# P G & RESEARCH DEPARTMENT OF

**PHYSICS**

**NATIONAL COLLEGE (AUTONOMOUS)**

**TIRUCHIRAPPALLI**

**M. Sc. - SYLLABUS**

**FROM JUNE 2022 ONWARDS**

**COURSE CONTENTS**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester** | **Course** | **Code No.** | **Title of the course** | **Instruction Hrs.** | **Credit** | **Exam Hrs.** | **Marks** | | | **Total Marks** |
| **Int.** | **Ext.** | |
| **Oral** | **W** |
| I | CC-I | P22PH1 | Mathematical Physics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-II | P22 PH2 | Classical Mechanics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-III | P22PH3 | Statistical Mechanics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-IVP | P22PH4P | Physics Practical - I (General & Electronics) | 6 | 5 | 4 | 25 | 5 | 70 | 100 |
| EC-I | P22PH5E | Special Electronics - I | 6 | 4 | 3 | 25 |  | 75 | 100 |
| **Papers:5** |  |  | **30** | **24** |  |  |  |  | **500** |
| II | CC-V | P22PH6 | Atomic and Molecular Spectroscopy | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-VI | P22PH7 | Quantum Mechanics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-VII | P22PH8 | Nuclear and Particle Physics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-VIIIP | P22PH9P | Physics Practical – II (General and Electronics) | 6 | 5 | 4 | 25 | 5 | 70 | 100 |
| EC-II | P22PH10E | Special Electronics - II | 6 | 4 | 3 | 25 |  | 75 | 100 |
| **Papers:5** |  |  | **30** | **24** |  |  |  |  | **500** |
| III | CC-IX | P22PH11 | Electromagnetic Theory | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-X | P22PH12 | Crystal Growth and Thin Film Physics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CC-XIP | P22PH13P | Physics Practical – III (Advanced Electronics – I) | 6 | 5 | 4 | 25 | 5 | 70 | 100 |
| EC III | P22PH14E | Numerical methods and C Programming | 6 | 4 | 3 | 25 |  | 5 | 100 |
| EC IV | P22PH15E | Basics of Nano Science and its Applications | 6 | 4 | 3 | 25 |  | 75 | 100 |
| **Papers:5** |  |  | **30** | **23** |  |  |  |  | **500** |
| IV | CCXII | P22PH16 | Condensed Matter Physics | 6 | 5 | 3 | 25 |  | 75 | 100 |
| CCXIIP | P22PH17P | Physics Practical – IV (Advanced Electronics – II) | 6 | 5 | 3 | 25 | 5 | 70 | 100 |
| EC V | P22PH18E | Fiber Optics and Non-Linear Optics | 6 | 4 | 3 | 25 |  | 75 | 100 |
| PROJECT | P22PHP19 | Project Work | 12 | 5 | -- |  | 25 | 75 | 100 |
| **Papers:4** |  |  | **30** | **19** |  |  |  |  | **19** |
| **Total Credits** | | | | | **90** |  |  |  |  | **1900** |

# Programme: M. Sc., PHYSICS

* To be the pinnacle of academic and research excellence in **PHYSICS**

(Learn Physics and Stay as a Physicist)

# MISSION

* As a department, we are committed to achieve academic excellence through innovative teaching and learning processes.
* To prepare the students to be professionally competent to face the challenges in the industry.
* To promote quality and ethics among the students.

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| --- | --- |
| **PO No.** | **Programme Outcome**  ***Upon completion of the M.Sc. Degree Programme, the post graduate will be*** |
| PO-1 | To practice analytical thinking and research skills in his career requirements. |
| PO-2 | Strive for consistent academic excellence and to go for research related career. |
| PO-3 | Appreciate and apply Basic Physics principles in everyday life. |
| PO-4 | Realize and develop an understanding of the impact of physics and science on society. |
| PO- 5 | Apply the knowledge of Mathematics and fundamentals of Physics to the solution of complex problems in Physics. |

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| **SO No.** | **Programme Specific Outcomes Upon completion of these courses the student** |
| PSO-1 | Will have the capacity to develop analytical thinking and solving approaches. |
| PSO-2 | Will have a perfect background for pursuing pedagogic education. |
| PSO-3 | Will get familiarity with contemporary research within various fields of Physics. |
| PSO-4 | Will be confident to seek solutions to the problem areas that require an  analytical and innovative approaches with the experience obtained via the M.Sc., Project work done. |
| PSO-5 | Will be able to apply Physics principles to manage projects in multi disciplinary  Environment. |

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| **Course Title** | **MAJOR CORE 1: MATHEMATICAL PHYSICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH1** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **I** |

# Course Objectives:

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Apply, analyze and evaluate problems using Fourier series and Fourier transforms. |
| COB-2 | Apply, analyze and evaluate problems through vector calculus. |
| COB-3 | Understand the concept of complex numbers and to apply wherever needed. |
| COB-4 | Analysis of several properties and theorems in group theory. |
| COB-5 | Use matrices in solving difficult Physics problems in a relatively simple manner. |

# UNIT - I: FOURIER SERIES AND TRANSFORMS

Review of Trigonometric series and Euler’s formula - Fourier series – Dirichlet’s theorem, condition – Problems on periods with simple functions Sinnx,   
Cosnx. – Fourier transform – Integral theorem – Fourier Sine, Cosine transform - Shifting theorem – Change of scale.

# UNIT- II: VECTOR ANALYSIS AND VECTOR SPACE

**Vector Analysis -** Concept of vector and scalar fields – Gradient, divergence, curl and Laplace operator – Line integral, surface integral and volume integral – Gauss divergence theorem-Green’s theorem-Stoke’s theorem.

**Vector Space**: Linear Dependence (LD) and Linear Independence (LI) of vectors – Schwarz inequality theorem-Gram-Schmidt’s Orthogonalization process.

# UNIT -III: COMPLEX ANALYSIS

Functions of complex variables – Differentiability – Cauchy-Riemann conditions –Cauchy’s integral theorem and integral formula – Residues and singularities - Cauchy’s residue theorem – Evaluation of definite integrals (Trigonometric functions around the unit circles).

# UNIT- IV: GROUP THEORY

Multiplication table – Subgroups, cosets and classes -Point groups and space   
groups-Homomorphism and Isomorphism –Representation of finite groups-Reducible and irreducible representations –Orthogonality theorem- Character table for C2v and C3v Point group.

# UNIT- V: MATRICES AND TENSOR:

**MATRICES:** Rank of a matrix - Characteristic equation-Eigen values and Eigen   
vectors- Cayley-Hamilton Theorem-Diagonalization of a matrix – Trace of a   
matrix-Sylvester’s theorem.

**TENSOR:** Transformation Co-ordinates-Summation Convention -Contra variant, Covariant and Mixed tensors - Algebra of tensors - outer and inner products - Symmetric and   
Anti- symmetric tensors.

# BOOKS FOR STUDY

1. L. A. Pipes and L. R. Harvill, Applied Mathematics for Engineers and   
   Physicists – Mc Graw-Hill (1987).
2. Satya Prakash, Mathematical Physics, Sulthan, Chand & Sons., New Delhi (2006).
3. Goyal and Gupta Laplace and Fourier Transforms, Pragati Prakashan, Meerut (1995).
4. H.K. Dass and Dr. Rama Verma, Mathematical Physics, S. Chand Publishing,   
   8th Edition,(2019).

# BOOKS FOR REFERENCE

1. B.D. Gupta, Mathematical Physics, Vikas Publishing House Pvt Ltd., New Delhi (2006).
2. A. K. Ghatak, I.C. Goyal and S. J. Chua, Mathematical Physics, Mac Millan India Ltd.(1995).
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 10th Edition, (2015).

# Course Outcomes:

The learner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSO’s**  **Addressed** | **Cognitive Level** |
| CO-1 | Solve problems using Fourier series and Fourier  transforms, apply for X-ray diffraction studies | PSO-1 | K3, K4 |
| CO-2 | Solve problems using Vector calculus | PSO-2 | K1, K5 |
| CO-3 | Understand complex variables and their utility | PSO-2 | K1, K2 |
| CO-4 | Evaluate problems using group theory | PSO-4 | K2, K5 |
| CO-5 | Apply matrices basic to solve higher level problems in quantum mechanics | PSO-5 | K1, K4 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | S | S | M | S | M |
| CO-2 | S | M | S | S | S |
| CO-3 | M | S | M | M | S |
| CO-4 | L | L | L | L | M |
| CO-5 | M | S | S | S | L |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE 2: CLASSICAL MECHANICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH2** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **I** |

**Course Objectives (COB):** To enable the learner to

|  |  |
| --- | --- |
| CO **No.** | **Course Objectives** |
| COB-1 | Understand the fundamental Principles of D’Alembert and derive Langrange’s equation |
| COB-2 | Analyze Hamiltonian formalism and solve related problems |
| COB-3 | Apply both Lagrangian and Hamiltonian concepts to simple machines in Physics |
| COB-4 | Understand the concept of brackets and Jacobian formulation |
| COB-5 | Apply classical formulation to simple oscillations |

# UNIT-I: FUNDAMENTALS AND LAGRANGIAN FORMALISM

Principle of virtual work-Generalized co-ordinates – Generalized momentum – Generalized kinetic energy – D’Alembert’s principle –Lagrange’s equation of motion from D’Alembert’s principle – Cyclic co-ordinates – Conservation of angular momentum and total energy.

