A.D.M. COLLEGE FOR WOMEN (AUTONOMOUS)

(Accredited With 'A' Grade By NAAC 3rd Cycle)

(Affiliated to Bharathidasan University, Tiruchirappalli)

NAGAPATTINAM – 611 001

PG AND RESEARCH DEPARTMENT OF PHYSICS

SYLLABUS

M.Sc. PHYSICS

(2021-2024 Batch)

PG DEPARTMENT OF PHYSICS

M.Sc., PHYSICS COURSE STRUCTURE UNDER CBCS

(2021-2023 Batch)

OBE ELEMENTS

Programme Educational Objectives (PEO):

PEO 1:	To impart knowledge in advanced concepts and applications indifferent fields of Physics.
PEO 2:	To prepare students enter in to professional courses.
PEO 3:	To educate students to occupy important positions in business houses, industries and organizations.
PEO 4:	To equip students with skills to excel in their future careers.
PEO 5:	To enable students to take up challenging jobs.

Programme Outcomes (PO):

On completion of the course the learner will be able

PO 1:	Students must be able to take important managerial decisions. Demonstrate relevant generic skills and global competencies at National and Global level.
PO 2:	Students would have acquired thorough knowledge in the field of problem-solving skills that are required to solve different types of Physics-related problems
PO 3:	With well – defined solutions, and tackle open-ended problems that belong to the disciplinary area.
PO 4:	Investigative skills, including skills of independent investigation of Physics-related issues and problems in Research areas.
PO 5:	Communication skills involving the ability to listen carefully, to read texts and research.

Programme Specific Outcomes (PSO):

On completion of the course the learner will be able

PSO 1:	Research–Acquire recent knowledge towards research
PSO 2:	Entrepreneurship and Employability
PSO 3:	Exploring problem solving
PSO 4:	Adopt new technology
PSO 5:	Projects and model design

M.Sc. PHYSICS 2021- 2023 Batch

STRUCTURE OF THE PROGRAMME

Course	No. of Papers	Hours	Credit
Core Course	14	89	61
Elective Course	5	25	25
Project	1	6	4
Total	**20**	**120**	**90**

M.Sc. PHYSICS 2021- 2023 Batch

SCHEME OF THE PROGRAMME

Sem.	Course Code	Course	Ins. Hrs	Credit	Exam Hours	Marks		Total Marks
						CIA	SE	
I	PGPA	Core Course – I(CC) Mathematical Physics	6	4	3	25	75	100
	PGPB	Core Course– II(CC) Classical Dynamics and Relativity	6	4	3	25	75	100
	PGPC	Core Course–III(CC) Electronics	5	4	3	25	75	100
	PGPD	Core Course– IV (CC) Methods of Spectroscopy	5	4	3	25	75	100
	PGPE	Core Practical – I (CP) Physics Practical – I (General and Electronics)	8	4	3	40	60	100
		TOTAL	**30**	**20**	-	-	-	**500**
II	PGPF	Core Course– V(CC) Electromagnetic Theory	6	5	3	25	75	100
	PGPG	Core Course– VI(CC) Quantum Mechanics	6	5	3	25	75	100
	PGPHY	Core Practical – II(CP) Physics Practical – III (General and Electronics)	8	4	3	40	60	100
	PGPE1	Elective Course – I(EC) -Microprocessor and Microcontroller/ Data Communication and Computer Networks	5	5	3	25	75	100
	PGPE2	Elective Course – II (EC)Numerical Methods and C++ Programming/ Computer Organizations	5	5	3	25	75	100
		TOTAL	**30**	**24**	-	-	-	**500**

III	PGPI	Core Course– VII(CC) Statistical Mechanics	6	5	3	25	75	100
	PGPJ	Core Course–VIII (CC) Solid State Physics	6	5	3	25	75	100
	PGPKY	Core Practical – III (CP) Physics Practical – III (Microprocessor and Programming)	8	4	3	40	60	100
	PGPE3	Elective Course –III (EC) Nano Materials and Applications/ Crystal Physics	5	5	3	25	75	100
	PGPE4	Elective Course – IV (EC)Communication Physics/ Laser and Fiber Optics	5	5	3	25	75	100
		TOTAL	**30**	**24**	-	-	-	**500**
IV	PGPL	Core Course –IX(CC) Nuclear and Particle Physics	6	5	3	25	75	100
	PGPM	Core Course– X(CC) -Advanced Physics	6	4	3	25	75	100
	PGPNY	Core Practical – IV (CP)Physics Practical – IV (Electronics)	7	4	3	40	60	100
	PGPE5	Elective Course – V (EC) - Advanced Experimental Techniques/ Basic Computational Nano Electronics	5	5	3	25	75	100
	PGPP	Project	6	4	-	-	-	100
		Extra Credit Course - SWAYAM / MOOC	-	2	-	-	-	-
		TOTAL	**30**	**24**	-	-	-	**500**
		GRANDTOTAL	**120**	**92**				**2000**

MSc – EXTRA CREDIT COURSE

Year	SEM	Title of the Paper	Credit
I	II	Swayam / MOOC	2
III	IV	Internship Training	2

Semester-I/ **Core Course I**	**MATHEMATICAL PHYSICS**	Course Code: PGPA
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To learn various mathematical concepts and techniques in vector space, groups and functions of special types to solve physical problems. • Revise the knowledge of calculus, vectors, vector calculus, probability and probability distributions. • Learn the basic properties of gamma, beta function and differential equation • Describe the basic ideas about cauchy's integral theorem and integral formulation • Quantitative understanding of group theory, classes, cosets sub groups.

UNIT	CONTENT	HOURS
I	**VECTOR ANALYSIS** Concept of vector and scalar fields – Gradient, divergence, curl and Laplacian – Vector identities – Line integral, surface integral and volume integral – Gauss theorem, Green's theorem, Stoke's theorem and their applications – Definitions in linear independence of vectors.	**18**
II	**MATRIX THEORY AND TENSORS** **Matrix Theory:** Characteristic equation of a matrix – Eigen values and eigenvectors –Cayley–Hamilton theorem -Reduction of a matrix to diagonal form – Jacobi method. **Tensors**: Contra variant, covariant and mixed tensors – Rank of a tensor – Symmetric and anti symmetric tensors – Contraction of tensor –	**18**

	Quotient law	
III	**GROUP THEORY** Basic definitions – Multiplication table – Subgroups, cosets and classes – Point and space groups – Homomorphism and isomorphism – Reducible and irreducible representations – Schur's lemma -- The great orthogonality theorem (qualitative treatment without proof) – Formation of character table of C2v and C3v.	**18**
IV	**COMPLEX ANALYSIS** Cauchy-Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residues and singularities – Cauchy's residue theorem-Computation of residues-Evaluation of definite integrals using residues.	**18**
V	**SPECIAL FUNCTIONS** Basic properties of gamma and beta functions -- Legendre, Bessel, Laugerre and Hermite differential equation: Series solution, generating function, recurrence relations and orthogonality relations.	**18**
VI	• Green's function, partial differential equations, elements of computational techniques • Simpson's rule, solution of the first-order differential equation using the Runge-Kutta method. • Finite difference methods, tensors, introductory group theories. • Taylor's and Laurent's series – Poles. • Tensors: Introductory group theory SU(2), O(3).	**Group Discussion**

Text Books:

1. B.D. Gupta, Mathematical Physics (Vikas Pub., Noida, 2015) 4th edition.

Reference Books:

1. A.W. Joshi, Matrices and Tensors in Physics (New Age, New Delhi, 2006).
2. H.K. Dass and Rama Verma, Mathematical Physics (S. Chand, New Delhi ,2008).
3. Sathyaprakash, Mathematical Physics.e Resources:

Course Outcome:

CO 1: To learn various mathematical concepts and techniques in vector space, groups and functions of special types to solve physical problems. CO 2: Revise the knowledge of calculus, vectors, vector calculus, probability and probability distributions. CO 3: Learn the basic properties of gamma, beta function and differential equation CO 4: Describe the basic ideas about cauchy's integral theorem and integral formulation CO 5: Quantitative understanding of group theory, classes, cosets sub groups.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating

M – Moderately Correlating

W – Weakly Correlating

N – No Correlation

Semester-I / Core Course-II	**CLASSICAL DYNAMICS AND RELATIVITY**	Course Code- PGPB
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To develop an understanding of lagrangian and Hamiltonian formulation which allow for simplified treatments of many problems. • To know what central conservative forces mathematically, understand the conservative theorems of angular momentum. • Using vector and matrix methods to develop the basic principles of rigid bodies – Euler's equation. • To establish the Kepler's law are just consequence Newton's law of gravitation and that of motion. • To understand the basic ideas of vectors, energy, Newtonian relativity. \

UNIT	CONTENT	HOURS
I	**FUNDAMENTAL PRINCIPLES AND LAGRANGIAN FORMULATION** Mechanics of a particle and a system of particles – Conservation laws – Constraints –Generalized coordinates – D'Alembert's principle and Lagrange's equation –Hamilton's principle – Lagrange's equations of motion – Conservation theorems and symmetry properties – Applications to linear harmonic oscillator, pendulum, compound pendulum, charged particles in an electromagnetic field and Atwood's machine.	18
II	**MOTION UNDER CENTRAL FORCE** Conservation of energy and angular momentum – Inverse square law –	18

	Kepler's problem – Vitriol theorem – Scattering in a central force field – Artificial satellites – Geo stationary satellites – Eccentricity of orbit of satellites – Escape velocity.	
III	**RIGID BODY DYNAMICS AND OSCILLATORY MOTION** Euler's angles – Moments and products of inertia – Euler's equations – Symmetrical top – Theory of small oscillations – Normal modes and frequencies – Linear triatomic molecule – Wave equation and motion – Phase velocity – Group velocity -- Dispersion.	**18**
IV	**HAMILTON'S FORMULATION** Hamilton's canonical equations of motion – Hamilton's equations from variational principle – Principle of least action – Canonical transformations – Poission bracket – Hamilton--Jacobi method – Action and angle variables – Kepler's problem in action angle variables – Applications of Hamilton's equations of motion to linear harmonic oscillator, pendulum, compound pendulum and charged particles in an electromagnetic field.	**18**
V	**RELATIVISTIC MECHANICS** Reviews of basic ideas of special relativity – Energy momentum four - vector –Minkowski's four-dimensional space – Newtonian relativity- Galileon transformation equations- Lorentz transformation as rotation in Minkowski's space – Composition of Lorentz transformation about two orthogonal directions – Thomas precession – Elements of general theory of relativity.	**18**
VI	• Dynamical systems, phase space dynamics, stability analysis • Poisson brackets, and canonical transformations, symmetry, invariance and Noether's theorem • Radiation from moving charge and dipoles and retarded potentials.	**Group Discussion**

Text Books:

1. H. Goldstein, C.P. Poole and J.L. Safko, Classical Mechanics (Pearson Education and Dorling Kindersley, New Delhi, 2007).
2. S.L. Gupta, V. Kumar and H.V. Sharma, Classical Mechanics (Pragati Prakashan)

Reference Books:

1. V.B. Bhatia, Classical Mechanics (Narosa, New Delhi, 1997).
2. T.L. Chow, Classical Mechanics (John-Wiley, New York, 199

Web-Resources:

1. https://Physics. Stackexchange.com
2. https://www.world scientific.com
3. https://www.semantics scholar.org

Course Outcome:

CO 1: Have a deep understanding of Newton law.

