M.Sc PHYSICS

SYLLABUS

PROGRAM CODE: PSPH

2023-2024 ONWARDS

PG & RESEARCH DEPARTMENT OF PHYSICS

GOVERNMENT COLLEGE FOR WOMEN
(AUTONOMOUS)
KUMBAKONAM-612 001

Programme	M. Sc., Physics
Programme Code	PSPH
Duration	**PG – 2YEARS**
Programme Outcomes (POs)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to ehance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conductingone's life.

Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit. **PSO 6** Students will utilize e-resources, digital tools and techniques for widening their knowledge base. **PSO 7** Students gain exposure to programming language and skills. **PSO 8** Student will appreciate the interplay of mathematics, physics and technology. **PSO 9** Students will develop adequate knowledge and skills for employment and entrepreneurship. **PSO 10** An awareness of civic and ecological duties as good citizens and importance of human values will be inculcated in students

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS) KUMBAKONAM
(Common Course Structure – PG – 2023 - 2024)

Department: Physics **Programme Code: PSPH**

SEMESTER – I

Part	Course Type	Subject Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
							CIA	ESE	Total
I	CC – I	P23PC101	Statistical Mechanics	6	5	3	25	75	100
I	CC – II	P23PC102	Classical Mechanics and Relativity	6	5	3	25	75	100
I	CC – III	P23PC103P	General and Electronics Practical – I	6	3	3	40	60	100
I	EC – I	P23PDE1	1. Crystal Growth and Thin Films	5	4	3	25	75	100
		P23PDE2	2. Analysis of Crystal Structures						
I	EC – II	P23PDE3	1. Linear and Digital IC's and applications	5	3	3	25	75	100
		P23PDE4	2. Advanced Optics						
II	SEC – I	P23P1SE1	Document Preparation System – Latex (Theory)	2	2	3	25	75	100
			Total	**30**	**22**				**600**

SEMESTER – II

Part	Course Type	Subject Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
							CIA	ESE	Total
I	CC – IV	P23PC204	Mathematical Physics	6	5	3	25	75	100
I	CC – V	P23PC205	Condensed Matter Physics	6	5	3	25	75	100
I	CC –VI	P23PC206P	General and Electronics Practical - II	6	3	3	40	60	100
I	EC – III	P23PDE5	1. Physics of Nano Science and Technology	5	4	3	25	75	100
		P23PDE6	2. Communication Electronics						
I	EC – IV	P23PDE7	1. Numerical Methods and Computer Programming	5	3	3	25	75	100
		P23PDE8	2. Digital Communication						
II	SEC – II	P23P1SE2	Latex – II	2	2	3	25	75	100
II	ECC – I		Moocs/Swayam Courses	-	**2/3**				
			Internship/Industrial training*						
			Total	**30**	**22**				**600**

***Internship/industrial training during summer vacation. The credits shall be awarded in Semester III statement of marks.**

SEMESTER - I

CC-I - STATISTICAL MECHANICS		I YEAR - FIRST SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**
P23PC101	**STATISTICAL MECHANICS**	CC-I				5	6

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 dimenstional 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 Verlang, 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	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition
CO2	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behaviour of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function
CO4	To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.
CO5	To discuss and examine the thermodynamical behaviour of gases under fluctuation and also using Ising model

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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	✓	✓	✓				✓			✓

CC II - CLASSICAL MECHANICS AND RELATIVITY			I YEAR - FIRST SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PC102	**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 OFCLASSICAL 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 Publshing. Co. New Delhi.
3. R. Resnick, 1968, *Introduction to Special Theory of Relativity,* Wiley Eastern, New Delhi.
4. R. G. Takwala and P.S. Puranik, Introduction to Classical Mechanics –Tata – McGraw Hill, New Delhi, 1980.
5. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001

REFERENCE 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	Understand the fundamentals of classical mechanics
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems
CO3	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.

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	✓			✓		✓	✓			

CC III – GENERAL & ELECTRONICS PRACTICAL - I			I YEAR - FIRST SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PC103P	**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's ratio by Elliptical fringes – Cornu's Method.
2. Determination of Stefan's constant of radiation from a hot body.
3. Measurement of Susceptibility of liquid – Quincke's Method.
4. Measurement of Magnetic Susceptibility – Guoy's Method.
5. Arc spectrum – Copper.
6. Determination of Specific charge of an - Magnetron method.
7. Biprism – Determination of Refractive index.
8. Self-inductance of a coil – Anderson's method.
9. Planck's constant -Photoelectric effect.
10. Spectrometer – Polarizability of liquids.
11. Spectrometer charge of an electron.
12. Operational Amplifier Filters.

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. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.

COURSE OUTCOMES:

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

CO1	Understand the strength of material using Young's modulus.
CO2	Acquire knowledge of thermal behaviour of the matetials.
CO3	Understand theoretical principles of magnetism through the experiments.
CO4	Acquire knowledge about arc spectrum and applications of laser
CO5	Improve the analytical and observation ability in Physics Experiments
CO6	Conduct experiments on applications of FET and UJT
CO7	Analyze various parameters related to operational amplifiers.
CO8	Understand the concepts involved in arithmatic and logical circuits using IC's
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits
CO10	Analyze the applications of counters and registers

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1				✓						✓
CO2			✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓				2
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 I - 1. CRYSTAL GROWTH AND THIN FILMS						I YEAR – FIRST SEMESTER		
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE1	**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 - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition - Stoichiometry.

UNIT IV:THIN FILM DEPOSITION METHODS

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

COURSE OUTCOMES:

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

CO1	Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth
CO2	Understand the Crystallization Principles and Growth techniques
CO3	Study various methods of Crystal growth techniques
CO4	Understand the Thin film deposition methods
CO5	Apply the techniques of Thin Film Formation and thickness Measurement

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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		✓	✓	✓		✓	✓	✓	✓	

EC I – 2. ANALYSIS OF CRYSTAL STRUCTURES			I YEAR – FIRST SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE2	**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 silts - sample preparation and data collection - identification of unknowns - powder diffraction files (ICDD) - Rietveld refinement fundamentals - profile analysis - peak shapes - whole pattern fitting - structure refinement procedures – auto-indexing – structure determination from powder data - new developments. Energy dispersive X-ray analysis – texture studies - crystallite size determination - residual stress analysis - high and low temperature and high pressure crystallography (basics only).

UNIT V:PROTEIN CRYSTALLOGRAPHY

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

REFERENCE 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	Understand crystal symmetry and reciprocal lattice concept for X-ray diffraction
CO2	Gain a working knowledge of X-ray generation, X-ray photography with Laue, oscillation and moving film methods, and space group determination
CO3	Get an exposure to crystal structure determination using program packages
CO4	Understand the instrumentation used for powder diffraction, data collection, data interpretation, and structure refinement using Rietveld method
CO5	Get an insight into the structural aspects of proteins and nucleic acids, crystallization of proteins and methods to solve protein structures

MAPPING WITH PROGRAM OUTCOMES AND SPECIFIC 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	✓									

EC – II 1. LINEAR AND DIGITAL ICs & APPLICATIONS			I YEAR - FIRST SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE3	**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.,NewDelhi,India
2. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, NewDelhi.
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	Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems
CO2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.
CO3	Gain knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it.
CO4	Learn about various techniques to develop A/D and D/A converters.
CO5	Acquire the knowledge about the CMOS logic, combinational and sequential circuits

MAPPING WITH PROGRAM OUTCOMES AND SPECIFIC 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	✓	✓	✓					✓		

EC – II 2. ADVANCED OPTICS		I YEAR – FIRST SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE4	**ADVANCED OPTICS**	ELECTIVE				3	5	75

Pre-Requisites: Knowledge of ray 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 1: 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 – CO_2 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. AjoyGhatak, 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

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	Discuss the transverse character of light waves and different polarization phenomenon
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages
CO4	Identify the properties of nonlinear interactions of light and matter
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓
C02	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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

	SKILL ENHANCEMENT - I	I YEAR – FIRST SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
	DOCUMENT PREPARTION SYSTEM **LATEX (THEORY)**	SKILL ENHANCEMENT				3	5	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.

SEMESTER - II

CC IV - MATHEMATICAL PHYSICS		I YEAR – SECOND SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PC204	**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

UNITI: 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.

UNITV: 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, 6 th Edition, International Edition

WEB SOURCES

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

COURSEOUTCOMES:

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

CO1	Understand use of bra-ket vector notation and explain the meaning of complete orthonormal set of basis vectors, and transformations and be able to apply them
CO2	Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.
CO3	Analyze characteristics of matrices and its different types, and the process of diagonalization.
CO4	Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology
CO5	To find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems

MAPPINGWITHPROGRAMOUTCOMES AND SPECIFIC 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	✓		✓	✓		✓	✓			✓

CC V - CONDENSED MATTER PHYSICS		I YEAR - SECOND SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PC205	**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 - Umkalapp 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 antiferomagnetism.

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 paring 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. Rosenburg, 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	Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure
CO2	Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.
CO3	Student will be able to comprehend the heat conduction in solids
CO4	Student will be able to generalize the electronic nature of solids from band theories.
CO5	Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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										✓

CC – VI - GENERAL AND ELECTRONICS PRACTICAL II			I YEAR - SECOND SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PC206P	**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)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Measurement of Susceptibility of liquid - Quincke's method
4. B-H curve using CRO
5. Thickness of LG Plate
6. Arc spectrum: Copper
7. Determination of e/m - Millikan's method
8. Miscibility measurements using ultrasonic diffraction method
9. Determination of Thickness of thin film. - Michelson Interferometer
10. Iodine absorption spectra
11. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
12. Measurement of Dielectricity - Microwave test bench
13. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility
14. Interpretation of vibrational spectra of a given material
15. Determination of I-V Characteristics and efficiency of solar cell
16. GM counter – Absorption coefficient – Maximum range of β rays
17. IC 7490 as scalar and seven segment display using IC7447
18. Solving simultaneous equations – IC 741 / IC LM324
19. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
20. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
21. Construction of second order butterworth multiple feedback narrow band pass filter
22. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
23. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
24. Construction of pulse generator using the IC 555 – Application as frequency divider
25. BCD to Excess- 3 and Excess 3 to BCD code conversion
26. Study of binary up / down counters - IC 7476 / IC7473
27. 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.Chattopadhayay, 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	Understand the strength of material using Young's modulus
CO2	Acquire knowledge of thermal behavior of the materials
CO3	Understand theoretical principles of magnetism through the experiments.
CO4	Acquire knowledge about arc spectrum and applications of laser
CO5	Improve the analytical and observation ability in Physics Experiments
CO6	Conduct experiments on applications of FET and UJT
CO7	Analyze various parameters related to operational amplifiers
CO8	Understand the concepts involved in arithmetic and logical circuits using IC's
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits
CO10	Analyze the applications of counters and registers

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 – III 1. PHYSICS OF NANOSCIENCE AND TECHNOLOGY			I YEAR – SECOND SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE5	**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 – HuozhongGao – Imperial College Press (2004).
2. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
3. Nano particles and Nano structured films; Preparation, Characterization and Applications, J.H.Fendler John Wiley and Sons. (2007)
4. Textbook of Nanoscience and Nanotechnology, B.S.Murty, et al., Universities Press. (2012)
5. The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.

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	Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.
CO5	Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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	✓	✓					✓	✓	✓	✓

EC-III 2. COMMUNICATION ELECTRONICS		I YEAR –SECOND SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE6	**COMMUNICATION ELECTRONICS**	ELECTIVE				4	5	75

Pre-Requisites: Knowledge of Regions of electromagnetic spectrum and its characteristics

Learning Objectives

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

UNIT I: ANTENNAS AND WAVE PROPAGATION

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

UNIT II: MICROWAVES

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

UNIT III: RADAR AND TELEVISION

Elements of a radar system-radar equation-radar performance Factorsradar transmitting systems-radar antennas-duplexers-radarreceivers and indicators-pulsed systems-other radar systems-colour TVtransmission and reception-colour mixing principle-colour picture tubes-Delta gun picture tube-PIL colour picture tube-cable TV, CCTV andtheatre TV

UNIT IV: OPTICAL FIBER

Propagation of light in an optical fibre-acceptance angle-numericalaperture-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 systemlink models-satellite system parameters-satellite system link equationlinkbudget-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 Roody and Coolen, Prentice Hall of India, IV edition, 1995.
2. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998
3. Dennis Roddy and Coolen,1995,Electronics communications,Prentice Hall of India IV Edition.
4. Wayne Tomasi,1998 "Advanced Electronics communication System" 4thedition, Prentice Hall of India, 1998
5. S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.

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	Compare and differentiate the methods of generation of microwaves analyze the propagation of microwaves through wave guides- discuss and compare the different methods of generation of microwaves
CO2	Classify and compare the working of different radar systems- apply the principle of radar in detecting locating, tracking, and recognizing objects of various kinds at considerable distances – discuss the importance of radar in military- elaborate and compare the working of different picture tube
CO3	Classify, discuss and compare the different types of optical fiber and also to justify the need of it-discover the use of optical fiber as wave guide
CO4	Explain the importance of satellite communication in our daily life-distinguish between orbital and geostationary satellites elaborate the linking of satellites with ground station on the earth

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

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

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

EC- IV 1. NUMERICAL METHODS AND COMPUTER PROGRAMMING			I YEAR –SECOND SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE7	**NUMERICAL METHODS AND COMPUTER PROGRAMMING**	ELECTIVE				3	5	75
Pre-Requisites: Prior knowledge on computer and basic mathematics								

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 RungaKutta 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 EngineeringComputation, 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 RecipesinFORTRAN, 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(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874
3. https://nptel.ac.in/course/122106033/
4. https://nptel.ac.in/course/103106074/
5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

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

CO1	Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.
CO2	Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.
CO3	Understand, how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation
CO4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration.
CO5	Understand the basics of C-programming and conditional statements.

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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	✓		✓				✓			✓

EC- IV 2. DIGITAL COMMUNICATION			I YEAR - SECOND SEMESTER					
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
P23PDE8	**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.aticourses.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	Apply the techniques of Fourier transform, convolution and sampling theorems in signal processing
CO2	Apply different information theories in the process of study of coding of information, storage and communication
CO3	Explain and compare the various methods of pulse modulation techniques
CO4	Apply the error control coding techniques in detecting and correcting errors- able to discuss, analyze and compare the different error control coding
CO5	Apply, discuss and compare the spread spectrum techniques for secure communications

MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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	✓	✓	✓				✓			✓

SKILL ENHANCEMENT - II		I YEAR – SECOND SEMESTER					
Subject Name	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
DOCUMENT PREPARTION SYSTEM **LATEX - II**	SKILL ENHANCEMENT				3	5	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 prepration using LaTeX Documents.