# UNIT-II: HAMILTONIANFORMALISM

Hamilton as total energy operator – Hamilton’s variational principle – Deduction of Hamilton’s principle from D’Alembert’s principle – Deduction of Lagrange equation of motion from Hamilton’s principle – Hamilton’s equation of motion – Hamilton’s equation of motion from Hamilton’s variational principle.

# UNIT-III: APPLICATIONS AND CANONICAL TRANSFORMATIONS

Applications of Lagrange formalism: Harmonic Oscillator- Spherical   
pendulum – Transformations: point or contact, Canonical – Generating function of canonical transformation – Four types of canonical transformations - ∆ Variation – Principle of least action.

# UNIT-IV: BRACKETS AND HAMILTON – JACOBI THEORY

Lagrange and Poisson’s brackets – Symmetry, invariance of Poisson bracket under Canonical transformation – Hamilton’s characteristic function – Hamilton-Jacobi equation – Physical significance of S – Action – angle variables- Kepler’s problem and its solution by   
Hamilton- Jacobi method.

# UNIT-V: LINEAR OSCILLATIONS

Theory of small oscillations – Normal modes of oscillations and frequencies – Simple harmonic oscillator, Double pendulum and its normal modes – CO2 as linear symmetrical molecule, its normal frequencies and its normal modes.

# BOOKS FOR STUDY

1. Gupta-Kumar-Sharma, Classical Mechanics, S. Chand and Co. (1987).
2. J.C. Upadhyaya, Classical Mechanics, Himalaya Publishing House.(2019)

# BOOKS FOR REFERENCE

1. H. Goldstein, Classical Mechanics, McGraw Hill Pvt., New Delhi (1981).
2. G. Aruldhas – Classical Mechanics – PHI Learning Pvt., New Delhi (2009).

# Course Outcomes:

The Learner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO**  **No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | List the fundamental principles of D’Alembert and  Hamiltonian and apply it to derive Lagrange’s equation from D’Alembert and Hamiltonian principle | PSO 3 | K1, K2 |
| CO-2 | Describe Hamiltonian formalism | PSO 2 | K2, K3 |
| CO-3 | Explain the concept of Hamiltonian Canonical equations of motion | PSO 5 | K2, K4 |
| CO-4 | Compare Jacobian formulation with Lagrange and Hamilton equations. | PSO 1 | K2, K5 |
| CO-5 | Understand linear oscillations using classical approach | PSO 4 | K1, K4 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | M | L | S | L | M |
| CO-2 | S | M | M | S | M |
| CO-3 | M | L | M | L | L |
| CO-4 | S | L | S | M | L |
| CO-5 | L | M | L | L | S |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE 3: STATISTICAL MECHANICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH3** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **I** |

**General Objective:** To study the fundamental principles of thermodynamics and various statistical distributions and to understand the basic ideas of particle behavior

# Course Objectives (COB):

To enable the learner to

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| --- | --- |
| **COB- No.** | **Course Objectives** |
| COB-1 | Understand the fundamental principles thermodynamics |
| COB-2 | Analyze kinetic theory of gas particles |
| COB-3 | Understand the nature of classical and semi classical particle and their statically different nature |
| COB-4 | Understand the concept of quantum particle nature and their statistics |
| COB-5 | Understand the application advanced statistical tools |

# UNIT – I: REVIEW OF THERMODYNAMICS

First law –Entropy and second law - Principle of degradation of energy-Thermodynamic Potentials and its reciprocity relations-Gibb’s-Helmholtz relation- Thermodynamic equilibria- Nernst heat theorem- Phase transitions-First order and Second order.

# UNIT – II: KINETIC THEORY

Distribution function-Boltzmann transport equation for homogeneous and heterogeneous medium and its validity-Kinetic theory of gases-Maxwell Boltzmann distribution law of velocities-Mean free path-Expression and experimental determination.

# UNIT – III: STATISTICAL MECHANICS

Macro and micro states – Stirling’s approximation –Classical Maxwell- Boltzmann distribution law - Principle of equipartition of energy- Phase space and   
ensembles - Liouville's theorem-Statistical equilibrium- Partition function - Relation between partition function and thermodynamic quantities-Bose Einstein statistics, Fermi Dirac statistics.

# UNIT – IV: QUANTUM STATISTICAL MECHANICS

Black body and Planck's radiation - Specific heat of solids-Dulong and Petit’s Law-Einstein’s theory- Debye’s theory. Ideal Bose gas - Energy, pressure of gas- Gas   
degeneracy-Bose- Einstein condensation – properties of liquid Helium I and II.

# UNIT – V: ADVANCED STATISTICAL MECHANICS

Electron gas - Free electron model and thermionic emission –White Dwarfs – Electrons in White Dwarfs – irreversible process-Onsager relations-linear law-Onsager reciprocal relations-Proof of Onsager reciprocal relations.

# BOOK FOR STUDY

1. Gupta, Kumar, Sharma, Statistical Mechanics, Pragati Prakashan Publications(2005).
2. B.K Agarwal and N. Eisnor, Statistical Mechanics, Wiley Eastern Limited, NewDelhi, 2nd Edn.(1989).

# BOOKS FOR REFERENCE

1. Sathya Prakash, Statistical Mechanics, Pragati Prakashan Publications (2004).
2. K Huang, Statistical Mechanics, Wiley Eastern Ltd., New Delhi (1986).
3. F. Reif, Statistical and Thermal Physics, McGraw Hill, International Edition,  
   Singapore (1975).
4. Mayer Joseph Edward, Statistical Mechanics, John Wiley and Son, New York (1949).

# Course Outcomes:

The Leaner will be able to

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| --- | --- | --- | --- |
| **CO**  **No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | List the fundamental theorems that governsthe  thermodynamics of gas molecules | PSO 3 | K2, K3 |
| CO-2 | Describe the basics of kinetic theory that governs the  different natured particles | PSO 2 | K1, K2 |
| CO-3 | Explain the concept of statistics of non-quantum  particles | PSO 5 | K2, K3 |
| CO-4 | Compare Maxwell Boltzmann, Bose-Einstein and  Fermi Dirac statistics in quantum statistics | PSO 1 | K2, K4 |
| CO-5 | Discuss the different models suggested on the basis  of statistical approach | PSO 4 | K2, K5 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | L | M | S | M |
| CO2 | S | S | M | S | M |
| CO3 | M | L | M | M | L |
| CO4 | M | M | L | M | L |
| CO5 | S | S | S | L | M |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

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| --- | --- |
| **Course Title** | **MAJOR CORE 4: MAJOR PRACTICAL: I**  **GENERAL AND ELECTRONICS EXPERIMENTS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH5P** |
| **Course Type** | **Practical** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **I** |

**Any FIFTEEN experiments**

1. Determination of q, n, σ by elliptical fringes method.
2. Determination of Stefan’s constant.
3. Determination of Rydberg’s constant.
4. Study of Hall’s effect in a given semiconductor.
5. Determination of dielectric constant at high frequency by Lecher wire method.
6. Determination of wavelength of the monochromatic source using bi prism.
7. Determination of charge of the electron using spectrometer.
8. Determination of the wavelength of the predominant colors of a given Cu/Fe spectrum photo through Hartmann’s formulas.
9. Full adder demonstration using both discrete ICs and NAND ICs only.
10. Design and study of Wien’s bridge oscillator using OPAMP IC 741.
11. Study the Characteristics of FET and construct an amplifier using FET.
12. Study the thermal conductivity of the given probe using Forbe’s method.
13. Determination of the compressibility of the given liquid using R.F oscillator   
    output- Acoustic grating.
14. Full subtraction demonstration using both discrete ICs and NAND ICs only.
15. Instrumentation amplifier using IC741.
16. V-I characteristics of the SOLAR cell.
17. G.M Counter
18. Michelson Interferometer
19. Analysis of FTIR spectrum.
20. Op-AMP: parameters
21. UJT- Characteristics and relaxation oscillator.

