

SEMESTER - I

PPC 101

CC-I - STATISTICAL MECHANICS		I YEAR - FIRST SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	STATISTICAL MECHANICS	CC-I	5	6	75
Pre-Requisites					
Laws of thermodynamics, phase transition, entropy, ensembles, partition function, classical and quantum statistics, thermal equilibrium, Brownian motion					
Learning 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

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 II: STATISTICAL MECHANICS AND THERMODYNAMICS

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

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

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: ISING MODEL AND FLUCTUATIONS

Fluctuations and transport phenomena - Ising Models - One dimensional random walk - Brownian motion - Langevin's theory - Fluctuation - dissipation theorem.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

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.
6. Gupta Kumar, 2019, *Elementary Statistical Mechanics*, Pragati Publication.

REFERENCE BOOKS

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. Neiseand H. Stoecker, *Thermodynamics and Statistical Mechanics*, Springer Verlag, New York.
5. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.

WEB SOURCES

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

COURSE OUTCOMES:

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

CO1	Recall and define key concepts related to thermodynamic potentials, phase equilibrium, Gibb's phase rule, Ehrenfest's classifications, and the third law of thermodynamics.	K1
CO2	Explain the foundations of statistical mechanics, including the specification of states, microcanonical ensemble, phase space, and the connection between statistics and thermodynamics, including the entropy of an ideal gas.	K2
CO3	Apply concepts of canonical and grand canonical ensembles to calculate partition functions and derive statistical quantities such as energy and density fluctuations.	K3
CO4	Analyze and compare different statistical mechanics frameworks, including Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics, and evaluate their implications in systems of indistinguishable particles.	K4
CO5	Evaluate the Ising model, its significance in phase transitions, and discuss fluctuation phenomena in systems, including applications of Langevin's theory and the fluctuation-dissipation theorem and thermodynamics, statistical mechanics, and fluctuations to formulate a coherent understanding of complex systems, demonstrating proficiency in both theoretical concepts and practical applications.	K5,K6

K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5 –Evaluate; K6- Create

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	2	3	2	1	1	1	2	1	1	1	2	1	1
CO2	4	3	3	2	1	1	2	2	1	1	1	2	1	1
CO3	4	2	4	3	1	1	2	2	1	1	2	2	2	1
CO4	4	3	4	3	1	1	2	2	1	1	2	2	2	1
CO5	4	2	4	3	1	1	2	2	1	1	2	2	2	1

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)



CC II - CLASSICAL MECHANICS AND RELATIVITY		I YEAR - FIRST SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	CLASSICAL MECHANICS AND RELATIVITY	CC-II	5	6	75
Pre-Requisites: Fundamentals of mechanics, Foundation in mathematical methods.					
Learning 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. ➤ To learn the relativistic formulation of mechanics of a system.					

UNIT I: PRINCIPLES OF CLASSICAL MECHANICS

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 – principle of virtual work – D'Alembert's principle – Lagrangian equations of motion – Applications: (i) simple pendulum (ii) Atwood's machine

UNIT II: HAMILTONIAN FORMULATION

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 III: SMALL OSCILLATIONS

Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – Two coupled Harmonic oscillator – linear triatomic molecule.

UNIT IV: RELATIVITY

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

UNIT V: NONLINEAR DYNAMICS

Dynamical system – Implications of Nonlinearity, Regular and chaotic motion – Linear and nonlinear oscillators – Phase trajectories – Fixed point – Limit cycles – Chaos in a Duffing oscillator through period Doubling – Solitons – Cnoidal waves (derivation) of K-dv equation – AKNS Eigen value problem – Derivation of K-dv, M-Kdv equation.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

BOOKS FOR STUDY

1. H. Goldstein, 2002, *Classical Mechanics*, 3rd Edition, Pearson Edu.
2. J. C. Upadhyaya, *Classical Mechanics*, Himalaya Publishing. 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 BOOKS

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.

WEB SOURCES

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>

COURSE OUTCOMES:

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

CO1	Recall and define fundamental concepts related to the mechanics of particles, conservation laws, constraints, generalized coordinates, and the principle of virtual work.	K1
CO2	Explain the Hamiltonian formulation of mechanics, including phase space, conjugate momentum, and Hamilton's canonical equations, with specific applications to simple systems.	K2
CO3	Apply the principles of small oscillations, including the formulation of normal modes and the analysis of coupled oscillators, to solve problems involving harmonic oscillators and molecular dynamics.	K3
CO4	Analyze and interpret the implications of special relativity, including Lorentz transformations, time dilation, and mass-energy equivalence, utilizing four-vector notation to describe relativistic motion.	K4
CO5	Evaluate the behavior of dynamical systems under nonlinearity, including regular and chaotic motion, phase trajectories, and the dynamics of systems such as the Duffing oscillator and solitons. Synthesize knowledge from classical mechanics, relativity, and nonlinear dynamics to formulate a comprehensive understanding of complex physical systems, demonstrating proficiency in both theoretical concepts and practical applications.	K5&K6
K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5 –Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

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CO2	4	3	3	2	1	1	2	2	1	1	1	2	1	1
CO3	4	2	4	3	1	1	2	2	1	1	2	2	2	1
CO4	4	3	4	3	1	1	2	2	1	1	1	2	1	1
CO5	4	2	4	3	1	1	2	2	1	1	2	2	2	1

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

EC I - 1. CRYSTAL GROWTH AND THIN FILMS			I YEAR – FIRST SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	CRYSTAL GROWTH AND THIN FILMS	EC- I	4	5	75
Pre-Requisites : Fundamentals of Crystal Physics					
Learning 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

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

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

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 - Bridgman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition - Stoichiometry.

UNIT IV: THIN FILM DEPOSITION METHODS

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

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.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

BOOKS FOR STUDY

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 BOOKS

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. SanthanaRaghavan and P. Ramasamy, "Crystal Growth Processes", KRU Publications.
4. H.E. Buckley, 1951, Crystal Growth, John Wiley and Sons, New York
5. B.R. Pamplin, 1980, Crystal Growth, Pergman Press, London.

WEB SOURCES

1. <https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrI08kZl1D1Jp>
2. <https://www.youtube.com/playlist?list=PLFW6IRTa1g83HGEihgwcY7KeTLUuBu3WF>
3. <https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m>
4. <https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIlKQFsRoky3Yd1Emw>
5. <https://www.electrical4u.com/thermal-conductivity-of-metals/>

COURSE OUTCOMES:

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

CO1	Define the basic concepts of crystal growth Principles, techniques of thin film deposition methods.	K1
CO2	Explain the nucleation theories, various methods of crystal growth such as melt, solution vapour growth, thin film deposition methods such as physical vapour deposition, chemical vapour deposition etc.,	K2
CO3	Study various methods of Crystal growth techniques, Thin film deposition and thin film formation techniques.	K3
CO4	Analyze various crystal growth and thin film deposition methods and assess their Advantages and disadvantages.	K4
CO5	Evaluate the practical applications of crystal growth and thin film deposition in various contexts including industrial applications and will try to create new technologies.	K5,K6
K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5 –Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

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CO1	1	1	3	3	3	3	4	3	2	2	4	1	4	2
CO2	1	1	3	3	2	3	4	2	3	2	4	1	4	4
CO3	1	1	4	3	3	4	4	4	2	2	4	2	4	4
CO4	1	2	4	3	3	4	4	4	3	2	4	2	4	4
CO5	2	2	4	3	2	4	4	3	3	1	4	2	4	4

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

EC – II 1. LINEAR AND DIGITAL ICs & APPLICATIONS			I YEAR - FIRST SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	LINEAR AND DIGITAL ICs & APPLICATIONS	ELECTIVE	3	5	75
Pre-Requisites : Knowledge of semiconductor devices, basic concepts of digital and analog electronics.					
Learning Objectives ➤ To introduce the basic building blocks of linear integrated circuits. ➤ To teach the linear and non-linear applications of operational amplifiers. ➤ To introduce the theory and applications of PLL. ➤ To introduce the concepts of waveform generation and introduce one special function ICs. ➤ Exposure to digital IC's					

UNIT I: INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER

Introduction, Classification of IC's, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit and Op-Amp Characteristics.

