse reading materials.

**CO4:** comprehend the writing process, construct coherent and focused paragraphs and develop efficient note-taking and note-making techniques.

**CO5:** engage effectively in group discussions and debates to excel in interviews.

CO's- PO's & PSO's MAPPING.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 3 | 3 |
| **2** | 1 | 2 | 1 | 2 | 2 | 1 | 0 | 2 | 2 | 3 |
| **3** | 0 | 3 | 2 | 1 | 1 | 2 | 0 | 1 | 3 | 3 |
| **4** | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 3 |
| **5** | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 3 |
| **CO** | 1 | 1.6 | 1 | 1.2 | 1.6 | 1.5 | 1 | 1.4 | 3 | 3 |

1- Low, 2- medium, 3- high and 0 - no correlation

| 23MA132 | MATHEMATICS-II | L | T | P | C | Total Marks |
|---|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 | 100 |

**PREREQUISITES: NIL**

**COURSE OBJECTIVES:**

The main objectives of this course are to:

| | |
|---|---|
| **1** | To learn the basic concepts of Integrations. |
| **2** | To train the students in Differential equations. |
| **3** | Concepts of Laplace Transforms is also introduced. |
| **4** | To Understand Partial Differential Equations. |
| **5** | To Learn Laplace transformations. |

| **UNIT 1:** | **INTEGRAL CALCULUS** | **12** |
|---|---|---|

**Bernoulli's formula.** Reduction formulae - $\int_0^{\frac{\pi}{2}} sin^n x dx$, (m, n being $\int_0^{\frac{\pi}{2}} cos^n x dx, \int_0^{\frac{\pi}{2}} sin^m x cos^n x dx$ positive integers).

| **UNIT 2:** | **FOURIER SERIES** | **12** |
|---|---|---|

Fourier series for functions in $(0,2\pi)$ and $(0, 2l)$- Half range sine and cosine series in $\pi$) .

| **UNIT 3:** | **DIFFERENTIAL EQUATIONS** | **12** |
|---|---|---|

**Ordinary Differential Equations**: Second order non- homogeneous differential equations with constant coefficients of the form ay‖+by‟+cy=X where X is of the form $e^{\alpha x} sin\beta x$ and $e^{\alpha x} cos\beta x$.

| **UNIT 4:** | **PARTIAL DIFFERENTIAL EQUATIONS** | **12** |
|---|---|---|

Formation, complete integrals and general integrals-four standard types and solving Lagrange's linear equation P p +Q q=R

| **UNIT 5:** | **LAPLACE TRANSFORMS** | **12** |
|---|---|---|

Laplace transformations of standard functions and simple properties- inverse Laplac transforms- Application to solution of linear differential equations up to 2nd order- simple problems.

**60 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| **CO1** | Solve all type of integrals. |
| **CO2** | Acquire the knowledge of Fourier series. |
| **CO3** | Get the knowledge to solve ordinary differential equations. |
| **CO4** | Get the knowledge to solve partial differential equations. |
| **CO5** | Acquire the knowledge of Laplace transformations. |

**TEXT /REFERENCES BOOKS**


1. Allied Mathematics Volume I and II by P. Duraipandian and S. Udayabaskaran, Published by S. Chand-2016 Edition (Reprint)
2. S. Narayanan and T.K. Manickavasagam Pillai – Ancillary Mathematics, S. Viswanathan Printers, 2009, Chennai.
3. Dr. A.Singaravelu-Allied Mathematics, Published by Meenakshi Agency 2017 .

CO's- PO's & PSO's MAPPING.

| CO's\PO's\PSO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 1 |
| **CO2** | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 |
| **CO3** | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 3 |
| **CO4** | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 2 |
| **CO5** | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 2 |

1. low 2- medium 3- high 0 - no correlation

| 23PH181 | BASIC INSTRUMENTATION SKILLS | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 | 100 |

**Pre-Requisites: Nil**

**COURSE OBJECTIVES:**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Understand measurement concepts, instrument accuracy, precision, and errors. |
| **2** | Analyze the advantages of electronic voltmeters over conventional multimeters. |
| **3** | Identify the components and working principles of a CRO. |
| **4** | Compare analogue and digital meters and their measurement characteristics. |
| **5** | Explain the workings of a digital multimeter and frequency measurement. |

| **UNIT 1:** | **Basic of Measurement** | **9** |
|---|---|---|

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurementof dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

| **UNIT 2:** | **Electronic Voltmeter** | **9** |
|---|---|---|

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance.

| **UNIT 3:** | **Cathode** Ray **Oscilloscope** | **9** |
|---|---|---|

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence &chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

| **UNIT 4:** | **Digital Instruments** | **9** |
|---|---|---|

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digitalvoltmeter.

| **UNIT 5:** | **Digital Multimeter** | **9** |
|---|---|---|

Block diagram and working of a digital multimeter. Workingprinciple of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

**45 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| **CO1:** | Explain the principles of multimeter operation and its specifications. |
| **CO2:** | Describe the working principles and specifications of AC millivoltmeters. |
| **CO3:** | Adjust front panel controls and time base operation for proper waveform observation. |
| **CO4:** | Operate digital voltmeters and interpret their readings. |
| **CO5:** | Identify the various digital ICs and understand their operation. |

**TEXT BOOKS**

| | |
|---|---|
| **1.** | A text book in Electrical Technology - B L Theraja - S Chand and Co. |
| **2.** | Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk,2008, Springer |

| REFERENCES | |
|---|---|
| **1.** | Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012,Tata Mc-Graw Hill |
| **2.** | Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. |
| **3.** | Logic circuit design, Shimon P. Vingron, 2012, Springer. |

**CO's-PO's & PSO's MAPPING**

| CO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

**1 - Low, 2 - Medium, 3 - High**

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH111 | Basic Physics II | 5 0 0 4 |

**Prerequisites :Nil**

**Course Objectives:**

- Demonstrate the bending of beams and measure Young's modulus experimentally.
- Analyze optical aberrations and methods to minimize them.
- Understand the nature, production, and applications of X-rays.
- Study electrolysis, ionic mobility, and thermoelectric effects.
- Demonstrate thermodynamic processes and heat engine principles.

**UNIT 1 :** Bending of Beams **12 hours**

Cantilever – expression for bending moment – expression for depression – cantilever oscillations – Expression for time period – Experiment to find Young's modulus – Non uniform bending – Experiment to determine Young's modulus by Koenig's method – uniform bending – expression for elevation – experiment to determine Young's modulus using microscope

**UNIT 2 :** Geometrical Optics **12 hours**

Spherical aberration in lenses - methods of minimizing spherical aberration - condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in and out of contact) - Dispersion produced by a thin prism - Achromatic prisms - Combination of prisms to produce - Dispersion without deviation - Deviation without dispersion.

**UNIT 3:** X-Rays **12 hours**

Bragg's law - X-ray spectroscopy - characteristic X-ray spectra -satellite and Auger effect - continuous X-ray spectra - X-ray absorption and fluorescence - Moseley's law - uses of X-rays - Compton effect - experimental verification of Compton effect

**UNIT 4 :** Chemical Effects of Electric Current **12 hours**

Faraday's laws of Electrolysis - ionic velocities and mobilities. Calculation and experimental determination of ionic mobilities - transport number. Thermoelectricity Peltier effect - Experimental determination of Peltier coefficient - Thomson coefficient - experimental determination of Thomson coefficient - application of thermodynamics to a thermocouple and connected relations - thermoelectric diagram and uses.

**UNIT 5 :** Thermodynamics **12 hours**

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics-Heat engine – Carnot's engine – Carnot's theorem – Internal combustion engines – petrol and diesel engines – thermodynamics scale of temperature- Entropy – entropy and available energy – temperature – entropy diagram for Carnot's cycle - III Law of thermodynamics – Nernst's heat theorem.

**TOTAL HOURS :60**

**Text Book:**

1. Mechanics – Part I and II , Narayanamoorthy, National Publishing Company.
2. A Text book of Optics , Subrahmanyam N., Brijlal and M.N. Avadhanulu, S.Chand & Co., New Delhi(2018).
3. Modern Physics , R. Murugeshan, Kiruthiga Sivaprasath, S. Chand & Co., New Delhi(2008)
4. Electricity & Magnetism , M.Narayanamurthy & N.Nagarathnam, NPC pub., Revised edition
5. Heat and Thermodynamics ,D.S.Mathur, 3rd edition Sulthan Chand & Sons, New Delhi (1978)

**Reference Books :**

1. Fundamentals of Physics, D. Halliday, R.Rensick and J. Walker, 6th edition, Wiley, NY (2001).
2. Optics , Ajay Ghatak, Tata Mc Graw-Hill publishing Co. Ltd., New Delhi(1998).
3. Modern Physics , Kenneth S.Krane, John Willey & sons, Canada(1998).
4. Electricity & Magnetism by K.K.Tewari, S.Chand & Co., New Delhi, .(2002).
5. Heat and Thermodynamics , Zemansky, McGraw – Hill Book Co. Inc., New York.

**Expected Course Outcomes:**

Students will be able to

**CO1**: Perform experiments on cantilever oscillations and bending methods to determine Young's modulus.

**CO2**: Explain the conditions for achromatism, dispersion without deviation, and deviation without dispersion.

**CO3**: Describe Bragg's law, Moseley's law, Compton effect, and X-ray spectroscopy.

**CO4**: Explain Faraday's laws, Peltier and Thomson coefficients, and thermoelectric applications.

**CO5**: Apply the law of thermodynamics and entropy concepts in analyzing the thermal efficiencies of heat engines such as Carnot cycles.

**CO's-PO's & PSO's MAPPING**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1:** | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 2 | 2 |
| **CO2:** | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CO3:** | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 1 |
| **CO4:** | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO5:** | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO** | 2.6 | 2 | 2.6 | 2.6 | 2 | 1 | 2 | 3 | 2.6 | 2.8 | 2.6 | 2.2 |

**1 - Low, 2 - Medium, 3 - High**

| Course Code 23PH112 | Course Title BASIC PHYSICS LAB II | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Demonstrate the uniform bending method to determine Young's modulus. |
| **2** | Perform the deflection method for measuring Young's modulus using cantilever oscillations. |
| **3** | Set up an optical system to determine the focal length and refractive index of a convex lens. |
| **4** | Investigate the optical properties of a concave lens. |
| **5** | Apply the analytical technique and graphical analysis to the experimental data. |

**PRACTICAL EXERCISES: 30 PERIODS**

| | |
|---|---|
| **1.** | Young's modulus – Uniform bending – Pin & microscope |
| **2.** | Young's modulus - cantilever oscillations - (Deflection method) |
| **3.** | Focal length, Power, R and refractive index of a long focus convex lens. |
| **4.** | Focal length, Power, R and refractive index of a concave lens. |
| **5.** | Sonometer - A.C. Frequency - Steel and Brass wires |
| **6.** | Thermal conductivity of a bad conductor - Lee's disc method |
| **7.** | Post-office box Measurement of resistance and specific resistance. |
| **8.** | Spectrometer - μ of a glass prism - i-d Curve |

**COURSE OUTCOMES**

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

| | |
|---|---|
| **CO1:** | Measure the depression and calculate Young's modulus using the pin & microscope method. |
| **CO2:** | Calculate the modulus by analyzing the oscillations and deflection of the cantilever. |
| **CO3:** | Compute the focal length, power, radius of curvature, and refractive index experimentally. |
| **CO4:** | Determine the focal length, power, radius of curvature, and refractive index using experimental methods. |
| **CO5:** | Apply the analytical technique and graphical analysis to the experimental data. |

**REFERENCES**

| | |
|---|---|
| **1.** | Practical Engineering Physics Laboratory Manual., Dr. S. Stella Mary, RK Publication (2019) |

**CO's-PO's & PSO's MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |

**1 - Low, 2 - Medium, 3 - High**

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23CA135 | ADVANCED EXCEL | 3 | 0 | 0 | 3 |

**Pre-requisites :Nil**

**Course Objectives:**

UNIT I: Know Your Workbook

Workbook and worksheets- Navigation with keyboard - Tabs and ribbons – file menu - quick access toolbar - create print and save workbook - worksheet basics - protecting excel workbook and worksheet - importing and exporting data - co-authoring.

UNIT II: Data and Formatting

Data and Formatting - Adding Data – Cut Copy Paste - Data fill - Data Movement - Cell Formatting - Conditional Formatting – Cell Operations – Reusable Lists - Data Validation – Sorting and Filtering - Tables.

UNIT III: Formulas and Functions

Understanding formulas – operators in formula - named ranges –calculations – functions in formulas - relative and absolute addressing - referencing cells outside the worksheet and workbook.

UNIT IV: Functions

Functions- logical – summarizing - what if analysis – data validation – logical analysis - look up functions – array functions – text- lookup – reference - data and time - math functions – error handling -formula auditing.

UNIT V: Charts

Charts types and uses - Chart depiction – column – line – pie – bar – bubble – histogram Analysis -Pivot Table -Pivot Charts.

Textbooks:

Manisha Nigam, ―Data Analysis with Excel‖, BPP publications

**Expected Course Outcomes:**

Students will be able to

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH205 | Electricity and Electromagnetism | 5 | 0 | 0 | 4 |

**Prerequisites: Nil**

**Course Objectives:**

- Demonstrate the principles of electric fields, potentials, and charge distributions.
- Demonstrate the effect of conductors and dielectrics in an electric field.
- Operate instruments to study magnetic fields produced by current-carrying conductors.
- Perform experiments to study electromagnetic induction and transformer efficiency.
- Demonstrate the propagation of electromagnetic waves using Maxwell's equations.