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| **Course Title** | **ELECTIVE COURSE-I: SPECIAL ELECTRONICS– I: MICRO ELECTRONIC DEVICES** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH4E** |
| **Course Type** | **Elective- Theory** |
| **Credits** | **4** |
| **Marks** | **100** |
| **Semester** | **I** |

**Course Objectives (COB):**

To enable the learner to

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| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the working of different Semiconductor devices |
| COB-2 | Analyze the concept of certain special semiconductor devices |
| COB-3 | Apply the characteristics of operational amplifier for different circuits |
| COB-4 | Apply the op-amp to different oscillator circuits and digital applications |
| COB-5 | Learn to understand the fabrication of ICs and the concepts of IC 555 for timer operations |

# UNIT- I: SEMI CONDUCTOR AND OPTO ELECTRONIC DIODES

Continuity Equation (PN Junction) -Tunnel diode - Backward diode -Varactor diode – PIN diode-Schottky diode - IMPATT Diode - Gunn diode -Optoelectronic diodes –Opto   
resistor- LED-Multi colour LED - photo diode, Laser diode.

# UNIT -II: SPECIAL SEMICONDUCTOR DEVICES

JFET- Structure and working - V-I Characteristics under different conditions - Biasing of JFET-DC load line-CS amplifier design-MOSFET: Depletion and enhancement type MOSFFT - Comparison of p with n-channel FETs - Digital MOSFET   
circuits- Complementary MOS - FET as a Voltage Variable Resistor (VVR) –– Common source and drain amplifier at high frequencies – SCR , DIAC, TRIAC -characteristics and applications

# UNIT – III: OPERATIONAL AMPLIFIERS

Operational amplifier characteristics-CMRR-Slew rate -Input offset current and   
voltage- Frequency response - Inverting and non-inverting amplifier -Voltage   
follower -Differential amplifier - Voltage to current and current to voltage conversions- Log and antilog amplifiers - Integrating and differential circuits-Solving first order simultaneous equations.

# UNIT-IV: OP-AMP APPLICATIONS (OSCILLATORS AND CONVERTORS)

**Oscillators:** Schmitt’s trigger -Square (Astable multi vibrator)- Triangular-Sine wave generators-Phase shift and Wien bridge oscillator.

**Convertors:** Digital to Analog conversion: weighted resistor - Binary   
R-2R ladder - Analog to Digital conversion: counter type ADC - Successive approximation converter – Dual slope ADC.

# UNIT – V: IC FABRICATIONS AND IC TIMER

**Fabrications:** Fundamentals of monolithic ICs - Epitaxial   
growth -Masking -Etching - Impurity diffusion-Fabricating monolithic resistors, diodes, transistors, inductors and capacitors - Circuit layout - Contacts and inter connections

**555 Timer** – Description of the functional diagram –Astable-Mono stable   
operation - Bistable multi vibrator - Applications-Missing pulse detector - Pulse width modulator - Schmitt’s trigger – Voltage controlled oscillator.

# BOOKS FOR STUDY

1. D Chattopadhyay, P C Rakshit, B Saha, N.Purkait, Foundations of Electronics- New Age International Publishers, New Delhi(2006).
2. Roy Choudry , Operational Amplifier and Integrated Electronics, New Age International Publishers, New Delhi(2006).
3. B.L. Theraja, Basic Electronics- S.Chand and Co., New Age(2006).
4. J. Milmann and C.C. Halkias, Integrated Electronics, Mc Graw Hill , NewDelhi.

# BOOKS FORREFERENCE

1. V. K. Mehta, Rohit Mehta, Principles of Electronics- S.Chand and Co**,** New Delhi, (2008).
2. A. Mottershed, Semiconductor Devices and Applications - New Age Int. Pub, New Delhi.
3. Michael Schur, Physics of Semiconductor Devices, Pearson, (1990).

**Course Outcomes:** The Learner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Recognize the working of different Semiconductor  devices | PSO 5 | K1, K2 |
| CO-2 | Describe the function of special semiconductor devices | PSO 2 | K2, K3 |
| CO-3 | Apply the characteristics of operational amplifier  for different circuits | PSO 3 | K2, K3 |
| CO-4 | Op-amp as oscillators and digital convertors is learnt | PSO 1 | K1, K4 |
| CO-5 | Understand IC fabrications and to know the fundamentals of 555 timer in Applications of op-amp and 555 Timer | PSO 4 | K1, K5 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific out come R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze;

**E- Evaluate (K5) and C – Create (K6)**

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CO/PO | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 |
| CO-1 | M | S | M | S | L |
| CO-2 | M | S | S | M | L |
| CO-3 | S | S | M | M | L |
| CO-4 | S | M | M | S | S |
| CO-5 | M | S | S | M | M |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJORCORE VI: Atomic and Molecular Spectroscopy** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH6** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **II** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | To Understand an d Recognize the concept of spectroscopy, coupling  schemes and interactions of atoms |
| COB-2 | Understanding the impact of atoms placed in the external fields |
| COB-3 | The concept of microwave spectroscopy is well explained |
| COB-4 | To Analyze the Raman and Electronic spectroscopic methods |
| COB-5 | Understand the advanced mechanism like NMR, ESR methods of Spectroscopy |

# UNIT-I: COUPLING SCHEMES AND SPIN INTERACTIONS

Concept of Vector atom model and its quantum numbers-Stern –Gerlach   
experiment – Fine structure of hydrogen lines – Spin-orbit interaction –Lande “g”   
factor– LS-JJ coupling schemes –Pauli’s exclusion principle and its physical significance- Periodic table-Alkali type spectra-Equivalent electrons-Hund’s rule.

# UNIT-II: ATOMS IN EXTERNAL FIELDS AND QUANTUMCHEMISTRY

Atoms in external fields: Zeeman effect-Paschen-Back effect-and it’s quantum mechanical treatment- Zeeman effect-Paschen-Back effect in two-electron   
systems- selection rules-Stark effect.

Quantum chemistry of molecules: Born-Oppenheimer approximation-Heitler-London and molecular orbital theories of hydrogen molecule-Bonding and anti-bonding   
MOs- Huckel’s molecular approximation-Application to butadiene molecule.

# UNIT-III: MICROWAVE AND IR SPECTROSCOPY

Classification of molecules-Rotational spectra of diatomic molecules-Effect of isotropic substitution-Non- Rigid rotator-Rotational spectra of polyatomic molecules-Linear, symmetric top, and asymmetric top molecules-Experimental techniques-Vibrating diatomic molecule-Diatomic vibrating rotator-Linear and symmetric top   
molecules- Characteristic and group frequencies- IR spectrophotometer: Instrumentation.

# UNIT-IV: RAMAN AND ELECTRONICS PECTROSCOPY

Raman Effect: Classical theory of Raman effect- Pure rotational and vibrational Raman spectra of the diatomic molecules-Raman spectrometer.

Electronic spectroscopy of diatomic molecules: Vibrational coarse structure-Progressions and sequences-Franck-Condon principle -Dissociation energy and dissociation products.

# UNIT-V: RESONANCE SPECTROSCOPY

Nuclear magnetic resonance: Magnetic properties of nuclei-Resonance condition-NMR instrumentation-Additional techniques-Relaxation processes-Bloch equation-Dipolar interaction-Chemical shift.

Electron Spin Resonance: Principle-ESR spectrometer-Total Hamiltonian-Hyperfine Structure.

# Books for Study

1. C.N.Banwell, Elaine M. Mc Cash, Fundamental of Molecular Spectroscopy, Mc Graw Hill, New Delhi (2010).
2. G.Aruldhas, Molecular Structure and Spectroscopy, PHI Learning Private Limited, NewDelhi(2009).
3. Gupta, S.L.Kumar, Sharma, Elements of Spectroscopy, Pragati Prakashan Publication, Meerut(2009).

# Books for Reference

* 1. P.S.Sindhu, Elements of Molecular Spectroscopy, NewAge International, (2007). 2.A.K.Chandra, Introductory Quantum Chemistry, Mc Graw Hill, New Delhi,(2003).

