# M.Sc., PHYSICS

**(Academic year 2023-2024)**

# SYLLABUS

**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**
**(AUTONOMOUS)**
*(Affiliated to Bharathidasan University,Tiruchirappalli)*
**Accredited by NAAC-AnISO9001:2015Certified Institution**
**SUNDARAKKOTTAI,MANNARGUDI–614016.**
**TAMILNADU, INDIA.**

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# M.Sc., Physics

**CHOICE BASED CREDIT SYSTEM-LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (CBCS -LOCF)**
*(For the Candidate admitted in the academic year 2023-2024)*

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## CHOICE BASED CREDIT SYSTEM

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a _cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our College have has moved to CBCS and implemented the grading system.

## OUTCOME-BASED EDUCATION (OBE)

## LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses with in a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an important point of reference for designing teaching- learning strategies, assessing student learning

levels, and periodic review of programmes and academic standards.

**Some important aspects of the Outcome Based Education**

**Course:** is defined as a theory, practical or theory cum practical subject studied in a semester.

**Course Outcomes (COs):** are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may bespecified for each course based on its Weightage.

**Programme:** is defined as the specialization or discipline of a Degree.

**Programme Outcomes (POs):** Programme outcomes are narrower statements that describe what students areexpected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

**Programme Specific Outcomes (PSOs):** PSOs are what the students should be able to do at the time ofgraduation with reference to a specific discipline.

**Some important terminologies repeatedly used in LOCF.**

**Core Courses (CC)** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helpsin providing a universal recognition to the said academic program.

**Discipline Specific Elective Courses (DSE)** Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme andprovide extensive exposure in the area chosen; these are also more applied in nature.

**Generic Elective Courses** An elective course chosen generally from an **unrelated discipline/subject,** with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of**other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

**Non Major Elective (NME):** A student shall choose at least two Non-major Elective Courses (NME) from outside his/her department.

**Skill Enhancement Courses (SECs)** These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge**.**

**Field Study/Industrial Visit/Case Study:** It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester‘s marks statement.

**Internship:** Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester's mark statement.

**Extra Credit Courses:** In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTELetc.

**Postgraduate Programme:**

**Programme Pattern:** The Post Graduate degree programme consists of **FIVE** vital components. They are as follows:

| | | |
|---|---|---|
| Part –A | : | Core Course (Theory, Practicals) Core Industry Module, Core Project |
| Part-B (i) | : | Elective courses |
| Part-B (ii) | : | Non Major Elective, Skill Enhancement course, Professional Competency course |
| Part-B (iii) | : | Internship |
| Part –C | : | Extension activity |

**EXAMINATION**

**Continuous Internal Assessment (CIA):**

**PG - Distribution of CIA Marks**

**Passing Minimum: 50 %**

Assignments – 3 = 30%
Tests- 3(Best 2 out of 3) = 50%
Seminar=10 %
Attendance= 10 %

**Question Paper Pattern**

**Part A**: includes two subsections

**Part A** 1 (10X1=10 marks)
One word question/ Fill in/ Match the following/True or False/ Multiple Choice Questions
Two Questions from Each unit

**Part A 2**(5X2=10 marks)
Short Answers
One question from Each unit
**Total Marks - 20**

**Part B**: (5X5=25 marks)
Paragraph Answers
Either/ or type, One Question from each unit

**Part C**: (10X3=30)
Essay Type Answers
Answer 3 out of 5 Questions
One Question from each unit

**Part A**: K1 Level

**Part B**: K2, K3 and K4 Level

**Part C**: K5 and K6 Level

**Knowledge levels for assessment of Outcomes based on Blooms Taxonomy**

| S.No. | Level | Parameter | Description |
|---|---|---|---|
| 1 | K1 | Knowledge/Remembering | It is the ability to remember the previously learned |
| 2 | K2 | Comprehension/ Understanding | The learner explains ideas or concepts |
| 3 | K3 | Application/Applying | The learner uses information in a new way |
| 4 | K4 | Analysis/Analysing | The learner distinguishes among different parts |
| 5 | K5 | Evaluation/Evaluating | The learner justifies a stand or decision |
| 6 | K6 | Synthesis/Creating | The learner creates a new product or point of view |

**WEIGHTAGE of K –LEVELS IN QUESTION PAPER**

| (Cognitive Level) K-LEVELS → | Lower Order Thinking | | | Higher Order Thinking | | | Total |
|---|---|---|---|---|---|---|---|
| | K1 | K2 | K3 | K4 | K5 | K6 | |
| **END SEMESTER EXAMINATIONS (ESE)** | 20 | 25 | | | 30 | | **75** |
| **Continuous Internal Assessment (CIA)** | 20 | 25 | | | 30 | | **75** |

| **QUESTION PATTERN FOR END SEMESTER EXAMINATION/ Continuous Internal Assessment** | | |
|---|---|---|
| **PART** | | **MARKS** |
| **PART –A I.** (No choice ,One Mark) **TWO** questions from each unit<br>**II.** (No choice, Two Mark) **ONE** question from each unit | (10x1=10)<br>(5x2=10) | **20** |
| **PART –B** (Either/ or type,5-Marks) **ONE** question from each unit | (5x5=25) | **25** |
| **PART –C** (3 out of 5) (10Marks) **ONE** question from each unit | (3x10=30) | **30** |
| | **Total** | **75** |

| BLUE PRINT OF QUESTION PAPER FOR END SEMESTER EXAMINATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **DURATION: 3.00 Hours.** | | | | | | | **Max Mark :75** |
| **K-LEVELS** | **K1** | **K2** | **K3** | **K4** | **K5** | **K6** | **Total** |
| **PART** | | | | | | | **Marks** |
| **PART –A** (One Mark, No choice) (10x1=10) | 10 | | | | | | **10** |
| (2-Marks,Nochoice) (5x2=10) | 10 | | | | | | **10** |
| **PART –B** (5-Marks)(Either/or type) (5x5=25) | | 5 | 10 | 10 | | | **25** |
| **PART –C** (10 Marks)(3 out of 5) (3x10=30) Courses having only **K5,K6** levels, K5 level- 3 Questions, K6 level- 2 Questions **(One K6 level question is compulsory)** | | | | | 20 | 10 | **30** |
| **Total** | **20** | **05** | **10** | **10** | 20 | 10 | **75** |

## EVALUATION

### GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) , respectively. These two are calculated by the following formulae:

| | |
|---|---|
| $GPA = \frac{\sum_{I=1}^{n} C_i G_i}{\sum_{I=1}^{n} C_i}$ | $WAM(\text{Weighted Average Marks}) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{I=1}^{n} C_i}$ |
| Where, $C_i$ is the Credit earned for the Course i, $G_i$ is the Grade Point obtained by the student for the Course i, $M_i$ is the marks obtained for the course i and n is the number of Courses **Passed** in that semester. | |

**CGPA:** Average GPA of all the Courses starting from the first semester to the current semester.

### CLASSIFICATION OF FINAL RESULTS:

i. The classification of final results shall be based on the CGPA, as indicated in Table-2.

ii. For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as _Outstanding‘. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as _Excellent‘, _Very Good‘, _Good‘, and _Above Average‘ respectively.

iii. Absence from an examination shall not be taken an attempt.

**Table- 1: Grading of the Courses**

| Marks Range | Grade Point | Corresponding Grade |
|---|---|---|
| 90 and above | **10** | **O** |
| 80 and above and below 90 | **9** | A+ |
| 70 and above and below 80 | **8** | **A** |
| 60 and above and below 70 | **7** | **B+** |
| 50 and above and below 60 | **6** | **B** |
| Below50 | **NA** | **RA** |

**NA- Not Applicable, RA- Reappearance**

The candidates performance in every current semester is indicated by **Semester Grade Point Average (SGPA)** and from the second semester onwards, the continuous performance including previous semester/s is indicated by **Cumulative Grade Point Average (CGPA)**

**Table-2: Final Result**

| CGPA | Corresponding Grade | Classification of Final Result |
|---|---|---|
| 9.00 and above | **O** | **Outstanding** |
| 8.00 to 8.99 | A+ | **Excellent** |
| 7.00 to 7.99 | **A** | **Very Good** |
| 6.00 to 6.99 | **B+** | **Good** |
| 5.00 to 5.99 | **B** | **Above Average** |

The candidates who have passed in the first appearance and within the prescribed duration of the PG Programme areeligible. If the candidate‘s Grade is O/A+ with more than one attempt, the performance is fixed as –Very Good

## Vision

To become a centre of excellence in Physics by dissemination and creation of knowledge through teaching and research in Physics at various levels and to help create a scientific society which encourages logical thinking.