**UNIT I: ELECTROSTATICS I (12 Hours)**

Properties of charges - Coulomb's law and its Validity –Superposition Principle – Electric field and Electric Potential – Relations between field and potential - Energy consideration – Flux – Gauss law – Linear, Surface and Volume charge distributions – Solutions of Laplace equation – Stability of Charges – Electric dipole – Multipole expansion

**UNIT II: CONDUCTORS, CAPACITORS AND DIELECTRICS (12 Hours)**

Electrical Images and its Applications (Earthed sheet and earthed Spherical conductor) – Capacitance – Energy Consideration – Classical Radius of an Electron –Polarization Density – Polarization Charge Densities – Relation between D, E and P, Gauss's law in the presence of a dielectric – Boundary condition on D and E

**UNIT III: MAGNETIC EFFECTS OF AN ELECTRIC CURRENT (12 Hours)**

Biot-Savart's law and its Application to Circular Loop-Helmholtz Galvanometer-Ampere's Circuital Law both in Integral and Differential Form and its Application to Current Carrying Loop, Solenoid and Toroid-Properties of B: Curl and Divergence- Force on a current element in a magnetic field-Moving coil Ballistic Galvanometer-Damping Correction-Figure of Merit-Determination of Absolute Capacitance of a capacitor

**UNIT IV: ELECTROMAGNETIC INDUCTION (12 Hours)**

Faraday's law of Electromagnetic Induction (Differential and Integral form)- Lenz's law- Self Inductance– Mutual Inductance – Coefficient of Coupling-Self Inductance of a long solenoid-Mutual Inductance of two coils- Measurement of L and M using Ballistic Galvanometer Transformers- Construction and working -Efficiency and Energy loss

**UNIT V: ELECTROMAGNETIC WAVES (12 Hours)**

Types of currents- Concept of Displacement Current – Maxwell's equations – Maxwell's equations in Free Space- Electromagnetic Waves Equations- Velocity of EM wave-Transverse nature of EM wave- Poynting vector and its significance- Reflection and Transmission of electromagnetic waves at an interface of non-conducting medium

**TOTAL HOURS: 60**

**Books for Study:**

1. Electricity and Magnetism, A S Mahajan, A A Rangwala, McGraw Hill, New Delhi (2017)
2. Introduction to Electrodynamics, David J. Griffith, PHI, New Delhi, (2012).
3. Electromagnetic theory, Chopra & Agarwal, K Nath& Co.

**Books for Reference:**

1. Electricity and Magnetism, E M. Purcell, David Morin (3rd Edition), Cambridge University Press.
2. Basic laws of Electromagnetism, I E Irodov, New Age International Publishers, New Delhi, (2019).
3. Electricity and Magnetism, Navina Wadhwani, PHI, New Delhi, (2007).
4. Electricity and Magnetism, K.K Tewari, S Chand & Co, New Delhi, (2007).
5. Fundamentals of Physics – Electricity and Magnetism, Halliday – Resnick and Walker, Wiley India Pvt Ltd, (2011).
6. https://swayam.gov.in/nd1_noc20_ph08/preview
7. https://www.youtube.com/playlist?list=PLQNC9KhS56XwsAtI28BZGC9cEGWGhuEOk
8. https://nptel.ac.in/courses/115101005/
9. https://nptel.ac.in/content/storage2/courses/115101004/downloads/module1/ed-1-1-new.pdf

**Expected Course Outcomes:**

After the successful completion of this paper, students will be able to:

**CO1:** Construct electrostatic field configurations using Coulomb's law and Gauss's law.

**CO2:** Analyze the effects of polarization, boundary conditions, and capacitance in dielectric materials.

**CO3:** Calibrate a ballistic galvanometer and measure magnetic fields using Biot-Savart's law.

**CO4:** Measure self-inductance and mutual inductance using a ballistic galvanometer.

**CO5:** Interpret the behavior of EM waves through reflection, transmission, and Poynting vector analysis.

**CO's-PO's & PSO's MAPPING**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1:** | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 2 | 2 |
| **CO2:** | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 2 |
| **CO3:** | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 1 |
| **CO4:** | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO5:** | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO** | 2.6 | 2 | 2.6 | 2.6 | 2 | 1 | 2 | 2 | 2.6 | 2.8 | 2.6 | 2.2 |

**1 - Low, 2 - Medium, 3 – High**

| Course Code 23PH206 | **Course Title** Electricity and Electromagnetism Lab | **L** | **T** | **P** | **C** | **TOTAL MARKS** |
|---|---|---|---|---|---|---|
| | | **0** | **0** | **3** | **2** | **100** |

Prerequisites: Nil

**COURSE OBJECTIVES**

The main objectives of this course are to:

| | |
|---|---|
| 1 | Assemble various experimental setups to measure electrical, magnetic, and thermal properties accurately. |
| 2 | Operate potentiometers, ballistic galvanometers, and magnetometers to calibrate electrical instruments and determine physical constants. |
| 3 | Analyze the behavior of electrical and magnetic fields using deflection and vibration magnetometers. |
| 4 | Evaluate sources of error in measurements and apply correction techniques for increased accuracy. |
| 5 | Interpret experimental results and compare them with theoretical values to enhance problem-solving skills. |

**PRACTICAL EXERCISES: 30 PERIODS**

| | |
|---|---|
| **1.** | Potentiometer – Internal resistance |
| **2.** | m and $B_H$ - deflection magnetometer Tan C position and vibration magnetometer |
| **3.** | Carey Foster bridge - Temperature coefficient of resistance of a coil |
| **4.** | Potentiometer - Calibration of low range voltmeter. |
| **5.** | Potentiometer - Calibration of high range voltmeter. |
| **6.** | Potentiometer - Ammeter calibration. |
| **7.** | Field along axis of a circular coil - Deflection magnetometer - $B_H$ and M. |
| **8.** | Field along axis of a circular coil - vibration magnetic needle - $B_H$. |
| **9.** | B.G - Figure of merit (quantity of charge) |
| **10.** | B.G - Comparison of EMFs |
| **11.** | B.G - Comparison of capacitances |
| **12.** | B.G - Internal resistance of a cell |

**COURSE OUTCOMES**

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

| | |
|---|---|
| **CO1:** | Conduct precise measurements using potentiometers, galvanometers, and magnetometers for electrical and magnetic analysis. |
| **CO2:** | Determine key physical parameters such as internal resistance, temperature coefficient, and horizontal magnetic field component. |
| **CO3:** | Compare experimental observations with theoretical predictions to validate scientific principles. |
| **CO4:** | Apply calibration techniques to improve the accuracy of electrical measuring instruments. |
| **CO5:** | Develop critical thinking and technical skills in handling experimental setups for real-world applications. |

**REFERENCES**


| | |
|---|---|
| **1.** | Practical Engineering Physics Laboratory Manual., Dr. S. Stella Mary, RK Publication (2019) |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23CY221 | Allied Chemistry- I | 5 | 0 | 0 | 4 |

**Prerequisites: Nil**

**Course Objectives:**

- To acquire knowledge in industrial and nuclear chemistry
- To understand the basics of organic chemistry
- To gain knowledge in the field of thermodynamics and chemical kinetics

**Unit 1: NUCLEAR CHEMISTRY**

Fundamental particles of nucleus, isobars, isotones and isomers – Differences between chemical reactions; fusion and fission – Radioactive series, group displacement law – Mass defect, derivation of 1amu = 931 MeV – nuclear binding energy and calculation – Applications of radio isotopes – carbon dating, and medicinal applications.

**Unit 2: INDUSTRIAL CHEMISTRY**

Fuels- Classification-gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, Compressed natural gas - Fertilizers- Classification – urea, Ammonium sulphate, superphosphate, Triple superphosphate, potassium nitrate- manufacture and uses - Silicones - Preparation, properties and applications. Hardness of water: temporary and permanent hardness, disadvantages of hard water - Softening of hard water - Zeolite process, demineralization process and reverse osmosis - Purification of water for domestic use: use of chlorine, Ozone and UV light - Definition and determinations of BOD and COD.

**Unit 3: FUNDAMENTALS OF ORGANIC CHEMISTRY**

Classification of organic compounds -.Hybridization in methane, ethane, acetylene, benzene - classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions addition, substitution, elimination, condensation and polymerisation - Polar Effects - Inductive effect, resonance, hyper-conjugation, steric effect - Keto-enol tautomerism - electrophilic substitution mechanism in benzene (Nitration and Sulphonation) – Heterocyclic compounds - Preparation, properties and uses of furan, Thiophene, pyrrole and pyridine

**Unit 4: THERMODYNAMICS**

Definition of Certain terms - system, surrounding, reversible and irreversible process - Limitations of I Law Need for II Law - Different Statements of II. Law - Carnot cycle - Efficiency - Carnot Theorem - Thermodynamic Scale Of Temperature - Entropy- Definition Unit and change of entropy for phase transformation 'Free energy nature of Process in terms of Free energy and entropy-Statement of Third Law.

**Unit 5: CHEMICAL KINETICS**

Rate of chemical reaction- Differential rate expression - order and molecularity - Integrated rate expression for first, second, and zero order reactions - Half-life period— Effect of temperature on rate - Activation energy. Arrhenius equation - Arrhenius reaction rate theory - Homogeneous and heterogeneous catalysis. Photochemistry - Statement of Grothus - Draper Law, Stark-Einstein's Law, Quantum Yield. Hydrogen chlorine reaction (elementary idea only) Photosynthesis, Photosensitisation, Phosphorescence Fluorescence, Chemiluminescence - Definition with examples.

**BOOK FOR REFERENCE**

1. Dr. Veeraiyan V., Text book of Ancillary Chemistry, Highmount Publishing house, Chennai-14. Edition - 2008. (Both In Tamil and English)

2. Vaithyanathan S. and Others, Text book of Ancillary Chemistry, Priya Publications, Karur-2. Edition-2006.

3. Soni P., and Others, Text book of Organic chemistry, Sultan Chand and Company, New Delhi, Edition - 2006.

4. 8oni P. and Others, Text book of Inorganic Chemistry, Sultan Chand and Company, New Delhi, Edition - 2006.

5. Puri B.R., Sharma and Pathania, Text book of Physical Chemistry, Vishal Publishing Co., New Delhi. Edition-2006.

6. Dara S.S., Text book of Environmental chemistry and Pollution Control. - S.Chand and Co., New Delhi, Edition 2006.

**Expected Course Outcomes:**

After the successful completion of the course, students will be able to:

CO1 - Impart knowledge on design and mechanism of various chemical reactions in nuclear, industrial and organic chemistry.
CO2 - Gain knowledge on industrial chemistry and water technology, purification of hard water.
CO3 - Understanding the basic concept of organic chemistry, keto- enol tautomerism, hybridization
CO4 - Gain knowledge various thermodynamic laws
CO5 - Understand the chemical kinetics, various theories of photochemistry

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | **1** | **-** | **-** | **1** | **-** | **-** | **-** | **-** |
| **CO2** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO3** | **-** | **-** | **1** | **-** | **-** | **-** | **3** | **-** |
| **CO4** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO5** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **-** |
| **AVERAGE** | **0.2** | **0.2** | **0.2** | **0.4** | **-** | **-** | **1.2** | **-** |

Since it is mapped with, PO1, PO2, PO3, PO5 and PO7 this subject is considered for employability

| Course code 23CY222 | Chemistry – I Allied Practical | L | T | P | C | Total Marks |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 | 100 |

**Prerequisites:**

**Course Objectives**

To gain knowledge on various types of titrimetric analysis

**PRACTICAL EXERCISES:** **30 PERIODS**

**Volumetric Analysis**

| | |
|---|---|
| **1.** | Estimation of sodium hydroxide using standard sodium carbonate. |
| **2.** | Estimation of Hydrochloric acid using standard Oxalic acid. |
| **3.** | Estimation of Ferrous sulphate using standard Mohr's salt |
| **4.** | Estimation of oxalic acid using standard Ferrous sulphate. |
| **5.** | Estimation of potassium permanganate using standard Sodium hydroxide. |
| **6.** | Estimation of Magnesium by EDTA. |
| **7.** | Estimation of Ferrous ion using diphenylamine as internal indicator. |

**COURSE OUTCOMES**

On completion of the lab course student will be able to demonstrate skills learnt quantitative aspects to industrial requirements.

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23CP225 | **Internet Technologies & Tools** | **4** | **0** | **0** | **4** |

**Prerequisites : None**

**Course Objectives:**

1. To teach the basics involved in publishing content on the World Wide Web.
2. To learn _language of the Web' – HTML, the fundamentals of how the Internet and the Web function, a basic understanding of graphic production with a specific stress on creating graphics for the Web, and a general grounding introduction to more advanced topics such as programming and scripting.
3. To expose students to the basic tools and applications used in Web publishing.

**Unit 1 : Networking Protocols and Internet:**

Introduction, Protocols in Computer Communications, the OSI Model, OSI Layer Functions. Why Internet Working?, Problems in Internet Working, Dealing with Incompatibility Issues, A Virtual Network, Internet Working Devices, Repeaters, Bridges, Routers, Gateways, A Brief History of the Internet, Growth of the Internet.

**No. of Hours 9**

**Unit 2 : WWW, HTTP, TELNET:**

Introduction, Brief History of WWW, the Basics of WWW and Browsing, Hyper Text Markup Language, Common Gateway Interface, Remote Login.

**No. of Hours 9**

**Unit 3 : JavaScript and AJAX**

Introduction, JavaScript, Basic Concepts, Controlling JavaScript Execution, Miscellaneous Features, JavaScript and Form Processing, Pop-up Boxes. AJAX: Introduction, How AJAX Works? , Life without AJAX, AJAX Coding, Life with AJAX.

**No. of Hours 9**

**Unit 4 : Introduction to XML**:

What is XML?, XML versus HTML, Electronic Data Interchange, XML Terminology, Introduction to DTD, Document-Type Declaration, Element-Type Declaration, Attribute Declaration, Limitations of DTDs, Introduction to Schema, Complex Types, Extensible Style sheet Language Transformations, Basics of Parsing, JAXP

**No. of Hours 9**

**Unit 5 : Creating Good Web Pages:**

Introduction, Top Level Navigation, Creating Sample Layouts, Metaphor, Theme, and Storyboard, Screen Resolution,3-Column Layout, Using Frameworks, Using Graphics, Usability for the Handheld Devices, Creating Multilingual Web sites, XHTML and Web Browser Compatibility Issues, Designing the Basic Elements of a Home Page.

**No. of Hours 9**

**Text Books:**

1. Achyut Godbole, Atul Kahate "Web Technologies: TCP/IP, Web/Java Programming, and Cloud Computing‖, Third Edition, McGraw Hill Education.