# Course Outcomes:

The learner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| **CO-1** | Recognizing the concept of spectroscopy | **PSO1** | **K1, K2** |
| **CO-2** | Describe the application of external fields on an a tom | **PSO5** | **K1, K3** |
| **CO-3** | Acquire knowledge and understand of the aspects of  rotational and vibrational spectroscopy and its technique | **PSO2** | **K1, K4** |
| **CO-4** | Analyse the Raman and electronic spectrograph for  different Atoms | **PSO3** | **K1, K3** |
| **CO-5** | Know the physics behind NMR and ESR spectroscopy and the techniques behind it | **PSO4** | **K1, K5** |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6) CO-PO Mapping

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** |
| **CO-1** | **S** | **L** | **M** | **M** | **L** |
| **CO-2** | **S** | **L** | **M** | **M** | **L** |
| **CO-3** | **S** | **S** | **S** | **M** | **S** |
| **CO-4** | **S** | **S** | **S** | **M** | **S** |
| **CO-5** | **S** | **S** | **S** | **M** | **S** |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE 7: QUANTUM MECHANICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH7** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **II** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the fundamentals of quantum mechanics |
| COB-2 | Apply the Schrodinger’s equation to some problems |
| COB-3 | Deal with approximations in quantum mechanics |
| COB-4 | Represent the quantum theories |
| COB-5 | Analyze the scattering mechanism through quantum treatment |

# UNIT- I: INTRODUCTION TO QUANTUM MECHANICS

Wave Function – Operator formalism – Total energy, momentum, kinetic and potential energy operators - Derivation of Schrodinger’s equation (time dependent and independent)   
Ground state of Hydrogen – Linear Harmonic oscillator – Zeeman Effect (Semi classical treatment only)

# UNIT- II: PERETURBATION THEORY

Time independent – Time dependent perturbation theories - Evaluation of first order wave function and Energy– Degenerate and non-degenerate cases – Transition of continuum states

– Fermi – Golden Rule – Einstein’s coefficients.

# UNIT - III APPROXIMATIONS

Stark Effect – Zeeman Effect – Quantum Mechanical Treatment – Heisenberg, Schrodinger, Interaction Pictures – W.K.B Approximation – Validity – Born Approximation

# UNIT -IV: REPRESENTATION THEORY AND IDENTICAL PARTICLES

Variation method - Ground state of Hydrogen atom using variation method - Bracket notation - Harmonic oscillator in matrix theory – Identical particles – Symmetry and   
anti-symmetric wave functions.

# UNIT -V: THEORY OF SCATTERING AND RELATIVISTIC QUANTUM MECH.

Partial wave analysis – Scattering amplitude – Total scattering cross-section – Klein-Gordon equation – Dirac relativistic equation for free particle – Negative energy states.

# BOOKS FOR STUDY

1. Gupta, Kumar and Sharma – Quantum Mechanics, S. Chand and Company publications.
2. G. Aruldhas - Quantum Mechanics – PHI Publications (2008).

# BOOKS FOR REFERENCE

* 1. V.Devanathan, Quantum Mechanics, Narosa Publishing House (2005).
  2. P.M. Mathews and K.Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill publications, New Delhi(1987).
  3. V.K. Thankappan, Quantum Mechanics, Wiley –Eastern, New Delhi (1985).
  4. P.G. Puranik, Quantum Particle Dynamics, S. Chand and Company Publications.
  5. L. Schiff, Quantum Mechanics – Tata Mc Graw Hill Publications, NewDelhi.
  6. D.J. Griffiths, D.F. Schroeter, Introduction to Quantum Mechanics, 3rdEdition, Cambridge University Press,(2019).
  7. R. Shankar, Principles of Quantum Mechanics, Springer, (2014).
  8. Nouredine Zettili, Quantum Mechanics- Concepts and Applications, WILEY,(2016).

# Course Outcomes:

The Leaner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO**  **No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Recognize the concept of quantum mechanical tool | PSO 2 | K1, K2 |
| CO-2 | Describe the application of Schrodinger’s equation to exactly solvable problems | PSO 5 | K2, K3 |
| CO-3 | Analyzing the approximations of certain problems | PSO 1 | K2, K5 |
| CO-4 | Quantum tool is represented in different format | PSO 3 | K1, K3 |
| CO-5 | Scattering mechanism is well understood | PSO 4 | K1, K4 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific out come R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze;

**E- Evaluate (K5) and C – Create (K6)**

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No. /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | S | L | S | L | S |
| CO-2 | S | L | S | L | S |
| CO-3 | S | L | S | L | S |
| CO-4 | S | L | S | L | S |
| CO-5 | S | L | S | L | S |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE 8: NUCLEAR AND PARTICLE PHYSICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH8** |
| **Course Type** | **Theory** |
| **Credits** | **4** |
| **Marks** | **100** |
| **Semester** | **II** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the nuclear structure and nuclear forces through various models |
| COB-2 | Analyze the theories involved in the ,  and  radioactive decays |
| COB-3 | Remember the basic knowledge about nuclear fission, fusion and astrophysics |
| COB-4 | Understand the various types of nuclear reactions based on nuclear reaction cross sections |
| COB-5 | Understand the elementary particles based on theoretical model and theory |

# UNIT -I: PROPERTIES OF ATOMIC NUCLEI

Nuclear size and shape –Parity- Nuclear forces –Nuclear mass-Dempster’s mass spectrograph-Properties of deuteron-Simple theory of ground state of deuteron– Spin dependence of nuclear forces– Singlet and triplet states in deuteron ground   
state - Properties of nuclear forces - Meson theory of nuclear forces.

# UNIT -II: RADIOACTIVE DECAYS

Range of alpha particles and Geiger-Nuttal law – Gamow’s theory - Neutrino   
hypothesis – Fermi theory of beta decay – Selection rules – Gamma decay-measurement of gamma energies by bent crystal spectrometer – Selection rules of gamma radiation – Gas filled detectors – G.M counters -Scintillation counter.

# UNIT -III: NUCLEAR REACTIONS AND NUCLEAR MODELS

Reaction Energetics -Q-Value-Threshold energy – Level width- Types of nuclear  
 reactions- Compound nucleus theory – Breit - Wigner formula– Semi empirical mass formula -Liquid drop model-Shell model-Collective model.

# UNIT -IV: ACCELERATORS AND REACTORS

Linear accelerator-Cyclotron – Synchro cyclotron – Betatron–Nuclear fission –distribution of mass of fission products –Bohr-Wheeler’s theory of nuclear fission – nuclear   
reactor- classification of nuclear reactors-Research and power reactors- Nuclear fusion- Stellar energy- Research and power reactors.

# UNIT -V: COSMIC RAYS AND ELEMENTARY PARTICLES

Cosmic rays-primary and secondary cosmic rays-Geomagnetic effects -Cosmic ray   
showers- origin of cosmic rays-Classification of elementary particles–Fundamental interactions among particles-Quantum numbers specifying states of particles-Discovery of antiparticles– Quark and its types-Existence of quarks.

# BOOKS FOR STUDY

1. Sathya Prakash, Text Book of Nuclear and particle Physics, Sultan Chand and Sons, New Delhi(2005).
2. M.L.Pandya and R.P.S Yadav, Elements of Nuclear Physics, Kedar Nath Ramnath, Meerut(2015).

# BOOKS FOR REFERENCE

* 1. V. Devanathan, Nuclear Physics, Narosa Publishing House (2006).
  2. S. B. Patel, An Introduction to Nuclear Physics, (Wiley-Eastern) New Delhi (2008).
  3. B. L. Cohen, Concepts of Nuclear Physics Tata Mc Graw Hill, New Delhi(1993).
  4. D. Griffiths, Introduction to Elementary Particles, Wiley International, New York (1987).
  5. Arora. C. L, Nuclear Physics, S.Chand and Co, New Delhi (1999).
  6. Sharma.R. C, Nuclear Physics, K. Nath and Co, Meerut(1997).

# Course Outcomes:

The Leaner will be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Summarize the properties of atomic nuclei | PSO 3 | K2, K3 |
| CO-2 | Discuss the theories involved in ,  and   Radioactive decays. | PSO 2 | K2, K4 |
| CO-3 | Explain the nuclear reactions and its models | PSO 5 | K1, K4 |
| CO-4 | Discuss about the accelerators | PSO 1 | K2, K5 |
| CO-5 | Understand elementary particles and discuss its classification based on theoretical models | PSO 4 | K1, K2 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | L | M | M | M | M |
| CO-2 | S | L | S | L | L |
| CO-3 | L | L | S | M | M |
| CO-4 | S | M | L | S | M |
| CO-5 | M | L | M | L | S |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE 9: MAJOR PRACTICALS: II GENERAL AND ELECTRONICS EXPERIMENTS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH9P** |
| **Course Type** | **Practical** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **II** |

**Any FIFTEEN experiments**

1. Determination of q, n, σ by hyperbolic fringes method.
2. Determination of bulk modulus of a liquid using ultrasonic interferometer.
3. Determination the band gap of a semiconductor using four probe method.
4. Determination of e/m ratio of an electron using Thomson’s method.
5. Determination of the wavelength of a LASER source and thickness of wire using Plane diffraction grating method.
6. Determine the polarizability of the given liquid by finding the refractive indices at different wavelengths.
7. Determination of Numerical aperture and other parameters of a fiber cable,
8. Determination of the specific rotator power of a given liquid using Polarimeter.
9. Reduce the given Boolean expression (both SOP & POS) by forming K-Map and study of it using logic gates.
10. Design and study of Phase shift oscillator using OPAMP IC741.
11. Design and study of Bi-stable Multi vibrator using Transistor.
12. Study of energy loss mechanism in a Schimitt’ trigger using IC741
13. Design and study the 0 -9 and 0 -99 mod counters. Design Mod 20, 40 and60.
14. Analysis of Absorption spectrum of iodine
15. Using IC 555 time study the temperature coefficient.
16. Study of LDR- characteristics and wavelength dependency
17. Op-AMP: Solving simultaneous linear equations
18. Transistor Oscillators- Hartley and Colpitts circuits
19. Op-Amp: Wave forms generation
20. Determination of e/m ratio of an electron using magnetron method.