UNIT II: APPLICATIONS OF OP-AMP

LINEAR APPLICATIONS OF OP-AMP: Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters.

NON-LINEAR APPLICATIONS OF OP-AMP:

Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Square waveform generators.

UNIT III: ACTIVE FILTERS & TIMER AND PHASE LOCKED LOOPS

ACTIVE FILTERS: Introduction, Butterworth filters – 1st order pass and high pass filters, band pass, band reject and all pass filters.

TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator.

UNIT IV: VOLTAGE REGULATOR & D to A AND A to D CONVERTERS

VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

D to A AND A to D CONVERTERS: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

UNIT V: CMOS LOGIC, COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL CIRCUITS USING TTL 74XX ICs

CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC 74154), BCD to 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154).

SEQUENTIAL CIRCUITS USING TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd., New Delhi, India
2. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
3. B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co.
4. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
5. V. Vijayendran, 2008, Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, Reprint. V.

REFERENCE BOOKS

1. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
2. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.
3. Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi
4. Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
5. Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Reprint (2000)

WEB SOURCES

1. https://nptel.ac.in/course.html/digital_circuits/
2. https://nptel.ac.in/course.html/electronics/operational_amplifier/
3. <https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/>
4. <https://www.electrical4u.com/applications-of-op-amp/>
5. <https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/>

COURSE OUTCOMES:

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

CO1	Recall and define fundamental concepts of integrated circuits and operational amplifiers.	K1
CO2	Explain the applications of operational amplifiers in various circuits.	K2
CO3	Analyze and solve problems using operational amplifiers and active filters.	K3
CO4	Design and implement voltage regulators and converters.	K4
CO5	Synthesize and evaluate CMOS and TTL logic circuits.	K5,K6

K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5 –Evaluate,K6-Create

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
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CO2	4	4	3	2	1	1	1	4	3	2	1	1	1	1
CO3	4	2	4	3	1	2	1	4	2	3	2	1	2	1
CO4	4	3	4	3	1	2	1	4	3	3	2	1	2	1
CO5	4	3	4	2	1	3	2	4	3	3	2	2	3	2

Question pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

PP18E1

SKILL ENHANCEMENT - I		I YEAR – FIRST SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	DOCUMENT PREPARATION SYSTEM LATEX (THEORY)	SKILL ENHANCEMENT	2	2	75

Unit I:

Installation of Latex in different operating systems; create, title and basic layout of Latex documents; Document structure: section, subsections and paragraphs etc.

Unit II:

Latex packages: installing, including and purpose of packages. Latex math and equations: Inline math, equations, fractions, Matrices scaling of parantheses, Brackets etc.

Unit III:

Latex image: caption, position and multiple images; Latex table: contents, list of figures. Depth, spacing etc.; Bibliography, Footnotes.

Unit IV:

Special pages, Special documents, Font: Families, styles and sizes; Colors: Font, text background and page background; Special characters and symbols.

Unit V:

Hyperlinks, Automatic plot generation, Automatic table generation, Drawing graphs, Circuit diagrams, Advanced circuit diagrams, Source code highlighting, Lists.

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EC I – 2. ANALYSIS OF CRYSTAL STRUCTURES			I YEAR – FIRST SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	ANALYSIS OF CRYSTAL STRUCTURES	ELECTIVE	4	5	75
Pre-Requisites : Fundamentals of crystal structures, symmetry and X-Ray Diffraction techniques					
Learning 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

Unit cell and Bravais lattices - crystal planes and directions - basic symmetry elements operations - translational symmetries - point groups - space groups - equivalent positions - Bragg's law - reciprocal lattice concept - Laue conditions - Ewald and limiting spheres - diffraction symmetry - Laue groups.

UNIT II: DIFFRACTION

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

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: POWDER METHODS

Fundamentals of powder diffraction - Debye Scherrer method - diffractometer geometries - use of monochromators and Soller slits - 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

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.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

1. Azaroff, L.V., "Elements of X-Ray Crystallography", Techbooks, 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 BOOKS

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

WEB SOURCES

1. <https://archive.nptel.ac.in/courses/112/106/112106227/>
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/>

COURSE OUTCOMES:

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

CO1	Recall and define key concepts related to crystallography, including unit cells, Bravais lattices, symmetry operations, translational symmetries, point groups, space groups, Bragg's law, and reciprocal lattice concepts.	K1
CO2	Explain the principles and methods of X-ray diffraction, covering X-ray generation (sealed tube, rotating anode, synchrotron radiation), absorption mechanisms, atomic scattering factors, Fourier transformations, and the interpretation of diffraction patterns.	K2
CO3	Apply structure analysis techniques using single crystal diffractometers, including data collection, data reduction, and resolving the phase problem through methods such as the Patterson function and heavy atom method, along with structure refinement processes.	K3
CO4	Analyze powder diffraction data using the Debye-Scherrer method and Rietveld refinement, evaluating profile analysis, peak shapes, whole pattern fitting, and the implications of crystallite size and residual stress.	K4
CO5	Synthesize knowledge of protein crystallography, focusing on the various structures of proteins and nucleic acids, methods for protein crystallization, factors influencing crystallization, and techniques for solving protein structures using anomalous dispersion methods. Critically evaluate crystallographic data and experimental techniques, integrating knowledge from various units to formulate coherent arguments and design experiments in both materials science and structural biology contexts.	K5,K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6- Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	2	2	3	1	1	1	3	2	1	2	1	1	1
CO2	4	3	3	3	1	1	1	3	2	1	2	1	1	1
CO3	4	2	3	3	1	1	1	3	2	2	3	1	2	1
CO4	4	2	4	3	1	1	1	3	2	1	2	1	1	1
CO5	4	3	3	4	1	1	1	4	2	1	3	2	2	1

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

EC – II 2. ADVANCED OPTICS		I YEAR – FIRST SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	ADVANCED OPTICS	ELECTIVE	3	5	75
Pre-Requisites: Knowledge of properties and wave nature of light					
Learning Objectives ➤ To know the concepts behind polarization and could pursue research work on application aspects of laser ➤ To impart an extensive understanding of fiber and non-linear optics ➤ To study the working of different types of LASERS ➤ To differentiate first and second harmonic generation ➤ Learn the principles of magneto-optic and electro-optic effects and its applications					

UNIT I: POLARIZATION AND DOUBLE REFRACTION

Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity

UNIT II: LASERS

Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd:YAG laser – gas lasers – He-Ne laser – CO₂ laser – Chemical lasers – HCl laser – Semiconductor laser

UNIT III: FIBER OPTICS

Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor

UNIT IV: NON-LINEAR OPTICS

Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light.