**Reference Books:**

1. Deitel, Deitel, Goldberg, "Internet & WorldWideWeb How to Program",3rd Edition, Pearson Education, 2006.
2. Raj Kamal, ―Internet and Web Technologies‖, Tata McGraw-Hill

**Expected Course Outcomes:** The student will be able to:

**CO1:** Analyze a web page and identify its elements and attributes.
**CO2:** Create web pages using XHTML and Cascading Style Sheets.
**CO3**: Build dynamic web pages using JavaScript (Client side programming).
**CO4:** Create XML documents and Schemas.
**CO5:** Build interactive web applications using AJAX.

| Course Code | Course Title | L T P C |
|---|---|---|
| 23VA270 | Environmental Science | 5 0 0 4 |

**Prerequisites: Nil**

**Course Objectives:**

- Identify different types of natural resources and their sustainable usage.
- Explain the structure, functions, and dynamics of ecosystems.
- Classify biodiversity at global, national, and local levels and assess conservation strategies.
- Analyze various types of pollution, their effects, and control measures.
- Evaluate environmental laws, policies, and sustainable practices for ecological conservation.

**Unit 1: Natural Resources** **12 hrs**

Definition, scope and importance, need for public awareness.

**Renewable and non-renewable resources:**

Natural resources and associated problems.

a. Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b. Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c. Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d. Food resources : World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e. Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
f. Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

**Unit 2 : Ecosystems** **12 hrs**

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystems :-
  (a) Forest ecosystem
  (b) Grassland ecosystem
  (c) Desert ecosystem
  **(d)** Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Unit 3: Biodiversity and its conservation** **12 hrs**

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**Unit 4 : Environmental Pollution** **12 hrs**

Definition

• Cause, effects and control measures of :-

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

- Solid waste Management : Causes, effects and control measures of urban and
- industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Diaster management : floods, earthquake, cyclone and landslides.

**Unit 5 : Social Issues and the Environment** **12 hrs**

From Unsustainable to Sustainable development

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rahabilitation of people; its problems and concerns. Case
- Studies
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear
- accidents and holocaust. Case Studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

**Total: 60 hrs**

**Expected Course Outcomes:**

- Differentiate between renewable and non-renewable resources and propose conservation strategies.
- Illustrate food chains, ecological pyramids, and energy flow in different ecosystems.
- Examine biodiversity threats and conservation methods, including in-situ and ex-situ approaches.
- Assess the causes, effects, and preventive measures of environmental pollution.
- Apply environmental protection laws and sustainable practices to real-world challenges.

**CO's-PO's & PSO's Matrices**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO2** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO3** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO4** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO5** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **AVG** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |

**1.- Low, 2 - Medium, 3 – High**

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH282 | Electrical Circuits and Network Skills | 5 0 0 4 |

**Prerequisites: Nil**

**Course Objectives:**

- Demonstrate the fundamental principles of voltage, current, resistance, and power in electrical circuits.
- Interpret electrical symbols, blueprints, and circuit schematics for practical applications.
- Analyze the working principles of electric motors, solid-state devices, and transformers.
- Apply electrical wiring techniques, including circuit protection methods.
- Evaluate electrical protections, conductor types, and power measurement techniques.

**UNIT I: ELECTRICAL CIRCUITS AND BASIC PRINCIPLE (12 Hours)**

Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC, Electricity. Familiarization with multimeter, voltmeter and ammeter. Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

**UNIT II: ELECTRICAL DRAWING AND SYMBOLS (12 Hours)**

Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identifying current flow and voltage drop.

**UNIT III: ELECTRIC MOTORS AND SOLID-STATE DEVICES (12 Hours)**

DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heater and motors, speed and power of ac motor. Resistors, inductors and capacitors, Diode and rectifiers, Components in series or in shunt, Response of Inductors and capacitors with AC or DC sources.

**UNIT IV: ELECTRICAL WIRING (12 Hours)**

Relays, fuses and disconnect switches, Circuit breakers, Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device).

**UNIT V: ELECTRICAL PROTECTIONS (12 Hours)**

Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of the extension board.**TOTAL HOURS: 60**

**BOOKS FOR STUDY:**

1. A textbook in Electrical Technology - B L Theraja - S Chand & Co.
2. A textbook of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.

**Expected Course Outcomes:**

After the successful completion of this paper, students will be able to:

- Design and troubleshoot certain electrical circuits and domestic appliances along with the understanding of the working of those appliances.
- Do electrical wiring and repairing. This knowledge will develop the skill of the students for various electrical repairing and servicing purposes.

**CO's-PO's & PSO's Matrices**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO 1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1:** | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 2 | 2 |
| **CO2:** | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 2 |
| **CO3:** | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 1 |
| **CO4:** | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO5:** | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO** | 2.6 | 2 | 2.6 | 2.6 | 2 | 1 | 2 | 2.6 | 2.6 | 2.8 | 2.6 | 2.2 |

**1 - Low, 2 - Medium, 3 – High**

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH207 | Optics and Spectroscopy | 6 | 0 | 0 | 5 |

**Prerequisites: Nil**

**Course Objectives:**

- Demonstrate the principles of geometrical optics, including reflection, refraction, and image formation.
- Analyze interference phenomena in thin films, Newton's rings, and Michelson's interferometer.
- Illustrate the concepts of polarization, double refraction, and optical activity using polarizing elements.
- Construct holograms using laser principles and apply interference techniques for reconstruction.
- Interpret spectroscopic techniques such as microwave, vibrational, and Raman spectroscopy for molecular characterization.

**UNIT I: GEOMETRICAL OPTICS (12 Hours)**

Elementary geometrical optics in the paraxial approximation. Refractive index; reflection and refraction at a plane boundary from Huygens' principle and Fermat's principle; Snell's Law; total internal reflection. Image formation by reflection at a spherical boundary; concave and convex mirrors. Real and virtual images. Magnification. Image formation by refraction at a spherical boundary and by converging and diverging thin lenses. Derivation of the expression for the focal length of a thin lens.

**UNIT II: INTERFERENCE (12 Hours)**

Analytical treatment of interference - Expression for intensity - Condition for maxima and minima in terms of phase and path difference - Coherent sources, Interference in thin films – transmitted and reflected - Colour of thin films -Air wedge - Determination of diameter of thin wire - Test for optical flatness - Determination of wavelength of light using Newton's rings - Haidinger's fringes - Michelson's Interferometer – Theory - Applications - Determination of wavelength - Thickness of thin transparent material and resolution of interferometer.

**UNIT III: POLARISATION (12 Hours)**

Double refraction - Nicol prism - Polarizer and analyser - Huygens explanation of double refraction in uni-axial crystals - Double image polarizing prisms - Quarter wave plate and Half wave plate - Plane, elliptically and circularly polarized light - Production and detection - Babinet's Compensator - Optical Activity - Fresnel's explanation of optical activity - Specific rotatory power - Determination using Laurent's half shade polarimeter.

**UNIT IV: HOLOGRAPHY (12 Hours)**

Laser - Ruby laser - He-Ne, $CO_2$ laser construction and working - application of laser. Principle of Holography, Recording and Reconstruction Method, Theory of Holography as Interference between two Plane Waves, Point Source Holograms.

**UNIT V: SPECTROSCOPY (12 Hours)**

Introduction to spectroscopy - Electromagnetic spectrum - characterization of electromagnetic radiation - quantization of energy - regions of the spectrum – classification of molecules – microwave spectroscopy – rigid rotator - vibrational spectroscopy – harmonic oscillator - Raman effect - experimental set up - Characteristics of Raman lines.

**TOTAL HOURS: 60**

**BOOKS FOR STUDY:**


1. Optics, Ajay Ghatak, Tata McGraw-Hill Publishing Co. Ltd., New Delhi (1998).
2. A Textbook of Optics, Subrahmanyam N., Brij Lal and M. N. Avadhanulu, S. Chand & Co., New Delhi (2006).
3. Optics and Spectroscopy, R. Murugesan and Kiruthiga Sivaprasath, S. Chand & Co., New Delhi (2006).
4. Modern Optics, A.B. Gupta, 2013, Books & Allied (P) Ltd.


**BOOKS FOR REFERENCE:**


1. Optics, Khanna D. R. &Gulati H. R., S. Chand & Co., New Delhi (1979).
2. Fundamental of optics, Jenkins & White, McGraw Hill 4th edition (1981).
3. Fundamentals of Physics, D. Halliday, R. Resnick and J. Walker, Wiley, 6th Edition, New York (2001).
4. H. Lipson and D.S Tannhauser, S.G. Lipson, Optical Physics, (3rd edition), Cambridge University Press (1995).
5. Miles V. Klein and Thomas E.Furtak, Optics, John Wiley & sons(2nd edition ) (1987)


**Websites**

1. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
2. https://nptel.ac.in/courses/122103011/

**Expected Course Outcomes:**

After the successful completion of this paper, students will be able to:

- Apply Snell's Law, Huygens' and Fermat's principles to solve problems in geometrical optics.
- Examine interference patterns and determine the wavelength of light using interferometric methods.
- Operate optical instruments like polarimeters and wave plates to analyze polarization effects.
- Utilize laser and holography techniques for recording and reconstructing 3D images.
- Differentiate various spectroscopic methods and interpret molecular spectra based on electromagnetic interactions.

**CO's-PO's & PSO's MAPPING**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO 1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1:** | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 2 | 2 |
| **CO2:** | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 2 |
| **CO3:** | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 1 |
| **CO4:** | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO5:** | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO** | 2.6 | 2 | 2.6 | 2.6 | 2 | 1 | 2 | 2.6 | 2.6 | 2.8 | 2.6 | 2.2 |

**1 - Low, 2 - Medium, 3 – High**

| Course code 23PH208 | OPTICS LAB | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Know the concept of spectrometer |
| **2** | Gain the knowledge by optical properties |
| **3** | Apply the concept of refractive index |
| **4** | Gain practical knowledge by applying the experimental methods to correlate with the physics theory. |
| **5** | Apply the analytical technique and graphical analysis to the experimental data. |

**PRACTICAL EXERCISES: 30 PERIODS**

| | |
|---|---|
| **1.** | Determination of the refractive index of a given liquid by travelling microscope. |
| **2.** | Spectrometer - Small angled prism - Normal incidence and emergence refractive index of the material of the prism. |
| **3.** | Spectrometer – refractive index of a liquid. |
| **4.** | Refractive index of a liquid and materials of the lens with mercury-liquid lens. |
| **5.** | Refractive index of a liquid and materials of the lens with another liquid of known refractive index. |
| **6.** | Spectrometer - Cauchy's constant. |
| **7.** | Newton's rings - R1, R2 and μ of convex lens |
| **8.** | Newton's rings - Refractive index of liquid |

**COURSE OUTCOMES**

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

| | |
|---|---|
| **CO1:** | Apply the concepts of spectrometer |
| **CO2:** | Recall the concept of optical properties |
| **CO3:** | Gain knowledge about of refractive index |
| **CO4:** | Acquire the knowledge about experimental methods to correlate with the physics theory |
| **CO5:** | Apply the analytical technique and graphical analysis to the experimental data. |

**REFERENCES**


| | |
|---|---|
| **1.** | Practical Engineering Physics Laboratory Manual., Dr. S. Stella Mary, RK Publication (2019) |


**CO's-PO's & PSO's MAPPING**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 1 | 1 |
| **CO2** | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 1 | 1 |
| **CO3** | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 1 | 1 |
| **CO4** | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 1 | 1 |
| **CO5** | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 1 | 1 |
| **AVG** | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 1 | 1 |

**1 - Low, 2 - Medium, 3 – High**

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH209 | Basic Electronics | 5 | 0 | 0 | 4 |

**Prerequisites: Nil**

**Course Objectives:**

- Analyze the energy band structure of semiconductors and demonstrate the behavior of intrinsic and extrinsic semiconductors.
- Examine the characteristics of diodes, transistors, and special semiconductor devices to understand their applications.
- Design and construct amplifier circuits using h-parameters and study their frequency response.
- Implement oscillators and multivibrators for signal generation and test their performance.
- Apply Boolean algebra and logic gate operations to develop digital circuits for computational applications.

**UNIT I: SEMICONDUCTORS (10 Hours)**

Band gap-Forbidden Gap-Valence and Conduction Bands-Pure Semiconductors-Impurity in Semiconductors-Energy band Diagram and Fermi level-Fermi Energy and Carrier Concentration of Intrinsic and Extrinsic Semiconductors-PN junction- barrier- Voltage across the junction - Junction Diodes- Zener Diodes- V-I characteristics-Light Emitting Diodes-Photo Diodes

**UNIT II: TRANSISTOR AMPLIFIER (14 Hours)**

Transistors- CB and CE modes-Characteristics-Two Port Representation of a Transistor- h-parameters-AC equivalent circuit using 'h' parameters-Analysis of an Amplifier using h parameters (CE configuration only)-Expression for current gain, voltage gain, input impedance, output impedance and power gain- RC Coupled Amplifier - Frequency Response - Analysis of low, mid and high frequency regions - Classification of Amplifiers - Class A Power Amplifier – Push Pull- Class B Power Amplifier - Emitter Follower

**UNIT III: OSCILLATORS AND MULTIVIBRATORS (12 Hours)**

Feedback in amplifiers - Effect of Negative Feedback- Barkhuesen Condition for Oscillations - Hartley and Colpit's Oscillators, Phase Shift and Wien's Bridge Oscillators - Expression for Frequency of Oscillation and condition for Oscillation in each case. Multivibrators - Astable, Monostable and Bistable Multivibrator - using transistors

**UNIT IV: SPECIAL SEMICONDUCTOR DEVICES AND WAVE SHAPING CIRCUITS (12 Hours)**

Unipolar Devices- FET – Construction- Working -Characteristics - FET Amplifiers-UJT – Construction- Working- Characteristics - UJT- Saw Tooth Wave Generator- SCR – Characteristics –SCR as a Switch- SCR Rectifier. Clipping and Clamping Circuits - Biased Clipper - RC Time Constant -Integrating and Differentiating Circuits.

**UNIT V: DIGITAL ELECTRONICS AND CIRCUITS (12 Hours)**

Analog and Digital circuits, Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary.

Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, XOR Gate, Algebraic Simplification, De Morgan‘s theorem, Realisation of NAND and NOR functions using TTL.

**Books for Study:**

1. Electronic devices and circuits, Theodore F. Bogart, 6th edition, Pearson, 2004.
2. Electronic Devices and Circuit Theory 11th edition by Robert L. Bolysted and Louis Nashelsky, Pearson, 2017.
3. Elements of Electronics, M.K.Bagde and Singh S.P., S. Chand &Co., New Delhi(1990).
4. Principles of Electronics, V.K. Mehta, Rohit Mehta, S. Chand & Co. (2006).
5. Applied Electronics, A. Subramanyam, National Publishing Co., (1997).
6. Hand Book of Electronics, Gupta and Kumar, Pragati Prakashan, Meerut, (2002).
7. Electronics, M. Arul Thalapathi, Comptek Publishers, (2005).
8. Elements of Electronic Instrumentation and Measurement, Joseph J Carr, Pearson Education.
9. A course in Electrical and Electronic Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co. (Pvt.) Ltd, Nineteenth Revised Edition, (2012).