CO 2: Apply to variation principle to real physical problems.

CO 3: Able to frame model in mechanical systems, both in inertial and rotating frames and Hamilton equation.

CO 4: Identify the forces and torques occurring in a given problem.

CO 5: To setup the equation of motion and solve the problems.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-I / **Core Course III**	**ELECTRONICS**	Course Code PGPC
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• This course is familiarize the students about the transistor, operational amplifier and Digital electronics Circuit. • Acquire the fundamental knowledge and application of the semiconductor Device. • Knowledge of the basic principles of electronic circuits operation. • Fundamental of analog and digital integrated circuit. • Design methodologies using practical integrated circuit and to understand the operation of various basic circuit of MOSFET and analyze and design MOSFET bias circuit.

UNIT	CONTENT	HOURS
I	**SEMICONDUCTOR DEVICES** Varactor, Schottky, tunnel, Gunn, optoelectronic, LASER, LED and photo diodes –Depletion and enhancement type MOSFFT– Characteristics of UJT,UJT Relaxation Oscillator and SCR –SCR as a Switch– Power control DIAC and TRIAC. **(Content- 12 Hrs, Assessment -3 Hrs) (15 Hrs)**	**18**
II	**OPERATION AMPLIFIER** Wien bridge and phase-shift oscillators– Triangular, saw-tooth and square-waves generators – Schmitt trigger– Voltage control oscillator Phase-locked	**18**

	loops -- Weighted resistor and binary R-2R ladder digital to analog converters -- Counter type and successive approximation analog to digital converters -- Solving simultaneous and differential equations.	
III	**DIGITAL CIRCUITS-I** Digital comparator – Parity generator/checker – Data selector -- BCD to decimal decoder –Seven segment decoder – Encoders – RS, JK, D and JK master-slave flip-flops.	**18**
IV	**DIGITAL CIRCUITS-II** Serial-in serial-out, serial-in parallel-out and parallel-in serial-out shift registers – Synchronous, asynchronous, ring and up/down (using mod 10) counters - Multiplexers(1-8) – Demultiplexers (8-1).	**18**
V	**FABRICATION AND IC TIMER** Basic monolithic ICs – Epitaxial growth – Masking – Etching impurity diffusion – Fabricating monolithic resistors, diodes, transistors, inductors and capacitors – Circuit layout – Contacts and inter connections – Charge coupled device – Applications of CCDs - 555 timer: Description of the functional diagram, applications of monostable and astable operations.	**18**
VI	• Filtering and noise reduction • Shielding and grounding • Fourier transforms, lock-in detector, box-car integrator, modulation techniques, high-frequency devices. • Working of solar cell, LED • Working of Register, Counters and comparators	**Practical**

Text Books:

1. T.F. Schubert, E.M. Kim, Active and Nonlinear Electronics (John Wiley, New York, 1996).
2. L. Floyd, Electronic Devices (Pearson Education, New York, 2004).

Reference Books:

1. R.L. Geiger, P.E. Allen and N.R Strader, VLSI Design Techniques for Analog and Digital Circuits (McGraw--Hill, Singapore, 1990).
2. D. Roy Choudhury and S.B. Jain, Linear Integrated Circuit (New Age International Publications, New Delhi, 2010).

Web-Resources:

1. https://www.Explainthatstuff.com
2. https://www.Physics and Radio-electronics.com
3. https://www.makers.space.com

Course Outcome:

CO 1: Explain the theoretical principles essential for understanding the operation of electronic circuit.

CO 2: Analyze electrical circuit and calculate the main parameters.

CO 3: Develop Design and create simple analogue and digital electronics circuit.

CO 4: Understand the fundamentals and area of application for the integrated circuit.

CO 5: Know about the multistage amplifier using BJT and FET various configuration

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	M
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	M	S	S

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Semester-I / **Core Course IV**	**METHOD OF SPECTROSCOPY**	Course Code PGPD
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To applications in the determinations of atomic structure, chemical composition and Physical properties of materials. • To explain the absorption and emission spectra. • To justify the difference in intensity between stokes and antistokes line. • Explain NMR Spectroscopy knows how nuclear spins are affected by a magnetic field. • To study Frank Condon principle.

UNIT	CONTENT	HOURS
I	**ATOMIC SPECTROSCOPY** Hyperfine structure – Zeeman and Paschen—Back effect of one and two electron systems – Selection rules – Stark effect. **MICROWAVE AND INFRARED ABSORPTION SPECTROSCOPIES** **MICROWAVE SPECTROSCOPY:** Rotation of diatomic molecules – Rotational spectra of polyatomic molecules – Spectrum of non rigid rotator – Experimental technique – Polyatomic molecules – Linear, symmetric top and asymmetric top molecules.	**18**
II	**INFRARED ABSORPTION SPECTROSCOPY:** Vibrating diatomic molecule –Anharmonic oscillator – Diatomic vibrating rotator – Vibration-rotation spectrum of carbon monoxide – Influence of rotation on the spectrum of polyatomic molecules – Linear and symmetric top molecules.	**18**
III	**RAMAN SPECTROSCOPY**	**18**

	Quantum theory of Raman effect –Pure rotational Raman spectra – Linear molecules – Symmetric top molecules – Vibration Raman spectra – Rotational fine structure – Structural determination – Raman spectra –Instrumentation – Raman effect and molecular structure – Raman activity of molecular vibrations.	
IV	**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY** Basic principles –Quantum theory of NMR- Bloch equations and solutions – Shielding and deshielding effects – Chemical shift – Spin lattice and spin-spin relaxation– Coupling constants – Experimental technique – Double coil method – Structural diagnosis and hydrogen bonding.	**18**
V	**ELECTRONIC AND ESR SPECTROSCOPY** **ELECTRONIC SPECTROSCOPY OF MOLECULES:** Electronic spectra of diatomic molecules -- The Franck-Condon principle – Dissociation energy and dissociation products – Rotational fine structure of electronic vibration transitions. **ESR:** Theory of ESR – Resonance conditions – Experimental study – ESR spectrometer – Crystalline solids and free radicals in solution – Determination of g factor.	**18**
VI	• Infrared (IR) Spectroscopy. ... • Ultraviolet-Visible (UV/Vis) Spectroscopy. ... • Nuclear Magnetic Resonance (NMR) Spectroscopy. ... • Raman Spectroscopy. ... • X-Ray Spectroscopy.	**Project**

Text Books:

1. Gupta kumar Sharma - Elements of Spectroscopy -10th Edition
2. C.N. Banwell, Fundamentals of Molecular Spectroscopy (McGraw Hill, New York, 1981).

Reference Books:

1. J. Michael Hollas, Modern Spectroscopy (Wiley India, New Delhi, 2004).
2. B.P. Straughan and S. Walker, Spectroscopy Volumes I--III (Chapman and Hall, New York, 1976).

Web-Resources:

1. https://guides.lib.unc.edu/spectroscopy/general.
2. https://guides.lib.unc.edu/spectroscopy/general.
3. ElectronMicroscopy-PrinciplesandFundamentals-S.Amenlinckx,etal.,(Wiley-VCH,1997) WW.pdf

Course Outcome:

CO 1: Explain what it means to use Spectroscopic methods for qualitative and quantitative analysis.

CO 2: Compare and contrast of atomic and molecular spectra.

CO 3: Explain the difference between stokes and anti-stokes line in a Raman spectrum.

CO 4: Understanding of Quantum theory and NMR spectroscopy.

CO 5: The probability of transition between vibration levels of two electronic states determined by Frank-Condon principle.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	S	S	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S

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Semester-I / **Core Practical - I**	**CORE PRACTICAL - I** **PHYSICS PRACTICAL I (GENERAL)**	Course Code: PGPE
Instruction Hours: 8	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Experimental determination of certain Physical constants and properties. • Verification of characteristics and applications of electronic components and devices. • Resolving power of optical equipment can be learnt firsthand. • In the laboratory course, the hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Michelson interferometer, Fresnel Biprism etc. • Understand the phase shifter, Wein bridge oscillator, Saw tooth and Stair case waves generators using op-amp comparator.
1.	Determination of q, n, σ by elliptical fringes method
2.	Determination of q, n, σ by Hyperbolic fringes method
3.	Determination of Stefan's constant
4.	Determination of bulk modulus of a liquid by ultrasonic wave propagation
5.	Determination of Rydberg's constant
6.	Study of Hall effect in a semiconductor
7.	Michelson interferometer -- Determination of wavelength of monochromatic source.
8.	Determination of wavelength of monochromatic source using biprism
9.	Charge of an electron by spectrometer

10.	Photo electric Effect-determination of Planck’s Constant.
11.	Determination of thermal conductivity of a good conductor – Forbe’s method
12.	Band gap energy of a semiconductor -- Four-probe method
13.	Polarizability of liquids by finding the refractive indices at different wavelengths
14.	Magnetic susceptibility of a paramagnetic solution using Quincke’s tube method
15.	Determination of magnetic susceptibility of liquid by Guoy method.
16.	Calibration of Thermistor.

Course Outcome:

CO 1: This programme could provide skilled in electronic principles

CO 2: Helps students to acquire conceptual knowledge on various kinds of Electronic devices.

CO 3: Learned about to basic concept of Hyperbolic fringes and elliptical fringes

CO 4: Develop and analysis of IC fabrication and Electronics measuring Instruments of CRO.

CO 5: To design the basic operational amplifier phase shifter, Wein bridge oscillator, Saw tooth and Stair case waves generators using op-amp comparator.

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	M	M	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S
CO3	S	M	S	M	M	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-I/ **CORE COURSE V**	**ELECTRO MAGNETIC THEORY**	Course Code: PGPF
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To learn the theory for the fields produced by stationary and moving charge and charged systems and propagation of electromagnetic fields. • Achieve an understanding of the Maxwell's equations, role of displacement current, gauge transformations, scalar and vector potentials, Coulomb and Lorentz gauge, boundary conditions at the interface between different media. • Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density. • Analyze the phenomena of wave propagation in the unbounded, bounded, vacuum, dielectric, guided and unguided media. • Understand the features of planer optical wave guide and obtain the Electric field components, Eigen value equations, phase and group velocities in a dielectric wave guide.

UNIT	CONTENT	HOURS
I	**ELECTROSTATICS AND POLARIZATION** Gauss's law – Field due to an infinite, straight, uniformly charged wire – Multipole expansion of a charge distribution -- Field inside a uniformly polarized sphere – Electric field inside a dielectric – Electric displacement and polarizability – Claussius- Mossotti relation – Polarization of polar molecules and Langevin equation and Debye relation – Electrostatic energy.	18

II	**BOUNDARY VALUE PROBLEMS IN ELECTROSTATICS** Boundary conditions – Potential at a point between the plates of a spherical capacitor – Potential at a point due to uniformly charged disc – Method of image charges – Point charge in the presence of a grounded conducting sphere- Point charge in the presence of a charged, insulated conducting sphere -- Conducting sphere in a uniform electric field – Laplace equation in rectangular coordinates.	**18**
III	**MAGNETO STATICS** Magnetic scalar and vector potentials – Magnetic dipole in a uniform field – Magnetization current – Magnetic intensity – Magnetic susceptibility and permeability– Hysteresis – Correspondences in electrostatics and magneto statics.	**18**
IV	**FIELD EQUATIONS AND CONSERVATION** Continuity equation – Displacement current – Maxwell's equations and their physical significance – Poynting theorem – Energy in electromagnetic fields – Electromagnetic potentials – Maxwell's equations in terms of electromagnetic potentials – Lorentz and Coulomb gauges.	**18**
V	**ELECTROMAGNETIC WAVES AND WAVE PROPAGATION** Electromagnetic waves in free space – Propagation of electromagnetic waves in isotropic dielectrics and in anisotropic dielectrics – Reflection and refraction of electromagnetic waves: Kinematic and dynamic properties – TM and TE modes – Propagation in rectangular waveguides – Cavity resonator.	**18**
VI	• Dispersion relations in plasma • Lorentz invariance of Maxwell's equation • Transmission lines and waveguides • Radiation- from moving charges and dipoles and retarded potentials.	**Group Discussion**

Text Books:

1. J.D. Jackson, *Classical Electrodynamics* (John-Wiley, New York, 1999) 3rd edition.
2. K.K. Chopra and G.C. Agarwal, *Electromagnetic Theory* (K. Nath& Co., Meerut).

Reference Books:

1. D.J. Griffiths, *Introduction to Electrodynamics* (Pearson, Essex, 2014) 4th edition.
2. T.L. Chow, *Electromagnetic Theory* (Jones and Bartlett Learning, 2012).

Web-Resources:

1. Elements of Electromagnetic theory.pdf
2. Griffiths-Introduction to Electrodynamics 3e(prentice,1999).pdf

Course Outcome:
CO 1: The theory of electromagnetic propagation of electromagnetic fields.
CO 2: Learn the boundary value problem in electrostatics methods of image charges.
CO 3: Understand Maxwell equation and its physical significance.
CO 4: Learn Electromagnetic waves and wave propagation.
CO 5: Understand magneto static and magnetic dipole

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Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	M	M	S	M	M	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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W – Weakly Correlating

N – No Correlation

Semester-II / **Core Course VI**	**QUANTUM MECHANICS**	Course Code: PGPG
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To learn the fundamental concepts and certain theoretical methods of quantum mechanics and their applications to microscopic systems. • To discuss the concepts of wave/particle duality, probability distributions and wave functions. • To acquire working knowledge of quantum mechanics postulates on the evolution of physical systems. • To apply the postulates of quantum mechanics to simple harmonic oscillator. • To understand relativistic Quantum mechanics.

UNIT	CONTENT	HOURS
I	**SCHRÖDINGER EQUATION AND GENERAL FORMULATION** Schrödinger equation and its plane wave solution – Physical meaning and conditions on the wave function – Expectation values– Hermitian operators and their Properties – Commutator relations -- Uncertainty relation-- Bra and Ket vectors – Hilbert space – Schrödinger, Heisenberg and interaction pictures.	**18**
II	**EXACTLY SOLVABLE SYSTEMS** Linear harmonic oscillator: Solving the one-dimensional Schrödinger equation and abstract operator method – Particle in a box -- Rectangular	**18**

	barrier potential –Rigid rotator – Hydrogen atom.	
III	**APPROXIMATION METHODS** **TIME-INDEPENDENT PERTURBATION THEORY:** Non-degenerate (first-order) and degenerate perturbation theories -- Stark effect – WKB approximation and its application to tunneling problem and quantization rules. **TIME-DEPENDENT PERTURBATION THEORY:** Constant and harmonic perturbations – Transition probability – Sudden approximation.	**18**
IV	**SCATTERING THEORY AND ANGULAR MOMENTUM** **SCATTERING THEORY:** Scattering amplitude and cross-section – Green's function approach -- Born approximation and its application to square-well and screened-Coulomb potentials. **ANGULAR MOMENTUM:** Components of orbital angular momentum – Properties of **L** and **L2 --** Eigen pairs of **L2and**Lz– Spin angular momentum.	**18**
V	**RELATIVISTIC QUANTUM MECHANICS** Klein--Gordon equation for a free particle and its solution – Dirac equation for a free particle and Dirac matrices -- Charge and current densities – Plane wave solution – Negative energy states – Zitterbewegung – Spin of a Dirac particle – Spin-orbit coupling.	**18**
VI	• Spin-orbit coupling, fine structure • WKB approximation, elementary theory of scattering • Relativistic quantum mechanics (Klein-Gordon and Dirac equations), the semi-classical theory of radiation • Tunneling through a barrier • Time dependent perturbation theory and Fermi's golden rule, selection rules.	**Group discussion**

Text Books:

1. 1.V. Devanathan, *Quantum Mechanics*, Naroso Publishing House (2005)
2. 2.S. Rajasekar and R.Velusamy, *Quantum Mechanics I: The Fundamentals* (CRC Press, Boca Raton, 2015).

Reference Books:

1. R. Shankar, *Principles of Quantum Mechanics* (Springer, New Delhi, 2007).
2. L. Schiff, *Quantum Mechanics* (Tata McGraw Hill, New Delhi, 2014) 4th edition.

Web-Resources:

1. Introduction to quantum Mechanics.pdf
2. Introduction to quantum theory and Atomic structure-P.A.Cox.pdf
3. Quantum Mechanics- A Modern Development-L.Ballentine.pdf

Course Outcome:

CO1: Solves the time-independent Scrondinger equation as an solve intermediate step to solve the time dependent Scrondinger equation.

CO2: Identifies correctly the mathematical space that contains all possible states of a physical system, using Dirac 's equation.

CO3: Build a Hilbert space based on a complete set commuting observables.

CO4: Relativistic Quantum mechanics understanding the Klein Gordon equation for a free particle and Dirac equation for a free particle and Dirac matrices.

CO5: Compute the energy levels and evaluation the quantum simple harmonic oscillator.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	M	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating
M – Moderately Correlating
W – Weakly Correlating
N – No Correlation

Semester-III / Core Practical - II	**PHYSICS PRACTICAL III (ELECTRONICS)**	**Course Code: PGPKY**
Instruction Hours: 8	**Credits: 4**	**Exam Hours: 3**
Internal Marks -40	**External Marks-60**	**Total Marks: 100**

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To gain practical knowledge by applying the experimental methods to correlate with the physics theory. • To learn the usage of general practical systems for various measurements. • Apply the analytical techniques and graphical analysis to the experimental data. • To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group. • Practice different types of wiring and instruments connections keeping in mind technical, Economical, safety issues.
	Electronics Experiments
1.	Characteristics of LED and photo diodes
2.	Characteristics of laser diode and tunnel diode
3.	Digital to analog converters using op-amp
4.	Study of phase-shift oscillator using op-amp
5.	Design and study of Schmitt trigger using op-amp
6.	Astable and monostable multivibrators using IC555
7.	Characteristics of UJT

8.	Characteristics of SCR
9.	Design and study of Wein bridge oscillator using op-amp
10.	Design and study of square and triangular waves generators using OP AMP.
11.	Flip-flops RS,JK,& D
12.	Decoder,Encoder
13.	Characteristics of FET
14.	Characteristics of LDR.
15.	FET Amplifier

Course Outcome:

CO 1: Able to use radio astronomical data to measure physical properties of astronomical targets.

CO 2: Identify and solve basic communication problems, analyse transmitter and receivers.

CO 3: Demonstrate measuring of basic medical parameters.

CO 4: Analyse the radio channel characteristics and the cellular principles

CO 5: Ability to analyse improved data services in cellular communication.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	M	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating

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N – No Correlation

Semester-I I / **Elective Course I**	**MICROPROCESSOR AND MICROCONTROLLER**	Course Code: PGPE1
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To understand the basic concept of microprocessor. • To understand techniques for faster execution of instructions and improve speed of operation and performance microprocessors. • To learn the fundamental programming concept and methodologies. • To understand the basic architecture of intel 8085 microprocessor. • To practice the fundamental programming methodologies in c programming language.

UNIT	CONTENT	HOURS
I	**MICROPROCESSOR ARCHITECTURE AND INTERFACING** Intel 8085 microprocessor architecture – Pin configuration – Instruction cycle – Timing diagram – Instruction and data formats – Addressing modes -- Memory mapping and I/O mapping I/O scheme-- Memory mapping I/O interfacing --Data transfer schemes -- Synchronous and asynchronous data transfer – Interrupt driven data transfer - Interrupts of Intel 8085.	**15**
II	**II ASSEMBLY LANGUAGE PROGRAMS (8085 ONLY)** BCD arithmetic –Addition and subtraction two 8-bit and 16-bit numbers-- Largest and smallest numbers in a data set – Ascending order and descending order –Sum of a series of a 8-bit numbers – Sum of a series of multibyte decimal numbers – Square root of a number – Block movement	**15**

	of data -- Time delay –Square-wave generator.	
III	**PERIPHERAL DEVICES AND MICROPROCESSOR APPLICATIONS** Generation of control signals for memory and I/O devices - I/O ports -- Programmable peripheral interface – Architecture of 8255A -Control word—Programmable interrupt controller (8259) 8279- Key board interfacing- Programmable counter- Intel 8253 -Architecture, control word and operation – Block diagram and interfacing of analog to digital converter (ADC 0800) – Digital to analog converter (DAC 0800)– Stepper motor – Traffic control.	**15**
IV	**MICROCONTROLLER 8051** Features of 8051– Architecture –Pin configuration –Memory organization External data and program memory -- Counters and timers – Serial data input/output– Interrupt structure – External interrupts – Addressing modes -- Comparison between microprocessor and microcontroller.	**15**
V	**8051 INSTRUCTION SET AND PROGRAMMING** Instruction set – Data transfer, arithmetic and logical instructions – Boolean variable manipulation instructions – Program and machine control instructions – Simple programs – Addition and subtraction of two 8-bit and 16-bit numbers – Division – Multiplication -- Largest number in a set – Sum of a set of numbers.	**15**

Text Books:

1. 1.B.Ram, Fundamentals of Microprocessor and Microcomputers (DhanpatRaiPub., New Delhi,2006).
2. R. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085

Reference Books:

1. M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, The 8051 Microcontroller and Embbeded
2. Systems using Assembly and C (Dorling Kindersley, New Delhi, 2013).
3. A.P. Godse and D.A.Godse, Microprocessors and Microcontrollers (Technical Pub., Pune, 2008).

Web-Resources:

1. https://www.javatpoint.com/microprocessor-vs-microcontroller
2. https://www.vssut.ac.in/lecture_notes/lecture1423813120.pdf

Course Outcome:

CO1: Write programs to run on 8085 microprocessor.

CO2: Understand and device techniques for faster execution of instruction, improve speed of operations.

CO3: Understand microprocessor and its advantage.

CO4: Describe the fundamental components of a C program e.g source file, header file, main function , functions and libraries.

CO5: Explain and apply fundamental syntax rules for identifies , declarations, expressions, statements and functions.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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W – Weakly Correlating

N – No Correlation

Semester-II / Elective Course I	DATA COMMUNICATION AND COMPUTER NETWORKS	Course Code: PGPE1
Instruction Hours: 5	**Credits: 5**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Become familiar with layered communication architectures (OSI and TCP/IP). • Understand the client/server model and key application layer protocols. • Learn sockets programming and how to implement client/server programs. • Understand the concepts of reliable data transfer and how TCP implements these concepts. • Know the principles of congestion control and trade-offs in fairness and efficiency.

UNIT	CONTENT	HOURS
I	Data transmission and encoding Concepts: Analog and Digital transmission, Transmission impairments-Transmission media-Synchronous / Asynchronous transmission-Line configurations-interfacing. Digital data digital signals-Variations of NRZ and bi-phase-Digital data Analog signals-ASK, FSK, PSK, QPSK-Analog data digital signals-PCM, DM.	**15**
II	Introduction and services - Error detection and correction - Multiple access protocols - LANs o Addressing & ARP - Link virtualization o MPLS • Data center networking - Web request processing - Data Link Control Flow control, Error control-HDLC, Multiplexing.	**15**
III	Introduction to Computer Networks and the Physical Layer Introduction: The uses of computer networks-Network hardware-Network software-Reference models, Example of networks-Network standardization. The	**15**

	physical layer: The theoretical basis for data communication-Guided Transmission media-Wireless transmission.	
IV	Error detection and correction-Elementary data link protocols-Sliding window protocols-Example of data link protocols-ETHERNET. The network layer: Network layer design issues-Routing algorithms-Congestion control algorithms- - Ethernet o Switches o VLANs o PPP	**15**
V	The transport and the Application Layers The transport layer: Transport layer design issues-Transport protocols-Simple transport protocol- Internet transport protocols UDP, TCP. The application layer: Domain name system-Electronic mail-World Wide Web.	**15**

Text Books:

1. Edition, 2008.
2. Andrew S. Tanenbaum, “ Computer networks”, Prentice-Hall of India, New Delhi, 4th edition 2005.
3. Behrouz Forouzan, “Introduction to Data Communication and Networking”, Tata McGraw-Hill, 2000.

Reference Books:

1. Douglas E. Comer, “Internet working with TCP/IP-Volume-I”, Prentice-Hall of India, 4th Edition, 2001.
2. Paub and Schilling, “Principles of Communication System”, MacGraw Hill, 1986.
3. James F. Kurose and Keith W. Ross, “Computer Networking-A top down Approach Featuring the Internet”, Pearson Education, Asia, 3rd Edition-2006.

Web-Resources:

1. http://nptel.ac.in/courses/106105082/
2. http://www.networkworld.com/blogs

Course Outcome:

CO 1: Understand importance of data communication systems and fundamentals.

CO 2: Distinguish and relate various physical Medias, interfacing standards and adapters.

CO 3: Explain various flow control techniques.

CO 4: Analyze short range and long range wireless technologies

CO 5: Analyze various modulation technique in analog and digital careery system

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

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Semester-II / **Elective Course II**	**NUMERICAL METHODS AND C++ PROGRAMMING**	Course Code: PGPE2
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To learn the necessarily of methods of least square for fitting a graph. • To learn the numerical methods of computing certain mathematical quantities, construction and evaluation of a function and solution of an ordinary differential equation. • To Write C++ computer programming necessary for numerical simulation of physical problems. • Know about the basis theory of errors, their analysis, estimation with examples of simple experiments in physics. • Learn to write C++ Program for all the methods.

UNIT	CONTENT	HOURS
I	**CURVE FITTING AND INTERPOLATION** **CURVE FITTING:** Method of least-squares - Straight-line fit -- Exponential and power-law fits. **INTERPOLATION:** Newton interpolation polynomial: Linear interpolation, Higher-order polynomials and first-order divided differences – Gregory--Newton interpolation polynomials – Lagrange interpolation.	15
II	**SOLUTIONS OF LINEAR AND NONLINEAR EQUATIONS** **SIMULTANEOUS LINEAR EQUATIONS:** Upper triangular form and	15

	back substitution –Augmented matrix -- Gauss elimination method -- Jordan's modification -- Inverse of a matrix by Gauss--Jordan method. **ROOTS OF NONLINEAR EQUATIONS:** Bi-section method and Newton--Raphson method.	
III	**NUMERICAL INTEGRATION AND DIFFERENTIATION** **NUMERICAL INTEGRATION:** Trapezoidal and Simpson's 1/3 rules -- Errors in the formulae -- Composite trapezoidal and Simpson's 1/3 rules - Simpson's 3/8 rules - Errors in the formulae.	**15**
IV	**PROGRAMMING IN C++** Constants and variables -- I/O operators and statements -- Header files -- Main function – Conditional statements -- Switch statement -- Void function -- Function program -- For, while and do-while statements -- Break, continue and go to statements - Arrays.	**15**
V	**PROGRAMMING IN** C++ 1. Least-squares curve fitting – Straight-line fit 2. Least-squares curve fitting – Exponential fit 3. Real roots of one-dimensional nonlinear equations -- Newton Raphson method 4. Complex roots of one-dimensional nonlinear equations -- Newton Raphson method 5. Interpolation – Lagrange method 6. Numerical integration – Composite trapezoidal rule 7. Numerical integration – Composite Simpson's 1/3 rule	**15**

Text Books:

1. J. R. Hubbard, Programming with C++ (McGraw-Hill, New Delhi, 2006).
2. E. Balagurusamy, Objected Oriented Programming in C++ (McGraw Hill, New Delhi,

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation (New Age International, New Delhi, 1993).
2. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering (Prentice-Hall of India, New Delhi, 1998).

Web-Resources:

1. Fundamental of Numerical Methods and Data Analysis-G.Collins.pdf

Course Outcome:

CO 1: To Equip them with sufficient Knowledge base of physics so that they do not find any difficulty pursuing higher Education

CO 2: Trained practical exposure which could equip to face the challenges in Physics.

CO 3: Understanding the Programming in C++ in constants and variables of the functions

CO 4: To Write C++ computer programming necessary for numerical integration to trapezoidal and simpson 's 1/3 rule

CO 5: Understand the various statements and Arrays.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S	M	S

S – Strongly Correlating

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N – No Correlation

Semester-II / **Elective Course II**	**COMPUTER ORGANIZATION**	Course Code: PGPE2
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Understand the organization of a computer with its various processing units, memory and peripherals. • Understand the modern computer with its various processing units. Also the Performance measurement of the computer system. • In addition to this the memory management system of the computer. • They can analyze the performance of a computer using the performance equation • Understanding of different instruction types

UNIT	CONTENT	HOURS
I	**Basic Structures of Computers** Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts, Bus Structures.	**15**
II	**Machine Instructions & Programmes** Memory Locations and Addresses , Byte Addressability, Big Endian and Little Endian Assignments, Word Alignment, Accessing numbers, characters and character strings, Memory Operations, Instruction and Instruction sequencing, Register Transfer notation, Assembly Language notation, Basic instruction types, Instruction execution and straight line sequencing, Branching, Condition codes, Addressing modes, Implementation of variables	**15**

	and constants, Indirection and pointers, Indexing and arrays, Relative addressing, Additional modes, Assembly Language, Assembler directives, Assembly and execution of programs, Basic Input- Output Operations.	
III	**Basic Processing Unit** Some Fundamental Concepts, Register transfers, Performing an Arithmetic or Logic operation, Fetching a word from memory, Storing a word in memory, Execution of a complete Instruction, Branch instructions, Multiple Bus Organization, Hardwired Control(basic block diagram only), A complete processor, Basic organization of Micro programmed Control Unit	**15**
IV	**Input Output Organization** Accessing I/O Devices, Interrupts, Interrupt Hardware, Enabling and Disabling\ Interrupts, Handling Multiple Devices, Controlling Device requests, Exceptions, Direct Memory Access, Bus arbitration, Buses, Synchronous bus, Asynchronous bus, Interface Circuits, Parallel port and Serial port (Basic concept only), Standard I/O Interfaces (Basic concepts only), Peripheral Component Interconnect (PCI) Bus , SCSI Bus(Basic concepts only), Universal Serial Bus (USB) (Basic concepts only)	**15**
Unit V	**The Memory System** Some Basic Concepts, Semiconductor RAM Memories, Internal Organization of memory chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of larger memories, Memory system consideration, Rambus memory, Read-Only Memories- ROM, PROM, EPROM, EEPROM, Flash Memory, Speed, Size and Cost, Cache Memories.	**15**

Text Books:

1. Computer Organization, Carl Hamacher, zvonko Vranesic and Safwat Zaky, McGraw Hill, 5th edition
2. Advanced Computer Architecture (A practical approach), Rajiv Chopra, S. Chand, Revised edition, reprint 2014, ISBN8121930774

Reference Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
2. Computer architecture and organization , 4th edition , P Chakraborty , JAICO Publishers

Web-Resources:

1. http://www.srmuniv.ac.in/downloads/computer_architecture.pdf
2. http://www.dauniv.ac.in/downloads/CArch_PPTs/CompArchCh06L01PipeLine.pdf
3. http://elearning.vtu.ac.in/06CS46.html
4. . http://nptel.ac.in/courses/Webcourse-contents/IIT %20Guwahati/comp_org_arc/web/

Course Outcome:

CO 1: Recognize and explain the functional units of computers

CO 2: Describe assembly languages and machine instructions by analyzing how the data is stored and fetched from memory.

CO 3: Explain the execution of complete instruction and bus organizations.

CO 4: Identify various interrupt handling mechanism and buses.

CO 5: Differentiate between different types of memories.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	M	S	S	S	M	S	S
CO5	S	S	M	M	S	S	S	M	S	S

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W – Weakly Correlating
N – No Correlation

Semester-III / **Core Course VII**	**STATISTICAL MECHANICS**	Course Code: PGPI
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Explain statistical physics and the thermodynamics as logical consequences of the postulates of statistical mechanics. • Apply the principles of statistical mechanics to selected problems • Carps the basis of ensembles approach in statistical mechanics to range of situations • To learn the fundamental difference between classical and quantum statistics and learn about quantum statistical distribution law

UNIT	CONTENT	HOURS
I	**Thermodynamics** Thermo dynamical laws and their consequences – Entropy -- Changes in entropy in reversible processes -- Principle of increase of entropy -- Thermodynamic functions- Enthalpy, Helmholtz and Gibbs functions -- Phase transitions –Clausius-Clayperon equation –Van der Wall equation of state.	**18**
II	**Kinetic Theory** Boltzmann transport equation and its validity -- Boltzmann's H-theorem -- Relation between H-function and entropy -- Maxwell--Boltzmann distribution --Mean free path – Conservation laws -- Transport phenomena – Viscosity of gases-- Thermal conductivity -- Diffusion process.	**18**
III	**Classical Statistical Mechanics** Review of probability theory -- Macro and micro states – Phase space –	**18**

	Statistical ensembles - Density function -- Liouville's theorem -- Maxwell—Boltzmann distribution law -- Micro canonical ensemble – Ideal gas – Entropy – Partition function – Equipartition theorem –Canonical and grand canonical ensembles.	
IV	**Quantum Statistical Mechanics** Basic concepts -- Ideal quantum gas – Bose--Einstein statistics -- Photon statistics --Fermi-Dirac statistics -- Sackur-Tetrode equation – Equation of state -- Bose-Einstein condensation –Comparison of classical and quantum statistics.	**18**
V	**Applications of Quantum statistical Mechanics** **Ideal Bose System:** Photons – Black body and Planck radiation – Specific heatof solids – Liquid helium. **Ideal Fermi System:** Properties – Degeneracy – Electron gas -- Pauli paramagnetism. **Ferromagnetism:** Ising and Heisenberg models.	**18**
VI	• Fluctuation–dissipation theorem. • Onsager reciprocal relations. • Green–Kubo relations. • Landauer–Büttiker formalism. • Mori–Zwanzig formalism.	**Group Discussion**

Text Books:

1. S.K. Sinha, *Introduction to Statistical Mechanics* (Narosa, New Delhi, 2007).
2. K. Huang, *Statistical Mechanics* (Wiley Eastern Limited, New Delhi, 1963).

Reference Books:

1. Singhal, Agarwal, Prakash, *Thermodynamics and Statistical Physics* (Prakashan, Meerut, 2003).

2. W. Greiner, L. Neise and H. Stocker, *Thermodynamics and Statistical Mechanics* (Springer, New York, 1995).

Web-Resources:

1. www.math.ox.ac.uk
2. www.math.upenn.edu**.**
3. Mathematical Physics-A Modern Intro to its Foundations S.Hassani(Springer,1999)WW.pdf

Course Outcome:

CO 1: They easily to determine the probability of any type of an event.

CO 2: Students have understood the concept of phase space and its volume.

CO 3: They can easily distinguish between different types of particles and statistics.

CO 4: They can easily distribute bosons and fermions and classical particles among energy levels.

CO 5: After studying Fermi Dirac Statistics, students have learnt to deal with many electron systems in real life.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S	S

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W – Weakly Correlating

N – No Correlation

Semester-III/ Core Course **VIII**	**SOLID STATE PHYSICS**	Course Code: PGPJ
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• The course gives an introduction to solid state physics, and will enable the student to employ classical and quantum mechanical theories needed to understand the physical properties of solids. Emphasis is put on building models able to explain several different phenomena in the solid state. • Understand the influence of lattice vibrations on thermal behavior • Apply the free electron theory to solids to describe electronic behavior and Explain how a lattice vibrates at finite temperature, and how these vibrations determine the heat capacity and conduction. • Know the concept density of states in one, two and three dimensions. • Explain simple theories for conduction of heat and electrical current in metals.	
UNIT	**CONTENT**	**HOURS**
I	**Lattice Vibrations and Thermal Properties** Vibration of monatomic lattices – Lattices with two atoms per primitive cell –Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons– Lattice heat capacity – Einstein model – Density of modes in one-dimension and three dimension– Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process.	**18**
II	**Free Electron Theory, Energy Bands and Semiconductor Crystal** Energy levels and density of orbitals – Fermi-Dirac distribution – Free	**18**

	electron gas in 3D – Heat capacity of electron gas – Electrical conductivity – Motion in magnetic fields – Hall effect – Thermal conductivity – Nearly conductivity of metals – Nearly free electron model – Electron ina periodic potential –Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration.	
III	**Dia, Para, Ferro and Antiferro-Magnetisms** Langevin classical theory of dia- and para-magnetisms – Weiss theory – Quantum theory of paramagnetism – Paramagnetic susceptibility of conduction electrons – Hund's rules – Ferroelectric order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Ferromagnetic order- Antiferromagnetic order –Ferromagnetic domains – Origin of domains – Coercive force and hysteresis.	**18**
IV	**Basics of Nonlinear Optics** Wave propagation in an anisotropic crystal – Polarization response of materials to light –Harmonic generation – Second harmonic generation – Sum and difference frequency generation– Phase matching – Third harmonic generation – Terahertz – Bistability – Self-focusing. **Nonlinear Optical Materials** Basic requirements – Inorganics – Borates – Organics – Urea, Nitroaniline – Semi organics – Thoreau complex – Laser induced surface damage threshold.	**18**
V	**Thin Film physics and Deposition Techniques** Principle of gel technique – Various types of gel -- Structure and importance of gel – Methods of gel growth and advantages -- Melt technique – Bridgeman method – Flux growth – Hydrothermal growth – Vapor-phase growth-Physical vapor deposition – Chemical vapor deposition. Vacuum evaporation -- E-beam, pulsed laser and ion beam evaporations - Glow discharge and plasmas -- Mechanisms and yield of sputtering processes – DC, RF, magnetically enhanced, reactive sputterings– Spray pyrolysis – Electro deposition – Sol-gel technique.	**18**

VI	• Electronic devices such as mobiles and computers • Optical devices such as lasers and fibre optics • Magnet based devices such as Magnetic Resonance Imaging (MRI) and vibrating devices • Silicon-based logic and memory bits	**Project**

Text Books:

1. C. Kittel, *Introduction to Solid State Physics* (Wiley Eastern, New Delhi, 2007)7th edition.
2. S.O. Pillai, *Solid State Physics* (New Age International, New Delhi, 2005) 6thedition.
3. H.C. Gupta, *Solid State Physics* (Vikas Publishing House, Noida, 2001) 2ndedition.

Reference Books:

1. N.W, Ashcroft and N.D. Mermin, *Solid State Physics* (Holt, Rinehart and
2. Winston, Philadelphia, 1976).
3. Rita John, *Solid State Physics* (McGraw Hill, New Delhi, 2014).

Web-Resources:

1. www.math.ox.ac.uk
2. www.math.upenn.edu

Course Outcome:

CO 1: Students will develop range of communication and teaching skills. CO 2: How diffraction of electromagnetic waves on solid matter can be used to obtain lattice structure. CO 3: Know the concept of phonons, and how the dispersion relationship appears for different lattice structures. CO 4: Explain how a lattice vibrates at finite temperature, and how these vibrations determine the heat capacity and conduction. CO 5: Apply models to describe defects and diffusion.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	M	S	S	S	M	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	M	M	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	M	S	M	S

S – Strongly Correlating

M – Moderately Correlating

W – Weakly Correlating

N – No Correlation

Semester-I I / **Core Practical III**	**MICROPROCESSOR AND PROGRAMMING**	Course Code: PGPHY
Instruction Hours: 8	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To develop programming skills of microprocessor and C++ programming in solving some mathematical problems and their applications. • In the laboratory he is expected to study of interfacing, Traffic control system, Control of • stepper motor using microprocessor. • To demonstrate simple programmes using assembly language and execute the programme • using a µp 8085 kit. • Write and solve the problems in curve fitting and Numerical Analysis. • Write C++ programming algorithms, flowcharts.

A. MICROPROCESSOR (8085)	
1.	Finding the largest and smallest numbers in a data array
2.	Arranging a set of numbers in ascending and descending orders
3.	Study of multibyte decimal addition
4.	Study of multibyte decimal subtraction
5.	Interfacing hexa key board (IC 8212)
6.	Study of seven segment display

7.	Study of DAC interfacing (DAC 0900)
8.	Study of ADC interfacing (ADC 0809)
9.	Traffic control system
10.	Control of stepper motor using microprocessor
B. C++ PROGRAMMING	
1.	Least-squares curve fitting – Straight-line fit
2.	Least-squares curve fitting – Exponential fit
3.	Real roots of one-dimensional nonlinear equations -- Newton Raphson method
4.	Complex roots of one-dimensional nonlinear equations -- Newton Raphson Method.
5.	Interpolation – Lagrange method
6.	Numerical integration – Composite trapezoidal rule
1.	Numerical integration – Composite Simpson's 1/3 rule

Course Outcome:

CO 1: Equip them with sufficient Knowledge base of physics so that they do not find any difficulty pursuing higher Education.
CO 2: Trained practical exposure which could equip to face the challenges in Physics.
CO 3: Understanding the Programming in C++ in constants and variables of the functions
CO 4: Demonstrate simple programmers using assembly language and execute the programme using a μp 8085 kit.
CO 5: Write C++ computer programming necessary for numerical integration to trapezoidal and Simpson‘s 1/3 rule

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-III / **Elective Course-III**	**Nano Materials and Applications**	Course Code: PGPE3
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To understand the theoretical concepts involved in crystal growth and thin film sciences and to learn the basic characterizing techniques of materials. • To foundational knowledge of the Nanoscience and related fields. • To make the students acquire an understanding the Nanoscience and Applications • To help them understand in broad outline of Nanoscience and Nanotechnology. • For Nanomaterials understood the principles and Characterization Techniques. • Understand and improved the application of Nanotechnology.

UNIT	CONTENT	HOURS
I	**Back ground of Nano technology** Scientific revolution-Emergence of Nano technology, Challenges in Nano technology –Periodic Table, Atomic structures, Molecules and Phases-Energy, Atomic size, surfaces and dimensional space.	**15**
II	**Preparation of Nano Materials** Nano Material-Preparation-Top down-ball milling,Nano lithography- Bottom up, Self Assembly -Sol gel -Hydro thermal method-Polyol Process	**15**
III	**carbon nano structures** Carbon molecules and carbon bond -- C60: Discovery and structure of C60 and its crystal -- Superconductivity in C60 -- Carbon nanotubes: Fabrication – Structure	**15**

	– Electrical properties – Vibrational properties – Mechanical properties -- Applications (fuel cells, chemical sensors, catalysts).	
IV	**Characterization of Nanomaterials** Principles, experimental set-up, procedure and utility of scanning electron microscopy (SEM), transmission electron microscopy (TEM), scanning tunneling microscope (STM) and scanning probe microscopy (SPM).	**15**
V	**Applications** Molecular electronics and nanoelectronics – Nanorobots -- Biological applications of nanoparticles - Catalysis by gold nanoparticles – Band-gap engineered quantum devices -- Nanomechanics -- CNT emitters – Photoelectrochemical cells -- Photonic crystals – Plasmon waveguides.	**15**
VI	• Preparation of Nanofertilizers • Synthesis of silver nanoparticles by biological method • Use of nanoparticles in medicine • Preparation of copper nanoparticles • Grapheme in mobile phones • Silica nano particles in textile industry • Nano coatings for car	**Project**

Text Book:

1. 1.ManasiKarkare,Nano Technology Fundamentals and App1ications.
2. K.InternationalPublishing House Limited.
3. CharlesP.Poole JRAnd Frank Owens."Introductionto Nanotechnology"Wiley,2003.
4. B.B.Laud,NonLinear Optics,2ndEdn.NewAge International (P)Limited.Delhi,1991.

Reference Books:

1. RobertW.Boyd, Non Linear Optics, 2ndEdn.AcademicPress,Newyork,2003.
2. K.Ravichandran, K.Swaminathan,B.SakthivelC.Pavidoss Introduction to Characterization of Nano Material and Thin Films(Publication JAZYM Publication)

Web Resources:

1. www.math.ox.ac.uk
2. www.math.upenn.edu**.**
3. Mathematical Physics-A Modern Intro to its Foundations-S.Hassani(Springer,1999)WW.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment
CO 2:	Apply their learned knowledge to develop Nanomaterial's.
CO 3:	Choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.
CO 4:	Appreciate enhanced sensitivity of nanomaterial based materials and their novel applications in industry.
CO 5:	Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-III / **Elective Course-III**	**CRYSTAL PHYSICS**	Course Code: PGPE3
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To provide a qualitative idea on the fundamentals of growing crystals and characterizing the grown samples. • This paper will serve as an eye opener for students keen in research activities particularly in experimental physics. • To know the principles in the method involved in the growth of crystal. know the principles the advantage and the disadvantages different thin film deposition method. • To understanding the theories involve in crystal growth nucleation process and solution, melt and vapour growth techniques. • To learn the importance of different thin films and coatings for a variety industrial applications.	
UNIT	**CONTENT**	**HOURS**
I	**NUCLEATION** Introduction-kinds of nucleation-equilibrium stability and Meta stable state-classical theory of nucleation-effect of soluble impurities on nucleation-determination of solubility-methods of induction period measurements-desupersaturation-steady state nucleation rate-nucleation parameters.	**15**
II	**SOLUTION AND GEL GROWTH TECHNIQUES** Low temperature solution growth-slow cooling methods-temperature gradient	**15**

	method-criteria for optimizing solution growth parameters-basic apparatus for solution growth. Gel growth-structure of silica gel and gelling mechanism-nucleation control-merits of gel method-experimental methods- chemical reaction method-chemical reduction method-complex de complex method-solubility reduction method-sol gel method.	
III	**HIGH TEMPERATURE AND OTHER TECHNIQUES OF GROWTH** Growth from melt-Bridgman, Czochralski, zone melting, Verneuil techniques-physical vapor deposition-flux growth-chemical vapor deposition chemical vapor transport-hydrothermal growth- epitaxial growth.	**15**
IV	**OPTICAL STUDIES** Atomic absorption spectroscopy-UV-Visible-NIR spectroscopy-Experimental set ups for Fourier Transform Infrared analysis, FT-Raman vibrational spectroscopy and NMR Illustrations with selected crystals-Nonlinear optical phenomenon (qualitative)-Kurtz powder SHG method-photoconductivity and schematic set up for measurements-negative photoconductivity.	**15**
V	**CRYSTAL CHARACTERIZATION** Thermal analysis-methods of thermal analysis-thermogravimetric analysis (TGA)-Differential thermal analysis (DTA)-Differential Scanning Calorimetry (DSC)-Mechanical studies-methods of hardness testing (qualitative)-Vickers hardness testing-correlation of microhardness with other properties-estimation of hardness number and work hardening coefficient (n)-dielectric studies-dielectric constant and dielectric loss measurements.	**15**

Text Books:

1. Brice J. C. (1986), ‘Crystal Growth Process’, John Wiley and Sons, New York.
2. Brice J.C. (1973), ‘The growth of crystals from liquids’, North Holland publishing company, Amsterdam.
3. Buckley H.E. (1951), 'Crystal Growth', John Wiley and Sons, New York.

4. Pamplin B.R. (1980), ‘Crystal Growth’, Pergman Press, London.
5. Henisch H.K. (1988), ‘Crystals in gels and Liesegang rings’, Cambridge Univ. Press. USA

Reference Books:

1. R.T. Sane and Jagdish K Ghadge ‘Thermal Analysis Theory and applications’ Quest Publications 1997
2. V G Dmitriev, G.G. Gurzadyan, D.N. Nikigosyan; ‘Handbook of Nonlinear optical crystals’ Springer- Verlag 1991
3. Joshi V.N. (1990), ‘Photoconductivity’, Marcel Dekker, New York.
4. Santhanaraghavan P. and Ramasamy P. Crystal growth Process and Methods, (2000) KRU Publications, Kumbakonam.

Course Outcome:

CO 1: Students will learn about the fundamentals of CO 2: Nucleation mechanism and different kinds of nucleation. CO 3: To learn about important crystal growth technique like Bridgeman, czochralski (pulling method), solution growth and hydrothermal methods, physical and chemical vapor transport. CO 4: To understand with various techniques involved in crystal growth. CO 5: To determine various theoretical parameters

. **Mapping of COs with POs & PSOs:**

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	M	M	S	S	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	S	S	S

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Semester-III / Elective Course-IV	COMMUNICATION PHYSICS	Course Code: PGPE4
Instruction Hours: 5	**Credits: 5**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Students will demonstrate an understanding of multiple theoretical perspectives and diverse intellectual traditions in communication. • Students will demonstrate an understanding of importance of free expression. • Students will competency in human relational interaction. • To understanding of professional and ethical responsibility. • An ability to communicate effectively.

UNIT	CONTENT	HOURS
I	**WAVE PROPAGATION** Fundamental of EM Waves - Free Space propagation –surface wave propagation –sky wave propagation space wave propagation-Troposphere scatter propagation-structure of Atmosphere-Virtual height-MUF-Lowest Usable Frequency-skip distance –Optimum length-duct propagation.	**15**
II	**AMPLITUDE MODULATION** Introduction - Principle - AM - DSBSC, SSB, VSB Techniques-Generation of Amplitude modulation Signals-Generation of AM, DSBSC, SSB,VSB-Introduction to PAM, PCM, PPM, PWM	**15**

III	**ANGLE MODULATION TECHNIQUES** Introduction of communication system- Elements of Communication System- Information-Transmitter, Channel, Receiver –Need for modulation-Theory of angle modulation techniques (FM, PM) - Comparison of Phase modulation and Frequency modulation-Characteristics of PM and FM –Practical issues in FM (Noise and Frequency Modulation)	**15**
IV	**ANTENNAS** Electromagnetic Radiation- Elementary doublet-Current and Voltage Distribution-Resonant Antennas, Radiation Pattern and length contraction-Antenna Resonance- Band width, Beam width and Polarization – Grounded and ungrounded Antennas-Effect of Height-Feed Point-impedance Matching.	**15**
V	**INFORMATION THEORY, CODING and DATA COMMUNICATION.** Introduction, coding-digital code- Error Detection and Correction-Characteristic of data Communication System, Transmission System – Network and control consideration (Network organization, network Protocols)	**15**

Text Books:

1. Kennedy and Davis, Electronic Communication System, Tata McGraw Hill,8th edition

Web-Resources:

1. www.math.ox.ac.uk
2. www.math.upenn.edu**.**
3. Mathematical Physics-A Modern Intro to its Foundations-S.Hassani(Springer,1999)WW.pdf

Course Outcome:

CO 1: Demonstrate critical and innovative thinking
CO 2: Display competence in oral, written and visual communication.
CO 3: Show an understanding of opportunities in the field of communication.
CO 4: Students will demonstrate an understanding of the impact of physics and science on society
CO 5: Identify the applications in communications.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

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Semester-III / **Elective Course-IV**	**LASER AND FIBER OPTICS**	Course Code: PGPE4
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Learn the underlying physics of Lasers and laser systems by combining the knowledge of gain media together with the aspects of design, configuration and operation of lasers. • Fundamental principles of stimulated emission and how to convert it into coherent light emission. • The manipulation of light i. e. mode selection, continuous and pulsed generation, spectral narrowing etc. • Applications of various lasers in various fields including scientific research to common use.

UNIT	CONTENT	HOURS
I	**LASER AND FIBER OPTICS** **Lasers:** Basic concepts of stimulated emission-Population inversion and metastable state-Ruby laser and He –Ne laser production –applications. **Fiber optics** : Introduction –Optical fiber – total –Critical angle - Principle of propagation of light through optical fibers – Type of optical fibers - Fiber optics communication system –Fiber optics sensors.	**15**
II	**Laser Resonance and cavity modes:** ABCD law for Gaussian Beams; Gaussian beams in stable resonators; ABCD law applied to cavities; Mode volume, Resonance; Q- factor & finesse; Photon lifetime; Resonance of Hermite – Gaussian modes. 8 hrs 5.	**15**

	Laser oscillation: Threshold condition; Oscillation frequency, Oscillation and amplification in a homogeneously broadened transition; Gain saturation; Oscillations in an inhomogeneous system; Hole burning & Lamb dip.	
III	**FIBER OPTICAL SOURCES AND COUPLERS LED** LED materials – fiber LED coupling – LASER – spatial emission pattern of LASER – modulation response of LASER – single frequency LASER – light emitting transistor. Optical Couplers: Types of optical couplers – star couplers – T couplers – source to fiber coupling efficiency – opto-couplers and applications.	**15**
IV	**ANALOG AND DIGITAL TRANSMISSION SYSTEM** Overview of analog links – multichannel transmission techniques – multichannel amplitude modulation – multichannel frequency modulation – digital transmission - line coding – NRZ codes RZ codes – Block codes	**15**
V	**COHERENT OPTICAL FIBER COMMUNICATION SYSTEM** Fundamental concepts – homodyne detection – heterodyne detection – modulation techniques – direct detection OOK – OOK homodyne detection – PSK homodyne detection – heterodyne detection schemes – polarization control requirements.	**15**

Text Books:

1. Optical Fiber Communication – Gerd Keiser – McGraw-Hill – 2nd Edition
2. Optical Communication System – John Gowar – Prentice Hall of India –
3. 2nd Edition
4. Optical fiber and fiber optic communication system – Subirkumarsarkar-
5. S.Chand – 4th Edition (2010).

Reference Books:

1. Svelto O.: Principles of Lasers, (V Edition), Springer 2010.
2. William Silfvast, Laser Fundamentals, Cambridge press, 2004.
3. Verdeyen,J.T.: Laser Electronics, (III Edition) Prentice Hall, 1995.
4. Govind P. Agarwal - Fiber Optic Communication System John Wiley & Sons (2002)

Web-Resources:

1. https://www.ikbooks.com/home/samplechapter?filename=190_Sample-Chapter.pdf
2. https://www.ikbooks.com/home/samplechapter?filename=190_Sample-Chapter.pdf

Course Outcome:

CO 1: Understand the principle and structure of optical fibers.

CO 2: Understand the working principle of fiber optical sources and couplers and apply it in the optical communication systems.

CO 3: Apply the fundamental principles of optics and light wave to design optical fiber communication systems.

CO 4: Understand different analog and digital transmission systems.

CO 5: Understand and apply the concepts of coherent optical modulation and detection techniques.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-IV/ **Core Course IX**	**NUCLEAR AND PARTICLE PHYSICS**	Course Code: PGPL
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• Introduce students to the fundamental principles and concepts governing nuclear and particle • Physics • Observational aspects of nuclei, including their binding energy, size, spin and parity • Nuclear models: liquid drop and shell models. • The semi-empirical mass formula and deductions from it concerning nuclear stability. • The classification of fundamental particles and their interactions according to the Standard • Model quark structure of mesons and baryons.

UNIT	CONTENT	HOURS
I	**Nuclear Properties** Nuclear energy levels - Nuclear angular momentum, parity, isospin – Nuclear magnetic dipole moment – Nuclear electric quadropole moment - Ground state of deuteron – Magnetic dipole moment of deuteron – Proton-neutron scattering at low energies – Scattering length, phase shift– Nature and properties of nuclear forces – Spin dependence – Charge symmetry – Charge independence – Repulsion at short distances – Exchange forces – Meson theory.	18

II	**Radioactive Decays** Alpha emission – Geiger-Nuttal law – Gamow theory – Neutrino hypothesis –Fermi theory of beta decay – Selection rules – No conservation of parity –Gamma emission – Selection rules –Nuclear isomerism -- Gamma ray spectroscopy – Mossbauer effect -- Interaction of charged particles and X-rays with matter – Types and basic principles of particle detectors.	**18**
III	**Nuclear Reactions and Nuclear** Reciprocity theorem – Breit-Wigner formula – Resonance theory – Liquid drop model – Shell model -- Evidences for shell model -- Magic numbers -- Harmonic oscillator – Square-well potential – Spin-orbit interaction – Collective model of a nucleus.	**18**
IV	**Fission and Fusion Reactors** Characteristics of fission – Mass distribution of fragments – Radioactive decayprocesses – Fission cross-section – Energy in fission – Bohr-Wheeler's theory of nuclear fission – Fission reactors –Thermal reactors – Homogeneous reactors –Heterogen.	**18**
Unit V	**Particle Physics** Nucleons, leptons, mesons, baryons, hyperonseous reactors – Basic fusion processes -- Characteristics of fusion –Solar fusion – Controlled fusion reactors., hadrons, strange particles - Classification of fundamental forces and elementary particles – Basic conservation laws – Additional conservation laws: Baryonic, leptonic, strangeness and isospin charges/quantum numbers – Gell-mann—Nishijima23formula - Invariance under charge conjugation (C), parity (P) and time reversal (T) – CPT theorem -- Parity non conservation in weak interactions – CP violation – Eight-fold way and super multiplets – SU(3) symmetry and quark model.	**18**
VI	• Nuclear Diagnostics for Inertial Confinement Fusion	**Field Visit**

	• Nuclear Threat Reduction and Global Security • Forensic analysis of a nuclear explosion • Nuclear Geophysics • Nuclear Logging in the Oil, Gas, Coal, and Mineral Industries. • Geo-neutrinos and the Earth's Internal Heat • Nuclear Medicine • Nuclear Imaging	

Text Books:

1. K. S. Krane, *Introductory of Nuclear Physics* (John-Wiley, New York, 1987).
2. S. B. Patel, *Nuclear Physics: An Introduction* (New Age, New Delhi, 2009).
3. D. C. Cheng and G. K. O'Neill, *Elementary Particle Physics: An Introduction* (Addison-Wesley, New York, 1979).
4. D.C. Tayal, *Nuclear Physics* (Himalaya Pub. House, New Delhi, 2011).

Reference Books:

1. R.C. Sharma, *Nuclear Physics* (K. Nath and Co, Meerut, 2004).
2. B. L. Cohen, *Concepts of Nuclear Physics* (Tata McGraw Hill, New Delhi, 1988).

Web-Resources:

1. www.math.ox.ac.uk
2. www.math.upenn.edu
3. Mathematical Physics-A Modern Intro to its Foundations S.Hassani(Springer,1999)WW.pdf

Course Outcome:

CO 1: Determine nuclear properties such as binding energy, spin and parity in the framework of the liquid drop model and the shell model of the nucleus. CO 2: Use the liquid drop model and the law of radioactive decay to describe alpha-decay, beta-decay, fission and fusion, predict decay reactions and calculate the energy release in nuclear decays CO 3: It will teach the students about the spin parity concept &magic no. Related to shell. CO 4: About the scattering process how it will occur. CO 5: Explain the experimental evidence for quarks, gluons, quark confinement, asymptotic freedom, sea quarks, the running coupling constant and colour charge

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	M	M	S	S	S	M	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-IV / Core CourseX	ADVANCED PHYSICS	Course Code: PGPM
Instruction Hours: 6	**Credits: 4**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To learn the basics and the advanced applications of physics in the fields of Astrophysics, Biomedical and wireless communication. • Understanding basic principles and phenomena in the area of medical diagnostic instrumentations. • Introduce communication systems for space vehicles. • To introduce the concepts and techniques associated with wireless communication system. • To familiarize with state of art standards used in wireless cellular systems.	
UNIT	**CONTENT**	**HOURS**
I	**Astrophysics and Radio Astronomy** **Astrophysics:** Physical properties of stars - Life cycle of a star – Endproducts of stellar evolution –Structure of milky way - Expanding universe -Future prospects. **Radio Astronomy (RA):** Radio telescopes - Synchrotron radiation – Spectrallines in RA - Major discoveries in RA - RA in India - Hot big bang cosmology.	**18**
II	**India's Space Programme** Overview - Methodological issues in cost beneficial analysis of space	**18**

	programme - The INSAT system - Broadcasting - Telecommunication - Meteorology - Indian remote sensing programme – Geo informatics (basic idea only) - The launching programme.	
III	**India's Space Programme** Overview - Methodological issues in cost beneficial analysis of space programme - The INSAT system - Broadcasting - Telecommunication - Meteorology - Indian remote sensing programme – Geo informatics (basic idea only) - The launching programme.	**18**
IV	**Biomedical Instruments** Ear and hearing Aids: Basic measurements of ear function - Air and bone conduction -Masking –Middle ear impedance audiometry - Oto-acoustic emission - Types of hearing aids and Cochlea rim plants - Sensory substitution aids - Electrophysiology: Source of biological potentials – Signal size and electrodes - Functions - Features of ECG, EEG and EMG. Cardiac and blood related devices: Pacemakers –Electromagnetic compatibility – Defibrillators -Artificial heart valves – Cardiopulmonary bypass – Hemodialysis.	**18**
Unit V	**Wireless Communication Technology-I** Cellular Radio: IMTS, AMPS control system - Security and privacy – Cellular telephone specifications and operations - Cell site equipment - Fax and data communication using cellular phones and CDPD – Digital cellular systems Personal Communication Systems (PCS): Differences between CS and PCS, IS-136 TDMA PCS, GSM, IS-95 CDMA PCS - Comparison of modulation schemes -Data communication with PCS.	**18**
Unit VI	**Radio Astronomy** **RADAR** Cellular Radio **Reconnaissance & Communications** Data communication	**Field Visit**

Text Books:

1. R. Blake, *Wireless Communication Technology* (DELMAR, New Delhi, 2001). 2.. A.W. Joshi, *Horizons of Physics* (Wiley Eastern Ltd, New Delhi, 2000).
2. R.D. Begamure (Ed.), *Scientific Truths About Our ,*
   niverse: Know Your Universe: Part I & II (Pune, 2002).

Reference Books:

1. www.math.ox.ac.uk
2. www.math.upenn.edu

Course Outcome:

CO 1: Able to use radio astronomical data to measure physical properties of astronomical targets.

CO 2: Identify and solve basic communication problems, analyse transmitter and receivers.

CO 3: Demonstrate measuring of basic medical parameters

CO 4: Analyse the radio channel characteristics and the cellular principles

CO 5: Ability to analyse improved data services in cellular communication.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	M	S	M	M	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	M	M	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating

M – Moderately Correlating

W – Weakly Correlating

N – No Correlation

Semester-IV / **Core Practical - IV**	**PHYSICS PRACTICAL IV (ELECTRONICS)**	Course Code: PGPNY
Instruction Hours: 7	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To gain practical knowledge by applying the experimental methods to correlate with the physics theory. • To learn the usage of electrical and electronic systems for various measurements. • Apply the analytical techniques and graphical analysis to the experimental data. • To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group. • Practice different types of wiring and instruments connections keeping in mind technical, Economical, safety issues. • Verification of characteristics and applications of electronic components and devices.
Any FIFTEEN experiments	
1.	Characteristics of Strain gauge
2.	Characteristics of Load cell
3.	Characteristics of Torque transducer
4.	Digital to analog converter -- R-2R and weighted method
5.	Digital comparator using XOR and NAND gates
6.	Four bit binary up and down counter using IC 7473

7.	BCD to 7 segment display
8.	Study of RAM
9.	Study of A/D converter -- Counter ramp type method
10.	Study of Arithmetic Logic Unit (ALU) -- IC 74181
11.	Pulse code modulation and demodulation
12.	Voltage controlled oscillator using IC 555
13.	Design of AC/DC voltage regulator using SCR
14.	Characteristics of Gunn diode oscillator
15.	Up/down counter using mod 10

Course Outcome:

CO 1: Understand the behaviour of electronic components and perform analysis and design of bias circuits for diodes, transistors etc.

CO 2: Set up testing strategies and select proper instruments to evaluate performance characteristics of electronic circuit.

CO 3: Choosing testing and experimental procedures on different types of electronic circuit and analyse their operation different operating conditions.

CO 4: Use special function ICs for different applications.

CO 5: Develop logic circuits for various applications in real life and Design and develop data convertors.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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Semester-III / Elective Course-V	**ADVANCED EXPERIMENTAL TECHNIQUES**	**Course Code: PGPE5**
Instruction Hours: 6	**Credits: 4**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• To make the students understand the principles. • To involve in measuring devices, error measurements, the standards of measurements. • To understand performance characteristics of an instrumentation system, transducers, and vibration sensing devices. • To apply the techniques.

UNIT	CONTENT	HOURS
I	**X ray diffraction methods** Sterographic projection - wulff net – measurement of angle between poles-determination of Miller indices of an unknown pole. X- ray diffraction under non ideal conditions – Scherrer formula for estimation ofparticlesize. Laue method, rotating crystal method – powder method-Scherrer camera.	15
II	**Spectroscopic techniques** Mass spectroscopy and Xray emission spectroscopy (principle and limitations), Quadrupole mass spectrometer- X ray photo electron spectroscopy (XPS), Auger electron spectroscopy (AES) – laser Raman spectroscopy – Fourier transform infrared spectroscopy.	15

III	**Electron beam techniques** Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Ruther ford back scattering spectrometry (RBS), Ion beam techniques, Field ion microscopy (IM)	**15**
IV	**Optical techniques** Use of polarized light in the study of transparent materials – polarized light microscopy – coloscopy –compensator techniques–Babinet– Soleil compensator - Berek compensator.	**15**
V	**Thermal analytical techniques** Differential thermal analysis – Instrumentation – differential scanning calorimetry – thermo gravimetric analysis –Instrumentation.	**15**

Text Books:

1. Cullity BD, Elements of X ray diffraction Addison Wesley PublishingCo, 1967,3rd Edition.
2. Dieter K Schroder, *Semiconductor material and Characterization* John Wiley and sons inc, 1990, 2nd edition).
3. PruttonM ,Surface Physics,ClarendonPress,1975,2nd edition.
4. M.Woolfson,An IntroductiontoXrayCrystallography,CambridgeCambridge,1970,2nd edition.

Reference Books:

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3. PruttonM ,Surface Physics,ClarendonPress,1975,2nd edition.
4. M.Woolfson,An IntroductiontoXrayCrystallography,CambridgeCambridge,1970,2nd edition.

Web-Resources:

1. https://www.amazon.in/Advanced-Experimental-Techniques-Physics-Prakashan/dp/B07YCM821T
2. https://eng.ua.edu/tag/advanced-experimental-techniques/

Course Outcome:

CO 1: The students are expected to learn the art and science of carrying out experimental research.
CO 2: At the end of the course a student should be able to design and carry out an experiment on his/her own.
CO 3: This is an important skill which anybody wanting to do experimental research is expected to possess.
CO 4: To learn the art and science of carrying out experimental research
CO 5: Techniques of curve fitting and parameter estimation

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	M	S	M	S	S	S	S	S

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Semester-IV / Elective Course V	BASICS OF COMPUTATIONAL NANOELECTRONICS	Course Code:- PGPE5
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create
Course Objectives	• The purpose of this course is to introduce the physical concepts underlying the phenomena in the mesoscopic systems. • The aim of the course is, how to model and solve nanojunctions. • In this course, students will learn some new advanced topics such as: quantization of electrical conductance, Coulomb Blockade, quantum capacitance and etc.

UNIT	CONTENT	HOURS
I	Two Key Concepts, Why Electrons Flow, Conductance Formula, Ballistic Conductance, Diffusive Conductance, Connecting Ballistic to Diffusive, Drude Formula, Characteristic Length Scale, Transport Regime.	**15**
II	Density of States, Number of Modes, Electron Density, Conductivity vs. Electron Density, Quantum Capacitance, Nanotransistors, What and Where is the Voltage, Spin Voltage, Current from QuasiFermi Levels, Electrostatic Potential	**15**
III	What a Probe Measures, Boltzmann Equation, Semiclassical Model, Quantum Model, Landauer Formulas, NEGF Equations, Self-Energy, Surface Green's Function, Current Operator, Scattering Theory, Transmission, Rate Equations.	**15**

IV	Spin Transport, Vectors and Spinors, Spin-Orbit Coupling, Spin Hamiltonian, Spin Density/Current, Seebeck Coefficient, heat Current, Second Law, Entropy, Fuel Value of Information	**15**
V	Application of Nanomaterials Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics - Carbon Nanotube – Photonics- Nano structures as single electron transistor –principle and design.	**15**

Text Books:

1. Lessons from Nanoelectronics: A New Perspective on Transport: Volume 1 & 2 by Supriyo Datta (World Scientific) G:
2. Theory of Quantum Transport at Nanoscale: An Introduction by Dmitry A Ryndyk (Springer) H:
3. Quantum Transport: Introduction to Nanoscience by Yuli V. Nazarov and Yaroslav M. Blanter (CAMBRIDGE)

Reference Books:

1. S.P. Gaponenko, Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1980.
2. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 2002. \

Web-Resources:

1. https://www.ecc.itu.edu.tr/index.php/ELE_523E
2. https://www.nature.com/subjects/computational-nanotechnology

Course Outcome:

CO 1: Discuss the types of nanotechnology, molecular technology and the preparation of nano materials. CO 2: Explains the fundamental of the devices such as logic devices, field effect devices, and spintronics. CO 3: Describe the concepts of silicon MOSFET and Quantum Transport Devices. CO 4: Summarize the types, synthesis, interconnects and applications of carbon nano tubes. CO 5: Explain the concepts, functions, fabrications and applications of molecular electronics

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	M	S	S
CO2	S	S	M	M	S	S	S	S	S	S
CO3	S	S	M	M	S	S	S	M	S	S
CO4	S	S	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

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