UNIT V: MAGNETO-OPTICS AND ELECTRO-OPTICS

Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect – Voigt effect – Cotton-mouton effect – Kerr magneto-optic effect – Electro-optical effects – Stark effect – Inverse stark effect – Electric double refraction – Kerr electro-optic effect – Pockels electro-optic effect.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

1. B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2. Ajoy Ghatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3. William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York
4. J. Peatros, Physics of Light and Optics, a good (and free!) electronic book
5. B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley-Interscience,

REFERENCE BOOKS

1. F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition.
2. Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH.
3. Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011.
4. Y. B. Band, Light and Matter, Wiley and Sons (2006)
5. R. Guenther, Modern Optics, Wiley and Sons (1990)

WEB SOURCES

1. <https://www.youtube.com/watch?v=WgzynezPiyc>
2. <https://www.youtube.com/watch?v=ShQWwobpW60>
3. <https://www.ukessays.com/essays/physics/fiber-optics-and-it-applications.php>
4. <https://www.youtube.com/watch?v=0kEvr4DKGRI>
5. <http://optics.byu.edu/textbook.aspx>

COURSE OUTCOMES:

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

CO1	Recall and classify the various types of polarization, including the mechanisms of double refraction and optical activity.	K1
CO2	Explain the fundamental principles of lasers, including the processes of spontaneous and stimulated emissions, and describe different types of lasers and their applications.	K2
CO3	Analyze the principles of fiber optics, including total internal reflection, numerical aperture, and the functioning of single-mode and multi-mode fibers.	K3
CO4	Evaluate the concepts of non-linear optics, including harmonic generation and phase matching, and discuss their applications.	K4
CO5	Apply knowledge of magneto-optics and electro-optics to analyze effects such as the Zeeman effect, Faraday effect, and Kerr effect in practical scenarios.	K5,K6
K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5 –Evaluate,K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	1	1	1	1	3	2	1	1	1	1	1
CO2	4	3	3	2	1	1	1	3	2	2	1	1	1	1
CO3	4	3	3	2	1	1	1	3	2	2	1	1	1	1
CO4	3	2	3	2	1	1	1	3	2	2	2	1	1	1
CO5	4	2	3	2	1	1	1	3	2	2	2	1	1	1

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

COURSE OUTCOMES:

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

CO1	Identify and describe the different operating systems suitable for LaTeX installation and the basic layout components of LaTeX documents.	K1
CO2	Explain the document structure in LaTeX, including sections, subsections, paragraphs, and their significance in organizing content.	K2
CO3	Apply the installation and inclusion of various LaTeX packages to enhance document functionality and layout.	K3
CO4	Analyze and evaluate the use of inline math, equations, fractions, matrices, and scaling of parentheses and brackets in LaTeX to ensure mathematical accuracy and presentation quality.	K4
CO5	Develop complex LaTeX documents that include images, tables, bibliographies, and footnotes, integrating various formatting and structuring elements to create professional documents. Critique and assess the effectiveness of advanced LaTeX features, such as hyperlinks, automatic plot and table generation, and circuit diagrams, in enhancing the readability and functionality of technical documents.	K5,K6
K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5 –Evaluate,K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	1	1	1	1	2	2	1	1	1	1	1
CO2	3	3	2	1	1	1	1	3	2	1	1	1	1	1
CO3	4	3	2	1	1	1	1	3	2	1	1	1	1	1
CO4	4	3	4	2	1	1	1	3	2	1	1	1	1	1
CO5	4	3	4	3	1	1	1	3	2	1	2	1	1	1

Question Pattern:

Section A

1 question from each unit.(Either or type)
(5 unit-) (5X15=75)

CC III – GENERAL & ELECTRONICS PRACTICAL - I			I YEAR - FIRST SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	GENERAL & ELECTRONICS PRACTICAL - I	CC- III	3	6	60
Pre-Requisites: Knowledge and hands on experience of basic general and electronics experiments of Physics.					
Learning 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) General Experiments

1. Determination of Young's Modulus and poisson ratio by Elliptical Fringes – Cornu's method.
2. Determination of Stefan's constant of radiation from a hot body.
3. Determination of compressibility of a liquid using Ultrasonics interferometer.
4. Planck's constant – photo electric effect.
5. Spectrometer – Charge of Electron.
6. Determination of specific charge of an – e/m Magnetron method.

7. Arc spectrum – Copper.
8. Self – Induction of a coil – Anderson's Method.
9. Biprism –Determination of Refractive index.
10. Hall Effect in semiconductor. Determination Hall Co-efficient carries concentration and carrier mobility.
11. Determination of wavelength using Michelson Interferometer.

Electronics Experiments

1. Operational Amplifier (Mathematical Operations- I) – Inverter, Multiplier, Divider, Adder and Averager (Any three).
2. Characteristics of UJT
3. Characteristics of LDR
4. Flip flops – Clocked RS, Clocked D and RS flip flop.
5. FET CS amplifier - Frequency response, input impedance, output impedance.
6. V-I Characteristic of different colours of LED.
7. Construction of square wave Triangular wave generator using IC 741.
8. Construction of Encoder and Decoder circuits using ICs.
9. Digital to Analog convertor – Binary Weighted and R-2R method.
10. BCD seven segment display.
11. Verification of Karnugh maps – Reduction & Logic circuit implementation.

BOOKS FOR STUDY

1. Practical Physics, Gupta and Kumar, PragatiPrakasan.
2. Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences.

REFERENCE BOOKS

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D. Chattopadhyay, 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.

SEMESTER - II

CC IV - MATHEMATICAL PHYSICS		I YEAR - SECOND SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	MATHEMATICAL PHYSICS	CC-IV	5	6	75
Pre-Requisites: Knowledge of Matrices, vectors, differentiation, integration, differential equations					
Learning 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

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

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

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

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

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.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

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* (2nd 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* (4th edition), VikasPublishing House, New Delhi.
5. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.

REFERENCEBOOKS

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 EastWest, New Delhi.
5. C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6th Edition, International Edition

WEB SOURCES

1. www.khanacademy.org
2. https://youtu.be/LZnRIOA1_2I
3. <http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath>
4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SIED56gNjVJGO2qaZ
5. <https://archive.nptel.ac.in/courses/115/106/115106086/>

COURSE OUTCOMES:

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

CO1	Recall and define key concepts related to linear vector spaces, including definitions, examples, linear independence, orthogonality, and basic operations such as projections and eigenvalues.	K1
CO2	Explain the fundamentals of complex analysis, including the properties of analytic functions, contour integration, and the application of the residue theorem in solving electrostatic and heat problems.	K2
CO3	Analyze various types of matrices, their properties, and applications, including matrix rank, eigenvalues and eigenvectors, and techniques for diagonalization.	K3
CO4	Apply Fourier and Laplace transforms to solve differential equations, including the diffusion and wave equations, and perform operations such as differentiation and integration of transforms.	K4
CO5	Evaluate second-order differential equations using Sturm-Liouville theory, exploring orthogonal polynomials, generating functions, and Green's functions for one-dimensional problems.	K5&K6
K1-Remember; K2 –Understand; K3 -Apply; K4- Analyze; K5 –Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	2	3	2	1	1	1	3	2	2	2	2	2	2
CO2	4	3	3	2	1	1	1	3	3	2	2	2	1	1
CO3	4	2	3	2	2	1	1	3	2	3	2	2	2	2
CO4	4	2	4	3	2	1	1	3	2	2	3	2	2	2
CO5	4	2	4	3	1	1	1	3	1	2	3	2	2	2

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

CC V - CONDENSED MATTER PHYSICS		I YEAR - SECOND SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	CONDENSED MATTER PHYSICS	CC-V	5	6	75
Pre-Requisites : Basic knowledge of atomic physics, quantum mechanics and statistical mechanics.					
Learning Objectives ➤ To describe various crystal structures, symmetry and to differentiate different types of bonding. ➤ To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat. ➤ To critically assess various theories of electrons in solids and their impact in distinguishing solids. ➤ Outline different types of magnetic materials and explain the underlying phenomena. ➤ Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.					

UNIT I: CRYSTAL PHYSICS

Types of lattices - Miller indices - Symmetry elements and allowed rotations - Simple crystal structures - Atomic Packing Factor- Crystal diffraction - Bragg's law - Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc). Structure and properties of liquid crystals. Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).

UNIT II: LATTICE DYNAMICS

Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umklapp processes.

UNIT III: THEORY OF METALS AND SEMICONDUCTORS

Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration - Temperature Dependence - Mobility - Impurity conductivity - Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect.

UNIT IV: MAGNETISM

Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall -

Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferromagnetism.

UNIT V: SUPERCONDUCTIVITY

Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect - Critical field - Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors.