# \*\*\*\*\*\*\*\*\*\*\*\*\*

|  |  |
| --- | --- |
| **Course Title** | **ELECTIVE-I: SPECIAL ELECTRONICS– II MICROCONTROLLER ANDCOMMUNICATION ELECTRONICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH10E** |
| **Course Type** | **Theory** |
| **Credits** | **4** |
| **Marks** | **100** |
| **Semester** | **II** |

**Course Objectives (COB):** To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the architecture of the microcontroller 8051 |
| COB-2 | Get introduced to the assembly language |
| COB-3 | Know the principles of Analog modulation |
| COB-4 | Understand the types of pulse and digital modulation techniques. |
| COB-5 | Learn the fundamentals of cellular phones and satellite communication. |

# UNIT -I: MICROCONTROLLER ARCHITECTURE - 8051

The 8051 architecture - 8051 oscillator and clock - Program counter data pointer - CPU registers-Flags and the program status word (PSW) -Internal memory- Internal RAM and ROM -The stack and the stack pointers. Special function registers-Signals of 8051-I/O   
ports - Timers and counters.

# UNIT- II: ASSEMBLY LANGUAGE PROGRAMMING CONCEPTS

8051-Programming - 8051 instruction syntax - Moving data: addressing modes – External data moves- Code memory- Read only data moves -Push and pop op codes- Data exchanges example programs - Logical operations: Byte-level logical operations –Bit level logical operations- Rotate and swap operations- Example programs.

# UNIT -III: ANALOG MODULATION

Amplitude modulation- Amplitude modulation index-Modulation index for sinusoidal   
AM- Double sideband suppressed carrier (DSBSC) modulation- Amplitude modulator circuits- Amplitude demodulator circuits. Single sideband principles- Balanced   
modulators- SSB generation-SSB reception. Frequency modulation – Sinusoidal   
FM- Frequency spectrum for sinusoidal FM-Average power for sinusoidal FM- Modulation index for sinusoidal FM-Phase modulation- Equivalence between PM and FM.

# UNIT- IV: PULSE AND DIGITAL MODULATION

Pulse Amplitude Modulation (PAM)- Pulse Code Modulation (PCM)- Pulse Frequency Modulation (PFM)- Pulse Time Modulation (PTM)- Pulse Position Modulation (PPM)-Pulse Width Modulation (PWM).Digital communication- Synchronization - Asynchronous transmission-Probability of Bit error in base band transmission –Digital carrier systems.

# UNIT- V: CELLULAR TELEPHONE AND SATELLITE COMMUNICATIONS

Evolution of cellular telephone -Analog cellular telephone - personal communication   
system, Digital cellular telephone, Global system for mobile communication. Kepler’s   
laws – Orbits - Geostationary orbit-Altitude and attitude control-Satellite station   
keeping-Transponders uplink-Power budget calculation-Down link power budget calculations - Multiple access methods.

# BOOKS FOR STUDY

* 1. Kenneth J.Ayala, the 8051 Microcontroller, Architecture, Programming and Applications, 3rd Edition, 2007, Cengage Learning Publication, ISBN: 9788131502006, 8131502007
  2. Krishnakanth, Microprocessors and Microcontroller, Prentice Hall of India,2013, ISBN:978-8120331914
  3. G.Kennedy, B. Davis and S.R.M. Prasanna, Electronic communication systems,   
     Mc Graw Hill publications, 5th Ed.(2011).
  4. Dennis Roddy,John Coolen, Electronic Communications- 4thEdition, Prentice Hall of India, 2004, ISBN:9780133120837.
  5. Wayne Tomasi, Advanced Electronic Communication systems, Pearson Education, Advanced Electronic Communications Systems, 2004, 6th Edition, ISBN: 978-1-292- 02735-7

# BOOKS FOR REFERENCE

1. Gupta S.L and Kumar - Hand book of Electronics, Pragati Prakasan Publications, 2012, ISBN:978-9350065365
2. P.S. Manoharan, Microprocessors and Microcontroller – Charulatha Publications (2013).

**Course Outcomes:** The learner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Course Outcome** | **PSO’s**  **addressed** | **Cognitive**  **Level** |
| **CO-1** | Understand the architecture of the Microcontroller 8051. | PSO1 | K1, K2 |
| **CO-2** | Programming in the assembly language. | PSO2 | K3, K4, K5 |
| **CO-3** | Understand the concepts of Amplitude and Frequency modulation techniques. | PSO3 | K2, K3 |
| **CO-4** | Explain the latest modulation techniques used in digital communication. | PSO5 | K2 |
| **CO-5** | Explain the fundamentals of cellular phones and its signal propagation methods. | PSO4 | K2 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Programme Outcome** | | | | |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | S | M | M | M | L |
| **CO2** | S | S | S | M | M |
| **CO3** | S | M | M | M | L |
| **CO4** | S | M | M | M | L |
| **CO5** | S | L | M | M | L |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE - 11: ELECTROMAGNETIC THEORY** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH11** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **III** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand Green’s function and apply it to find the boundary value problems in electrostatics. |
| COB-2 | Understand the basic laws in magneto statics and apply it to find its boundary  condition. |
| COB-3 | Understand the concepts of displacement current and apply it to derive Maxwell’s equation. |
| COB-4 | Analyze and compare the propagation of plane electromagnetic waves in  Different medium. |
| COB-5 | Apply and analyze the concepts of interaction of electromagnetic waves with macroscopic matter. |

# UNIT - I: INTRODUCTION TO ELECTROSTATICS AND MAGNETOSTATICS

Coulomb’s law – Electric field –Electrostatic potential- Electric field and potential of a   
Dipole- Gauss law –Poisson and Laplace Equations in differential form Ampere’s force   
law-Biotand Savart law -Ampere’s circuital law–Amperian loop-Magnetic scalar   
potential-Magnetic vector potential – Boundary conditions on E,D,B and H – Dirichlet and Newmann conditions.

# UNIT - II: ELECTRODYNAMICS

Equation of continuity- Maxwell’s displacement current – Maxwell’s equations –Differential and integral forms - Poynting’s theorem - Differential form of Poynting’s theorem - Electromagnetic Potential (A and Φ) – Maxwell’s equations in terms of Electromagnetic potential- Gauge transformations – Lorentz gauge.

# UNIT - III: PLANE ELECTRO MAGNETIC WAVES AND WAVE PROPAGATION

Plane wave equation – Propagation of e.m. waves in free space - in a non conducting isotropic medium – in a conducting medium- Reflection and refraction of electromagnetic waves (Snell’s Law ) – Propagation of electromagnetic waves in a rectangular wave guide -TM and TE modes.

# UNIT - IV: CHRACTERISTICS OF ANTENNAS

Radiation by an oscillating dipole –– Radiation patterns of antennas – Gain of an   
antenna – Linear array of antennas (N-arrays) – Qualitative analysis of a dipole   
antenna – Characteristics of micro strip antenna

# UNIT - V RADIO WAVEPROPAGATION

Fundamental equation for free space propagation – Modes of propagation – Ground wave up to 2 MHz – UHF up to 300 MHz – Introduction to sky wave propagation – Mechanism of radio wave bending by the ionosphere – skip distance

# BOOKS FOR STUDY

1. S.L.Gupta and V.Kumar, Electrodynamics, Pragati Prakashan Publications (2004).
2. K.K.Chopra and G.C.Agarwal, Electromagnetic Theory, K.Nath and Co.(1993).
3. Sathya Prakash, Electromagnetic Theory, Sulthan Chand and Sons, New Delhi (2005).
4. S.K. Dash and S.R. Khunita, Fundamentals of Electromagnetic Theory, PHI Publications, New Delhi (2011).