**Books for Reference:**

1. Electronic Devices, Mittal.G.K., G.K. Publishers Pvt. Ltd., (1993).
2. Basic Electronics, B.L. Theraja, S. Chand & Co., (2008).
3. Solid State Electronics, Ambrose and Vincent Devaraj, Meera Publication.
4. Applied Electronics, R.S. Sedha, S. Chand & Co., (1990).
5. Digital Instrumentation, A. J. Bouwen, McGraw Hill, (1986).
6. Electronic Instrumentation andMeasurement Technique, W. D. Cooper and A. D. Helfrick III Edition, Prentice-Hall, India, (1991).
7. Instrumentation, devices and systems, Rangan, Sarma and Mani, Tata Mc-Graw Hill
8. Electronic Instrumentation, H. S. Kalsi, Tata Mc-Graw Hill.

E-source:

1. http://www.freestudy.co.uk/instrumentation/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/122106025/lec39.pdf
3. https://nptel.ac.in/content/storage2/courses/113106062/Lec13.pdf

**Expected Course Outcomes:**

- Explain semiconductor physics and evaluate the behaviour of PN junctions, LEDs, and photo-diodes.
- Construct and analyze transistor amplifiers, calculating parameters like voltage gain and input impedance.
- Design and experiment with oscillators and multivibrators to generate periodic signals.
- Demonstrate the working principles of FET, UJT, SCR, and their applications in wave shaping circuits.
- Utilize number systems, logic gates, and De Morgan's theorem to build and simplify digital electronic circuits.

**CO's-PO's & PSO's Matrices**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |
| **CO2** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |
| **CO3** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |
| **CO4** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |
| **CO5** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |
| **AVG** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |

**1 - Low, 2 - Medium, 3 – High**

| Course code 23PH210 | ELECTRONICS LAB | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES**

The main objectives of this course are to:

| | |
|---|---|
| **1** | Know the fundamentals of transistor |
| **2** | Gain the knowledge about FET,UJT |
| **3** | Apply the Logics of Boolean algebra |
| **4** | Gain practical knowledge by applying the experimental methods to correlate with the physics theory. |
| **5** | Apply the analytical technique and graphical analysis to the experimental data. |

**PRACTICAL EXERCISES: 30 PERIODS**

| | |
|---|---|
| **1.** | Transistor – Phase Shift Oscillator |
| **2.** | Transistor – Wien's Bridge Oscillator |
| **3.** | FET characteristics FET amplifier |
| **4.** | UJT characteristics |
| **5** | UJT Relaxation oscillator |
| **6.** | Transistor – Astable multivibrator |
| **7.** | Transistor – Bistable multivibrator |
| **8.** | NAND / NOR as universal gates. |
| **9.** | Half Adder – Full adder – Ex-OR (7486) |
| **10** | Half Subtractor – Full subtractor – Ex – OR (7486) |
| **11.** | 4 bit ripple counter using 7473/7476 |
| **12.** | 4 bit shift register using 7473/7476 |
| **13.** | Decode counter using 7490 |

**COURSE OUTCOMES**

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

| | |
|---|---|
| **CO1:** | Know the fundamentals of transistor |
| **CO2:** | Gain the knowledge about FET,UJT |
| **CO3:** | Apply the Logics of Boolean algebra |
| **CO4:** | Gain practical knowledge by applying the experimental methods to correlate with the physics theory. |
| **CO5:** | Apply the analytical technique and graphical analysis to the experimental data. |

**REFERENCES**


| | |
|---|---|
| **1.** | Practical Physics by D. Chattopadhyay, P.C. Rakshit, New Central Book Agency (p) Ltd. Kolkata (2007). |
| **2.** | Practical Physics and Electronics by C.C.Ouseph, U.J.Rao and Vijayendran, S.Viswanathan (Printers & Publishers) Pvt., Ltd (2007). |
| **3.** | Practical Physics by C L Arora, S. Chand & Co., New Delhi (2008) |

**CO's-PO's & PSO's Matrices**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **AVG** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**1 - Low, 2 - Medium, 3 – High**

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23CY231 | Chemistry-II | 5 | 0 | 0 | 4 |

**Prerequisites: Nil**

**Course Objectives:**

- To gain knowledge in the basics of coordination chemistry in complex formations.
- To understand the analytical skill in the interpretation of biomolecules.
- To acquire theoretical knowledge on Phase rule and electrochemical applications.

**Unit 1: CO-ORDINATION CHEMISTRY**

Definition of terms - Classification of Ligands - Nomenclature - Chelation - EDTA and the application – Wernar‘s Theory - Effective Atomic Number - Pauling's theory- Postulates - Applications to Ni(CO)4,Ni(CN)4, (CO(CN)6)3- Merits and Demerits of. Werners and Pauling's theory - Biological Role of haemoglobin and Chlorophyll (elementary idea only) - Applications of co-ordination compounds in qualitative analysis and Quantitative analysis like Separation of. copper and cadmium ions; Nickel and cobalt ion; Identification of metal ions like cu, Fe and Ni. Estimation of Ni using DMG and Al using Oxine.

**Unit 2: BIOMOLECULES**

Classifications, preparation and reactions of glucose and fructose. Discussion of open and ring structure of glucose. Mutarotation. Interconversion of glucose to fructose and vice versa - Preparation and properties of sucrose. Properties of starch, cellulose and derivatives of cellulose - Diabetes - causes and control : measures RNA and DNA (elementary idea only) -Amino acids: Classification, preparation and properties of alanine -preparation of dipeptide using Bergman method.

**Unit 3: PHASE DIAGRAM**

Phase rule: Definition of terms, application of phase rule to water system - reduced phase rule and its application to Pb-Ag system. Freezing mixture - Completely miscible and partially miscible liquid systems - upper and lower critical solution temperatures.

**Unit 4: ELECTROCHEMISTRY**

Galvanic cells – emf - standard electrode potential - reference electrodes -electrochemical series and its applications - Determination of pH using electrometric method - Electroplating process -Nickel and Chrome plating - Different type of cells - primary cell, Secondary cell and fuel cells -Corrosion and methods of prevention, Conductometric titrations - hydrolysis of salts. Derivation of Kh - Definition of pH and its determination by colorimetric method. Buffer solution -; Henderson‘s equation. Applications of pH and buffer in biological processors and industries – Corrosion and its prevention.

**Unit 5: ANALYTICAL CHEMISTRY**

Introduction to Qualitative and Quantitative Analysis - Principle of volumetric analysis - Separation techniques - extraction - distillation - crystallization— Chromatographic separations - Principles and applications of column, paper, thin layer, gas-liquid and ion-exchange.

**Books for Reference:**

1. Dr. Veeraiyan V., Text book of Ancillary Chemistry, Highmount Publishing house, Chennai-14. Edition -206o. (Both in Tamil and English)
2. Vaithiyanathan S. and Others, Text book of Ancillary Chemistry, Priya Publications, Karur-2. Edition -2006.
3. Soni P.L and Others, Text book of Organic chemistry, Sultan Chand and Company, New Delhi, Edition-2006.
4. Soni P.L. and Others, Textbook of Inorganic Chemistry, Sultan Chand and Company, New Delhi, Edition -2006.
5. Puri B.R., Sharma and Pathania, text book of Physical Chemistry, Vishal Publishing Co., New Delhi. Edition-2006.
6. Dara S.S., Text book of Environmental chemistry and Pollution Control- S.Chand and Co., New Delhi, Edition 2006.7. Electronics, M. Arul Thalapathi, Comptek Publishers, (2005).

**Expected Course Outcomes:**

After the successful completion of this paper, students will be able to:

- Understand the Synthesize different inorganic complexes of valuable properties
- Apply skill learnt in the field of Electrochemistry and Phase rule
- Execute analytical techniques to synthesize biomolecules
- Gain knowledge on Electrochemistry Cell mechanism, principles and applications
- Knowledge gain on Analytical skills and chromatographic techniques

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | - | 1 | - | - | - | - |
| CO2 | - | 2 | - | - | - | - | - | - |
| CO3 | - | - | 1 | - | - | - | 3 | - |
| CO4 | 0.2 | - | - | - | 1 | - | - | - |
| CO5 | - | - | - | - | - | - | 3 | - |
| AVERAGE | 0.2 | 0.2 | 0.2 | 0.4 | - | - | 1.2 | - |

Since it is mapped with, PO1, PO2, PO3, PO5 and PO7 this subject is considered for employability

| Course code 23CY232 | CHEMISTRY LAB– II | L | T | P | C | TOTAL MARKS |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 | 100 |

**PREREQUISITES:**

**COURSE OBJECTIVES**

To gain knowledge on various types of organic salt analysis

**PRACTICAL EXERCISES:** **30 PERIODS**

**Organic salt analysis**

| | |
|---|---|
| **1.** | Detection of Aliphatic and aromatic elements. |
| **2.** | Test for Saturation and unsaturation for elements. |
| **3.** | Identification of function of groups |
| **4.** | Detection of special elements |

**COURSE OUTCOMES**

On completion of the lab course student will be able to demonstrate skills learnt organic salt analysis aspects to industrial requirements.

| Course Code | Course Title | LTPC |
|---|---|---|
| 23VA271 | Yoga for Human Excellence | 3 0 0 2 |

**Prerequisites: Nil**

**Course Objectives:**

- Demonstrate simplified physical exercises and perform yogasanas to enhance physical health.
- Practice Kaya Kalpa techniques to strengthen life force energy and maintain youthfulness.
- Apply meditation techniques to cultivate mental wellness and develop virtues.
- Analyze thoughts, desires, and emotions to implement introspection for self-improvement.
- Neutralize anger and worries by practicing tolerance, forgiveness, and compassion.

**UNIT I -PHYSICAL HEALTH**

Introduction to SKY -Education as a means of Youth Empowerment-Simplified Physical exercises- Yogasanas (Rules- Sun Salutation-Dandasana-Chakrasana-Vrichasana-Trikonasana-Vajrasana-Pranayama-Nadi Suddhi-Clearance Practice).

**UNIT II -STRENGTHENING THE LIFE FORCE**

Reasons for Diseases-Philosophy of Kaya Kalpa -Maintaining Youthfulness & Postponing Aging – Transformation of Food into seven Body Constituents -Greatness of Seminal Fluid -Limit and Methodin Five Factors- Kaya Kalpa Practice.

**UNIT III-WELLNESS OF MIND**

Classification of Mind Waves-Agna Meditation- Shanthi Meditation- Thuriya Meditation-Blessing and Benefits-Virtues: Individual Virtues and Societal Virtues -Morals (Importance of Introspection, Six Temperaments and Manoevering, Benefits of Meditation).

**UNIT IV PROSPERITY OF MIND- PART I**

Philosophy of Life (Purpose of Life, Philosophy of Life, Five Duties-Safeguarding Natural Resources)-Analysis of Thoughts (Ten stages of the Mind-The Five Kosas-Thoughts-Analysis of thoughts and practice)- Moralisation of Desires (Desires-Explanation, Nature, Reasons, Moralisation Practice).

**UNIT V PROSPERITY OF MIND-PART II**

Neutralisation of Anger (Anger-Reasons, Effects, Peace, Tolerance and Forgiving, Neutralisation) - Eradication of Worries (Reasons, Effects, Corrective measures, Eradication)- Diversity in Men- Loveand Compassion

**Course Outcomes:**

- Perform and demonstrate various yogic practices, including Surya Namaskar and Pranayama, to improve physical health.
- Apply Kaya Kalpa principles to enhance vitality and delay ageing effects.
- Practice Agna, Shanthi, and Thuriya meditation to regulate mental waves and enhance inner peace.
- Analyze and control desires through thought moralization and self-awareness techniques.
- Implement techniques to eradicate worries and anger while cultivating love and compassion for holistic well-being.

**CO's-PO's & PSO's Matrices**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO2** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO3** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO4** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **CO5** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |
| **AVG** | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - |

**1.- Low, 2 - Medium, 3 – High**

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH301 | Atomic Physics | 5 0 0 4 |

**Prerequisites: Nil**

**COURSE OBJECTIVES**

- Analyze the motion of charged particles in electric and magnetic fields and determine the specific charge of an electron.
- Demonstrate the principles of photoelectric emission through experiments and verify Einstein's photoelectric equation.
- Examine atomic models and apply quantum numbers to explain atomic structure and spectral lines.
- Investigate ionization potential and spectral line splitting and demonstrate Zeeman and Stark effects.
- Apply X-ray spectroscopy principles to analyze characteristic and continuous X-ray spectra.

**Unit I: Discharge Phenomenon on Through Gases 12 hrs**

Moving of a charge in transverse electric and magnetic fields – specific charge of an electron – Dunnington's method – magnetron method – positive rays – Aston's- Dempster's mass spectrographs.

**Unit II: Photoelectric Effect 12 hrs**

Richardson and Compton experiment – Laws of photoelectric emission – Einstein photoelectric equation – Millikan's experiment- verification of photoelectric equation - Photo electric cells- photo emissive cells – photo voltaic cell- photo conducting cell - photomultiplier.

**Unit III: Atomic Structure 12 hrs**

Bohr and Sommerfield atom models-Vector atom model-Pauli's exclusion principle - explanation of periodic table – various quantum numbers – angular momentum and magnetic moment – coupling schemes – LS and JJ coupling – special 104 quantization –Bohr magnetron –Stern and Gerlach experiments.

**Unit IV: Ionisation Potential and Splitting of Energy Levels 12 hrs**

Excitation and ionization potential – Frank and Hertz's experiment – Davis and Goucher's method. Spectral terms and notions – selection rules – intensity rule and interval rule – fine structure of sodium D lines – alkali spectra – fine structure of alkali spectra – spectrum of Helium – Zeeman effect – Larmor's theorem – Debye's explanation of normal Zeeman effect. Anomalous Zeeman effect – theoretical explanation. Lande's -g factor and explanation of splitting of D1 and D2 lines of sodium. Paschen-Back effect –Starke effect (qualitative study only).