Theoretical Explanation: Thermodynamics of super conducting transition - London equation - Coherence length - Isotope effect - Cooper pairs - Bardeen Cooper Schrieffer (BCS) Theory - BCS to Bose - Einstein Condensation (BEC) regime- Nature of pairing and condensation of Fermions. Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors - SQUIDS.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

1. C. Kittel, 1996, *Introduction to SolidState Physics*, 7th Edition, Wiley, New York.
2. Rita John, *Solid State Physics*, Tata Mc-GrawHill Publication.
3. A. J. Dekker, *SolidState Physics*, Macmillan India, New Delhi.
4. M. Ali Omar, 1974, *Elementary SolidState Physics – Principles and Applications*, Addison - Wesley
5. H. P. Myers, 1998, *Introductory SolidState Physics*, 2nd Edition, Viva Book, New Delhi.

REFERENCE BOOKS

1. J. S. Blakemore, 1974, *Solid state Physics*, 2nd Edition, W.B. Saunder, Philadelphia
2. H. M. Rosenberg, 1993, *The SolidState*, 3rd Edition, OxfordUniversity Press, Oxford.
3. J. M. Ziman, 1971, *Principles of the Theory of Solids*, CambridgeUniversity Press, London.
4. C. Ross-Innes and E. H. Rhoderick, 1976, *Introduction to Superconductivity*, Pergamon, Oxford.
5. J. P. Srivastava, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.

WEB SOURCES

1. <http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html>
2. <http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html>
3. <https://www.britannica.com/science/crystal>
4. <https://www.nationalgeographic.org/encyclopedia/magnetism/>
5. https://www.brainkart.com/article/Super-Conductors_6824/

COURSE OUTCOMES:

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

CO1	Basic Definition and concepts of the crystal system, symmetries allowed in a system and also The diffraction techniques to find the crystal structure.	K1
CO2	Explain and identify the idea of reciprocal spaces, Brillouin Zone and their extension to band Theory of solids.	K2
CO3	Ability to explain electrical properties of metals and semiconductors based on band theory.	K3
CO4	Analyze the electronic nature of solids from band theories.	K4
CO5	Compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.	K5, K6
K1-Remember; K2 –Understand; K3 -Apply; K4- Analyze; K5 –Evaluate K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	3	4	3	2	3	3	4	3	4	3	2	3	3
CO2	4	2	4	4	2	2	3	4	3	4	4	2	2	3
CO3	4	2	4	4	2	3	3	4	3	4	4	2	3	3
CO4	4	3	4	4	2	3	3	4	3	4	4	2	3	3
CO5	4	3	4	4	2	2	3	4	3	4	4	3	3	3

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

CC – VI - GENERAL AND ELECTRONICS PRACTICAL II			I YEAR - SECOND SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	GENERAL AND ELECTRONICS PRACTICAL II	CC - VI	3	6	75
Pre-Requisites: Knowledge and handling of basic general and electronics experiments of Physics					
Learning 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					

(Minimum of Twelve Experiments from the list)

GENERAL

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes.
2. GM counter – characteristics, Inverse square law and absorption coefficient.
3. Measurement of conductivity – Four Probe method.
4. Arc spectrum – Iron.
5. "g" factor determination – ESR spectrometer.
6. Biprism – wavelength of light.
7. Measurement of susceptibility of liquid – Quincke's method.
8. Measurement of Magnetic susceptibility – Guoy's method.
9. Determination of specific charge of an electron – Thomson's method.
10. Spectrometer – Polarizability of liquids.
11. Dielectric constant of solids and liquids.

ELECTRONICS

1. IC 7490 as scalar and seven segment display using IC7447
2. Solving simultaneous equations – IC 741 / IC LM324
3. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Butter worth filter
4. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
5. Construction of second order butterworth multiple feedback narrow band pass filter
6. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
7. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
8. Construction of pulse generator using the IC 555 – Application as frequency divider
9. BCD to Excess- 3 and Excess 3 to BCD code conversion
10. Study of binary up / down counters - IC 7476 / IC7473
11. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474.

TEXT BOOKS

1. Practical Physics, Gupta and Kumar, PragatiPrakasan
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.Chattopadhyay, C.RRakshit, New Central Book Agency Pvt. Ltd
2. Advanced Practical Physics, S.P Singh, PragatiPrakasan
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

COURSE OUTCOMES:

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

CO1	Recall and define key concepts related to linear vector spaces, including definitions, examples, and basic operations.	K1
CO2	Understand the fundamentals of complex analysis, including properties of analytic functions and contour integration	K2
CO3	Apply various types of matrices in problem-solving, including their properties, eigen values, and eigenvectors.	K3
CO4	Analyze and interpret the use of Fourier and Laplace transforms in solving differential equations and their applications.	K4
CO5	Evaluate second-order differential equations using Sturm-Liouville theory and assess their applications in physical contexts. Create innovative solutions for complex problems using knowledge from linear algebra, complex analysis, and differential equations.	K5, K6
K1-Remember; K2 –Understand; K3 -Apply; K4- Analyze; K5 –Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	3	4	3	2	3	3	4	3	4	3	2	3	3
CO2	4	2	4	4	2	2	3	4	3	4	4	2	2	3
CO3	4	2	4	4	2	3	3	4	3	4	4	2	3	3
CO4	4	3	4	4	2	3	3	4	3	4	4	2	3	3
CO5	4	3	4	4	2	2	3	4	3	4	4	3	3	3

EC – III 1. PHYSICS OF NANOSCIENCE AND TECHNOLOGY			I YEAR – SECOND SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	PHYSICS OF NANOSCIENCE AND TECHNOLOGY	ELECTIVE	4	5	75

Pre-Requisites

Basic knowledge in Solid State Physics

Learning 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

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

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

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

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

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 of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

1. A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. (2012).
1. Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).
2. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).
3. 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 BOOKS

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 Bhargadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.

WEB SOURCES

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>

COURSE OUTCOMES:

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

CO1	Know what physical & mechanical properties are different types of nanomaterials, optical, XPS, SEM and application of nanomaterials.	K1
CO2	Explain 1D, 2D nanostructured materials, Ferroelectric, dielectric, super para magnetism, Electrospinning, ballmilling, STM Imaging techniques and super capacitor and photo voltaic	K2
CO3	Apply the concept of surface effect of nanomaterials and experiment with magnetic, ferroelectric, Super ferromagnetic, properties of nanomaterials and various characterization techniques and electro chemical sensors.	K3
CO4	Classify different types of nanomaterials, different properties of nanomaterials and functioning of Pulsed laser deposition, UV-Visible spectroscopy, vibrating sample magnetometer, air and water purification.	K4
CO5	Evaluate the performance of surface plasma resonance, diluted magnetic semiconductor (DMS), physical vapour deposition, chemical vapour deposition and scanning probe microscopy and photo dynamic therapy for the synthesis of nanomaterials.	K5, K6
K1-Remember; K2 –Understand; K3 -Apply; K4- Analyze; K5 –Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	3	2	2	1	1	1	3	2	3	2	1	1	1
CO2	4	3	3	3	1	2	1	4	3	3	3	1	1	1
CO3	4	2	4	3	1	2	2	4	3	4	4	1	2	2
CO4	3	3	3	2	1	1	2	3	3	3	2	1	1	2
CO5	4	3	3	3	1	1	2	4	3	3	3	1	1	2

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

EC-III 2. COMMUNICATION ELECTRONICS		I YEAR –SECOND SEMESTER			
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	COMMUNICATION ELECTRONICS	ELECTIVE	4	5	75
Pre-Requisites: Propagation of information through different modes of communications					
Learning Objectives ➤ To comprehend the transmission of electromagnetic waves through 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

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

UNIT II: MICROWAVES

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

UNIT III: RADAR AND TELEVISION

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

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

UNIT V: SATELLITE COMMUNICATION

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

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS

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, UmeshPublications, 1998.
5. Mono Chrome and colour television, R. R. Ghulathi

REFERENCE BOOKS

1. Electronic communications – Dennis Roddy 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. Suers Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.