# BOOKS FOR REFERENCE

1. D. Jackson, Classical Electrodynamics, Wiley Eastern Ltd., New Delhi,(1993).
2. D**.** Griffiths, Introduction to Electrodynamics, Cambridge University Press, 4th Edition, (2020).

**Course Outcomes:** The learner will be able to:

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Solve electrostatic boundary value problems  using Green’s function. | PSO 1 | K2,K3 |
| CO-2 | Describe the boundary condition in magneto statics. | PSO 3 | K1,K2 |
| CO-3 | Connect electrostatics and magneto statics. | PSO 2 | K2,K4 |
| CO-4 | Derive Maxwell’s equation in differential and integral form. | PSO 4 | K1,K5 |
| CO-5 | Discuss the propagation of electromagnetic waves in different medium and its interaction with matter | PSO 5 | K2, K4 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze;

**E- Evaluate (K5) and C – Create (K6)**

**MAPPING**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | S | L | S | L | M |
| CO-2 | S | L | S | L | M |
| CO-3 | S | L | S | L | M |
| CO-4 | S | L | S | L | M |
| CO-5 | S | L | S | L | M |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE - 12: CRYSTAL GROWTH AND THIN**  **FILM PHYSICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH12** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **III** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the fundamentals of crystal growth and nucleation |
| COB-2 | Analyze the low temperature method of crystal growth |
| COB-3 | Understand the melt growth technique of crystal growing |
| COB-4 | Be aware of Thin film formation through vapour deposition |
| COB-5 | Introduce Characterization techniques |

# UNIT -I: NUCLEATION AND GROWTH

Nucleation –Classical theory of nucleation –Gibb’s Thomson for vapour, melt and   
solution- Spherical and cylindrical nucleus – Hetrogenious nucleation-CAP shaped   
nucleus-Disc shaped nucleus-Growth Kinetics - Singular and rough faces- Models on surface roughness- Kossel, Stranski, Volmer (KSV) theory.

# UNIT -II: LOW TEMPERATURE GROWTH TECHNIQUES

**Solution Growth Techniqu**e: Solution - Solubility and super solubility – Expression of super saturation – Mier’s T-C diagram - Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.

**Gel Growth Technique:** Principle – Various types – Structure of gel – Importance of   
gel – Experimental procedure–Chemical reaction method – Single and double diffusion method – Chemical reduction method –Complex and de complexion method – Advantages of gel method.

# UNIT- III: MELT AND VAPOUR GROWTH TECHNIQUES

**Melt Growth:** Bridgman technique - Basic process – Various crucibles design - Thermal consideration – Vertical Bridgman technique - Czochralski technique – Experimental arrangement – Growth process.

**Vapour Growth:** Physical vapour deposition – Chemical vapour deposition   
(CVD) – Chemical Vapour Transport.

# UNIT- IV: THIN FILM DEPOSITION TECHNIQUES

Introduction- Thin film growth stages- Application of thin films- Deposition   
techniques - Physical methods– Chemical methods- Resistive heating, Electron beam gun, Laser gun evaporation and flash evaporations, sputtering - Reactive Sputtering,   
Radio-Frequency sputtering - Chemical methods – Spray pyrolysis – Preparation of TCO tin oxide thin films.

# UNIT- V: CHARACTERIZATION TECHNIQUES

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier Transform Infra-Red Analysis (FT-IR) – Elemental analysis – Elemental Dispersive X-ray Analysis (EDAX) using Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vicker’s micro hardness.

# BOOKS FOR STUDY

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York(1986).
2. P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam(2006).
3. A. Goswami, Thin Film Fundamentals, New Age International (P) Limited, New Delhi(1996).
4. Kasturi L. Chopra, Thin film Phenomena, McGraw Hill Book Company(1969).

5.K. Ravichandran, K. Swaminathan, B. Sakthivel and A.T. Ravichandran, Introduction to Thin Films and Crystal Growth(Jayam Publications, Trichy)

# BOOK FOR REFERENCE

1. Smith Donald. L, Thin Film Deposition, McGraw Hill, London (1995).

# Course Outcomes:

The learner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO**  **No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Grow crystal using a simple technique | PSO 1 | K2, K3 |
| CO-2 | Understand laboratory technique of growing crystal | PSO 3 | K1, K4 |
| CO-3 | Understand the High level technique of melt growth | PSO 5 | K1, K3 |
| CO-4 | Understand the formation of thin film mechanism | PSO 4 | K2, K4 |
| CO-5 | Analyze and characterize the grown crystals | PSO 2 | K1, K5 |

**PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific out come**

# R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | S | L | S | L | M |
| CO-2 | S | L | S | L | M |
| CO-3 | S | L | S | L | M |
| CO-4 | S | L | S | L | M |
| CO-5 | S | L | S | L | M |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE 13: MAJOR PRACTICAL: III ADVANCED ELECTRONICS – I:**  **(DIGITAL ELECTRONICS, MICROPROCESSORS AND**  **MICROCONTROLLERS)** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH13P** |
| **Course Type** | **Practical** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **III** |

**ADVANCED ELECTRONICS –I**

**Any FIFTEEN experiments**

1. Scalar or Modulus counter.
2. Study the function of Decoder and Encoder.
3. Digital comparator.
4. Study of DAC interfacing (DAC0900).
5. Study of ADC interfacing (ADC0809).
6. Digital to Analog Converter - R-2R and weighted methods.
7. Study the function of Multiplexer and De multiplexer.
8. Traffic control system using microprocessor8085.
9. Control of stepper motor using microprocessor8085.
10. Digital Clock using microprocessor8085.
11. Construction of all Flip-Flops using gates.
12. Construction of RAM cells.
13. Study of ALU.
14. Voltage control oscillators.
15. Up-Down counter using J-K Flip-Flops.
16. Shift registers – all modes of operations.
17. Regenerative waveform using 555timer.
18. ARM Cortex Microcontroller (32-bit)- LED Flasher.
19. ARM Cortex Microcontroller (32-bit)- Pulse generation for optical coupling.
20. ARM Cortex Microcontroller (32-bit)- ADC.

# \*\*\*\*\*\*\*\*

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| --- | --- |
| **Course Title** | **ELECTIVE COURSE-III: NUMERICAL METHODS AND C PROGRAMMING** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH14E** |
| **Course Type** | **Theory** |
| **Credits** | **4** |
| **Marks** | **100** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the fundamentals of error and measurements |
| COB-2 | Analyzing the transcended equations and algebraic methods |
| COB-3 | Learn the concept of interpolation methods |
| COB-4 | Apply numerical techniques to differentiation and integration |
| COB-5 | Use C program to apply for numerical techniques |

# UNIT- I: ERRORS AND MEASUREMENTS

General formula for Errors-Errors and its Types-Graphical Method - Empirical   
formula - Principle of Least Squares- Fitting a straight line-Fitting a Parabola-Fitting an Exponential Curve-Fitting the curve (y=axb)

# UNIT -II: ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

The Iteration Method –Method of false position-Newton-Raphson method –Convergence of Newton-Raphson Method – Order of Convergence for N-R Method.

# Linear Algebraic Equations

Gauss Elimination method-Jordan’s modification**-**Gauss-Seidel method of Iteration.

# UNIT- III: INTERPOLATION

Linear Interpolation-Gregory-Newton forward and Backward Interpolation formula-Central difference formula-Gauss forward and backward interpolation formula- Lagrange’s interpolation formula for unequal intervals.

# UNIT- IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Numerical Differentiation for solving first order differential equations:-Euler’s   
method- Modified Euler’s method –Runge - Kutta second and fourth order method for solving first order differential equations-Numerical Integration: Trapezoidal rule-Simpson’s 1/3rd rule-Simpson’s 3/8 the rule-formula and derivation.

# UNIT- V: C PROGRAMS

Structure of a C program-Primary data types-Constants-Integers-Various types of operators and expressions-Control structure-if-if-els**e**– go to – while – do, while – for   
statements- declaration and initialization of arrays(1-d,2-d)-Functions-Calling a   
function-Return values and their types.

# Development of C program for

1. Fitting a straight line, 2)Newton-Raphson method,3)Euler’s method, 4) Runge - Kutta Second order method 5)Trapezoidal rule

# BOOKS FORSTUDY

* 1. B.P.Flannery, S.A.Teukolsky, W.T.Vetterling, Numerical Recipes in C, W.H. Press, Cambridge University(1996).
  2. M.K.Venkataraman, Numerical methods in Science and Engineering, National Publishing Company, Chennai (2004).
  3. E.Balagurusamy, Programming in ANSI – C, Tata McGraw Hill publications (2004).

# BOOKS FOR REFERENCE

1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi(2003).
2. Numerical Methods in Science and Engineering – The National PublishingCo. Madras (2001).
3. Veerarajan, Numerical Methods in C and C++, S. Chand, New Delhi(2006).

# Course Outcomes:

The leaner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Define the error and measurements | PSO 1 | K1, K2 |
| CO-2 | Explain the Transcendental techniques | PSO 2 | K2, K3 |
| CO-3 | Apply the interpolation formula | PSO 4 | K1, K4 |
| CO-4 | Apply numerical methods for differential and integral equations | PSO 3 | K2, K4 |
| CO-5 | Apply C program for numerical techniques | PSO 5 | K2, K5 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific out come R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze;

**E- Evaluate (K5) and C – Create (K6)**

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** |
| **CO-1** | **M** | **M** | **S** | **L** | **S** |
| **CO-2** | **S** | **L** | **S** | **M** | **M** |
| **CO-3** | **S** | **L** | **M** | **M** | **S** |
| **CO-4** | **S** | **S** | **L** | **M** | **S** |
| **CO-5** | **M** | **L** | **M** | **M** | **S** |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **ELECTIVE COURSE-IV: BASICS OF NANOSCIENCE AND ITS APPLICATIONS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH15E** |
| **Course Type** | **Theory** |
| **Credits** | **4** |
| **Marks** | **100** |
| **Semester** | **III** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| CO No. | Course Objectives |
| COB-1 | Know the types of nano materials |
| COB-2 | Understand the properties and synthesis of CNTs |
| COB-3 | Understand the synthesis of nano systems |
| COB-4 | Learn the characterizing techniques of nano systems |
| COB-5 | Be aware of the application of nano systems |

# UNIT -I: INTRODUCTION TO NANO AND TYPES OF NANOMATERIALS

Nanoscience and nanotechnology – Need for nano - Origins of concepts of nano -Nano and energetics – Top down and Bottom up approaches – Types of nano materials (introductory ideas only): One dimensional(1D)– Two dimensional(2D)- Three dimensional(3D) nano structured materials – Quantum dots – Quantum wire-Quantum well – Quantum   
Dot – Excitation confinement in Quantum Dots.

# UNIT-II: NANO STRUCTURES EFFECTS

Fullerenes - Properties of fullerenes-Carbon Nano Tubes (CNTs)- Types, properties, synthesis and applications of CNTs. -Polymers – Bio mimetics – Self assembled mono  
layers – Nano structured metals and alloys – Semiconductors – Band gap engineering and optical response.

# UNIT-III: UNDERSTANDING AND SYNTHESIS OF NANO SYSTEMS

Nano materials variety – Micro emulsion based methods for Nano materials - Salvo-thermal synthesis – Magnetic Nano materials – Anisotropic Nano materials – Exciton confinement in Quantum dots – Quantum mechanics of confined Nano clusters – Band gap engineering and optical response.

# UNIT- IV: NANOMATERIAL CHARACTERIZATION

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Probe Microscopy (SPM) techniques- (Principle, experimental set up, procedure and utility for the all the techniques)

# UNIT- V: ELECTRONICS AND BIOMEDICAL APPLICATIONS

Molecular electronics and Nano electronics – Nano dots- Biological applications of Nano particles- Catalysis by gold Nano particles - band gap engineered quantum devices-Nano mechanics - CNT emitters- Photo electro chemical cells- Photonic crystals - Plasmon Wave guides.

# BOOKS FOR STUDY

1. T. Pradeep et al., A text book of Nano science and Nanotechnology, TMGH, New Delhi(2012).
2. Guozhong Cao, Nanostructures and Nano materials, Imperial College Press, London(2004).
3. C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley-India(2009).

# BOOKS FOR REFERENCE

1. Lusia Filipponian Duncan Sutherland, Nanotechnologies: Principles, Applications, Implications and Hands-on Activities (ISBN 978 -92 -79 -21437 -0) European Commission, B-1049 Brussels(2013).
2. Hari Singh Nalwa, “Nano structured Materials and Nanotechnology”, Academic Press, (2002).
3. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press India Pvt. Ltd, New Delhi, First Edition(2005).
4. S. Shanmugam, Nanotechnology, MJP Publishers, Chennai (2010).
5. Lynn E. Foster, Nano Technology, Science, Innovations and Opportunity, Pearson Education (2010).
6. Suhas Bhattacharya, a Text book of Nano Science and Technology, Wisdom Press, (2013).
7. Subbiah Balaji, Nano Biotechnology, MJP Publishers,(2021).

# Course Outcomes:

The Leaner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Understand the types of nano materials | PSO 1 | K1, K2 |
| CO-2 | Analyse the properties and synthesis of CNT | PSO 2 | K2, K3 |
| CO-3 | Analyse the synthesis of nano systems | PSO 4 | K2, K4 |
| CO-4 | Characterize the nano system techniques | PSO 3 | K1, K4 |
| CO-5 | Explain the application of nano systems | PSO 5 | K2, K5 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific out come R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze;

**E- Evaluate (K5) and C – Create (K6)**

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO No.** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO-1 | S | M | S | S | S |
| CO-2 | S | M | M | S | M |
| CO-3 | S | S | S | M | L |
| CO-4 | S | L | M | L | S |
| CO-5 | S | S | L | M | M |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE -XVI: CONDENSED MATTER PHYSICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH16** |
| **Course Type** | **Theory** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **IV** |

**Course Objectives:**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the basic idea about crystal physics and to determine the Crystal Structure by different methods |
| COB-2 | Identify the Lattice Vibrations in solids and to measure the electrical and  thermal conductivity of metals by studying Band Theory of Solids |
| COB-3 | Know electric conductivity and band theory of the materials |
| COB-4 | Understand all the magnetic properties of materials |
| COB-5 | Familiarize with the basic concepts of the occurrence of Super Conductivity and to study the characteristic properties, types and applications of superconductors |

# UNIT- I: CRYSTAL STRUCTURE

Crystals- Lattice representation - Bravais Lattices- Unit cell- Wigner -Seitz   
cell - Symmetry operations - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing –X-ray diffraction – The Laue equations – Equivalence of Bragg and Laue equations – Interpretation of Bragg equation –- Powder and single crystal diffraction methods-Diffracto meters.

# UNIT- II: LATTICE VIBRATIONS AND THERMAL PROPERTIES

Vibration of mono atomic lattices – Lattices with two atoms per primitive cell – Phonon momentum – Inelastic scattering of neutrons by phonons –Dulong and Petit’s Law– Einstein model – Density of modes in one-dimension and three-dimension – Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process.

# UNIT- III: ELECTRICAL PROPERTIES OF METALS AND SEMICONDUCTORS

Free electron gas- Ohm’s law- Electrical conductivity and thermal conductivity-Wiedemann and Franz ratio- Quantum theory free electrons - Free electron gas in one dimension and three-dimension-Band theory of solids – Brillouin zone-I, II, III Order – Semi   
conductors – Intrinsic semiconductor-Carrier concentration in intrinsic Semiconductor-Hall effect- Experimental determination of Hall coefficient.

# UNIT- IV: MAGNETIC PROPERTIES OF MATERIALS

Terms and definitions used in magnetism – Classification of magnetic materials – Atomic theory of magnetism– Langevin’s classical theory of diamagnetism –– Langevin’s classical theory of para magnetism – Ferromagnetism – Weiss molecular field – Temperature dependence of spontaneous magnetization – The physical origin of Weiss molecular   
field - Ferromagnetic domains - Domain theory – Anti ferro magnetism –Expression for susceptibility- Ferri magnetism – Structure of ferrite.

# UNIT-V: SUPERCONDUCTIVITY

Occurence of superconductivity - Meissner effect – Type I and Type II super  
conductors- Isotope effect - London equation - Coherence length - BCS theory of superconductivity- Flux quantisation in a superconducting ring -Josephson tunneling - DC Josephson effect - AC Josephson effect - Macroscopic quantum interference (SQUID) – High temperature superconductors – Applications.

# BOOKS FOR STUDY

1. Yu. L.S Irotin, M.P. Shaskolskaya, Fundamental of Crystal Physics, Mir Publics Moscow (1983).
2. C. Kittel, Introduction to Solid State Physics, Wiley Eastern, New Delhi(2008).
3. M. M. Woolfson, An Introduction to X-ray Crystallography, Cambridge University Press, Cambridge (1970).
4. S. O. Pillai, Solid State Physics, New Age International, New Delhi (2007).
5. M.A. Wahab, Solid State Physics, Narosa Publishing House,(2015).