**Unit V: X-Rays 12 hrs**

Bragg's law – X-ray spectroscopy – characteristic X-ray spectra – satellite and Auger effect- continuous X-ray spectra- X-ray absorption and fluorescence-Moseley's law- uses of X-rays – Compton effect-experimental verification of Compton effect.

**TOTAL HOURS: 60**

## Books for Study


1. Modern Physics, R. Murugeshan, Kiruthiga Sivaprasath, S.Chand&Co., New Delhi (2018).
2. Modern Physics, D.L.Sehgal, K.L.Chopra and N.K.Sehgal. Sultan Chand Sons Publication, 10th Edition, NewDelhi (2017).
3. Atomic Physics, J.B. Rajam, S. Chand&Co., 20th Edition, New Delhi (2007).
4. Atomic and Nuclear Physics by N. Subrahmanyam and Brij Lal, S.Chand&Co. 5th Edition, New Delhi (2000).

Course Outcomes

CO1: Determine the specific charge of an electron using experimental methods like Dunnington's and magnetron techniques.

CO2: Perform photoelectric effect experiments and validate Einstein's photoelectric equation.

CO3: Illustrate atomic structure using Bohr, Sommerfeld, and vector atom models and explain quantum numbers.

CO4: Demonstrate Zeeman and Stark effects in spectral line splitting and analyze atomic energy levels.

CO5: Explain the properties of X-rays, apply Bragg's law to crystal structures, and verify the Compton effect experimentally.

**CO –PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **AVG** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH302 | Electronics and communication lab | 0 0 4 2 |

**Prerequisites: Nil**

**COURSE OBJECTIVES**

- To study the basics of the Inverting Amplifier.
- To gain practical knowledge by applying the experimental methods to correlate with the physics theory.
- To gain insight into how to apply the analytical technique and graphical analysis to the experimental data.

**List of Experiments (Any Seven)**

1. Opamp741 - Inverting, Non- Inverting amplifier, unity follower.
2. Opamp741 -Summing and difference amplifier
3. Opamp741 –Differentiator, integrator
4. OPamp741–Solving simultaneous equations
5. Opamp741 – Wein's Bridge oscillator
6. Opamp 741-PhaseShift oscillator
7. 555-Timer-Schmitt Trigger
8. 555-Timer-Astable operation
9. 555 -Timer-Monostable
10. D/A Converter–4-bit, binary weighted resistor method.

**TOTAL HOURS: 60**

**Books for Study:**

1. Practical Physics and Electronics, Vijeyandran, CC Ouseph, U.J. Rao, S. Viswanathan Pvt. Ltd (2011).

**COURSE OUTCOMES**

**CO1:** Construct analog circuits using Op-Amp 741 and 555 timer ICs to demonstrate the behavior of amplifiers, oscillators, and multivibrators based on given circuit diagrams.

**CO2:** Demonstrate the use of operational amplifiers in practical configurations such as inverting, non-inverting, summing, and differential amplifiers through hands-on experiments.

**CO3:** Configure 555 timer IC in astable, monostable, and Schmitt trigger modes and verify their timing characteristics through waveform observation and measurement.

**CO4:** Calibrate and test waveform outputs of oscillator circuits like Wien's bridge and phase-shift oscillators to analyze frequency response and stability.

**CO5:** Assemble and verify the functionality of a 4-bit Digital-to-Analog Converter using a binary-weighted resistor method and observe the analog output for digital input variations.

**CO –PO MATRICES:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | - | - | 2 |
| **CO2** | 3 | 2 | 3 | 3 | - | - | 2 |
| **CO3** | 3 | 2 | 3 | 3 | - | - | 2 |
| **CO4** | 3 | 2 | 3 | 3 | - | - | 2 |
| **CO5** | 3 | 2 | 3 | 3 | - | - | 2 |
| **AVG** | 3 | 2 | 3 | 3 | - | - | 2 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH303 | Fundamentals of Microprocessor | 5 0 0 4 |

**Pre-requisites: Nil**

**COURSE OBJECTIVES**

- Identify the architecture and functional components of the 8085 microprocessor, including registers, ALU, buses, and control signals.
- Write assembly language programs using different instruction sets and addressing modes of the 8085 microprocessor.
- Interface ROM and RAM with the 8085 microprocessor and analyze the timing diagram of basic instructions.
- Interface input and output ports with the 8085 microprocessor using the 8255 Programmable Peripheral Interface.
- Demonstrate hardware and software interrupts in the 8085 microprocessor and their execution priorities.

**Unit I: Architecture** **12 hrs**

Architecture of 8085 registers, flags, ALU, address and data bus, demultiplexing address/ data bus–control and status signals– control bus, Programmer's model of 8085 –Pinout diagram–Functions of different pins.

**Unit II: Programming Techniques** **12 hrs**

Instruction set of 8085–data transfer, arithmetic, logic, branching and machine control group of instructions – addressing modes – register indirect, direct, immediate and implied addressing modes. Assembly language & machine language – programming techniques: addition, subtraction, multiplication, division, ascending, descending order, largest and smallest (single byte)

**UNIT III: Interfacing memory to 8085** **12 hrs**

Memory interfacing – Interfacing 2kx8 ROM and RAM, Timing diagram of 8085(MOVR$_d$, R$_S$–MVIR$_d$, data (8)).

**Unit IV: Interfacing I/O Ports to 8085** **12 hrs**

Interfacing input port and output port to 8085 – Programmable peripheral interface 8255– flashing LEDs.

**Unit V: Interrupts** **12 hrs**

Interrupts in 8085- hardware and software interrupts–RIM, SIM instructions–priorities– simple polled and interrupt-controlled data transfer.

**TOTAL HOURS:60**

**Books for Study:**


1. Microprocessor Architecture programming and application with 8085/8080 A.R.S. Gaonkar, Wiley Eastern Ltd (2019).
2. Fundamental of microprocessor 8085 by V.Vijayendran, S.Viswanathan Publishers, Chennai (2003)
3. Fundamentals of Microprocessors and microcomputers by B. Ram – Dhanpat RAI publication.
4. Introduction to microprocessor by Aditya Mathur - Tata McGraw Hill Publishing Company Ltd (2009).
5. Microprocessor and digital system by Dougles V. Hall - 2nd Edition - McGraw Hill Company (2018).


**Useful websites:**

http://www.engj.ulst.ac.uk/sidk/eeellla/lecture-series//microprocessor.

**Expected Course Outcomes:**

**CO1:** Illustrate the pinout diagram and functions of different pins in the 8085 microprocessor.

**CO2:** Execute basic arithmetic and logical operations such as addition, subtraction, multiplication, and division in assembly language.

**CO3:** Interpret the timing diagrams for MOV Rd, Rs and MVI Rd, data (8-bit) instructions.

**CO4:** Design an interfacing circuit to control LEDs using the 8255 peripheral interface.

CO5: Compare simple polled and interrupt-controlled data transfer mechanisms.

**CO –PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | - | - | 1 | |
| **CO2** | 3 | 2 | 2 | 2 | - | - | 1 | |
| **CO3** | 3 | 2 | 2 | 2 | - | - | 1 | |
| **CO4** | 3 | 2 | 2 | 2 | - | - | 1 | |
| **CO5** | 3 | 2 | 2 | 2 | - | - | 1 | |
| **AVG** | 3 | 2 | 2 | 2 | - | - | 1 | |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH304 | Microprocessor Lab | 0 0 3 2 |

**Pre-requisites: Nil**

**COURSE OBJECTIVES**

- Execute 8-bit addition and subtraction operations using the 8085 microprocessor.
- Implement 8-bit multiplication and division operations using the 8085 microprocessor.
- Perform the addition of multiple single-byte numbers using looping techniques in 8085 assembly language.
- Sort a set of numbers in ascending and descending order using 8085 assembly language.
- Identify the largest and smallest number from a given dataset using the 8085 microprocessor.

**List of Experiments (Any seven)**

1. Microprocessor–8085–8bit Addition and Subtraction
2. Microprocessor–8085–8bit Multiplication and Division
3. Microprocessor–8085–Addition of N Number of single byte numbers
4. Microprocessor–8085–Sorting of the given set of numbers in ascending order and descending order
5. Microprocessor–8085–Finding the largest and smallest number in a given set of numbers.

**TOTAL HOURS: 30**

**Books for Study:**

1. Practical Physics and Electronics, V. Vijeyandran, C.C. Ouseph, U.J. Rao, S.Viswanathan Pvt. Ltd (2011).

**Expected Course Outcomes:**

CO1: Write assembly language programs to perform 8-bit addition and subtraction.
CO2: Develop assembly language programs for multiplication and division of 8-bit numbers.
CO3: Write an efficient assembly language program to add N single-byte numbers.
CO4: Design an assembly language program to implement sorting algorithms (e.g., bubble sort) on a given dataset.
CO5: Test the program with different datasets and observe the register/memory outputs

**CO –PO MATRICES:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | - | - | 2 | 1 |
| **CO2** | 3 | 2 | 3 | 3 | - | - | 2 | 1 |
| **CO3** | 3 | 2 | 3 | 3 | - | - | 2 | 1 |
| **CO4** | 3 | 2 | 3 | 3 | - | - | 2 | 1 |
| **CO5** | 3 | 2 | 3 | 3 | - | - | 2 | 1 |
| **AVG** | 3 | 2 | 3 | 3 | - | - | 2 | 1 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23VA305 | Physics of Renewable Energy Systems | 5 0 0 4 |

**Prerequisites: Nil**

**COURSE OBJECTIVES**

- Explain the fundamentals of semiconductors, nanomaterials, and renewable energy sources.
- Classify various renewable energy systems such as solar, wind, hydro, tidal, and geothermal energy.
- Analyze the working principles and classifications of fuel cells and energy storage technologies.
- Demonstrate the energy storage mechanisms of supercapacitors and batteries and examine the role of the double layer in energy storage.
- Apply advanced characterization techniques like XRD, UV-Vis, SEM, TEM, and EIS to analyze material properties.

**Unit I** **12 hrs**

Basics of semiconductor, nanomaterials and nanotechnology- Renewable energy sources and classifications

**Unit II** **12 hrs**

Solar Power- Wind power- Hydro, Tidal and Geothermal Systems

**Unit III** **12 hrs**

Energy storage Technology: Classification and principle- Fuel Cells: Principles, Classifications and Operations

**Unit IV** **12 hrs**

Supercapacitors and Battery- Energy storage mechanism- Effect of double layer in energy storage: Chemical approach

**Unit V** **12 hrs**

Characterization techniques- X-ray diffraction method- UV-visible spectroscopy- Fourier Transform Infrared Spectroscopy- SEM, TEM and XPS- Particle size and zeta potential analysis- BET analysis- Electrochemical Impedance Spectroscopy.

**TOTAL HOURS: 60**

**REFERENCE BOOKS**


1. Physics of Energy Sources, George C. King.
2. Advance Renewable Energy Systems, S.C. Bhatia.
3. Physics and Technology of sustainable energy, E. L. Wolf.


**NPTEL Website:**

1. https://nptel.ac.in/courses/115105127

Expected Course Outcomes:

CO1: Differentiate between semiconductors, nanomaterials, and their applications in renewable energy technologies.

CO2: Compare different renewable energy sources and evaluate their efficiency and sustainability.

CO3: Demonstrate the principles and classifications of fuel cells and assess their performance.

CO4: Investigate energy storage technologies and experiment with supercapacitor and battery mechanisms.

CO5: Utilize advanced characterization techniques to analyze material properties and interpret their applications in energy storage.

**CO –PO MATRICES:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **AVG** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23IK301 | Introduction to Indian Knowledge System | 3 | 0 | 0 | 2 |

**Prerequisites: Nil**

**Course Objectives:**

To introduce students to the foundational concepts of the Indian Knowledge System (IKS).

To explore the relevance and applications of IKS in contemporary times.

To promote interdisciplinary learning through the integration of traditional Indian knowledge and modern education.

**Unit I: Foundations of Indian Knowledge Systems** **6 hr**

Meaning and Scope of Indian Knowledge System (IKS)- Historical evolution and literary sources: Vedas, Upanishads, Puranas, Smritis, and other classical texts-Philosophical foundations: Darshanas – Nyaya, Vaisheshika, Samkhya, Yoga, Mimamsa, and Vedanta-Unity in diversity: Interdisciplinary nature of IKS

**Unit II: Education, Language, and Literature** **6 hr**

Traditional Indian education system: Gurukula, Pathashalas, and higher education centers (Nalanda, Takshashila, etc.)-Role of Sanskrit and regional languages in knowledge transmission-Classical Indian literature: Ramayana, Mahabharata, Panchatantra, Jataka tales-Contribution of Indian linguists: Panini, Bhartrihari.

**Unit III: Science and Technology in IKS** **6 hr**

Mathematics: Sulbasutras, Aryabhata, Bhaskara-Astronomy and Cosmology: Concepts from Surya Siddhanta-Ayurveda: Basic principles, Tridosha theory, and holistic healing-Metallurgy, architecture (Vastu Shastra), and water management systems

**Unit IV: Indian Art, Culture, and Society** **6 hr**

Indian art forms: Music, dance, painting, sculpture-Role of aesthetics: Rasa theory and Natya Shastra-Festivals, rituals, and socio-cultural practices-Concepts of Dharma, Purusharthas, and social organization

**Unit V: Contemporary Relevance and Applications of IKS** **6 hr**

Integrating IKS with modern education and research-Sustainable practices in agriculture, ecology, and lifestyle-Yoga and meditation in mental and physical wellness-Role of IKS in national identity and global influence

**References:**

**Michel Danino** – *Indian Knowledge Systems: A Primer* A concise and accessible introduction to various domains of IKS including science, arts, and philosophy.

**Kapil Kapoor** – *Text and Interpretation: The Indian Tradition* Explores Indian theories of knowledge, language, and literary traditions from a traditional Indian perspective.

**S.R. Ranganathan** – *The Five Laws of Library Science* Showcases traditional Indian epistemology and its application in information organization.

**Subhash Kak** – *The Astronomical Code of the Rigveda* Demonstrates scientific knowledge embedded in ancient texts.

**R. Balasubramanian** – *Indian Philosophy: A Counter Perspective* Gives insights into Indian metaphysical and epistemological systems.

**D.P. Chattopadhyaya (Ed.)** – *History of Science, Philosophy and Culture in Indian Civilization* (multi-volume series) A comprehensive academic series covering various domains of Indian knowledge from history to technology.

**Sisir Kumar Mitra** – *The Decline of Indian Scientific Tradition* A reflective work on historical challenges to the continuity of IKS.

| |
|---|
| **AICTE eBook on Indian Knowledge System** (freely available) Offers a modular and structured introduction to IKS with applications in engineering and science |
| **NCERT Textbook** – *Knowledge Traditions and Practices of India* (Class XI Elective) |

**Online Contents:**

1. https://iksindia.org – AICTE IKS Division
2. https://insa.nic.in – Indian National Science Academy
3. NPTEL & IGNOU video lectures on IKS and history of Indian science

**Course Outcomes:**

CO1: Explain the foundational principles and interdisciplinary nature of the Indian Knowledge System

CO2: Analyze the traditional Indian education system, language development, and classical literature

CO3: Evaluate contributions of India in science, technology, mathematics, and medicine.

CO4: Appreciate the richness of Indian art, culture, and societal values through traditional knowledge frameworks.

CO5: Apply the insights of Indian Knowledge Systems to contemporary global and local challenges in education, health, sustainability, and wellness.

## CO's-PO's & PSO's MAPPING

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 : | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 |
| CO2 : | 2 | 3 | 2 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 |
| CO3 : | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| CO4 : | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 2 |
| CO5 : | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 3 | 3 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH307 | Solid State Physics | 5 0 0 4 |

**Pre-requisites: Nil**

**COURSE OBJECTIVES**

- Identify different types of crystal structures and analyze their lattice arrangements using Miller indices.
- Demonstrate X-ray diffraction techniques and interpret Bragg's law in determining crystal structures.
- Examine different types of chemical bonds and apply crystallographic principles to material analysis.
- Investigate dielectric properties, polarization mechanisms, and evaluate the effects of frequency and temperature on dielectric materials.
- Classify different types of magnetic materials and compare their properties using classical and quantum theories.

**Unit I: Crystal Structure** **12 hrs**

Crystal lattice – primitive and unit cell – seven classes of crystal – Bravais Lattice – Miller Indices–Structure of crystals–simple cubic, hexagonal close packed structure, face centred cubic structure, body centred cubic structure–Sodium chloride structure, Zinc Blende structure, Diamond structure.

**Unit II: Defects in Solids** **12 hrs**

X-ray diffraction – Bragg's law in one dimension – Experimental methods – Laue Method, powder crystal method and rotating crystal method. Defects in solids - Pointdefects-Frenkelandschottkydefects-Equilibriumconcentrations-Linedefects-Edgedislocationandscrewdislocation-Surfacedefects-Grainboundary- Effects of Crystal imperfections.

**Unit III: Chemical Bonds and Crystallography** **12 hrs**

Interatomic forces- Different types of chemical bonds- Ionic bond- Cohesive energy of ionic Crystals and Madelung constant- Covalent bond-Metallic bond- Vander Waal's bond- Hydrogen bond. Superconductivity-General properties-Type I and II Superconductors- Meissner effect- BCS theory-applications of superconductors.

**Unit 4: Dielectric Properties** **12 hrs**

Dielectric materials-Polarization, susceptibility and dielectric constant- Local field or internal field - Clausius - Mossoti relation - Sources of polarizability – Electronic polarizability- Ionic polarizability-Orientational polarizability- Frequency and temperature effects on polarization-Dielectric breakdown– Properties of different types of insulating materials.

**Unit5: Magnetic Properties** **12 hrs**

Different types of magnetic materials-classical theory of diamagnetism (Langevin theory)-Langevin theory of paramagnetism- Weiss theory of paramagnetism- Heisenberg interpretation on internal field and quantum theory of ferromagnetism –Anti ferro magnetism- Hard and soft magnetic materials.

**TOTAL HOURS: 60**

**Books for Study:**


1. Materials Science by M.Arumugam, Anuradha Agencies Publishers.(2012)
2. Solid State Physics by R L Singhal, Kedarnath Ram Nath & Co., Meerut (2017)
3. Introduction to Solid State Physics by Kittel, Willey Eastern Ltd (2013).
4. Materials Science and Engineering by V. Raghavan, Prentice Hall of India Private Limited, New Delhi (2014)
5. Solid State Physics by S.O.Pillai, New Age International (P)Ltd.,(2018).
6. Solid State Physics by A.J.Dekker, Macmillan India(2019).
7. Solid State Physics by HC Gupta, Vikas Publishing House Pvt. Ltd., New Delhi (2017).


**Useful websites:** http://folk.uio.no//dragos//solid/fys230Exerciser.html.

http://www.physics.brocku.ca/courses/ 4p7d

**Course Outcomes:**

CO1: Differentiate between various crystal structures and determine their lattice arrangements.

CO2: Apply X-ray diffraction methods to analyze the structural properties of materials.

CO3: Explain the role of different chemical bonds in crystal formation and evaluate their effects on material properties.

CO4: Measure dielectric properties and assess the impact of polarization on insulating materials.

CO5: Investigate the magnetic behavior of materials and apply theoretical models to explain their properties.

**CO-PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **AVG** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH308 | Solid State Physics Lab | 0 | 0 | 3 | 2 |

**Pre-requisite:** Nil

**Course Objectives:**

- Determine Young's modulus and Poisson's ratio using Cornu's method with elliptic fringes.
- Evaluate Stefan's constant through experimental measurement and analysis.
- Measure the band gap energy of a thermistor using temperature-dependent resistance.
- Analyze the thickness of enamel coating on a wire using diffraction techniques.
- Investigate optical properties using Fabry-Perot Etalon and laser beam parameters.

**Advanced Physics (Any Seven)**

1. Cornu's Method- Young's Modulus and Poison's ratio by elliptic fringes.
2. Stefan's Constant
3. Band gap energy- Thermistor
4. Thickness of the enamel coating on a wire- By diffraction
5. FP Etalon
6. Laser Experiments: Study of Laser beam parameters.
7. Viscosity of liquid – Meyer's disc.
8. Solar spectrum – Hartmann's formula.
9. Arc spectrum – Iron.
10. Edser and Butler fringes – Thickness of air film.
11. B-H loop using Anchor ring.
12. Specific charge of an electron – Thomson's method.

**TOTAL HOURS: 30**

**Course Outcomes:**

CO1: Perform Cornu's method to calculate Young's modulus and Poisson's ratio.
CO2: Estimate Stefan's constant through radiation measurements.
CO3: Examine the band gap energy of a thermistor by analyzing resistance variations.
CO4: Apply diffraction methods to measure the thickness of enamel coatings.
CO5: Demonstrate optical experiments, including Fabry-Perot Etalon and laser beam studies.

**CO-PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **AVG** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH309 | Nuclear Physics | 5 0 0 4 |

**Pre-requisites: Nil**

**COURSE OBJECTIVES**

- Understand the general properties of atomic nuclei and apply nuclear models to explain nuclear structure.
- Analyze the principles of radioactivity, decay laws, and evaluate their applications in dating methods.
- Demonstrate the working principles of radiation detectors and particle accelerators in nuclear experiments.
- Investigate nuclear reactions, fission, and fusion processes, and assess their significance in energy production.
- Classify elementary particles, examine fundamental interactions, and apply conservation laws in particle physics.

**Unit 1: General Properties of Nuclei** **12 hrs**

Nuclear size, charge, mass-determination of nuclear radius-mirror nucleus method-mass defect and binding energy-packing fraction-nuclear spin-magnetic dipole moment-electric quadrupole moment-nuclear models-liquid drop model-Weizacker semiempirical mass formula-Shell model and magic numbers-collective model-nuclear forces-meson theory of nuclear force (qualitative).

**Unit 2: Radioactivity** **12 hrs**

Natural radioactivity-law of disintegration-half life and mean life period- units of radioactivity- transient and secular equilibrium-radiocarbon dating-age of earth - alpha rays-characteristics- Geiger Nuttal law - α-ray spectra- Gamow's theory of α-decay (qualitative study)-beta rays- characteristics-betarayspectra-neutrinohypothesis-violationofparityconservation- experimental verification with $Co^{60}$-gamma rays and internal conversion-nuclear isomerism.

**Unit 3: Radiation Detectors and Particle Accelerators** **12 hrs**

Ionisation chamber-G.M.Counter-quenching and resolving time-scintillation counter-photomultiplier tube–thermo luminescence-thermo luminescence dosimetry(TLD)- Linear accelerator-cyclotron-synchro cyclotron, betatron.

**Unit 4: Nuclear Reactions** **12 hrs**

Conservation laws- nuclear reaction Kinematics-Q-value-threshold energy-artificial radioactivity- radio isotopes and its uses-classification of neutrons-nuclear fission-chain reaction-critical mass and size-nuclear reactor-breeder reactor - transuranic elements-nuclear fusion- thermo nuclear reactions-sources of stellar energy.

**Unit 5: Elementary Particles** **12 hrs**

Classification of elementary particles fundamental interaction-elementary particle quantum numbers - isospin and strangeness - conservation laws and symmetry-basic ideas about the quark-quark model.

**TOTAL HOURS: 60**

**REFERENCE BOOKS**


1. Nuclear Physics by R.R.Roy and B.P.Nigam, New Age International(P)Ltd., New Delhi (2017).
2. Fundamentals of Elementary Particle Physics by Longo, McGraw-Hill.
3. Nuclei and Particles by Serge., W.A.Benjamin, USA
4. Elements of Nuclear Physics by ML Pandya and RPS Yadav, Kedarnath Ram Nath, Meerut.


**Useful websites:**

1. http://ocw.mit.edu/ocwWeb/physics/8-701spring2004/Lectinenotes.
2. http://faraday.physics.utoronto.ca/GeneralInterest/D.Bailey/SubAtomic/Lectures/Lect.html.

**COURSE OUTCOMES**

CO1: Determine nuclear properties and apply nuclear models to explain binding energy and stability.

CO2: Explain the laws of radioactivity and evaluate their significance in nuclear decay processes.

CO3: Operate radiation detectors and analyze their efficiency in detecting different types of radiation.

CO4: Calculate reaction kinematics, Q-value, and assess the feasibility of nuclear reactions in reactors.

CO5: Apply quantum numbers and conservation laws to classify elementary particles and fundamental forces.

**CO –PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| **AVG** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH310 | Electronics Lab | 0 | 0 | 3 | 2 |

| Pre-requisite: | Nil |
|---|---|

**Course Objectives:**

- Design a FET-based common source amplifier to analyze its frequency response and impedance characteristics.
- Construct Wien's bridge and phase shift oscillator circuits using operational amplifiers.
- Implement Schmitt trigger circuits using IC 741 and IC 555 for waveform shaping applications.
- Assemble different types of flip-flops using NAND/NOR gates and IC 7476/7473.
- Develop waveform generation circuits, including active filters, relaxation oscillators, and frequency dividers.

**Electronic and Microprocessor 8085 (Any Seven)**

1. FET CS amplifier- design, Frequency response, input impedance, output impedance
2. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
3. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
4. Designs of Schmitt trigger circuit using IC 741 for a given hysteresis- application as squarer.
5. Study of R-S, clocked R-S and D-Flip flop using NAND/NOR gates
6. Study of J-K, D and T flip flops using IC 7476/7473
7. IC 7490 as scalar and seven segment display using IC7447.
8. Design of UJT relaxation oscillator for a given frequency – Generation of positive and negativetriggering pulses.
9. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worthfilter
10. Construction of square wave generator using IC 555 – Study of VCO.
11. Design of Schmitt trigger circuit using IC555 for a given hysteresis – Application as squarer.
12. Construction of pulse generator using the IC 555 – Application as frequency divider.

**TOTAL HOURS: 30**

**Course Outcomes:**

CO1: Measure the frequency response, input impedance, and output impedance of a FET common source amplifier.

CO2: Fabricate Wien's bridge and phase shift oscillators and examine their attenuation characteristics.

CO3: Simulate Schmitt trigger circuits and waveform generators using IC 741 and IC 555.

CO4: Integrate flip-flops and counters using NAND/NOR gates and digital ICs.

CO5: Calibrate active filters, relaxation oscillators, and frequency dividers for signal processing applications.

**Expected Course Outcomes:**

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

| CO No. | Course Outcome | RBT |
|---|---|---|
| **CO1** | Understand the basics of experimental physics. | K2 |
| **CO2** | Explore the concepts involved in the Electronics | K3 |
| **CO3** | Verify experimentally the circuits using devices like Op-Amp, UFT, FET | K4 |
| **CO4** | Understand the configuration of the IC chips to perform experiments using appropriate circuits | K6 |
| **CO5** | Verify experimentally the R-S, J-K, T and D Flip flops | K6 |

**CO –PO Matrices**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **AVG** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23PH311 | Relativity and Quantum Mechanics | 5 0 0 4 |

**Prerequisites: Nil**

**COURSE OBJECTIVES**

- Understand the fundamental concepts of special relativity and analyze its implications on space and time.
- Apply wave-particle duality principles and demonstrate experimental evidence supporting matter waves.
- Derive and interpret Schrödinger's equation, wave functions, and quantum mechanical operators.
- Explore the principles of angular momentum in quantum mechanics and apply them to atomic models.
- Solve quantum mechanical problems for potential wells, harmonic oscillators, and hydrogen atoms.

**Unit 1: Relativity** **12 hrs**

Frames of reference - Galilean transformation - Michelson - Morley experiment - Postulatesofspecialtheoryofrelativity-Lorentztransformation-lengthContraction- time dilation-Relativity of simultaneity-addition of velocities- variation of mass with velocity–Mass energy relation-Elementary ideas of general relativity.

**Unit 2: Wave Nature of Matter** **12 hrs**

Phase and group velocity - wave packet - expression of De Brogile's wavelength – Davisson and Germer's experiment- G.P.Thompson's experiment-Electron microscope

- Heisenberg's uncertainty principle and its consequences.

**Unit 3: Schrodinger Equation** **12 hrs**

Inadequacy of classical mechanics-Basic postulates of quantum mechanics- Schrodinger equation-Properties of wave function- Probability interpretation of wave function-linear operators-self adjoint operators- expectation value–eigen values and eigen functions-commutativity and compatibility.

**Unit 4: Angular Momentum in Quantum Mechanics** **12 hrs**

Orbital angular momentum operators and their commutation relations - separation of three-dimensional Schrodinger equation into radial and angular parts- Elementary ideas of spin angular momentum of an electron- Pauli matrices.

**Unit 5: Solutions of Schrodinger Equation** **12 hrs**

Free particle solution- Particle in a box-Potential well of finite depth (one dimension)

- Linear harmonic oscillator-rigid rotator and hydrogen atom.

**TOTAL HOURS: 60**

**Books for Study**

1. A Textbook of Quantum mechanics by P.M.Mathews and S.Venkatesan, Tata McGraw-Hill, New Delhi(2005).
2. Quantum Mechanics by V.K. Thankappan, New Age International (P) Ltd. Publishers, New Delhi (2003).
3. Quantum Mechanics by K.K.Chopra and G.C.Agrawal, Krishna Prakasam Media(P)Ltd., Meerut First Edition (1998).
4. Modern Physics by R. Murugeshan and Kiruthiga Sivaprasath, S. Chand & Co., (2008).

**Books for Reference**

1. Mechanics and Relativity by Brijlal Subramanyam, S.Chand&Co., New Delhi,. (1990).
2. Concepts of modern physics by A. Beiser. Tata McGraw-Hill, 5th edition, New Delhi (1997).
3. Introduction to quantum mechanics by Pauling and Wilson, McGraw–Hill.
4. Quantum mechanics by A.Ghatak and Loganathan, Macmillan India Pvt. Ltd.

**Website**

http://physics.usc.edu/~bars.http://www.nscl.msu.edu/~pratt/phy851/lectrues/lectures.html

**COURSE OUTCOMES**

CO1: Explain the postulates of relativity and analyze relativistic effects such as time dilation and mass-energy equivalence.

CO2: Calculate De Broglie wavelengths and demonstrate experimental verification of matter waves.

CO3: Formulate Schrödinger's equation for quantum systems and apply probability interpretations.

CO4: Derive commutation relations for angular momentum and analyze quantum states of electrons.

CO5: Solve Schrödinger's equation for fundamental quantum systems and interpret physical solutions.

**CO –PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **AVG** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

| Course Code | Course Title | LTPC |
|---|---|---|
| 23PH312 | Computational Physics | 5 0 0 4 |

**Prerequisites: Nil**

**Course Objectives:**

Students will be able to:

- Understand and apply numerical techniques in physics.
- Develop Python programs to solve real-world physical problems.
- Simulate and visualize classical, statistical, and quantum systems.
- Interpret numerical results and estimate errors.
- Present computational results effectively.

**Unit 1: Introduction to Computational Tools and Numerical Methods** 12 h

Python basics, Jupyter Notebooks, NumPy, Matplotlib- Error analysis, round-off and truncation errors- Numerical integration: Trapezoidal and Simpson's rule- Root finding: Bisection and Newton-Raphson methods

**Unit 2: Solving Ordinary Differential Equations (ODEs)** 12 h

Euler's method and error estimation- Runge-Kutta methods (RK2, RK4)- Applications: Free fall with air resistance- Damped harmonic oscillator- Projectile motion in 2D- Two-body and N-body systems.

**Unit 3: Random Processes, Monte Carlo Methods and Statistical Mechanics** 12 h

Random number generation and distributions- 1D and 2D random walks- Monte Carlo integration -Radioactive decay simulation- Ising model simulation and phase transition.

**Unit 4: Partial Differential Equations (PDEs) and Wave Motion** 12 h

Finite difference method for PDEs-1D heat and diffusion equations-1D wave equation

Vibrating string and membranes- Stability and convergence.

**Unit 5: Quantum Simulations, Data Analysis & Final Project** 12 h

Numerical solutions to the Schrödinger equation-Particle in a box, finite well, tunneling-Wavefunction evolution- Data fitting, interpolation, error analysis- Final project: problem selection, coding, report, presentation.

**Total: 60 hrs**

**Reference Books:**


1. Mark Newman, *Computational Physics* (Python-based), Amazon Digital Services, 2012.
2. Ian Hutchinson, A Student's Guide to Numerical Methods, Cambridge University Press, 2015.
3. William H. Press et al., Numerical Recipes in C / Python, Cambridge University Press; 3rd edition, 2007.
4. Santu Chakraborty, Introduction to Python Programming for Undergraduate Physics, New Academic Publishers, 2020.


**Online resources:**

1. https://public.websites.umich.edu/~mejn/cp/
2. https://jupyter.org/
3. https://scipy.org/

**Course Outcomes:**

**CO1:** Develop simulation code to numerically solve classical and quantum physical systems using Python and relevant scientific libraries.

**CO2:** Construct data visualisations to interpret and present the results of computational experiments in physics.

**CO3:** Implement numerical algorithms such as integration, differentiation, and differential equation solvers for modelling physical phenomena.

**CO4:** Operate computational tools and environments (e.g., Jupyter Notebooks, GitHub) to manage code, document procedures, and troubleshoot errors.

**CO5:** Design and execute a complete computational physics project — including modelling, simulation, analysis, and reporting — that addresses a real-world or theoretical physics problem

**CO-PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **AVG** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |

| Course Code | Course Title | L T P C |
|---|---|---|
| 23VA370 | Universal Human Values | 3 0 0 2 |

**Prerequisites: Nil**

**COURSE OBJECTIVES**

- Help students develop a holistic perspective towards life, profession, and happiness based on a correct understanding of the human reality and the rest of existence.
- Encourage self-exploration as the basis for understanding and integrating universal human values in personal and professional life.
- Cultivate ethical competence and sensitivity among students.
- Enable students to understand harmony at various levels – individual, family, society, and nature.
- Facilitate a shift from fear-driven and profit-driven motivation to self-driven and purpose-driven motivation.

**Unit I: Introduction to Value Education 6 hrs**

Purpose and motivation for the course- Self-exploration: What is it? Its content and process- Natural acceptance and experiential validation- Continuous happiness and prosperity – a look at basic human aspirations- The need for value education: content and purpose of education

**Unit II: Harmony in the Human Being 6 hrs**

Understanding the human being as a co-existence of the self ('I') and the body- Needs of the self and body: Sukh and Suvidha- Activities of the self and the body; harmony of 'I' with the body- Program to ensure Sanyam and Swasthya.

**Unit III: Harmony in the Family and Society 6 hrs**

Trust and respect as the foundational values in relationships- Understanding the dimensions of human relationship- The role of family and society in human development- Undivided society and Universal Order – Sarvabhauma Vyavastha

**Unit IV: Harmony in Nature and Existence 6 hrs**

Interconnectedness of all entities in nature- Four orders of nature – material, plant, animal, and human- Understanding the harmony in nature – ecological balance- Holistic perception of reality – the universal human order.

**Unit V: Implications of Universal Human Values in Professional and Social Life 6 hrs**

Ethical human conduct and profession- Concept of Holistic Technologies, Production Systems, and Management Models- Vision for a Universal Human Society- Transition from reactive to responsible behaviour in society.

**TOTAL HOURS: 30**

**Books for Study**

1. *A Foundation Course in Human Values and Professional Ethics* – R.R. Gaur, R. Sangal, G.P. Bagaria (Excel Books, New Delhi)
2. *Education for a New World* – Maria Montessori
3. *The Story of My Experiments with Truth* – M.K. Gandhi

**Course Outcomes**

**CO1:** Understand the need and basic guidelines for value-based living.
**CO2:** Develop clarity about human aspirations, right understanding, and the process of self-exploration.
**CO3:** Understand the harmony in the individual, family, society, and nature.
**CO4:** Apply the knowledge of universal human values in real-life personal and professional scenarios.
**CO5:** Practice ethical and responsible behaviour as an individual and professional.

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH401 | Mathematical Physics | 6 | 0 | 0 | 5 |

**Pre-requisite:** None

**Course Objectives:**

- Explain vector calculus concepts and their applications in different coordinate systems.
- Describe tensor transformations and matrix theory, including eigenvalues and eigenvectors.
- Apply complex analysis techniques, including Cauchy's theorems and residue methods.
- Solve differential equations using special functions like Legendre and Bessel functions.
- Explain the basics of group theory and its applications in molecular symmetry.

**Unit 1: Vector analysis** **15 hrs**

Concept of vector and scalar fields – Gradient, divergence, curl and Laplacian – Vector identities– Line integral, surface integral and volume integral – Gauss theorem, Green's Theorem, Stoke's theorem and applications – Orthogonal curvilinear coordinates – Expression for gradient divergence, curl and Laplacian in cylindrical and spherical co-ordinates - Definitions – Linear independence of vectors – Schmidt's orthogonalisation process – Schwartz inequality.

**Unit 2: Tensors and Matrix Theory** **15 hrs**

Transformation of coordinates – Summation convention – Contravariant, covariant and mixed tensors – Rank of a tensor – Symmetric and anti-symmetric tensors – contraction of tensor – Characteristic equation of a matrix – Eigen values and eigenvectors – Cayley – Hamilton theorem- Reduction of a matrix to diagonal form – Jacobi method – Sylvester's theorem.

**Unit 3: Complex Analysis** **15 hrs**

Functions of complex variables – Differentiability -- Cauchy-Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residues and singularities - Cauchy's residue theorem – Evaluation of definite integrals.

**Unit 4: Special Functions** **15 hrs**

Gamma and Beta functions – Sturm- Liouville problem – Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations: series solution – Rodriguez formula – Generating functions – Orthogonality relations – Important recurrence relations.

**Unit 5: Group Theory** **15 hrs**

Definition of groups, operations and subgroups- classes-Symmetry operations and elements, Point groups – Matrix representation of a group - Reducible and irreducible representations - Orthogonalitytheorem – construction of character Table ($C_{2v}$ and $C_{3v}$) - Application to Infrared and Raman active vibrations of $XY_2$ and $XY_3$ type molecules - Projection operators – Construction of symmetry coordinate for $XY_2$bent symmetric type molecule

**TOTAL HOURS: 75**

Books for Study:

1. A.W. Joshi, Matrices and Tensors in Physics, Wiley Eastern Ltd., New Delhi (1975)
2. Eugene Butkov, Mathematical Physics, Addison-Wesley, London (1973)
3. L.A. Pipes and L.R. Harvill, Applied Mathematics for Engineers and Physicists, McGraw-Hill Company, Singapore (1967)
4. P.K. Chattopadhyay, Mathematical Physics, Wiley Eastern Ltd., New Delhi (1990)
5. A.K. Ghattak, T.C. Goyal and S.J. Chua, Mathematical Physics, Macmillan, New Delhi (1995)
6. G.Arfken and H.J.Mathemattical Methods for Physicists, 4th ed. Physicists (Prism Books, Bangalore, 1995).
7. M.D.Greenberg, Advanced Engineering Mathematics, 2nd ed. International ed., Prentice – Hall International, NJ, (1998)

8. E.Kreyszig, Advanced Engineering Mathematics, 8th ed. Wiley, NY (1999)
9. W.W.Bell, Special Functions for Scientists and Engineers (Van Nostrand, New York, 1968).
10.A.W. Joshi, Elements of Group Theory for Physicists (Wiley Eastern, New Delhi, 1971).
11. F.A. Cotton, Chemical Applications of Group Theory (Wiley Eastern, New Delhi, 1987).

**Books for reference:**

1. P.R. Halmos, Finite Dimensional Vector Spaces, 2ndEd. (Affiliated East-West, New Delhi, 1965).
2. M. Hamermesh, Group Theory and Its application to Physical Problems (Addison Wesley)
3. C.R. Wylie and L.C. Barrett, Advanced Engineering Mathematics, 6th Ed., International Ed. (McGraw-Hill, NY, 1995).
4. P.K. Chakrabarti and S.N. Kundu, A Text Book of Mathematical Physic (New Central Book Agency, Kolkata, 1996).
5. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical Physics (Macmillan India, New Delhi,2002).
6. W.W. Bell, Special Functions for Scientists and Engineers, (Van Nostrand, London, 1968).
7. M.A. Abramowitz and I. Stegun (Editors), Handbook of Mathematical Functions (Dover, NY,1972).
8. R.P. Feynman, R.B. Leighton, and M. Sands, The Feynman Lectures on Physics, Vols. 1, 2 and 3(Narosa, New Delhi, 1998).

**Course Outcomes:**

CO1: Formulate Lagrange's and Hamilton's equations and apply them to solve central force problems and scattering phenomena.
CO2: Analyze rigid body dynamics using Euler equations and examine the role of the Coriolis force in rotational motion.
CO3: Utilize Poisson brackets and canonical transformations to solve problems in advanced mechanics.
CO4: Compute the frequencies of normal modes in small oscillation problems, including molecular vibrations.
CO5: Derive relativistic equations of motion and apply four-vector formalism to Maxwell's equations.

CO-PO Matrices:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | 2 | - | - | 2 |
| **CO2** | 3 | 2 | 2 | - | 2 | - | - | 2 |
| **CO3** | 3 | 2 | 2 | - | 2 | - | - | 2 |
| **CO4** | 3 | 2 | 2 | - | 2 | - | - | 2 |
| **CO5** | 3 | 2 | 2 | - | 2 | - | - | 2 |
| **AVG** | 3 | 2 | 2 | - | 2 | - | - | 2 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH402 | Classical Mechanics and Relativity | 6 | 0 | 0 | 5 |

**Pre-requisite:** None

**Course Objectives:**

- Explain Lagrangian and Hamiltonian mechanics and their applications to motion and conservation laws.
- Describe the motion of rigid bodies using Euler's equations and moment of inertia tensor.
- Apply canonical transformations and Poisson brackets to solve equations of motion.
- Analyze small oscillations and determine normal modes in physical systems.
- Explore the principles of special relativity and their applications in physics.

**Unit I: Lagrangian and Hamiltonian Formulations 15 hrs**

Hamiltonian variation principle-Lagrange's equations of motion-Canonical momenta-Cyclic coordinates and conservation of corresponding momenta-Legendre transformation and Hamiltonian-Hamilton's equations of motion-Two-body central force problem-Kepler problem and Kepler's laws-Scattering by central potential-Two particle scattering-Cross - section in lab frame.

**Unit II: Mechanics of Rigid body 15 hrs**

Rigid body motion-Kinematics-Euler angles-Infinitesimal rotations-Rate of change of a vector-Carioles force Dynamics-Angular moment a and kinetic energy-Moment of inertia tensor-Euler's equation of motion –Torque free motion-Symmetrical top.

**Unit III: Canonical Transformation 15 hrs**

Canonical transformations and their generators-Simple examples-Poisson brackets-Equations of motion in Poisson bracket formalism-Symmetries and conservation laws-Hamilton-Jacobi theory-Applications of harmonic oscillator problem.

**Unit IV: Small Oscillations 15 hrs**

Formulation of the problem - Transformation of normal coordinates - Frequencies of normal modes-Linear tri atomic molecule.

**Unit V: Relativity 15 hrs**

Lorentz transformations- Four vectors-Lorentz invariance of the four products of two four-vectors-Invariance of Maxwell's equations- Relativistic Lagrangian and Hamiltonian for a free particle.

**TOTAL HOURS:75**

**Books for study:**

1. H. Goldstein, Classical Mechanics, 3rd Ed., C. Poole and J. Safko (Pearson Eduction Asia Publications, New Delhi, 2002).
2. T.W.B. Kibble, Classical Mechanics, 5th edition, Imperial College Press, 2004.
3. R. Resnick, Introduction to Special Theory of Relativity, Wiley India Pvt Ltd, 2007.

**Books for reference:**

1. L.D. Landau and E.M. Lifshitz, Mechanics, Pergamon Press, 1969.
2. K.R. Symon, Mechanics, Pearson Publications, 1971.
3. J.L. Synge and B.A. Griffith, Principles of Classical Mechanics, Nabu Press, 2011.
4. S.N. Biswas, Classical Mechanics, Books and Allied publications, Kolkata, 1999.

**Course Outcomes:**

CO1: Use Lagrangian and Hamiltonian formulations to solve mechanics problems.
CO2: Apply Euler's equations to analyze rigid body dynamics.
CO3: Solve equations of motion using canonical transformation techniques.
CO4: Determine the frequencies of normal modes in oscillatory systems.
CO5: Apply Lorentz transformations and four-vector formulations in relativistic mechanics.

**CO-PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| **CO2** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| **CO4** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| **CO5** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| **AVG** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |

| Course Code 23PH403 | Course Title<br>Entrepreneurship for Physicists: From Discovery to Enterprise | L | T | P | C |
|---|---|---|---|---|---|
| | | 5 | 0 | 0 | 4 |

**Pre-requisite:** None

**Course Objectives:**

- Understand the fundamentals of innovation, technology transfer, and entrepreneurship in the context of physics.
- Explore processes of opportunity recognition, business model development, and startup financing.
- Learn to design and prototype value-added products or services based on physics innovations.
- Develop practical skills in communication, pitching, and team-based problem solving.
- Experience project-based learning to simulate enterprise creation from lab to market.

**Unit I: Introduction to Scientific Entrepreneurships 12 hrs**

Introduction to scientific entrepreneurship- Roles of physicists in innovation- Intellectual property and patents- Case studies of physicist entrepreneurs- Group discussion on physics startups- IP scavenger hunt- Career goal reflection.

**Unit II: Opportunity Recognition and Business Model Design 12 hrs**

Identifying market needs- Value proposition and customer segments- Business Model Canvas (BMC)- SWOT and competitor analysis- Create a BMC for a selected idea- SWOT analysis of a startup- Role-play: pitching session

**Unit III: Prototyping & Product Development 12 hrs**

Minimum Viable Product (MVP)- Physics-based prototyping tools- Rapid prototyping labs/simulations- Iterative design process- Build concept demos- Guest session with a physics-based founder-MVP building challenge.

**Unit IV: Financing and Legal Foundations 12 hrs**

Startup funding: grants, VCs, etc.- Writing executive summaries- Financial planning and forecasting- Legal aspects: company formation and IP- Develop a financial spreadsheet- Draft investor pitch email- Simulate startup registration process.

**Unit V: Teaming, Pitching and Project Execution 12 hrs**

Roles in startup teams- Communication and leadership- Pitching strategies and storytelling- Final project presentation and evaluation- Capstone group project- Final pitch event- Peer feedback and reflection

**TOTAL HOURS:60**

**References:**


1. Barringer, B. R., & Ireland, R. D. (2019). Entrepreneurship: Successfully Launching New Ventures (6th ed.). Pearson.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
3. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Wiley.
4. Timmons, J. A., & Spinelli, S. (2009). New Venture Creation: Entrepreneurship for the 21st Century. McGraw-Hill.
5. Aulet, B. (2013). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. MIT Press.
6. Kuratko, D. F. (2016). Entrepreneurship: Theory, Process, and Practice. Cengage Learning.
7. Martin, B. C., McNally, J. J., & Kay, M. J. (2013). Examining the Formation of Human Capital in Entrepreneurship: A Meta-Analysis of Entrepreneurship Education Outcomes. Journal of Business Venturing, 28(2), 211–224.

**Course Outcomes:**

CO1: Sketch business models and product ideas derived from physics-based research or inventions.

CO2: Assemble a basic prototype or concept demonstration of a physics-based product or service.

CO3: Demonstrate pitching skills through oral presentations and structured pitch decks for investors or academic panels.

CO4: Construct financial models and project feasibility for small-scale physics-based startups.

CO5: Organize team-based entrepreneurial projects simulating real-world innovation-to-market processes.

**CO-PO Matrices:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 |
| CO2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 |
| CO3 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 3 | 1 | 2 | 2 |
| CO5 | 2 | 2 | 3 | 3 | 2 | 1 | 3 | 1 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH405 | Thermodynamics and Statistical Mechanics | 6 | 0 | 0 | 5 |
| **Pre-requisite:** | Nil | | | | |

**Course Objectives:**

- Explain phase transitions, phase equilibrium, and thermodynamic potentials.
- Describe statistical mechanics and its connection to thermodynamics.
- Apply canonical and grand canonical ensembles to analyze statistical systems.
- Differentiate between classical and quantum statistics for various particle systems.
- Explore real gas behavior, the Ising model, and fluctuation phenomena in thermodynamics.

**Unit I: Phase Transitions** **15 hrs**

Thermodynamic potentials- Phase Equilibrium- Gibb's Phase rule- Phase transitions and Ehrenfest's classifications- Third law of thermodynamics- Order parameters- Landau theory of phase transition- Critical indices- Scale transformations and dimensional analysis.

**Unit II: Statistical Mechanics and Thermodynamics** **15 hrs**

Foundations of statistical mechanics- Specifications of states of a system- Microcanonical ensemble– Phase space- Entropy- Connection between statistics and thermodynamics- Entropy of an ideal gas using the microcanonical ensemble- Entropy of mixing and Gibb's paradox.

**Unit III: Canonical and Grand canonical Ensemble** **15 hrs**

Trajectories and density states- Liouville's theorem- Canonical and Grand canonical Ensembles- Partition function- Calculation of statistical quantities- Energy and density fluctuations.

**Unit IV: Classical and quantum Statistics** **15 hrs**

Density matrix- Statistics of ensembles- Statistics of indistinguishable particles- Maxwell-Boltzmann statistics- Fermi Dirac statistics- Ideal Fermi gas- Degeneracy- Bose-Einstein statistics-Plank radiation formula- Ideal Bose gas- Bose-Einstein condensation.

**Unit V: Real Gas, Ising Model and Fluctuations** **15 hrs**

Cluster expansion for a classical gas- Virial equation of state- Calculation of the first virial coefficient in the cluster expansion- Ising Model- Mean- field of the ising model in three, two and one dimensions- Exact solutions in one dimension. Correlation of space time-dependent fluctuations- Fluctuations dissipation theorem- The Fokker-Plank equation.

**TOTAL HOURS: 75**

**Books for study:**


1. F. Reif, Fundamentals of Statistical and Thermal Physics, Waveland Press, 2010.
2. B.K. Agarwal and M. Eisner, Statistical Mechanics, Second Edition (New Age InternationalPublications, New Delhi,1998.
3. C. Kittel, Thermal Physics, W.H. Freeman Pub., 1980.
4. M.K. Zemansky, Heat and Thermodynamics, McGraw Hill College Publications, 1996.
5. K. Huang, Statistical Mechanics, Wiley Publications, 1987.
6. Satya Prakash, Statistical Mechanics, Kedarnath Ramnath publications.


**Books for reference:**


1. R.K. Pathira, Statistical Mechanics, Academic Press, 2011.
2. L.D. Landau and E.M. Lifshitz, Statistical Physics, Butterworth-Heinemann Publications, 1980.
3. J.K. Bhattarcharjee, Statistical Mechanics: An Introductory Text, Allied Publications Pvt Ltd.
4. W. Greiner, L. Neise and H. Stoecker, thermodynamics and Statistical Mechanics, Springer Publications, 2001.

**Course Outcomes:**

CO1: Identify different types of phase transitions and their classifications.
CO2: Apply statistical mechanics principles to derive thermodynamic properties.
CO3: Use partition functions to calculate statistical quantities in various ensembles.
CO4: Analyze the behavior of Fermi-Dirac and Bose-Einstein gases.
CO5: Solve problems related to real gases, Ising models, and fluctuation-dissipation relations.

**CO-PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |
| **AVG** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH406 | Introduction to Numerical Methods | 6 | 0 | 0 | 5 |

**Pre-requisites: Nil**

**COURSE OBJECTIVES**

- Solve simultaneous linear algebraic equations using various numerical techniques.
- Apply numerical methods to solve algebraic, transcendental, and differential equations.
- Use interpolation techniques for estimating values between known data points.
- Fit curves to data using least squares and regression methods.
- Perform numerical integration using different quadrature rules.

**Unit 1: Simultaneous Linear Algebraic Equations** **15 hrs**

Method of triangularization - Gauss elimination method - Inverse of a matrix - Gauss–Jordan method

**Unit 2: Numerical Solution of Algebraic, Transcendental and Differential Equations 15 hrs**

Bisection method – Regula falsi method - Newton - Raphson method - - Horner's method – Solution of ordinary differential equation- Euler's method.

**Unit 3: Interpolation** **15 hrs**

Finite differences – operators – relation between operators –linear interpolation – interpolation with equal intervals–Newton forward interpolation formula– Newton backward interpolation formula.

**Unit 4: Curve Fitting** **15 hrs**

Principles of least squares-fitting a straight line-linear regression-fitting an exponential curve.

**Unit 5: Numerical Integration** **15 hrs**

Trapezoidal Rule-Simpson's 1/3 rule and 3/8 rule-Applications-Weddle's rule

**TOTAL HOURS:75**

**Books for Study**


1. Numerical methods-M.K.Venkatraman, National Publishing Company,(1990).
2. Numerical methods by V.Rajaraman, Prentice-Hall India Pvt.Ltd.,(2003).
3. Numerical methods by P.Kandasamy, K.Thilagavathy and K.Gunavathy, S.Chand&Co (2002).


**Books for References**


1. Numerical Methods for Scientific and Engineering computation by Jain Iyenger and Jain, New Age International(P)Ltd., (2004).
2. Numerical methods by S.S.Sastry, Prentice Hall of India Pvt.Ltd., New Delhi (2003).


**Web sites:**

http://www.sst.ph.ic.ac.uk/angur/lectures/compphys/compphys.html.http://www.library.cornell.edu/nn/(NumericalreceipieronlinebookinC&Fortran).

**Expected Course Outcomes:**

CO1: Apply Gaussian methods to solve linear equations and find matrix inverses.
CO2: Use numerical techniques to solve equations and ordinary differential equations.
CO3: Implement interpolation formulas to approximate unknown values.
CO4: Fit data to different types of curves using regression analysis.
CO5: Compute numerical integrals using Simpson's, Trapezoidal, and Weddle's rules.

**CO –PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |
| **AVG** | 3 | 2 | 3 | 3 | - | - | 2 | 3 |

| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 23PH407 | Innovation and Design Thinking in Physical Sciences | 5 | 0 | 0 | 4 |

**Pre-requisites: Nil**

**COURSE OBJECTIVES**

- Understand core principles of innovation and creative problem-solving within the context of physical sciences.
- Learn to apply design thinking methods to address scientific and societal challenges.
- Translate physical science research into innovative ideas and prototypes.
- Collaborate in multidisciplinary teams to develop and refine solutions.
- Present design solutions using visualization, storytelling, and prototyping techniques.

**Unit 1: Foundations of Innovation and Design Thinking** **12 hrs**

Definitions and types of innovation- Scientific creativity and lateral thinking- Overview of the design thinking framework- Role of physicists in innovation ecosystems

**Unit 2: Empathy and Problem Definition** **12 hrs**

Empathy mapping and user research- Identifying needs in scientific and technical environments- Defining problem statements.

**Unit 3: Ideation and Concept Development** **12 hrs**

Brainstorming and SCAMPER techniques- Idea evaluation and feasibility- Concept sketching and storyboarding.

**Unit 4: Prototyping and Testing** **12 hrs**

Types of prototypes (low/high fidelity)- Tools for physics-based prototyping- User testing and feedback.

**Unit 5: Communication and Implementation** **12 hrs**

Visual storytelling and science communication- Pitching innovative ideas- Planning for implementation and scalability

**TOTAL HOURS: 60**

**Tools and Resources:**

1. Design thinking toolkits (e.g., IDEO, Stanford d.school)
2. Prototyping platforms (TinkerCAD, Arduino, Figma)
3. Physics data visualization tools (Tracker, PhET Simulations)

**References**


1. Kelley, T., & Kelley, D. (2013). *Creative Confidence: Unleashing the Creative Potential Within Us All*. Crown Business.
2. Brown, T. (2009). *Change by Design: How Design Thinking Creates New Alternatives for Business and Society*. Harvard Business Press.
3. Liedtka, J., Ogilvie, T., & Brozenske, R. (2019). *The Designing for Growth Field Book: A Step-by-Step Project Guide*. Columbia Business School Publishing.
4. Razzouk, R., & Shute, V. (2012). *What Is Design Thinking and Why Is It Important? Review of Educational Research*, 82(3), 330–348.
5. Cross, N. (2006). *Designerly Ways of Knowing*. Springer.

**Expected Course Outcomes:**

CO1: Illustrate the design thinking process using real-world physical science problems.
CO2: Construct working models or demonstrators addressing physics-based issues.
CO3: Modify initial prototypes based on feedback and iterative testing.
CO4: Integrate scientific knowledge into the design of user-centric solutions.
CO5: Demonstrate team-based innovation projects with documented outcomes.

**CO –PO Matrices:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO7 | PO 8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| **CO5** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **AVG** | 2.4 | 2 | 1.8 | 1.8 | 2 | 1.8 | 2.2 | 2.2 |