WEB SOURCES

1. <https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/>
2. <https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/>
3. <http://nptel.iitm.ac.in/>
4. <http://web.ewu.edu/>
6. <http://nptel.iitm.ac.in/>

COURSE OUTCOMES:

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

CO1	Recall and describe key concepts related to antennas, microwaves, radar systems, optical fibers, and satellite communication technologies.	K1
CO2	Explain the fundamental principles underlying microwave generation, radar operation, and optical fiber functionality, demonstrating a clear understanding of their applications.	K2
CO3	Apply theoretical principles to solve practical problems in areas such as radar range calculation, optical fiber performance, and microwave system design.	K3
CO4	Analyze and differentiate between various communication technologies, assessing their strengths, weaknesses, and suitability for specific applications.	K4
CO5	Evaluate the effectiveness of different communication systems, including satellite and radar technologies, by comparing their performance metrics and real-world applications. Design a comprehensive communication system that integrates principles of antennas, microwaves, radar, optical fibers, and satellite technology to address specific challenges in the field.	K5, K6
K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	2	1	1	1	1	1	2	1	1	1	1	1	1
CO2	4	3	2	2	1	1	1	3	2	2	1	1	1	1
CO3	4	3	4	2	1	1	1	3	2	2	1	1	1	1
CO4	4	2	4	3	1	1	1	3	2	1	1	1	1	1
CO5	4	2	4	3	1	1	1	3	2	2	1	1	1	1

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

EC- IV 1. NUMERICAL METHODS AND COMPUTER PROGRAMMING			I YEAR –SECOND SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	NUMERICAL METHODS AND COMPUTER PROGRAMMING	ELECTIVE	3	5	75
Pre-Requisites: Prior knowledge of computer and Numerical Methods					
Learning Objectives					
➤ To make students to understand different numerical approaches to solve a problem. ➤ To understand the basics of programming					

UNIT I: SOLUTIONS OF EQUATIONS

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

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

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

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 RungeKutta methods.

UNIT V: PROGRAMMING WITH C

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.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS

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 BOOKS

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.

WEB SOURCES

1. <https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman>
2. [https://www.scirp.org/\(S\(lz5mqp453edsnp55rrgict55\)\)/reference/referencepapers.aspx?referenceid=1682874](https://www.scirp.org/(S(lz5mqp453edsnp55rrgict55))/reference/referencepapers.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

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

CO1	Recall and describe fundamental concepts related to solutions of equations, including the types of equations, methods for finding roots, and matrix representations.	K1
CO2	Explain the principles and limitations of various methods for solving non-linear algebraic and transcendental equations, including Bisection and Newton-Raphson methods.	K2
CO3	Apply numerical methods to solve simultaneous linear equations using matrix inversion, Gaussian elimination, and Gauss-Jordan methods.	K3
CO4	Analyze interpolation techniques and curve fitting methods, assessing the effectiveness of different interpolation approaches such as Lagrange and Newton's methods.	K4
CO5	Evaluate numerical differentiation and integration methods, including Trapezoidal and Simpson's rules, comparing their accuracy and applicability in solving ordinary differential equations. Design and implement computational programs using C language to execute various numerical methods, including root-finding, interpolation, and numerical integration techniques.	K5, K6
K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
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CO2	4	3	3	2	1	1	1	3	2	1	1	1	1	1
CO3	4	2	4	2	1	1	1	3	2	4	1	1	1	1
CO4	4	3	4	2	1	1	1	3	2	2	1	1	1	1
CO5	4	3	4	3	2	1	1	3	2	2	1	1	1	1

Question Pattern:

Section A		Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

EC- IV 2. DIGITAL COMMUNICATION			I YEAR - SECOND SEMESTER		
Subject Code	Subject Name	Category	Credits	Inst. Hours	Marks
	DIGITAL COMMUNICATION	ELECTIVE	3	5	75
Pre-Requisites: Exposure to Fourier transform, pulse modulation, multiplexing, noises in communication signals Learning 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

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

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

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

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

UNIT V: SPREAD SPECTRUM SYSTEMS

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

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS

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 BOOKS

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.

WEB SOURCES

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

COURSE OUTCOMES:

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

CO1	Identify and describe the properties and applications of Fourier transforms for gate and delta functions.	K1
CO2	Understand and explain the concepts of information theory, including noise effects and channel capacity.	K2
CO3	Apply pulse modulation techniques, including PAM and PCM, to analyze their performance and applications.	K3
CO4	Analyze and evaluate different error control coding techniques, including Hamming and BCH codes, and their effectiveness in communication systems.	K4
CO5	Evaluate and create solutions using spread spectrum techniques, focusing on performance in noise-prone environments and security applications.	K5 and K6

K1-Remember; K2 –Understand;K3 -Apply;K4- Analyze; K5-Evaluate; K6-Create

MAPPING WITH PROGRAM OUTCOMES:

Map Course Outcomes (CO) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) on a 4-point scale of VERY STRONG (4), STRONG (3) MEDIUM (2) and LOW (1).

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CO2	4	3	3	2	1	1	1	3	2	2	2	1	1	1
CO3	4	3	4	2	1	1	1	3	2	2	2	1	1	1
CO4	4	2	4	3	1	1	1	3	2	2	2	1	1	1
CO5	4	2	4	3	2	1	1	3	2	2	2	1	1	1

Question Pattern:

Section A	Section B	Section C
2 Multiple choice question from each unit (5 unit) (10X1=10)	1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)
1 question from each unit (5 unit) (5X2=10)	1 (a & b) question from each unit. (5unit) (5X5=25)	1 question from each unit. (5 unit) (3X10=30)

PP2SE2

SKILL ENHANCEMENT - II		I YEAR – SECOND SEMESTER		
Subject Name	Category	Credits	Inst. Hours	Marks
DOCUMENT PREPARATION SYSTEM LATEX - II	SKILL ENHANCEMENT	2	2	75

List of Experiments

1. Creating a LaTeX Document.
2. Mathematical Environments in LaTeX.
3. Table Creation in LaTeX.
4. Graphics in the LaTeX Document.
5. MS-Excel Chart in the LaTeX Document.
6. Landscape Figure in LaTeX Environment.
7. Thesis preparation using LaTeX Documents.

ldh

Programme	M.Sc., Physics
Programme Code	PSPH
Duration	PG-2YEARS
Programme Outcomes (POs)	PO1: Disciplinary knowledge: Ability to apply disciplinary knowledge and demonstrate comprehensive knowledge by understanding concepts and provide effective solutions. PO2: Communication Skills: Enable the students to understand appropriate Tools/ techniques, transfer knowledge both orally and in writing. PO3: Critical thinking, Problem solving & Analytical reasoning: Capability to apply analytical skills to analyse and evaluate evidence/arguments, claims, beliefs on the basis of empirical evidence; formulate coherent arguments; critically evaluate practices, policies and theories; to solve different kinds of non-familiar problems and to apply one's learning to real life situations; draw valid conclusions and support them with evidence and examples by following systematic approach. PO4: Research-related skills, Scientific reasoning & Reflective thinking:: A sense of inquiry and capability for asking relevant questions, identifying, synthesizing and articulating problem; Ability to recognize & predict cause-and-effect relationships, formulate, test and establish hypotheses, analyse, interpret and draw conclusions from data; ability to plan, execute and report the results of an experiment or investigation; Critical sensibility with self awareness and reflexivity of both self and society PO5: Multicultural competence, Moral and ethical awareness/reasoning: Acquire knowledge of the values and beliefs of multiple cultures and a global perspective and interact respectfully with diverse groups. Ability to embrace moral/ethical values, formulate a position/argument about an ethical issue from multiple perspectives, use ethical practices and avoid unethical behaviour. Ability to appreciate environmental and sustainability issues. PO6: Cooperation/Team work, Leadership readiness/qualities: Ability to emphasis on accomplishing tasks either individually or as a group in Multidisciplinary settings; Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. PO7: Self-directed & Lifelong learning acquiring Information/digital literacy: Ability to acquire and enhance knowledge and skills using ICT through self-paced and self-directed learning and lifelong learning with the capability to use appropriate software for the betterment of the profession.