# BOOKS FOR REFERENCE

1. N. W. Ashcrof and N. D. Mermin, Solid State Physics, Holt, Rinehart and Winston, Philadelphia (1976).
2. J. S. Blakemore, Solid State Physics, Cambridge University Press, Cambridge (1974).
3. A. J. Dekker, Solid State Physics, McMillan, Madras (1998).
4. HP Myers, A Compendium based on Introductory Solid State Physics, C & C Press (1997).

# Course Outcomes:

The Leaner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Define the crystal lattice, to differentiate the 2D and 3D crystal systems and determine the crystal structure by  different methods. | PSO 1 | K1, K2 |
| CO-2 | Explain the Lattice Vibrations in solids to measure the electrical and thermal conductivity of metals | PSO 2 | K2, K3 |
| CO-3 | Distinguish the Dielectric and Magnetic Properties of the materials. | PSO 4 | K2, K4 |
| CO-4 | Understand the fundamentals of magnetic properties | PSO 3 | K2, K4 |
| CO-5 | Explain the occurrence of Super Conductivity, properties, types and applications of super conductors. | PSO 5 | K2, K5 |

**PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific outcome R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze; E- Evaluate (K5) and C – Create (K6)**

# Mapping

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** |
| **CO-1** | **M** | **M** | **S** | **L** | **S** |
| **CO-2** | **S** | **L** | **S** | **M** | **M** |
| **CO-3** | **S** | **L** | **M** | **M** | **S** |
| **CO-4** | **S** | **S** | **L** | **M** | **S** |
| **CO-5** | **M** | **L** | **M** | **M** | **S** |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

|  |  |
| --- | --- |
| **Course Title** | **MAJOR CORE –XVII: MAJOR PRACTICAL IV: ADVANCED ELECTRONICS –**  **(MICROCONTROLLER AND COMPUTER PROGRAMMING)** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH17P** |
| **Course Type** | **Practical** |
| **Credits** | **5** |
| **Marks** | **100** |
| **Semester** | **IV** |

**Any FIFTEEN experiments**

**Programs using Micro-Controller**

1. Microcontroller- 8-Bit addition and subtraction.
2. Microcontroller- 8 Bit multiplication and division.
3. Microcontroller- 16Bit division and multiplication.
4. Microcontroller- Ascending and Descending order.
5. Microcontroller- Largest and Smallest number in a given array of numbers.
6. Sum of the given array.
7. Micro-Controller I/O interfacing-Application-I
8. I/O interfacing-Application-II
9. I/O interfacing-Application-III

**COMPUTER PROGRAMS**

1. Roots of algebraic equations - Newton-Raphson method.
2. Least-squares curve fitting – straight-line fit
3. Least-squares curve fitting – exponential fit.
4. Solution of simultaneous linear algebraic equations – Gauss elimination method.
5. Solution of simultaneous linear algebraic equations – Gauss-Seidal method.
6. Interpolation – Lagrange method.
7. Numerical differentiation – Euler method.
8. Solution of ordinary differential equations – Runge-Kutta 2ndordermethod.
9. Evaluation of definite integrals – Monte Carlo method.
10. Numerical integration –Trapezoidal rule
11. Numerical integration –Simpson’s 1/3rdrule.
12. Solution of ordinary differential equations – Runge-Kutta 4th order method.
13. Calculation of mean, standard deviation and probability distribution of a set of random numbers.

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| --- | --- |
| **Course Title** | **MAJOR CORE XVIII: FIBER OPTICS AND**  **NON-LINEAR OPTICS** |
| **Total Hours** | **90** |
| **Hours/Week** | **6** |
| **Code** | **P22PH18E** |
| **Course Type** | **Theory** |
| **Credits** | **4** |
| **Marks** | **100** |
| **Semester** | **IV** |

**Course Objectives (COB):**

To enable the learner to

|  |  |
| --- | --- |
| **CO No.** | **Course Objectives** |
| COB-1 | Understand the basic idea fiber optical sources |
| COB-2 | Analyze the communication components that suits optical communication |
| COB-3 | Learn about the transmission characteristics of optical fibers |
| COB-4 | Understand the fundamentals of non-linear optical techniques |
| COB-5 | Understand the materials required for NLO communication systems |

# UNIT- I: FIBER OPTICAL SOURCES

Operational principle in LED and Laser- External quantum efficiency of LED - LED modulation bandwidth- Coupling of LEDs with fiber- Edge emitting LEDs- Preparation of materials for LEDs- Fiber lasers- Super fluorescent fiber laser- Super luminescent diode.

# UNIT- II: FIBER OPTIC COMMUNICATION COMPONENTS AND SYSTEM

Coupling components- Modulation methods and   
modulators-Switches-Transmitters- Receivers- Repeaters- Solitons-Wavelength Division Multiplexing (WDM)-Optical Time Division Multiplexing (TDM) - Data buses- LAN systems- SONET, SDH, ISDN, BISDN networks- Microwave technical applications of light wave systems

# UNIT- III: TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS

Attenuation-Losses: Material absorption-Linear scattering-Non-linear scattering-Fiber bending- Dispersion-Intermodal – Intra modal and overall fiber dispersion- Dispersion shifted fibers- Dispersion flattened fibers- Modal birefringence.

# UNIT- IV: NON-LINEAR OPTICS

Introduction - Harmonic generation-Second Harmonic Generation- Phase matching -Third Harmonic Generation-Optical mixing: sum and difference frequencies-Parametric Generation of light-Self-focusing of intense light beams-Phase matching-Optical Matching- Advantages Applications.

# UNIT- V: NON LINEAR OPTICAL MATERIALS

Basic requirements-In-Organics-Borates-Organics-Urea-Nitro aniline- Rhodamine B -Semi organics-Thio Urea complex-Laser induced surface damage threshold-Kurtz and Perry powder technique.

# BOOKS FOR STUDY

1. D.C. Agarwal, Fiber Optic Communication, Sultan Chand, New Delhi(2009).
2. John M. Senior, Optical Fiber Communications, Prentice Hall India, 2nd Edition (2005).
3. B. B. Laud, Lasers and Non-Linear Optics, New Age International Publishers, New Delhi (2008).
4. Lecture notes and course material: NLO Materials, Department of Physics, NCT.

# BOOKS FOR REFERENCE

1. Govind .P. Agrawal, Nonlinear Fiber Optics, Third Edition, Academic Press (2001).
2. Govind. P. Agarwal, Fiber-Optics Communication Systems, 3rd Edn. JohnWiley and Sons, Singapore (2003).

# Course Outcomes:

The leaner will be able to

|  |  |  |  |
| --- | --- | --- | --- |
| **CO No.** | **Course Outcomes** | **PSOs**  **Addressed** | **Cognitive Level** |
| CO-1 | Understand the basic idea fiber optical sources | PSO 1 | K1, K2 |
| CO-2 | Analyse the communication components  that suits optical communication | PSO 2 | K2, K4 |
| CO-3 | Learn about the transmission characteristics of optical communication | PSO 4 | K2, K3 |
| CO-4 | Understand the fundamentals of non- linear optical techniques | PSO 5 | K2, K5 |
| CO-5 | Understand the materials require for NLO  communication systems | PSO 4 | K2, K3 |

# PO – Programme Outcomes; CO – Course Outcome; PSO –Programme specific out come R- Remember (K1); U- Understand (K2); Ap (K3) – Apply; An (K4) – Analyze;

**E- Evaluate (K5) and C – Create (K6)**

**Mapping**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** |
| **CO-1** | **M** | **S** | **M** | **S** | **L** |
| **CO-2** | **M** | **S** | **M** | **S** | **L** |
| **CO-3** | **S** | **S** | **M** | **M** | **M** |
| **CO-4** | **S** | **M** | **M** | **S** | **S** |
| **CO-5** | **S** | **S** | **S** | **S** | **S** |

**S- Strong Correlation, M- Medium Correlation, L- Lesser Correlation**

**Course XIX: PROJECT WORK**

|  |  |
| --- | --- |
| **Course Title** | **Project Work** |
| **Total Hours** | **180** |
| **Hours/Week** | **12** |
| **Code** | **P22PH19** |
| **Course Type** | **Project** |
| **Credits** | **5** |
| **Marks** | **100** |

**Course objective and outcome:**

* + To facilitate independent learning and research skills in the student in a chosen topic.
  + To monitor the progress of the student with a teacher exclusively assigned to supervise him/her.
  + To evaluate the performance of the student by assessing the dissertation of the work submitted by the student and with a viva-voce.

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