## Mission

Providing best infrastructure, opportunities and environment to students through which they obtain excellence in knowledge in Physics. Exposing the students in developing protocols for the working modules in Physics.

## PROGRAMME OUTCOMES-M,Sc,. DEGREE PROGRAMMES

| PO.No | Programme Outcomes<br>(*Upon completion of the M.Sc.,Degree Programme, the Post graduate will be able to)* |
|---|---|
| **PO-1** | **Disciplinary Knowledge**: demonstrate in-depth knowledge and understanding of theories, policies, and practices in one or more disciplines that form a part of a Post Graduate program of study in Master of Science. |
| **PO-2** | **Critical Thinking and Problem Solving**: apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development: solve problems and extrapolate the same to real life situation |
| **PO-3** | **Information/digital literacy and Communication Skills:** use ICT in a varietyof learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data: communicate thoughts and ideas analytically and effectively in writing and orally using appropriate media, and present complex information in a clear and concise manner to different groups.. |
| **PO-4** | **Research-related skills:** conduct independent inquiry in a chosen scientific discipline, demonstrate sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating; recognize cause-and-effect relationships,define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; plan, execute and report the results of an experiment or investigation. |
| **PO-5** | **Scientific reasoning and Reflective Thinking:** analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; critically and sensibly evaluate life experiences, with self awareness and reflexivity of both self and society. |
| **PO-6** | **Multidisciplinary Approach, Innovation and Entrepreneurship:** propose novel ideas of interdisciplinary approach in providing better solutions and new ideas for the sustainable developments; identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society. |

| | |
|---|---|
| **PO-7** | **Moral and ethical awareness/reasoning:** embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work, demonstrate the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work. |
| **PO-8** | **Self directed Learning:** work independently, identify appropriate resources required for a project, and manage a project till completion. |
| **PO-9** | **Life long Learning:** engage in continuous learning for professional growth and development, acquire knowledge and skills, adapt to changing environment and to changing trades and demands of work place through knowledge/skill development/reskilling. |
| **PO-10** | **Multicultural Competence, Social Interaction and Effective Citizenship:** understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings, and demonstrate empathetic social concern and equity centred national development |

## PROGRAMME SPECIFIC OUTCOMES-

## (PSO)

| PSO No. | Program Specific Outcomes<br>(M.Sc., PHYSICS) |
|---|---|
| PSO1 | Understand and apply inter disciplinary concepts of Physics for describing the natural phenomenon. |
| PSO2 | Demonstrate mathematical, statistical, computational and experimental techniques in problem solving. |
| PSO3 | Implement the analytical methods required to interpret and analyze results and draw conclusions as supported by their data. |
| PSO4 | Design the programme as a whole opens up several carrier doors for the students interested in various areas of physics in private, public and government sectors. |
| PSO5 | Pursue research related to Physics and Materials characterization. |
| PS06 | Understanding the basic concepts of physics particularly concepts in classical mechanics, quantum mechanics, electrodynamics and electronics to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws. |
| PSO7 | Acquire scientific and problem solving skills by performing experiments in general physics and electronics |

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**TAMILNADU, INDIA.**

**M.Sc., PHYSICS**

**CHOICE BASED CREDIT SYSTEM - LEARNINIG OUTCOMES BASED CURRICULUM**

**FRAMEWORK (CBCS - LOCF)**

**(Applicable to the candidates admitted form the academic year 2023-2024)**

**ELIGIBILITY:** A candidate who is a graduate of this University or any recognized University in B.Sc., Physics/ B.Sc. Electronics/Applied Physics/ Four years Physics (Honours)

| Sem | Part | Nature of the Course | Course Code | Title of the Paper | Inst. Hours/Week | Ins.Hours/Week | | | | Credit | Exam Hours | Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | T | P | S | | | CIA | ESE | |
| I | Part A | Core Course-I | P23PH101 | Mathematical Physics | 6 | 5 | 1 | - | - | 5 | 3 | 25 | 75 | 100 |
| | | Core Course-II | P23PH102 | Classical Mechanics and Relativity | 6 | 6 | - | - | - | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical- I | P23PH103P | Practical-I | 6 | - | - | 6 | - | 3 | 3 | 25 | 75 | 100 |
| | Part B (i) | Elective Course-I | P23PHE1A / P23PHE1B | Crystal Growth and Thin films / Digital Communication | 5 | 4 | - | 1 | - | 3 | 3 | 25 | 75 | 100 |
| | | Elective Course-II | P23PHE2A P23PHE2B | Spectroscopy/ Material Science | 5 | 4 | - | 1 | - | 3 | 3 | 25 | 75 | 100 |
| | Part B (ii) | Non Major Elective – I | P23NMEPH11 | Energy Physics | 2 | 2 | - | - | - | 2 | 3 | 25 | 75 | 100 |
| | | | | **TOTAL** | **30** | **21** | 1 | **8** | - | **21** | **-** | **-** | **-** | **600** |

| Sem | Part | Nature of theCourse | Course Code | Title of the Paper | Inst. Hours/Week | Ins.Hours/Week | | | | Credit | Exam Hours | Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | T | P | S | | | CIA | ESE | |
| II | Part A | Core Course –III | P23PH204 | Statistical Mechanics | 6 | 6 | - | - | - | 5 | 3 | 25 | 75 | 100 |
| | | Core Course –IV | P23PH205 | Quantum Mechanics | 6 | 6 | - | - | - | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical-II | P23PH206P | Practical-II | 6 | - | - | 6 | - | 3 | 3 | 25 | 75 | 100 |
| | Part B (i) | Elective Course -III | P23PHE3A/ P23PHE3B | Numerical Methods and Computer Programming /Bio Physics | 5 | 3 | 1 | 1 | - | 3 | 3 | 25 | 75 | 100 |
| | | Elective Course –IV | P23PHE4A / P23PHE4B | Physics of Nano Science and Technology/ Analysis of CrystalStructure | 5 | 4 | - | 1 | - | 3 | 3 | 25 | 75 | 100 |
| | Part B (ii) | Non Major Elective –II | P23NMEPH 22 | Communication Electronics | 2 | 2 | - | - | - | 2 | 3 | 25 | 75 | 100 |
| | Part B (iii) | Internship/ Industrial Activity | | | | - | - | - | - | - | - | | - | - |
| | | | | **TOTAL** | **30** | **21** | **1** | **8** | **-** | **21** | - | - | - | **600** |
| III | Part A | Core Course - V | | Linear and DigitalICs and Applications | 6 | 5 | - | 1 | - | 5 | 3 | 25 | 75 | 100 |
| | | Core Course-VI | | Condensed MatterPhysics | 6 | 6 | - | - | - | 5 | 3 | 25 | 75 | 100 |

| Sem | Part | Nature of the Course | Course Code | Title of the Paper | Inst. Hours/Week | Ins.Hours/Week | | | | Credit | Exam Hours | Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | T | P | S | | | CIA | ESE | |
| | | Core Practical -III | | Practical – III Numerical Methods and Computer Programming (FOTRAN/C ) | 6 | - | - | 6 | - | 3 | 3 | 25 | 75 | 100 |
| | | Core Industry Module | | Characterization of Materials | 5 | 3 | - | 1 | 1 | 3 | 3 | 25 | 75 | 100 |
| | Part B (i) | Elective Course-V | | Research Methodology/ Non-linear Dynamics | 5 | 4 | - | 1 | - | 3 | 3 | 25 | 75 | 100 |
| | Part B (ii) | Skill Enhancement Course | | Microprocessor 8086 and Microcontroller 8051 | 2 | 2 | - | - | - | 2 | 3 | 25 | 75 | 100 |
| | Part B(iii) | Internship/Industrial Activity | | | - | - | - | - | - | 2 | - | - | - | - |
| | **TOTAL** | | | | **30** | **20** | **-** | **9** | **1** | **23** | **-** | **-** | **-** | **700** |
| IV | Part A | Core Course-VII | | Nuclear and Particle Physics | 5 | 4 | - | - | 1 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course-VIII | | Electromagnetic Theory | 5 | 4 | - | - | 1 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical -IV | | Practical – IV | 6 | - | - | 6 | - | 3 | 3 | 25 | 75 | 100 |
| | | Core Project | | Project with Viva Voce | 8 | - | 2 | 6 | - | 7 | 3 | 25 | 75 | 100 |
| | Part B(i) | Elective Course-VI | | Advanced Optics / Medical Physics | 4 | 4 | - | - | - | 3 | 3 | 25 | 75 | 100 |
| | Part B(ii) | Professional Competency Course | | Physics for SET/NET | 2 | 2 | - | - | - | 2 | 3 | 25 | 75 | 100 |
| | Part C | Extension Activity | | | **-** | **-** | **-** | **-** | **-** | 1 | - | - | - | **-** |
| | | **TOTAL** | | | **30** | **14** | **-** | **12** | **4** | **26** | - | - | - | **600** |
| | | **GRAND TOTAL** | | | **120** | **76** | **2** | **37** | **5** | **91** | - | - | **-** | **2400** |
| | | **Extra Credit** | | **MOOC/SWAYAM/ NPTEL** | **-** | **-** | **-** | **-** | **-** | 2 | - | - | - | - |
| | | | | **Value Added Courses(At least one Courses per Year)** | **-** | **-** | **-** | **-** | **-** | 2 | - | - | - | **-** |

L- Lecture T-Tutorial P-Practical S-Seminar

## Credit Distribution for M.Sc., PHYSICS

| S.No | Subject | Total Credits |
|---|---|---|
| Part A | Core Course [8 Courses X 5 Credits] | 40 |
| | Core Practical[4 Courses X 3 Credits] | 12 |
| | Project Work with Viva Voce | 07 |
| | Core Industry Module | 03 |
| Part B(i) | Elective Course [ 6 Courses X 3 Credits] | 18 |
| Part B(ii) | Non Major Elective [2 Courses X 2 Credits] | 04 |
| | Skill Enhancement Course [1 Courses X 2 Credits] | 02 |
| | Professional Competency Course[1 Course X 2 Credits] | 02 |
| Part B(iii) | Internship | 02 |
| Part C | Extension Activity | 01 |
| | **Total Credit** | **91** |

Part A component and Part B (i) will be taken into account for CGPA calculation forthe postgraduate programme and the other components of Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

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**NON MAJOR ELECTIVE (NME) OFFERED BY THE DEPARTMENT**

| Semester | Part | Course | Course Code | Title of the Paper |
|---|---|---|---|---|
| I | Part B (ii) | NME-I | P23NMEPH11 | Energy Physics |
| II | | NME-II | P23NMEPH22 | Communication Electronics |

# SEMESTER I

**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**

(AUTONOMOUS)

**SUNDARAKKOTTAI, MANNARGUDI – 614016**

*(For the Candidate admitted in the academic year 2023-2024)*

**DEPARTMENT OF PHYSICS**

**M. Sc., PHYSICS**

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**Semester: I –CC - I:** Mathematical Physics

**Ins. Hrs. /Week: 6** **Course Credit: 5** **Course Code:P23PH101**

**OBJECTIVES**

- To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program
- To extend their manipulative skills to apply mathematical techniques in their fields
- To help students apply Mathematics in solving problems of Physics

**UNIT I: LINEAR VECTOR SPACE ( 18 Hours)**

Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure –linear operators – Dual space-ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation

**UNIT II: COMPLEX ANALYSIS ( 19 Hours)**

Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders

**UNIT III: MATRICES ( 16 Hours)**

Types of Matrices and their properties, Rank of a Matrix -Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem – Diagonalization

**UNIT IV: FOURIER TRANSFORMS & LAPLACE TRANSFORMS ( 19 Hours)**

Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string.

Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip

**UNIT V: DIFFERENTIAL EQUATIONS ( 18 Hours)**

Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties - Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension & their Green's function.

**Total Lecture Hours-90**

**COURSE OUTCOMES:**

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

**CO1** Understand use of bra-ket vector notation and explain the meaning of complete orthonormal set of basis vectors, and transformations and be able to apply them

**CO2** Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.

**CO3** Analyze characteristics of matrices and its different types, and the process of diagonalization.

**CO4** Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology

**CO5** To find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems

**TEXT BOOK (S)**


1. George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
2. P.K. Chattopadhyay, 2013, *Mathematical Physics* ($2^{nd}$ edition), New Age, New Delhi
3. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt. Ltd., India
4. B.D.Gupta,2009,*Mathematical Physics* ($4^{th}$edition), Vikas Publishing House, New Delhi.
5. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.


**REFERENCE BOOK(S)**


1. E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi,
2. D.G.Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics,3rd Ed.Narosa,New Delhi.
3. S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York 3. E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts.
4. P. R. Halmos,1965,Finite Dimensional Vector Spaces,2nd Edition,Affiliated East West,New Delhi.
5. C.R.Wylie and L.C.Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition, International Edition, McGraw-Hill, New York

**E- RESOURCES**

1. www.khanacademy.org
2. https://youtu.be/LZnRlOA1_2I
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5. https://archive.nptel.ac.in/courses/115/106/115106086/

**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**

(AUTONOMOUS)

**SUNDARAKKOTTAI, MANNARGUDI – 614016**

*(For the Candidate admitted in the academic year 2023-2024)*

**DEPARTMENT OF PHYSICS**

**M. Sc., PHYSICS**

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**Semester: I –CC - II: CLASSICAL MECHANICS AND RELATIVITY**

**Ins. Hrs. /Week: 6** **Course Credit: 5** **Course Code: P23PH102**

**OBJECTIVES**

- To understand fundamentals of classical mechanics.
- To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.
- To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.
- To discuss the theory of small oscillations of a system.

**UNIT I: PRINCIPLES OF CLASSICAL MECHANIC (17 Hours)**

Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work.

**UNIT II: LAGRANGIAN FORMULATION (18 Hours)**

D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.

**UNIT III: HAMILTONIAN FORMULATION (20 Hours)**

Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field

**UNIT IV: SMALL OSCILLATIONS (16 Hours)**

Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.

**UNIT V: RELATIVITY (19 Hours)**

Inertial and non-inertial frames – Lorentz transformation equations – length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations

**Total Lecture Hours-90**

**COURSE OUTCOMES:**

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

**CO1** Understand the fundamentals of classical mechanics.

**CO2** Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.

**CO3** Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.

**CO4** Analyze the small oscillations in systems and determine their normal modes of oscillations.

**CO5** Understand and apply the principles of relativistic kinematics to the mechanical systems.

**TEXT BOOK(S)**


1. H. Goldstein, 2002, *Classical Mechanics*, 3rd Edition, Pearson Edu.
2. J. C. Upadhyaya, *Classical Mechanics*, Himalaya Publshing. Co. New Delhi.
3. R. Resnick, 1968, *Introduction to Special Theory of Relativity,* Wiley Eastern, New Delhi.
4. R. G. Takwala and P.S. Puranik, Introduction to Classical Mechanics –Tata – McGraw Hill, New Delhi, 1980.
5. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001


**REFERENCE BOOK(S)**


1. K. R. Symon, 1971, *Mechanics,* Addison Wesley, London.
2. S. N. Biswas, 1999, *Classical Mechanics*, Books & Allied, Kolkata.
3. Gupta and Kumar, *Classical Mechanics*, Kedar Nath.
4. T.W.B. Kibble, *Classical Mechanics*, ELBS.
5. Greenwood, *Classical Dynamics*, PHI, New Delhi.


**E- RESOURCES**

1. http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2. https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html
3. https://nptel.ac.in/courses/122/106/122106027/
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

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**Semester: I –CP-I: PRACTICAL I**

**Ins. Hrs. /Week: 6** **Course Credit: 3** **Course Code: P23PH103P**

**OBJECTIVES**

- To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
- To calculate the thermodynamic quantities and physical properties of materials.
- To analyze the optical and electrical properties of materials

**(Any Twelve Experiments)**

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
2. Determination of Viscosity of the given liquid – Meyer's disc
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. B-H loop using Anchor ring.
5. Determination of Thickness of the enamel coating on a wire by diffraction
6. Determination of Rydberg's Constant - Hydrogen Spectrum
7. FP Etalon
8. Determination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes.
9. Measurement of Band gap energy- Thermistor
10. Determination of Planck Constant – LED Method
11. Determination of Specific charge of an electron – Thomson's method.
12. Determination of Compressibility of a liquid using Ultrasonics
13. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
14. GM counter – Characteristics, inverse square law and absorption coefficient.
15. Measurement of Conductivity - Four probe method.
16. Arc spectrum – Iron.
17. Molecular spectra – AlO band.
18. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
19. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
20. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
21. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern - Microwave test bench
22. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
23. Construction of relaxation oscillator using UJT
24. FET CS amplifier- Frequency response, input impedance, output impedance

25. Study of important electrical characteristics of IC741.
26. V- I Characteristics of different colours of LED.
27. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
28. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
29. Construction of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
30. Construction of square wave Triangular wave generator using IC 741
31. Construction of a quadrature wave using IC 324
32. Construction of pulse generator using the IC 741 – application as frequency divider
33. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
34. Study of Binary to Gray and Gray to Binary code conversion.
35. Study of R-S, clocked R-S and D-Flip flop using NAND gates
36. Study of J-K, D and T flip flops using IC 7476/7473
37. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
38. Study of Arithmetic logic unit using IC 74181.
39. Construction of Encoder and Decoder circuits using ICs.

**Total Lecture Hours-45**

**COURSE OUTCOMES:**

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

**CO 1** Understand the strength of material using Young's modulus.
**CO 2** Acquire knowledge of thermal behaviour of the matetials.
**CO 3** Understand theoretical principles of magnetism through the experiments.
**CO 4** Acquire knowledge about arc spectrum and applications of laser
**CO 5** Improve the analytical and observation ability in Physics Experiments

**TEXT BOOK(S)**


1. Practical Physics, Gupta and Kumar, Pragati Prakasan.
Kit Developed for doing experiments in Physics- Instruction manual,
2. R. Srinivasan K.R Priolkar, Indian Academy of Sciences.
3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing.
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition


**REFERENCE BOOK(S)**


1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency
Pvt. Ltd
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
5. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.

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**Semester: I –EC - I: CRYSTAL GROWTH AND THIN FILMS**

**Ins. Hrs. /Week: 5** **Course Credit: 3** **Course Code: P23PHE1A**

**OBJECTIVES**

- To acquire the knowledge on Nucleation and Kinetics of crystal growth
- To understand the Crystallization Principles and Growth techniques
- To study various methods of Crystal growth techniques
- To understand the thin film deposition methods
- To apply the techniques of Thin Film Formation and thickness Measurement

**UNIT I: CRYSTAL GROWTH KINETICS (16 Hours)**

Basic Concepts, Nucleation and Kinetics of growth Ambient phase equilibrium - super saturation - equilibrium of finite phases equation of Thomson - Gibbs - Types of Nucleation - Formation of critical Nucleus - Classical theory of Nucleation - Homo and heterogeneous formation of 3D nuclei - rate of Nucleation - Growth from vapour phase solutions, solutions and melts - epitaxial growth - Growth mechanism and classification - Kinetics of growth of epitaxial films

**UNIT II: CRYSTALLIZATION PRINCIPLES (16 Hours)**

Crystallization Principles and Growth techniques Classes of Crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Super solubility - expression for super saturation - Metastable zone and introduction period - Miers TC diagram - Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a Crystallizer.

**UNIT III: GEL, MELT AND VAPOUR GROWTH (15 Hours)**

Gel, Melt and Vapour growth techniques Principle of Gel techniques - Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages - Melt techniques - Czochralski growth - Floating zone - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition - Stoichiometry.

**UNIT IV: THIN FILM DEPOSITION METHODS (14 Hours)**

Thin film deposition methods of thin film preparation, Thermal evaporation, Electron beam evaporation, pulsed LASER deposition, Cathodic sputtering, RF Magnetron sputtering, MBE, chemical vapour deposition methods, Sol Gel spin coating, Spray pyrolysis, Chemical bath deposition.

**UNIT V: THIN FILM FORMATION** **(14 Hours)**

Thin Film Formation and thickness Measurement Nucleation, Film growth and structure - Various stages in Thin Film formation, Thermodynamics of Nucleation, Nucleation theories, Capillarity model and Atomistic model and their comparison. Structure of Thin Film, Roll of substrate, Roll of film thickness, Film thickness measurement - Interferometry, Ellipsometry, Micro balance, Quartz Crystal Oscillator techniques.

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth

**CO2** Understand the Crystallization Principles and Growth techniques

**CO3** Study various methods of Crystal growth techniques

**CO4** Understand the Thin film deposition methods

**CO5** Apply the techniques of Thin Film Formation and thickness Measurement

**TEXT BOOK(S)**


1. V. Markov Crystal growth for beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004) 2nd edition
2. A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008)
3. M. Ohora and R. C. Reid, ―Modeling of Crystal Growth Rates from Solution‖
4. D. Elwell and H. J. Scheel, ―Crystal Growth from High Temperature Solution‖
5. Heinz K. Henish, 1973, ―Crystal Growth in Gels‖, Cambridge University Press. USA.


**REFERENCE BOOK(S)**


1. J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986)
2. P. Ramasamy and F. D. Gnanam, 1983, ―UGC Summer School Notes‖.
3. P. Santhana Raghavan and P. Ramasamy, ―Crystal Growth Processes‖, KRU Publications.
4. H.E.Buckley,1951,Crystal Growth, John Wiley andSons, New York
5. B.R. Pamplin, 1980, Crystal Growth, Pergman Press, London.


**E- RESOURCES**

1. https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp
2. https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF
3. https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m
4. https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw
5. https://www.electrical4u.com/thermal-conductivity-of-metals/

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**Semester: I –EC - I: DIGITAL COMMUNICATION**

**Ins. Hrs. /Week: 5** **Course Credit: 3** **Course Code: P23PHE1B**

**OBJECTIVES**

- To understand the use of Fourier, transform in analyzing the signals
- To learn about the quanta of transmission of information
- To make students familiar with different types of pulse modulation
- To have an in depth knowledge about the various methods of error controlling codes
- To acquire knowledge about spread spectrum techniques in getting secured communication

**UNIT I: SIGNAL ANALYSIS (15 Hours)**

Fourier transforms of gate functions, delta functions at the origin – Two delta function and periodic delta function – Properties of Fourier transform – Frequency shifting –Time shifting - Convolution – Graphical representation – Convolution theorem – Time Convolution theorem –Frequency Convolution theorem –Sampling theorem.

**UNIT II: INFORMATION THEORY (15 Hours)**

Communication system – Measurement of information – Coding – Bandot Code CCITT Code – Hartley Law – Noise in an information Carrying Channel- Effects of noise- Capacity of noise in a channel – Shannon Hartley theorem –Redundancy.

**UNIT III: PULSE MODULATION (16 Hours)**

Pulse amplitude modulation - natural sampling – Instantaneous sampling - Transmission of PAM Signals -Pulse width modulation – Time division multiplexing – Band width requirements for PAM Signals. Pulse Code Modulation –Principles of PCM –Quantizing noise – Generation and demodulation of PCM -Effects of noise –Companding – Advantages and application

**UNIT IV: ERROR CONTROL CODING (15 Hours)**

Introduction to Linear Block Codes, Hamming Codes, BCH Coding, RS Coding, Convolutional Coding, Coding Grain Viterbi Coding

**UNIT V: SPREAD SPECTRUM SYSTEMS (14 Hours)**

Pseudo Noise sequences, generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, anti-jam and multipath performance

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Apply the techniques of Fourier transform, convolution and sampling theorems in signal processing

**CO2** Apply different information theories in the process of study of coding of information, storage and communication

**CO3** Explain and compare the various methods of pulse modulation techniques

**CO4** Apply the error control coding techniques in detecting and correcting errors- able to discuss, analyze and compare the different error control coding

**CO5** Apply, discuss and compare the spread spectrum techniques for secure communications

**TEXT BOOK(S)**


1. B.P. Lathi, *Communication system*, Wiley Eastern.
2. George Kennedy, *Electronic Communication Systems,* 3rd Edition, Mc Graw Hill.
3. Simon Haykin, *Communication System*, 3rd Edition, John Wiley & Sons.
4. George Kennedy and Davis, 1988, *Electronic Communication System,* Tata McGraw Hill 4th Edition.
5. Taub and Schilling, 1991, *"Principles of Communication System"*, Second edition Tata McGraw Hill.


**REFERENCE BOOK(S)**


1. John Proakis, 1995, *Digital Communication*, 3rd Edition, McGraw Hill, Malaysia.
2. M. K. Simen, 1999, *Digital Communication Techniques, Signal Design and Detection*, Prentice Hall of India.
3. Dennis Roddy and Coolen, 1995, *Electronics communications,* Prentice Hall of India IV Edition.
4. Wave Tomasi, 1998, *"Advanced Electronics communication System"* 4th Edition Prentice Hall, Inc.
5. M.Kulkarni,1988, *"Microwave and Radar Engineering",* Umesh Publications


**E- RESOURCES**

1. http://nptel.iitm.ac.in/
2. http://web.ewu.edu/
3. http://www.ece.umd.edu/class/enee630.F2012.html
4. http://www.aticourses.com/Advanced%20Topics%20in%20Digital%20Signals
5. http://nptel.iitm.ac.in/courses/117101051.html

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**Semester: I –EC - II: SPECTROSCOPY**

**Ins. Hrs. /Week: 5** **Course Credit: 3** **Course Code: P23PHE2A**

## OBJECTIVES

- To comprehend the theory behind different spectroscopic methods
- To know the working principles along with an overview of construction of different types of spectrometers involved
- To explore various applications of these techniques in R &D.
- Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds.
- Understand this important analytical tool

**UNIT I:MICROWAVE SPECTROSCOPY (16 Hours)**

Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram -Information Derived from Rotational Spectra- Stark effect- Problems.

**UNIT II: INFRA-RED SPECTROSCOPY (15 Hours)**

Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of $H_2O$ and $CO_2$ -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra– remote analysis of atmospheric gases like N2O using FTIR by National Remote Sensing Centre (NRSC), India– other simple applications

**UNIT III: RAMAN SPECTROSCOPY (15 Hours)**

Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of $H_2O$ and $CO_2$ -Mutual exclusion principle- determination of $N_2O$ structure -Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy- SERS

**UNIT IV: RESONANCE SPECTROSCOPY (15 Hours)**

Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan

Electron Spin Resonance: Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom ) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR

**UNIT V: UV SPECTROSCOPY (14 Hours)**

Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - molar absorptivity – transmittance and absorbance - Color in organic compounds- Absorption by organic Molecule -Chromophores -Effect of conjugation on chromophores - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer - Simple applications

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.

**CO2** Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.

**CO3** Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool

**CO4** Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances

**CO5** Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.

**TEXT BOOK(S)**


1. C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi.
2. G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi.
3. D.N. Satyanarayana, 2001, *Vibrational Spectroscopy and Applications*, New Age International Publication.
4. B.K. Sharma, 2015, *Spectroscopy*, Goel Publishing House Meerut.
5. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds ($7^{th}$ Edition), New Age International Publishers

**REFERENCE BOOK(S)**


1. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
2. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.
3. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York.
4. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi.
5. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, Springer Link.


**E-RESOURCES**

1. https://www.youtube.com/watch?v=0iQhirTf2PI
2. https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5
3. https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee
4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5. **https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu**

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**Semester: I –EC - II: MATERIALS SCIENCE**

**Ins. Hrs. /Week: 5** **Course Credit: 3** **Course Code: P23PHE2B**

## OBJECTIVES

- To gain knowledge on optoelectronic materials
- To learn about ceramic processing and advanced ceramics
- To understand the processing and applications of polymeric materials
- To gain knowledge on the fabrication of composite materials
- To learn about shape memory alloys, metallic glasses and nanomaterials

**UNIT I: OPTOELECTRONIC MATERIALS (16 Hours)**

Importance of optical materials – properties: Band gap and lattice matching – optical absorption and emission – charge injection, quasi-Fermi levels and recombination – optical absorption, loss and gain. Optical processes in quantum structures: Inter-band and intra-band transitions Organic semiconductors. Light propagation in materials – Electro-optic effect and modulation, electro-absorption modulation – exciton quenching.

**UNIT II: CERAMIC MATERIALS (14 Hours)**

Ceramic processing: powder processing, milling and sintering – structural ceramics: zirconia, almina, silicon carbide, tungsten carbide – electronic ceramics – refractories – glass and glass ceramics

**UNIT III: COMPOSITE MATERIALS (15 Hours)**

Polymers and copolymers – molecular weight measurement – synthesis: chain growth polymerization – polymerization techniques – glass transition temperature and its measurement – visco elasticity – polymer processing techniques – applications: conducting polymers, biopolymers and high temperature polymers.

**UNIT IV: RESONANCE SPECTROSCOPY (14 Hours)**

Particle reinforced composites – fiber reinforced composites – mechanical behavior – fabrication methods of polymer matrix composites and metal matrix composites – carbon/carbon composites: fabrication and applications.

**UNIT V: NEW MATERIALS (16 Hours)**

Shape memory alloys: mechanisms of one-way and two-way shape memory effect, reverse transformation, thermo-elasticity and pseudo-elasticity, examples and applications -bulk metallic glass: criteria for glass formation and stability, examples and mechanical behavior - nanomaterials: classification, size effect on structural and functional properties, processing and properties of Nano

crystalline materials, single walled and multi walled carbon nanotubes

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Acquire knowledge on optoelectronic materials

**CO2** Be able to prepare ceramic materials

**CO3** Be able to understand the processing and applications of polymeric materials

**CO4** Be aware of the fabrication of composite materials

**CO5** Be knowledgeable of shape memory alloys, metallic glasses and nanomaterials.

**TEXT BOOK(S)**


1. Jasprit Singh, Electronic and optoelectronic properties of semiconductor structures, Cambridge University Press, 2007
2. P. K. Mallick. Fiber-Reinforced Composites. CRC Press, 2008.
3. V. Raghavan, 2003, Materials Science and Engineering, 4th Edition, Prentice- Hall India, New Delhi(For units 2,3,4 and 5)
4. G.K. Narula, K.S. Narula and V.K. Gupta, 1988, Materials Science, Tata McGraw-Hill
5. M. Arumugam, 2002, Materials Science, 3rd revised Edition, Anuratha Agencies


**REFERENCE BOOK(S)**


1. B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday. Textbook of Nanoscience and Nanotechnology. Springer- Verlag, 2012.
2. K. Yamauchi, I. Ohkata, K. Tsuchiya and S. Miyazaki (Eds). Shape Memory and Super Elastic Alloys: Technologies and Applications. Wood head Publishing Limited, 2011.
3. Lawrence H. Van Vlack, 1998. Elements of Materials Science and Engineering, 6th Edition, Second ISE reprint, Addison-Wesley.
4. H. Iabch and H. Luth, 2002, Solid State Physics – An Introduction to Principles of Materials Science, 2nd Edition, Springer.
5. D. Hull & T. W. Clyne, An introduction to composite materials, Cambridge University Press, 2008.


**RESOURCES**

1. https://onlinecourses.nptel.ac.in/noc20_mm02/preview
2. https://nptel.ac.in/courses/112104229
3. https://archive.nptel.ac.in/courses/113/105/113105081
4. https://nptel.ac.in/courses/113/105/113105025/
5. https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Electronic_Properties/Lattice_Vibrations

**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**

(AUTONOMOUS)

**SUNDARAKKOTTAI, MANNARGUDI – 614016**

*(For the Candidate admitted in the academic year 2023-2024)*

**DEPARTMENT OF PHYSICS**

**M. Sc., PHYSICS**

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**Semester: I –NME - I: ENERGY PHYSICS**

**Ins. Hrs. /Week: 2** **Course Credit: 2** **Course Code:P23NMEPH11**

**OBJECTIVES**

- To learn about various renewable energy sources.
- To know the ways of effectively utilizing the oceanic energy.
- To study the method of harnessing wind energy and its advantages.
- To learn the techniques useful for the conversion of biomass into useful energy.
- To know about utilization of solar energy.

**UNIT I: INTRODUCTION TO ENERGY SOURCES (6 Hours)**

Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and distribution.

**UNIT II: ENERGY FROM THE OCEANS (6 Hours)**

Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems.

**UNIT III: WIND ENERGY SOURCES (6 Hours)**

Basic principles of wind energy conversion–power in the wind–forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) - Energy storage–Applications of wind energy.

**UNIT IV: ENERGY FROM BIOMASS (6 Hours)**

Biomass conversion Technologies– wet and dry process– Photosynthesis -Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion– factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas- utilization of biogas.

**UNIT V: SOLAR ENERGY SOURCES (6 Hours)**

Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter–solar cell electrical characteristics– Efficiency–solar water Heater –solar distillation– solar cooking–solar greenhouse – Solar pond and its applications.

**Total Lecture Hours-30**

**COURSE OUTCOMES:**

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

**CO1** To identify various forms of renewable and non-renewable energy sources

**CO2** Understand the principle of utilizing the oceanic energy and apply it for practical applications.

**CO3** Discuss the working of a windmill and analyze the advantages of wind energy.

**CO4** Distinguish aerobic digestion process from anaerobic digestion.

**CO5** Understand the components of solar radiation, their measurement and apply them to utilize solar energy.

**TEXT BOOK(S)**


1. G.D. Rai, 1996, Non – convention sources of, 4th edition, Khanna publishers, New Delhi.
2. S. Rao and Dr. Paru Lekar, Energy technology.
3. M.P. Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
4. Solar energy, principles of thermal collection and storage by S. P. Sukhatme, 2nd edition, Tata McGraw-Hill Publishing Co. Lt., New Delhi (1997).
5. Energy Technology by S. Rao and Dr. Parulekar.


**REFERENCE BOOK(S)**


1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York.
2. Applied solar energy, A. B. Meinel and A. P. Meinal
3. John Twidell and Tony Weir, Renewable energy resources, Taylor and Francis group, London and New York.
4. Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning
5. Introduction to Non-Conventional Energy Resources -Raja et. al., Sci. Tech Publications


**E RESOURCES**

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1

2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/

3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy

4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/

5. https://www.acciona.com/renewable-energy/solar-energy/

# SEMESTER II

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**Semester: II –CC - III: STATISTICAL MECHANICS**

**Ins. Hrs. /Week:6** **Course Credit: 5** **Course Code:P23PH204**

**OBJECTIVES**

- To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
- To identify the relationship between statistic and thermodynamic quantities
- To comprehend the concept of partition function, canonical and grand canonical ensembles
- To grasp the fundamental knowledge about the three types of statistics
- To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

**UNIT I: PHASE TRANSITIONS (19 Hours)**

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

**UNIT I: PHASE TRANSITIONS (19 Hours)**

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

**UNIT III: CANONICAL AND GRAND CANONICAL ENSEMBLES (16 Hours)**

Trajectories and density of 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 (16 Hours)**

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 (20 Hours)**

Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory – Fluctuation-dissipation theorem - The Fokker-Planck equation

**Total Lecture Hours-90**

**COURSE OUTCOMES:**

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

**CO 1** To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition

**CO 2** To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc.Describe the peculiar behaviour of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities

**CO 3** Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function

**CO 4** To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.

**CO 5** To discuss and examine the thermodynamical behaviour of gases under fluctuation and also using Ising model

**TEXT BOOK(S)**


1. S. K. Sinha, 1990, Statistical *Mechanics*, Tata McGraw Hill, New Delhi.
2. B. K. Agarwal and M. Eisner, 1998, *Statistical Mechanics,* Second Edition New Age International, New Delhi.
3. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi.
4. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics,* McGraw -Hill, New York.
5. M. K. Zemansky, 1968, *Heat and Thermodynamics,* 5th edition, McGraw-Hill New York.


**REFERENCE BOOK(S)**


1. R. K. Pathria, 1996, *Statistical Mechanics,* 2nd edition, Butter WorthHeinemann, New Delhi.
2. L. D. Landau and E. M. Lifshitz, 1969, *Statistical Physics,* Pergamon Press, Oxford.
3. K. Huang, 2002, *Statistical Mechanics,* Taylor and Francis, London
4. W. Greiner, L. Neise and H. Stoecker, *Thermodynamics and Statistical Mechanics,* Springer Verlang, New York.

5.A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.


**E RESOURCES**

1. https://byjus.com/chemistry/third-law-of-thermodynamics/
2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html
3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5. https://en.wikipedia.org/wiki/Ising_model

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**Semester:II –CC - IV: QUANTUM MECHANICS**

**Ins. Hrs. /Week:6** **Course Credit: 5** **Course Code:P23PH205**

**OBJECTIVES**

- To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
- To describe the propagation of a particle in a simple, one-dimensional potential.
- To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential.
- To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature
- To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.

**UNIT I: BASIC FORMALISM (18 Hours)**

Interpretation of the wave function – Time dependent Schrodinger equation –Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator –Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation

**UNIT II: ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS (19 Hours)**

Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Rigid rotator

**UNIT III: GENERAL FORMALISM (17 Hours)**

Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation – Parity and time reversal

**UNIT IV: APPROXIMATION METHODS (18 Hours)**

Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels –Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator.

**UNIT V: ANGULAR MOMENTUM (18 Hours)**

Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Matrix

representation – Spin angular momentum – Addition of angular momenta – CG Coefficients – Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle.

**Total Lecture Hours-90**

**COURSE OUTCOMES:**

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

**CO 1** Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics

**CO 2** Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems

**CO 3** Can discuss the various representations, space time symmetries and formulations of time evolution

**CO 4** Can formulate and analyze the approximation methods for various quantum mechanical problems

**CO 5** To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.

**TEXT BOOK(S)**


1.P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010.

2.G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.

3.David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.

4.SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.

5.A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4thEdition, Macmillan, India, 1984.


**REFERENCE BOOK(S)**


1. E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
2. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
3. L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
4. S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.
5. V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.


**E RESOURCES**

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html
3. http://web.mit.edu/8.05/handouts/jaffe1.pdf
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf
5. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

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**Semester:II –CP - II: PRACTICAL II**

**Ins. Hrs. /Week:6** **Course Credit: 3** **Course Code:P23PH206P**

**OBJECTIVES**

- To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
- To calculate the thermodynamic quantities and physical properties of materials.
- To analyze the optical and electrical properties of materials.
- To observe the applications of FET and UJT.
- To study the different applications of operational amplifier circuits.
- To learn about Combinational Logic Circuits and Sequential Logic Circuits
- **(Any Twelve Experiments)**

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. Measurement of Susceptibility of liquid - Quincke's method
5. B-H curve using CRO
6. Measurement of Magnetic Susceptibility - Guoy's method
7. LG Plate
8. Arc spectrum: Copper
9. Determination of Solar constant
10. Determination of e/m - Millikan's method
11. Miscibility measurements using ultrasonic diffraction method
12. Determination of Thickness of thin film. - Michelson Interferometer
13. GM counter – Feather's analysis: Range of Beta rays
14. Iodine absorption spectra
15. Molecular spectra – CN bands
16. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser
17. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
18. Measurement of Dielectricity - Microwave test bench
19. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility

20. Interpretation of vibrational spectra of a given material
21 Determination of I-V Characteristics and efficiency of solar cell.
22 IC 7490 as scalar and seven segment display using IC7447
23 Solving simultaneous equations – IC 741 / IC LM324
24 Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
25 Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
26 Construction of second order butter worth multiple feedback narrow band pass filter
27 Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
28 Construction of square wave generator using IC 555 – Study of VCO
29 Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
30 Construction of pulse generator using the IC 555 – Application as frequency divider
31 BCD to Excess- 3 and Excess 3 to BCD code conversion
32 Study of binary up / down counters - IC 7476 / IC7473
33 Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
34 Study of synchronous parallel 4-bit binary up/down counter using IC 74193
35 Study of asynchronous parallel 4-bit binary up/down counter using IC 7493
36 Study of Modulus Counter
37. Construction of Multiplexer and Demultiplexer using ICs.