Programme Specific Outcomes (PSOs)	PSO1: At the end of the programme, the students will develop extra disciplinary/interdisciplinary skills to understand natural phenomena. PSO2: Inculcate the skills to exploit learning resources including libraries, e-resources etc., to stay abreast of recent developments. PSO3: Acquire Expertise to develop coding skills, numerical simulation and exposure to classical, quantum, mathematical, statistical, condensed matter, electromagnetic theory and nuclear physics. PSO4: Develop Research aptitude towards experimental and theoretical physics. PSO5: Imbibe ethical values, social responsibility, leadership skills/entrepreneurial skills/internship/employability skills. PSO6: Acquire the ability/expertise to execute their project either as a team or as an individual. PSO7: Explore avenues of research in Institute of Plasma Research (IPR), Physical Research Laboratory (PRL), Institute of Physics (IOP), Saha Institute of Nuclear Physics (SINP), Raman Research Institute (RRI), IISc, IISER, CECRI, etc.
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PPC307

PGT-IIIrd sem

SEMESTER - III

P23PC307

CC – VII QUANTUM MECHANICS		II YEAR – THIRD SEMESTER					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	QUANTUM MECHANICS	CC-VII				6	6
Pre-Requisites							
Knowledge of Newton's laws of motion, Schrodinger's equation, integration, differentiation.							
Learning 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 eigen vectors 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 formulate and solve the Schrodinger's equation to obtain eigen vectors 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 Schrodinger equation.							

UNIT I: BASIC FORMALISM

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**

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 .

UNIT III: GENERAL FORMALISM AND SCATTERING THEORY

Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Scattering amplitude-cross sections- Born approximation and its validity-scattering by a screened coulomb potential- Partial Wave analysis-scattering by a central potential

UNIT IV: APPROXIMATION METHODS

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

Eigen value 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.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

BOOKS FOR STUDY:

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. Aruldas, 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, 4th Edition, Macmillan, India, 1984.

REFERENCE BOOKS :

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.

WEB SOURCES

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>

COURSE OUTCOMES:

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

CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems
CO3	Can discuss the various representations, space time symmetries and formulations of time evolution
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.

MAPPING WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓	✓		✓			✓
CO2	✓	✓	✓	✓	✓	✓	✓			✓
CO3		✓	✓		✓		✓			✓
CO4	✓	✓	✓	✓	✓		✓	✓		✓
CO5	✓	✓	✓		✓	✓	✓	✓		✓

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	✓	✓	✓	✓	✓		✓			✓
CO2	✓	✓	✓	✓	✓	✓	✓			✓
CO3		✓	✓		✓		✓			✓
CO4	✓	✓	✓	✓	✓		✓	✓		✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓

SEMESTER - III

P23PC308

CC - VIII NUCLEAR AND PARTICLE PHYSICS		II YEAR - THIRD SEMESTER					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	NUCLEAR AND PARTICLE PHYSICS	CC-VIII				5	6
Pre-Requisites							
Knowledge of basic structure of atom and nucleus.							
Learning Objectives							
➤ Introduces students to the different models of the nucleus in a chronological order ➤ Imparts an in-depth knowledge on the nuclear force, experiments to study it and the types of nuclear reactions and their principles ➤ Provides students with details of nuclear decay with relevant ➤ Exposes students to the Standard Model of Elementary Particles and Higgs boson							

UNIT I: NUCLEAR MODELS

Liquid drop model – Weizacker mass formula – Isobaric mass parabola – Mirror Pair – Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – Schmidt model – electric Quadrupole moment – Bohr and Mottelson collective model – rotational and vibrational bands.

UNIT II: NUCLEAR FORCES

Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron – Exchange Forces – Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering – effective range theory – spin dependence of nuclear forces – charge independence and charge symmetry – isospin formalism.

UNIT III: NUCLEAR REACTIONS

Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions – Nuclear Chain reaction – four factor formula.

UNIT IV: NUCLEAR DECAY

Beta decay – Continuous Beta spectrum – Fermi theory of beta decay – Comparative Half-life – Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay – neutrino physics – Helicity – Parity violation – Gamma decay – multipole radiations – Angular Correlation – internal conversion – nuclear isomerism – angular momentum and parity selection rules.

UNIT V: ELEMENTARY PARTICLES

Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks – SU (2) and SU (3) groups – Gell Mann matrices – Gell Mann Okuba Mass formula – Quark Model. Standard model of particle physics – Higgs boson.

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars – Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

BOOKS FOR STUDY:

1. D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011)
2. K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008)
3. R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996)
4. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011)
5. M. L. Pandya and R.P.S. Yadav – Elements of Nuclear Physics – Kedarnath Ramnath, New Delhi, 1995.

REFERENCE BOOKS

1. L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973)
2. H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974).
3. Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002)
4. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001)
5. B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.

WEB SOURCES

1. <http://bubl.ac.uk/link/n/nuclearphysics.html>
2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces
3. <https://www.nuclear-power.net/nuclear-power/nuclear-reactions/>
4. http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html
5. <https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html>

COURSE OUTCOMES:

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

CO1	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.
CO2	Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula
CO4	Analyze data from nuclear scattering experiments to identify different properties of the nuclear force.
CO5	Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.

MAPPING WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓					✓	✓	✓	✓
CO2	✓	✓					✓	✓	✓	✓
CO3	✓	✓					✓	✓	✓	✓
CO4	✓	✓		✓		✓	✓	✓	✓	✓
CO5	✓	✓		✓		✓	✓	✓	✓	✓

PPC309

P23PC309

CC – IX ELECTROMAGNETIC THEORY		II YEAR –THIRD SEMESTER						
Subject Code	Subject Name	Category	L	T	P	Credits	Inst	Hours
	ELECTROMAGNETIC THEORY	CC-IX				5		6
Pre-Requisites								
Knowledge of different coordinate systems, Laplace's equation, conducting & non-conducting medium, basic definitions in magnetism, propagation of electromagnetic waves								
Learning Objectives								
➤ To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables ➤ To understand Biot – Savart's law and Ampere's circuital law ➤ To comprehend the physical ideas contained in Maxwell's equations, Coulomb & Lorentz gauges, conservation laws ➤ To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves								

UNIT I: ELECTROSTATICS

Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems.

polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric

UNIT II: MAGNETOSTATICS

Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere.

UNIT III: MAXWELL EQUATION

Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force.

UNIT IV: WAVE PROPAGATION

Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide.

Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole.

UNIT V: INTRODUCTION TO ANTENNAS

Antenna-Antenna power-radiation resistance-Radiation by an oscillating dipole-Skip distance-Radiation patterns of antennas-Directional Characteristics- Gain of an antenna-Linear array of Antennas (N-arrays)- Qualitative analysis of a dipole antenna.

UNIT VI:**PROFESSIONAL COMPONENTS**

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

BOOKS FOR STUDY:

1. D. J. Griffiths, 2002, Introduction to Electrodynamics, 3rd Edition, Prentice-Hall of India, New Delhi.
2. Gupta, Kumar and Singh, Electrodynamics, S.Chand & Co., New Delhi
3. Satya Prakash, Electromagnetic theory and Electrodynamics, Kedar Nath Ram Nath, Meerut, Delhi

REFERENCE BOOKS

1. W. Panofsky and M. Phillips, 1962, Classical Electricity and Magnetism, Addison Wesley, London.
2. J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York.
3. B. Chakraborty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata.
4. P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa Publishing House, New Delhi.
5. Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.
6. J. D. Jackson, 1975, Classical Electrodynamics, Wiley Eastern Ltd. New Delhi.

WEB SOURCES

1. <http://www.plasma.uu.se/CED/Book/index.html>
2. <http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html>
3. <http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html>
4. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
5. <https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics>

COURSE OUTCOMES:

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

CO1	Solve the differential equations using Laplace equation and to find solutions for boundary value problems
CO2	Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems
CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media
CO4	Apply the concept of propagation of EM waves through wave guides in optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves
CO5	Investigate the interaction of ionized gases with self-consistent electric and magnetic fields

MAPPING WITH PROGRAM OUTCOMES:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	✓	✓								
CO2	✓	✓								
CO3	✓	✓								
CO4	✓	✓		✓		✓			✓	✓
CO5	✓	✓		✓		✓		✓	✓	✓

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓					✓			
CO2	✓	✓					✓			
CO3	✓	✓					✓			
CO4	✓	✓		✓		✓	✓		✓	✓
CO5	✓	✓		✓		✓	✓	✓	✓	✓

PPC310P

P23PC 310P

CC – X NUMERICAL METHODS AND COMPUTER PROGRAMMING PRACTICAL-III		II YEAR – THIRD SEMESTER					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	NUMERICAL METHODS AND COMPUTER PROGRAMMING – PRACTICAL	CC – X				3	6
Pre-Requisites							
Basic knowledge in differential equation and linear algebra							
Basic knowledge of operating system and computer fundamentals.							
Learning Objectives							
➤ The aim and objective of the course on Computational Practical is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high level language such as C ➤ To equip the computational skill using various mathematical tools. ➤ To apply the software tools to explore the concepts of physical science. ➤ To approach the real time activities using physics and mathematical formulations.							

Course Details

(Minimum of Twelve Experiments from the list)

1. Lagrange interpolation.
2. Newton forward interpolation.
3. Newton backward interpolation.
4. Curve-fitting: Least squares method.
5. Numerical integration by the trapezoidal rule .
6. Numerical integration by Simpson's rule 1/3 rule.
7. Numerical integration by Simpson's rule 3/8 rule.
8. Numerical solution of ordinary first-order differential equation By the Euler method.

9. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method.
10. Finding Roots of a Polynomial –Bisection Method.
11. Finding Roots of a Polynomial-Newton Raphson Method.
12. Solution of Simultaneous linear equation by Gauss elimination method
13. Runge kutta Fourth order method for solving first order ordinary Differential equations.
14. Runge kutta Second order method for solving first order ordinary Differential equations.
15. Runge kutta third order method for solving first order ordinary Differential equations.

BOOKS FOR STUDY:

1. Numerical methods using Matlab – John Mathews & Kurtis Fink, PrenticeHall, New Jersey 2006
2. Numerical methods in Science and Engineering - M.K. Venkataraman, National Publishing Co. Madras, 1996
3. V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Ed. (Prentice-Hall, New Delhi.
4. M.K. Jain, S.R. Iyengar and R.K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Ed. New Age International, NewDelhi.
5. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi.

REFERENCE BOOKS

1. S.D. Conte and C. de Boor, 1981, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw-Hill).
2. B.F. Gerald and P.O. Wheatley, 1994, Applied Numerical Analysis, 5th Edition, Addison Wesley, Reading, MA.
3. B. Carnahan, H.A. Luther and J.O. Wikes, 1969, Applied Numerical Methods (Wiley, New York.
4. S.S. Kuo, 1996, Numerical Methods and Computers, Addison - Wesley, London.
5. V. Rajaraman, Programming in FORTRAN/ Programming in C, PHI, New Delhi.

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

CO1	Program with the C Program with the C or any other high level language
CO2	Use various numerical methods in describing/solving physics problems.
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.
CO4	To enhance the problem-solving aptitudes of students using various numerical methods.
CO5	To apply various mathematical entities, facilitate to visualise any complicate tasks.
CO6	Process, analyze and plot data from various physical phenomena and interpret their meaning
CO7	Identify modern programming methods and describe the extent and limitations of computational methods in physics
CO8	Work out numerical differentiation and integration whenever routine are not applicable.
CO9	Apply various interpolation methods and finite difference concepts.
CO10	Understand and apply numerical methods to find out solution of algebraic equation using different methods under different conditions, and numerical solution of system of algebraic equation.

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MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1				✓	✓				✓	✓
CO2			✓	✓	✓			✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓		✓	✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO6		✓		✓	✓				✓	✓
CO7			✓	✓	✓			✓	✓	✓
CO8	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1				✓	✓				✓	✓
CO2			✓	✓	✓			✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO6		✓		✓	✓				✓	✓
CO7		✓	✓	✓	✓			✓	✓	✓
CO8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

EC – V SPECTROSCOPY		II YEAR – THIRD SEMESTER					
PPDE 3:1		P23 PC F3:1					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	SPECTROSCOPY	EC – V				3	4
Pre-Requisites							
Thorough understanding of electromagnetic spectrum, mathematical abilities, knowledge of molecules, their structure, bond nature, physical and chemical behaviour							
Learning 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

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 - Instrumentation techniques – block diagram -Information Derived from Rotational Spectra-Problems (rotational constant, internuclear distance and Energy)

UNIT II: INFRA-RED SPECTROSCOPY

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 H₂O and CO₂ – Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy- Interpretation of vibrational spectra.

UNIT III: RAMAN SPECTROSCOPY

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 H₂O and CO₂ -Mutual exclusion principle- determination of N₂ structure -Instrumentation technique and block diagram FT Raman spectroscopy

UNIT IV: RESONANCE SPECTROSCOPY

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 - Spin -Spin Interaction – interpretation of simple organic molecule (CH₃CHO)- Instrumentation techniques of NMR spectroscopy

Electron Spin Resonance: Basic principle Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation

UNIT V: UV SPECTROSCOPY

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 - Instrumentation - double beam UV-Spectrophotometer -Simple application (Qualitative analysis)

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

BOOKS FOR STUDY:

1. C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill, New Delhi.
2. G Aruldas, 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 (7th Edition), New Age International Publishers.
6. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi.
7. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, Springer Link.

REFERENCE BOOKS

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.

WEB SOURCES

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
<https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRuF>

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 substance
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.

MAPPING WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓		✓	✓	✓	✓	✓	
CO2				✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	✓	✓	✓		✓	✓	✓	✓	✓	
CO2				✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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I DSEC -III REACTOR PHYSICS		II YEAR – THIRD SEMESTER					
PP3IDC		P23PC31DC					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	REACTOR PHYSICS	I DSEC - III				2	2
Pre-Requisites							
Basic Knowledge of Nuclear reactor							
Learning Objectives							
> To expose the students to the physics of neutrons and fuel inside a reactor. > Also the construction of a nuclear reactor and precautions To be taken in its operation will be dealt in this paper							

UNIT-I NUCLEAR ENERGY

Nuclear mass-Binding energy-Radioactivity-Nuclear reactions- Nuclear fission - Mechanism of fission - Fuels - Products of fission - Energy release from fission - Reactor power - Fuel burn up - Consumption.

UNIT-II NEUTRON DIFFUSION

Multiplication factor -Neutron balance and conditions for criticality- Conversion and breeding - Classification of reactors.

Diffusion of neutrons:

Flux and current density - Equation of continuity-Fick's law-Diffusion equation-Boundary conditions and solutions - Diffusion length - Reciprocity theorem.

UNIT-III NEUTRON MODERATION

Energy loss in elastic collision-moderation of neutrons in Hydrogen -lethargy-Space dependent slowing down-Fermi's age theory- Moderation with absorption.

Fermi theory of Bare thermal reactor

Criticality of an infinite reactor-One region finite thermal reactor -Critical equation-Optimum reactor shape.

UNIT-IV REACTOR KINETICS

Infinite reactor with and without delayed neutrons -Stable period- Prompt jump - Prompt criticality - Negative reactivity - Changes in reactivity - Temperature coefficient - Burn up and conversion.

UNIT-V CONTROL AND SHIELDING

Reactor control: Rod worth-One control rod- modified one group, two group theory - ring of rods.

Radiation shielding:

Reactor safeguards-Reactor properties over life-core life estimation.