**Total Lecture Hours-45**

**COURSE OUTCOMES:**

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

CO1 Understand the strength of material using Young‘s modulus
CO 2 Acquire knowledge of thermal behaviour of the materials
CO 3 Understand theoretical principles of magnetism through the experiments.
CO 4 Acquire knowledge about arc spectrum and applications of laser
CO 5 Improve the analytical and observation ability in Physics Experiments
CO 6 Conduct experiments on applications of FET and UJT
CO 7 Analyze various parameters related to operational amplifiers
CO 8 Understand the concepts involved in arithmetic and logical circuits using IC‘s
**CO 9** Understand the concepts involved in arithmetic and logical circuits using IC‘s
**CO 10** Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits
CO 11 Analyze the applications of counters and registers

**TEXT BOOK(S)**


1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition


**REFERENCE BOOKS**


1. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
2. Advanced Practical Physics, S.P Singh, Pragati Prakasan
3. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd
4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
5. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi

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**Semester:II –EC - III: NUMERICAL METHODS AND COMPUTER PROGRAMMING**

**Ins. Hrs. /Week:5** **Course Credit: 3** **Course Code:P23PHE3A**

**OBJECTIVES**

- To make students to understand different numerical approaches to solve a problem.
- To understand the basics of programming

**UNIT I: SOLUTIONS OF EQUATIONS (14 Hours)**

Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations - Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.

**UNIT II: LINEAR SYSTEM OF EQUATIONS (14 Hours)**

Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors.

**UNIT III: INTERPOLATION AND CURVE FITTING (16 Hours)**

Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.

**UNIT IV: DIFFERENTIATION, INTEGRATION AND SOLUTION OF**

**DIFFERENTIAL EQUATIONS (16 Hours)**

Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule–Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadrature – solution of ordinary differential equations – Euler and Runga Kutta methods.

**UNIT V: PROGRAMMING WITH C (15 Hours)**

Flow-charts – Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements – Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non-linear equations by the Newton-Raphson method, (c) Newton's forward and

backward interpolation, Lagrange Interpolation, (d) Trapezoidal and Simpson‘s Rules, (e) Solution of first order differential equations by Euler‘s method.

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.

**CO2** Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.

**CO3** Understand, how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation

**CO4** Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson‘s method of numerical integration.

**CO5** Understand the basics of C-programming and conditional statements.

**TEXT BOOK(S)**


1. V. Rajaraman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi
2. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi
3. S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi
4. F. Scheid, 1998, Numerical Analysis, 2nd Edition, Schaum‘s series, McGraw Hill, New York

5.W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN,
2nd Edition, Cambridge Univ. Press


**REFERENCE BOOK(S)**


1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill,)
2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5th Edition, Addison-Wesley, MA.
3. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York.
4. S. S. Kuo, 1996, Numerical Methods and Computers, Addison-Wesley.
5. V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi


**E ROSOURCES**

1. https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman
2. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874
3. https://nptel.ac.in/course/122106033/
4. https://nptel.ac.in/course/103106074/
5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

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**Semester:II –EC - III: BIO PHYSICS**

**Ins. Hrs. /Week:5** **Course Credit: 3** **Course Code: P23PHE3B**

**OBJECTIVES**

- To understand the physical principles involved in cell function maintenance.
- To understand the fundamentals of macromolecular structures involved in propagation of life.
- To understand the biophysical function of membrane and neuron.
- To understand various kinds of radiation and their effects on living system and to know the hazards posed by such radiations and the required precautions.
- To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

**UNIT I: CELLULAR BIOPHYSICS (14 Hours)**

Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix - Molecular mechanisms of Vesicular traffic - Electrical activities of cardiac and neuronal cells.

**UNIT II: MOLECULAR BIOPHYSICS (14 Hours)**

Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins

Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation.

Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.

**UNIT III: MEMBRANE AND NEURO BIOPHYISCS (16 Hours)**

Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels.

Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.

**UNIT IV: RADIATION BIO PHYSICS (16 Hours)**

X-Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma radiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on bio-macromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.

**UNIT V: PHYSICAL METHODS IN BIOLOGY (15 Hours)**

Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis, polyacrylamide gel electrophoresis.

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.

**CO2** Comprehension of the role of biomolecular conformation to function.

**CO3** Conceptual understanding of the function of biological membranes and also to understand the functioning of nervous system.

**CO4** To know the effects of various radiations on living systems and how to prevent ill effects of radiations.

**CO5** Analyze and interpret data from various techniques viz., spectroscopy, crystallography, chromatography etc.,

**TEXT BOOK(S)**


1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009
3. Biophysics, P. S. Mishra VK Enterprises, 2010.
4. Biophysics, M. A Subramanian, MJP Publishers, 2005.
5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.


**REFERENCE BOOK(S)**


1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).

2.Essential cell biology by Bruce Albert et al (Garland Science)

3.Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).

4.Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).

5.Biological spectroscopyby Iain D. Campbell, Raymond A. Dwek


**E ROSOURCES**

1. General Bio: http://www.biology.arizona.edu/DEFAULT.html
2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm
3. Electrophoresis:http://learn.genetics.utah.edu/content/labs/gel/
4. Online biophysics programs: http://mw.concord.org/modeler/
5. https://blanco.biomol.uci.edu/WWWResources.html

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**Semester:II –EC - IV: PHYSICS OF NANOSCIENCE AND TECHNOLOGY**

**Ins. Hrs. /Week:5** **Course Credit:3** **Course Code: P23PHE4A**

## OBJECTIVES

- Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
- To provide the basic knowledge about nanoscience and technology.
- To learn the structures and properties of nanomaterials.
- To acquire the knowledge about synthesis methods and characterization techniques and its applications.

**UNIT I: FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY (15 Hours)**

Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.

**UNIT II: PROPERTIES OF NANOMATERIALS (16 Hours)**

Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).

**UNIT III: SYNTHESIS AND FABRICATION (15 Hours)**

Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.

**UNIT IV: CHARACTERIZATION TECHNIQUES (14 Hours)**

Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.

**UNIT V: APPLICATIONS OF NANOMATERIALS (15 Hours)**

Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification -Medicine:

Imaging o cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells – rechargeable batteries - supercapacitors – photovoltaics-field project.

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.

**CO2** Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.

**CO3** Understand the process and mechanism of synthesis and fabrication of nanomaterials.

**CO4** Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.

**CO5** Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.

**TEXT BOOK(S)**


1. A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. (2012).
2. Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).
3. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).
4. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002).
5. Nanotechnology and Nanoelectronics, D.P. Kothari,V. Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt. Ltd, New Delhi. (2018)


**REFERENCE BOOK(S)**


1. Nanostructures and Nanomaterials – Huozhong Gao – Imperial College Press (2004).
2. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
3. Nano particles and Nano structured films; Preparation, Characterization and Applications, J. H. Fendler John Wiley and Sons. (2007)
4. Textbook of Nanoscience and Nanotechnology, B. S. Murty, et al., Universities Press. (2012)
5. The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.


**E RESOURCES**

1. www.its.caltec.edu/feyman/plenty.html
2. http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
3. http://www.understandingnano.com
4. http://www.nano.gov
5. http://www.nanotechnology.com

**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**

(AUTONOMOUS)

**SUNDARAKKOTTAI, MANNARGUDI – 614016**

*(For the Candidate admitted in the academic year 2023-2024)*

**DEPARTMENT OF PHYSICS**

**M. Sc., PHYSICS**

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**Semester:II –EC - IV: ANALYSIS OF CRYSTAL STRUCTURES**

**Ins. Hrs. /Week:5** **Course Credit: 3** **Course Code: P23PHE4B**

**OBJECTIVES**

- To teach the concept of crystal structures and symmetry, and diffraction theory
- To provide students with a background to X-ray generation, scattering theory and experimental diffraction from single crystals
- To provide instruction on the methods and basis for determining low-molecular weight crystal structures using X-ray Crystallography
- To give the students a background to the instrumentation used for powder diffraction and structure refinement using Rietveld method
- To teach the different levels of structure exhibited by proteins and nucleic acids and methods used in protein crystallography.

**UNIT I: CRYSTAL LATTICE (14 Hours)**

Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.

**UNIT II: DIFFRACTION (16 Hours)**

X-ray generation, properties - sealed tube, rotating anode, synchrotron radiation - absorption - filters and monochromators Atomic scattering factor - Fourier transformation and structure factor - anomalous dispersion - Laue, rotation/oscillation, moving film methods- interpretation of diffraction patterns - cell parameter determination - systematic absences - space group determination

**UNIT III: STRUCTURE ANALYSIS (16 Hours)**

Single crystal diffractometers - geometries - scan modes - scintillation and area detectors - intensity data collection - data reduction - factors affecting X-ray intensities - temperature and scale factor - electron density - phase problem - normalized structure factor - direct method fundamentals and procedures -Patterson function and heavy atom method - structure refinement - least squares method - Fourier and difference Fourier synthesis - R factor - structure interpretation - geometric calculations - conformational studies - computer program packages.

**UNIT IV: UNIT IV:POWDER METHODS (14 Hours)**

Fundamentals of powder diffraction - Debye Scherrer method - diffractometer geometries - use of monochromators and Soller silts - sample preparation and data collection - identification of unknowns - powder diffraction files (ICDD) - Rietveld refinement fundamentals - profile

analysis - peak shapes - whole pattern fitting - structure refinement procedures – auto-indexing – structure determination from powder data - new developments. Energy dispersive X-ray analysis – texture studies - crystallite size determination - residual stress analysis - high and low temperature and high pressure crystallography (basics only).

**UNIT V: PROTEIN CRYSTALLOGRAPHY (15 Hours)**

Globular and fibrous proteins, nucleic acids - primary, secondary, tertiary and quaternary structures - helical and sheet structures - Ramachandran map and its significance – crystallization methods for proteins - factors affecting protein crystallization - heavy atom derivatives – methods used to solve protein structures - anomalous dispersion methods.

**Total Lecture Hours-75**

**COURSE OUTCOMES:**

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

**CO1** Understand crystal symmetry and reciprocal lattice concept for X-ray diffraction

**CO2** Gain a working knowledge of X-ray generation, X-ray photography with Laue, oscillation and moving film methods, and space group determination

**CO3** Get an exposure to crystal structure determination using program packages

**CO4** Understand the instrumentation used for powder diffraction, data collection, data interpretation, and structure refinement using Rietveld method

**CO5** Get an insight into the structural aspects of proteins and nucleic acids, crystallization of proteins and methods to solve protein structures

**TEXT BOOK(S)**


1. Azaroff, L.V., "Elements of X-Ray Crystallography", Techbooksl, New York, 1992.
2. Blundell, T.L. and Johnson, L., "Protein Crystallography", Academic Press, New York, 1986.
3. Cullity, B.D. and Stock,S.R. "Elements of X-ray Diffraction", Pearson, 2014.
4. H.L. Bhat, Introduction to Crystal Growth Principles and Practice CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.
5. B.R. Pamplin, Crystal Growth, Pergamon Press, Oxford, 1975.


**REFERENCE BOOK(S)**


1. Glusker, J.P. and Trueblood, K.N. Crystal Structure Analysis: A Primer", Oxford University, Press, New York, 1994.
2. Ladd, M.F.C. and Palmer, R.A., "Structure Determination by X-ray Crystallography", Plenum Press, New York, 3rd Edition, 1993.
3. Stout, G.H. and Jensen, L."X-ray Structure Determination, A Practical Guide", Macmillan:,New York, 1989.
4. Woolfson, M.M. "An Introduction to X-ray Crystallography" Cambridge University Press, New York, 1997.
5. Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009

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2. https://archive.nptel.ac.in/courses/104/108/104108098/
3. https://www.digimat.in/nptel/courses/video/102107086/L11.html
4. https://onlinecourses.nptel.ac.in/noc19_cy35/previewhttps://onlinecourses.nptel.ac.in/noc19_cy35/preview
5. https://nptel.ac.in/courses/104/104/104104011/

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**Semester:II –NME- II: COMMUNICATION ELECTRONICS**

**Ins. Hrs. /Week:2** **Course Credit: 2** **Course Code:P23NMEPH22**

**OBJECTIVES**

- To comprehend the transmission of electromagnetic waves thorough different types of antenna and also to acquire knowledge about the propagation of waves through earth's atmosphere and along the surface of the earth
- To gain knowledge in the generation and propagation of microwaves
- To acquire knowledge about radar systems and its applications and also the working principle of colour television
- To learn the working principle of fiber optics and its use in telecommunication
- To understand the general theory and operation of satellite communication systems

**UNIT I: ANTENNAS AND WAVE PROPAGATION** **(7 Hours)**

Radiation field and radiation resistance of short dipole antenna-grounded antenna-unrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave propagation

**UNIT II: MICROWAVES** **(6 Hours)**

Microwave generation—multi cavity Klystron-reflex klystron-magnetron travelling wave tubes (TWT) and other microwave tubes-MASER-Gunn diode-wave guides-rectangular wave guides-standing wave indicator and standing wave ratio(SWR)

**UNIT III: RADAR AND TELEVISION** **(7 Hours)**

Elements of a radar system-radar equation-radar performance Factors radar transmitting systems-radar antennas-duplexers-radar receivers and indicators-pulsed systems-other radar systems- colour TV transmission and reception-colour mixing principle-colour picture tubes-Delta gun picture tube-PIL colour picture tube-cable TV, CCTV and theatre TV

**UNIT IV: OPTICAL FIBER** **(5 Hours)**

Propagation of light in an optical fibre-acceptance angle-numerical aperture-step and graded index fibres- optical fibres as a cylindrical wave guide-wave guide equations-wave guide equations in step index fibres - fibre losses and dispersion-applications

**UNIT V: SATELLITE COMMUNICATION** **(5Hours)**

Orbital satellites-geostationary satellites-orbital patterns-satellite system link models-satellite system parameters-satellite system link equation link budget-INSAT communication satellites

**Total Lecture Hours-30**

**COURSE OUTCOMES:**

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

**CO1** Discuss and compare the propagation of electromagnetic waves through sky and on earth's surface Evaluate the energy and power radiated by the different types of antenna

**CO2** Compare and differentiate the methods of generation of microwaves analyze the propagation of microwaves through wave guides- discuss and compare the different methods of generation of microwaves

**CO3** Classify and compare the working of different radar systems- apply the principle of radar in detecting locating, tracking, and recognizing objects of various kinds at considerable distances – discuss the importance of radar in military- elaborate and compare the working of different picture tube

**CO4** Classify, discuss and compare the different types of optical fiber and also to justify the need of it-discover the use of optical fiber as wave guide

**CO5** Explain the importance of satellite communication in our daily life-distinguish between orbital and geostationary satellites elaborate the linking of satellites with ground station on the earth

**TEXT BOOK(S)**


1. Handbook of Electronics by Gupta and Kumar, 2008 edition.
2. Electronic communication systems – George Kennedy and Davis, Tata McGraw Hill, 4th edition, 1988.
3. Taub and Schilling, principles of communication systems, second edition, Tata Mc Graw Hill (1991).
4. M. Kulkarani, Microwave and radar engineering, Umesh Publications, 1998.
5. Mono Chrome and colour television, R. R. Ghulathi


**REFERENCE BOOK(S)**


1. Electronic communications – Dennis Roody and Coolen, Prentice Hall of India, IV edition, 1995.
2. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998
3. Dennis Roddy and Coolen, 1995, *Electronics communications,* Prentice Hall of India IV Edition.
4. Wayne Tomasi, 1998 *"Advanced Electronics communication System"* 4th edition, Prentice Hall of India, 1998
5. S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.


**E RESOURCES**

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2. https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/
3. http://nptel.iitm.ac.in/
4. http://web.ewu.edu/
5. http://nptel.iitm.ac.in/