BOOKS FOR STUDY:

1. John R. Lamarsh, Introduction to Nuclear Reactor Theory, American Nuclear Society (2002)
2. Samuel Glasstone, Milton C. Edlund, The Elements of Nuclear Reactor Theory, Van Nostrand, (1965)
3. H.S. Isbin, Introductory Nuclear Reactor Theory, Reinhold, New York (1963)

REFERENCES:

1. www.ans.org/PowerPlants
2. npcil.nic.in/main/AllProjectOperationDisplay.aspx
3. www.world-nuclear.org/info/inf53.html

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ECC-III GENERAL STUDIES FOR RESEARCH FELLOWSHIPS AND LECTURERSHIP		II YEAR – THIRD SEMESTER					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	GENERAL STUDIES FOR RESEARCH FELLOWSHIPS AND LECTURERSHIP	ECC -III				2	

UNIT-I TEACHING APTITUDE

Teaching- Nature, Objectives, Characteristics and basic requirements.
Learners.

Characteristics, Factors affecting teaching, Methods of teaching, Teaching aids Evaluation systems.

UNIT-II: RESEARCH APTITUDE

Research - Meaning, Characteristics and types, Steps of research, Methods of Research, Research Ethics. Paper, Article, Workshop, Seminar, Conference and Symposium. Thesis Writing-Its Characteristics and format.

UNIT-III: MATHEMATICAL REASONING

Series-Completion and its Types; Classification-Verbal, Letter, Number ; Coding and decoding.

UNIT-IV LOGIC-METHODOLOGY AND DATA ANALYSIS

Statement; Premises; Term-Types of Syllogism, Prepositions, Logical inferences; Fallacies or Possible errors in Logical conclusions - Types of Tables and Graphs, Interpretation of data - Sources, acquisition and interpretation, Qualitative and quantitative data, Graphical representation and mapping of data.

UNIT-V INFORMATION AND COMMUNICATION TECHNOLOGY

Overview of Computer-Hardware, Software, Internet, and e-mailing. EDUSAT - Space Science and Communication - Milestones, Space Transportation - Earth Observations.

BOOKFORSTUDY:

1. UGC -NET/JRF/SET Teaching & Research Aptitude by Dr.M.S.Ansari & RPH Editorial Board, 2014.Ramesh Publishing House, New Delhi.

BOOKS FOR REFERENCE:

1. Dr.K.Kautilya, 2013 UGC-NET/JRF/SET Teaching Research & Aptitude, UpkarPrakashan, Agra - 2.
2. Sajit Kumar & M.Gagan (2011)UGC-NET/HRF/SET Teaching Research & Aptitude. Damika Publishing Company, New Delhi.
3. Dr.M.S.Ansari (2011) UGC-NET/JRF/SET Teaching Research & Aptitude. Ramesh Publishing House, New Delhi.
4. Dr.Lal, Jain & Dr.K.C.Vashiatha (2011) UGC- NET/JRF /SET Teaching Research & Aptitude, UpkarPrakashan, Agra - 2.
5. Editorial board: Pratiyogita Darpan (2010) UGC-NET/JRF/SETTeaching Research & Aptitude, Upkar.Prakashan, Agra - 2.

P23PC411 PGT-IV sem

CC-XI MICROPROCESSOR 8085 AND MICROCONTROLLER 8051		II YEAR – FOURTH SEMESTER					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	CC-XI				6	6
Pre-Requisites							
Knowledge of number systems and binary operations							
Learning Objectives							
➤ To provide an understanding of the architecture and functioning of microprocessor 8085A and to the methods of interfacing I/O devices and memory to microprocessor ➤ To introduce 8085A programming and applications and the architecture and instruction sets of microcontroller 8051							

UNIT I: 8085 PROGRAMMING, PERIPHERAL DEVICE AND THEIR INTERFACING

Instruction set - Addressing modes - Programming techniques – 8 bit addition, subtraction, multiplication and division - 16 bit addition and subtraction- Interrupts of 8085 – Programmable peripheral interface (PPI) - Programmable DMA controller Programmable interrupt controller- Programmable communication interface – Programmable counter /interval timer.

UNIT II: 8085 INTERFACING APPLICATIONS

Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface -Measurement of electrical quantities –Voltage and current - Measurement of physical quantities (Temperature and strain).

UNIT III: 8051 MICROCONTROLLER HARDWARE

Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input / Output pins, Ports and Circuits – External data memory- External program memory.

UNIT IV: 8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING

Addressing modes – Data moving (Data transfer) instructions: Instructions to

Access external data memory, external ROM / program memory, PUSH and PO instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flag Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division

UNIT V: INTERRUPT PROGRAMMING AND INTERFACING TO EXTERNAL WORLD

8051 Interrupts – Interrupt vector table – Enabling and Disabling and interrupt Timer interrupts and programming – Programming external hardware interrupts Serial communication interrupts and programming -Interrupt priority in the 8051 Nested interrupts, Software triggering of interrupt. LED Interface Seven segment display interface-Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper Motor interface

UNIT VI: PROFESSIONAL COMPONENTS

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

BOOKS FOR STUDY:

1. A. NagorKani, Microprocessors & Microcontrollers, RBA Publications (2009).
2. A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune(2009).
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013).
4. B.Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016).
5. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.

REFERENCE BOOKS

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008)
3. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi
4. J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
5. W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

WEB SOURCES

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2. <http://www.electronicengineering.nbcafe.in/peripheral-mapped-io-interfacing/>
3. <https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/>
4. <http://www.circuitstoday.com/8051-microcontroller>
5. <https://www.elprocus.com/8051-assembly-language-programming/>

COURSE OUTCOMES:

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

CO1	Gain knowledge of architecture and working of 8085 microprocessor.
CO2	Get knowledge of architecture and working of 8051 Microcontroller.
CO3	Be able to write simple assembly language programs for 8085A microprocessor.
CO4	Able to write simple assembly language programs for 8051 Microcontroller.
CO5	Understand the different applications of microprocessor and microcontroller.

MAPPING WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓	✓	✓	✓					
CO2										
CO3	✓	✓	✓	✓	✓					
CO4	✓	✓	✓	✓	✓					
CO5	✓	✓	✓	✓	✓					

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1		✓	✓	✓	✓					
CO2										
CO3	✓	✓	✓	✓	✓					
CO4	✓	✓	✓	✓	✓					
CO5	✓	✓	✓	✓	✓					

for

CC – XII GENERAL & ADVANCED DIGITAL ELECTRONICS – PRACTICAL		II YEAR – FOURTH SEMESTER					
Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours
	GENERAL & ADVANCED DIGITAL ELECTRONICS – PRACTICAL	CC – XII				3	6
Pre-Requisites							
Knowledge and handling of general and experiments of Physics, as well as fundamentals of digital principles,							
Learning Objectives							
➤ To understand the theory and working of Microprocessor, Microcontroller and their applications To use microprocessor and Microcontroller in different applications							

Course Details

(Minimum of Twelve Experiments from the list)

Section A: Programming with Microprocessor 8085

1. 8 bit addition, subtraction, multiplication and division
2. Sum of N elements in an array
3. Largest and smallest in an array
4. Ascending and descending order
5. 16 bit addition and subtraction
6. Factorial of a given number
7. Interfacing ADC
8. Interfacing DAC

10. Interfacing of Stepper motor
11. Average of N numbers
12. Fibonacci series of N numbers

Section B: Programming with Microcontroller 8085

13. 8 bit addition, subtraction, multiplication and division
14. Ascending and descending order
15. Logical operations.
16. Code conversions –Hexa decimal to decimal, Decimal to Hexa decimal.
17. Sum of N elements in an array
18. Factorial of a given number
19. Largest and smallest in an array.

BOOKS FOR STUDY:

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Electronic lab manual Vol I, K A Navas, Rajath Publishing
3. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
4. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085”, 3rd Edition S.Visvanathan Pvt, Ltd.

REFERENCE BOOKS

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd
3. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
4. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi
5. Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications