J.J. COLLEGE OF ARTS AND SCIENCE, PUDUKKOTTAI – 622 422.
M.Sc. Physics Course Structure under CBCS
(For the candidates admitted from the academic year 2019-2020onwards)

Semester	Course Code	Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		
						Int.	Ext.	Total
I	P1R1PHCC1	Mathematical Physics	6	5	3	25	75	100
	P1R1PHCC2	Classical Mechanics	6	5	3	25	75	100
	P1R1PHCC3	Analog and Digital Electronics	6	5	3	25	75	100
	P1R1PHCC4P	Major Practical-I	6	5	4	40	60	100
	P1R1PHEC1	Numerical methods and Computational Physics	6	3	3	25	75	100
			30	**23**				**500**
II	P2R1PHCC5	Electromagnetic Theory	5	5	3	25	75	100
	P2R1PHCC6	Quantum Mechanics	5	5	3	25	75	100
	P2R1PHCC7	Statistical Mechanics	5	5		25	75	100
	P2R1PHCC8	Microprocessor and Micro controller	5	5	3	25	75	100
	P2R1PHCC9P	Major Practical-II	6	5	4	40	60	100
	P2R1PHCEC2	Crystal Growth and Thin Films	4	3	3	25	75	100
			30	**28**				**600**

III	P3R1PHCC10	Condensed Matter of Physics	6	5	3	25	75	100
	P3R1PHCC11	Atomic and Molecular Spectroscopy	6	5	3	25	75	100
	P3R1PHCC12P	Major Practical–III	6	5	4	40	60	100
	P3R1PHEC3	Nano Science and Nano Technology	6	3	3	25	75	100
	P3R1PHEC4	Advanced Physics	6	3	3	25	75	100
			30	**21**				**500**
IV	P4R1PHCC13P	Major Practicals–IV	6	5	4	40	60	100
	P4R1PHCC14	Nuclear and Particle Physics	6	5	3	25	75	100
	Core Course–XV Project Work	Dissertation 80 Marks [2 reviews– 20+20 =40marks Report Valuation =40 marks] Viva 20 Marks	18	8	***	***	***	100
		Total	30	18				300
		GRAND TOTAL		**90**				**1900**

SEMESTER-I: CORE COURSE-I MATHEMATICAL PHYSICS		
Course Code : P1R1PHCC1		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- To understand various mathematical techniques and concepts
- To practice mathematical methods for physics through vector analysis, matrices, tensors, complex analysis, special functions and group theory

UNIT - I: VECTOR ANALYSIS

Vector algebra – addition of vectors - product of vectors - Gradient, divergence, curl and Laplacian – Vector identities – Line integral, surface integral and volume integral – Gauss theorem, Green's Theorem, Stoke's theorem and applications – Orthogonal curvilinear coordinates – Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates.

UNIT - II: TENSORS AND MATRIX THEORY

Transformation of coordinates – Summation convention – Contravariant, covariant tensors – Tensors of higher rank – Symmetric and antisymmetric tensors – Characteristic equation of a matrix – Eigen values and eigenvectors – Cayley - Hamilton theorem - Reduction of a matrix to diagonal form – Jacobi method – Power of a Matrix.

UNIT - III: COMPLEX ANALYSIS

Functions of complex variables – Differentiability -- 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 – Evaluation of definite integrals.

UNIT -IV: SPECIAL FUNCTIONS

Gamma and Beta functions – Sturm-Liouville problem – Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations : series solution – Rodriguez formula – Generating functions – Orthogonality relations – Important recurrence relations

UNIT - V: GROUP THEORY

Basic definitions – Multiplication table – Subgroups, Cosets and Classes – Direct Product groups – Point groups – Space groups – Representation theory – Homomorphism and isomorphism– Reducible and irreducible representations – Schur's lemma – The great Orthogonality theorem – Character table -- D_3 as example.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study:

1. Mathematical Physics ,Sathya prakash, , Sultan Chand & sons, Fifth revised and enlarged edition, 2006, New Delhi – 110 002. (Unit I - IV)

2. Chemical Applications of Group Theory, F.A. Cotton, (Wiley Eastern, New Delhi, 1987). (Unit- V)

Books for Reference:

1. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern Ltd., New Delhi (1975)
2. Applied Mathematics for Engineers and Physicists, L.A.Pipes and L.R. Harvill, McGraw Hill Company, Singapore (1967)
3. Mathematical Physics, P.K.Chattopadhyay, Wiley Eastern Ltd., New Delhi (1990)
4. Mathematical Physics, A.K.Ghattak, T.C.Goyal and S.J. Chua, Macmillan, New Delhi (1995)
5. Methods for Physicists G.Arfken and H.J.Mathemattical, 4th ed. Physicists (Prism Books, Banagalore, 1995).
6. Special Functions for Scientists and Engineers W.W.Bell, (Van Nostrand, New York, 1968).

Course Outcome:

After completing this course students shall be able to

- ❖ Understand the methods and solutions of special functions.
- ❖ Understand the concept of complex analysis and various theorems.
- ❖ Acquire skill to solve physics problems using complex analysis.

SEMESTER-I: CORE COURSE-II CLASSICAL MECHANICS		
Course Code : P1R1PHCC2		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- To understand the fundamental principles of classical mechanics and their applications
- To understand Lagrangian and Hamiltonian principles and its applications
- To study the canonical transformations of Poisson's Brackets & Hamilton – Jacobi Theory
- To study the general theory of small oscillations and Rigid body dynamics
- To study the energy concepts in relativistic mechanics.

UNIT - I: FUNDAMENTALS OF CLASSICAL MECHANICS

Mechanics of a particle and system of particles – Conservation laws – Constraints – Generalized coordinates – D'Alembert's principle and Lagrange's equation – Hamilton's principle – Lagrange's equation of motion – conservation theorems and symmetry properties – Motion under central force : General features – The Kepler problem Scattering in a central force field.

UNIT -II: LAGRANGIAN FORMULATION: APPLICATIONS

a) Rigid Body Dynamics

Euler angles – Moments and products of inertia – Euler's equations – Symmetrical top.

b) Oscillatory Motion

Theory of small oscillations – Normal modes and frequencies – Linear triatomic molecule Wave motion – wave equation – Phase velocity – Group Velocity dispersion

UNIT -III: HAMILTON'S FORMULATION

Hamilton's canonical equations of motion – Hamilton's equations from variational principle – Principle of least action – Canonical transformations – Poisson brackets – Hamilton – Jacobi method – Action and angle variables – Kepler's problem in action – angle variables.

UNIT -IV: NON-LINEAR DYNAMICS

Linear and nonlinear oscillators- phase trajectories – Period doubling phenomenon in Duffing oscillator.

Soliton: Linear and nonlinear waves – Solitary Waves – KdV equation – Numerical experiments of Kruskal and Zabusky – Solitons.

UNIT -V: RELATIVISTIC MECHANICS

Reviews of basic ideas of special relativity – Energy momentum four vector – Minkowski's four dimensional space – Lorentz transformation as rotation in Minkowski's space – Compositions of L.T. about two orthogonal directions – Invariance of Maxwell's equations under Lorentz transformation – Elements of general theory of relativity.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for study

1. Classical Mechanics, H.Goldstein, Narosa Book distributors, New Delhi (1980)
2. Nonlinear Dynamics M.Lakshmanan and S.Rajasekar:: Integrability, Chaos and
3. Patterns, Springer – Verlag, Berlin (2003), Springer (India) 2004
4. Chaos in Nonlinear Oscillators,M.Lakshmanan and K.Murali: world Scientific Co., Singapore (1996). Chapters 2-4.

Books for Reference

1. Classical Mechanics,N.C.Rana and P.S.Joag Tata Mc: Graw Hill, New Delhi (1991)

Course Outcomes:

After completing this course students shall be able to

- ❖ Acquire knowledge about conservation laws and constraints.
- ❖ Apply Lagrangian formulation to solve problems in mechanics.
- ❖ Acquire knowledge about central force problem.
- ❖ Understand Kepler problem.
- ❖ Acquire knowledge about Hamilton's formulation.
- ❖ Apply Hamilton's formulation to solve problems in mechanics.
- ❖ Acquire knowledge to derive Euler's equations and to apply them for rigid body dynamics.
- ❖ Understand the concepts of relativistic mechanics.

SEMESTER-I: CORE COURSE-III ANALOG AND DIGITAL ELECTRONICS		
Course Code : P1R1PHCC3		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- ❖ To study the fabrication of semiconductor devices
- ❖ To study the constructions, operations and characteristics of solid state devices
- ❖ To learn the circuit operation of Op-amp and 555 timer applications.

UNIT -I: SEMI CONDUCTOR DEVICES AND THYRISTORS:

FET – Characteristics – Parameters – MOSFET – Depletion mode MOSFET – Enhancement mode MOSFET – V_MOSFET. SCR operation – SCR characteristics – Parameters - 90˚ phase control – TRIAC operation and Characteristics – TRIAC Phase control circuit – SUS – SBS – UJT operation – UJT characteristics – Parameters – Relaxation Oscillator – PUT.

UNIT - II: OPTO ELECTRONIC DEVICES:

LED - Photo diode - Photo transistor - PIN diode – Varactor diode – Tunnel diode – Gun diode – Schottky diode – LDR – Opto coupler – Solar cells.

UNIT –III: OPERATIONAL AMPLIFIER

Operational amplifier characteristics – inverting and non-inverting amplifier – instrumentation amplifier – voltage follower –integrating and differential circuits –log & antilog amplifiers – op-amp as comparator – Voltage to current and current to voltage conversions-active filters: low- pass, high pass, band pass -Solving simultaneous and differential equations.

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

Wien bridge, phase shift oscillators–triangular, saw-tooth and square wave generators-Schmitt's trigger – sample and hold circuits – Voltage control oscillator – phase locked loops. Basic D to A conversion: binary weighted resistor DAC – Binary R-2R ladder DAC – Basic A to D conversion: counter type ADC – successive approximation converter – dual slope ADC. IC 555 timer – description of the functional diagram – mono stable operation – Astable operation.

UNIT – V: SEQUENTIAL CIRCUIT COMPONENTS:

Introduction to sequential circuits - Latches and Flip Flop: SR latch – Timing problems and clocked SR latches - JK latch - Master slave latch - Delay Flip Flop - T Flip Flop - Flip Flop excitation requirements – Shift Registers.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Electronic devices and circuits, S.Sallaivahanan, N.Suresh kumar and A.Vallavaraj, Tata McGraw-Hill Publishing Company Lited, New Delhi(1998).
2. Linear integrated circuits S.Roy Chaudri, Shail Jain, New age International (P) Limited, New Delhi(1983).
3. Op-Amps & Linear integrated circuits, R.A.Gayakwad, Printice Hall India Pvt

Ltd.(1999)

Reference Books:

1. Electronic device and circuits, G.K.Mittal, Printice Hall India Pvt Ltd.(1999)
2. Active and Nonlinear Electronics, T.F.Schubert and E.M.Kim, John Wiley Sons, New York (1996)
3. Electronic Devices, L.Floyd, “Pearson Education” New York (2004)
4. Transitors, Dennis Le Crissitte, Printice Hall India Pvt. Ltd (1963)
5. Physics of Semiconductor Devices, S.M.Sze, Wiley-Eastern Ltd (1981)

Course Outcomes:

After completing this course students shall be able to

- the current voltage characteristics of semiconductor devices.
- Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation.
- Design and analyze of electronic circuits.
- Understand the fundamentals and areas of applications for the integrated circuits.
- Analyze important types of integrated circuits.
- Analyze, design and implement sequential logic circuits.

SEMESTER-I: CORE COURSE-IV MAJOR PRACTICAL - I(General & Electronics)		
Course Code : P1R1PHCC4P		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 40**
Credit : 5		**External Marks : 60**

Objectives:

- ❖ To understand a set of physical laws by using appropriate equipments through experiments.
- ❖ To design and learn the characteristics of significant electronic circuits.

Any fifteen Experiments (choosing a minimum of six experiments from each part)

A. General Experiments

1. Determination of q, n, b by elliptical fringes method
2. Determination of q, n, b by hyperbolic fringes method
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation
4. Determination of Stefan's constant
5. Identification of prominent lines by spectrum photography – Copper spectrum
6. Identification of prominent lines by spectrum photography – Iron spectrum
7. BH loop – Energy loss of a magnetic material – Anchor ring using B.G.
8. Determination of dielectric constant at high frequency by Lecher wire
9. Determination of e/m of an electron by magnetron method
10. Determination of e/m of an electron by Thomson's method
11. Determination of L of a coil by Anderson's method
12. Photoelectric effect (Planck's constant Determination)

B. Electronics Experiments

1. Design and study of Monostable Multivibrator
2. Design and study of Bistable Multivibrator
3. Design and study of Wein Bridge Oscillator (Op-amp)
4. Design and study of Phase Shift Oscillator (Op-amp)
5. Characteristics of JFET
6. Characteristics of UJT
7. Characteristics of LDR
8. FET amplifier - Common source
9. Hartley oscillator using Transistor
10. Colpitts oscillator using Transistor
11. Relaxation oscillator using UJT
12. Single stage amplifier using Transistor

SEMESTER-II: CORE COURSE-V ELECTROMAGNETIC THEORY		
Course Code : P2R1PHCC5		**Max. Marks : 100**
Hours/Week : 5		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objective:

- ❖ To study the basics of electrostatics and magnetostatics
- ❖ To understand the wave propagation in different medium.
- ❖ To acquire the knowledge of EM waves in conductor and dielectric
- ❖ To study the modes of propagation of guided waves and propagation through wave guides.

UNIT – I: ELECTROSTATICS

Coloumbs law-electric intensity-electric potential-gauss law-dielectrics and its polarization-dielectric constant-types of polarisibility - polarisation of polar and non polar molecules-claussiaus mosotti equation-langevein equations.

UNIT – II: BOUNDARY VALUE PROBLEMS IN ELECTORSTATICS

Boundary conditions- poissons and laplace equations –method of separation of variables in Cartesian coordinates(potential at a point between the parallel plate capacitor and two grounded plane electrode) - cylindrical coordinates(In a uniform field conducting cylinder and dielectric cylinder)-method of images (point charge near and infinity ground conducting plane point charge near conducting sphere)-green function method.

UNIT – III: MAGNETOSTATICS

Biot savart law-applications(long straight wire and circular coil)-ampere circuital law-applications(long straight wire & solenoid)-force on current carrying conductors(force between two parallel wires and force on a point charge moving in a magnetic field)-hysteresis.

UNIT – IV: ELECTROMAGNETIC

Faradays law of induction-maxwells diaplacement current- maxwells equations in terms of vector and scalar potentials-gauss transformations –lorentz gauge, coloumb gauge-poyting theorem-conservation of energy and momentum for a system of charged particles and electro magnetic fields.

UNIT - V: ELECTROMAGNETIC WAVES AND WAVE PROPAGATION

Propagation of electromagnetic wave in free space – propagation of electromagnetic wave in conducting media (Phase velocity, refractive index, spatial attenuation only) – equation of continuity – displacement current –Wave guides – rectangular wave guide – TM & TE mode.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Electromagnetic theory, Chopra &Agarwal, K.Nath and Co, Meerut, Sixth edition, 2006.

2. Electromagnetic Theory, Sathyaprakash, kedar nath Ramnath, publishing company meerut, (2006)
3. Classical Electrodynamics J. D. Jackson, (Wiley Eastern Ltd., New Delhi, 1999).

Books for Reference

1. Introduction to Electrodynamics D. Griffiths, (Prentice-Hall, New Delhi, 1999).
2. The Feynman Lectures on Physics,R. P. Feynman et al, Vol.II (Narosa, New Delhi, 1989).

COURSE OUTCOMES:

On completing this course students shall be able to

- ❖ demonstrate a mastery of Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- ❖ exploit alternative coordinate systems (Cartesian and spherical coordinates) to solve problems.
- ❖ reformulate the laws of electrostatics in the form of Laplace's or Poisson's equations for the potential, and solve boundary-value problems
- ❖ Examine the phenomena of wave propagation in different media..

SEMESTER-II: CORE COURSE-VI QUANTUM MECHANICS		
Course Code : P2R1PHCC6		**Max. Marks : 100**
Hours/Week : 5		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- To understand the concepts and Formalism of Quantum Mechanics.
- To know physical applications of Schrodinger's equations.
- To learn and acquire the knowledge of approximation methods.
- To empathize the Scattering theory and Angular momentum concepts.
- To study the concepts of Relativistic Quantum mechanics.

UNIT -I: SCHRODINGER EQUATION AND GENERAL FORMULATION

Matter waves - Schrodinger Equation – Physical significance and conditions on the wave function – Expectation values and Ehrenfest's theorem – Hermitian operators and their properties – Commutator relations - Uncertainity relation - Bra and ket vectors.

UNIT -II: EXACTLY SOLVABLE SYSTEMS

One dimensional Schrodinger equation – Particle in a box – Square well potential -- Rectangular Potential barrier – Linear harmonic oscillator - Rigid rotator – Hydrogen atom.

UNIT - III: APPROXIMATION METHODS

Time independent perturbation theory: Non-degenerate and degenerate perturbation theories (first order only) -- Stark effect – WKB Approximation -- Application to tunneling problem and quantization rules.

Time dependent perturbation theory: Harmonic Perturbation -- Transition probability – Fermi –Golden rule.

UNIT -IV: SCATTERING THEORY AND ANGULAR MOMENTUM

Scattering theory: Scattering cross section – Scattering amplitude -- Partial wave analysis -- Breit-Wigner formula -- Born Approximation.

Angular momentum: Angular momentum operators – commutation relations – Eigen values and Eigen functions of L and J – Angular momentum matrices -- Spin angular momentum -- Addition of angular momenta - Clebsch-Gordan coefficients (J=1 and J=2).

UNIT -V: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon equation for a free particle and in an electromagnetic field – Dirac equation for a free particle -- Dirac matrices – Charge and current densities -- Negative energy states – Spin of the Dirac particle – Spin-orbit interaction– Zitterbewegung.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Quantum mechanics, Sathya Prakash, Kedarnath Ramnath & Company, Meerut, (2006).
2. Quantum mechanics, G.Arul dhas, Prientice Hall of India, New Delhi (2006).
3. Quantum Mechanics, V.K.Thankappan, Wiley-Eastern, Second Edition, New Delhi,

(1995).

Books for Reference

1. Quantum Mechanics, V. Devanathan, Naroso Publishing House, (2011).
2. Quantum Mechanics, L. Schiff, Tata McGraw Hill, New Delhi, 1968.
3. A Text Book of Quantum Mechanics, P. M. Mathews and K. Venkatesan, Tata McGraw Hill, New Delhi, 1987.

Course Outcomes:

After completing this course students shall be able to

- ❖ Understand the concepts and principles of Quantum Mechanics: the Schrodinger equation, the wave function and its physical interpretation, stationary and non-stationary, time evolution and expectation values.
- ❖ Apply principle of quantum mechanics to calculate observables on known wave functions.
- ❖ Grasp the concept of spin and angular momentum as well as their quantization and addition rules.
- ❖ Explain physical properties of elementary particles (nucleons, atoms, molecules and solids (bond structure) based on quantum mechanics.

SEMESTER-II: CORE COURSE-VII STATISTICAL MECHANICS		
Course Code : P2R1PHCC7		**Max. Marks : 100**
Hours/Week : 5		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- To review the fundamental concepts of thermodynamics in order to understand Statistical Mechanics.
- To acquire knowledge about the phase transition of a system and its models.
- To study the kinetic theory of gases and principles of entropy.
- To know the concept of Boltzmann transport equation and its applications
- To understand the principles of classical statistical mechanic and its application to compute the various parameters of molecules.
- To understand the need for quantum Statistical Mechanics and its various applications.

UNIT -I: THERMODYNAMICS

Laws of thermodynamics — Entropy – Calculation of entropy changes in reversible processes – The principle of increase of entropy – Thermodynamic potentials –Enthalpy-Helmholtz and the Gibbs functions – Phase transitions – The Clausius-Clapeyron equation – Van der Waals equation of state.

UNIT -II: KINETIC THEORY

Distribution function and its evolution - Boltzmann transport equation and its validity – Boltzmann's H-theorem – Maxwell relation - Chemical potential- Transport phenomena: Mean free path – Conservation laws

UNIT - III: CLASSICAL STATISTICAL MECHANICS

Review of probability theory – Macro-and micro states – Statistical equilibrium – Phase space and ensembles – Density function – Liouville's theorem. Maxwell-Boltzmann distribution law – Micro canonical ensemble – Ideal gas – Entropy – Partition function – Principle of equipartition of energy – Canonical and grand canonical ensembles.

UNIT -IV: QUANTUM STATISTICAL MECHANICS

Basic concepts – Quantum ideal gas – Bose-Einstein and Fermi-Dirac statistics – Distribution laws – Sackur-Tetrode equation – Equations of state -- Bose-Einstein condensation- Random walk and Brownian motion - Diffusion equation.

UNIT -V : APPLICATIONS OF Q.S.M.

Ideal Bose gas : Principle of detailed balance- Photons – Black body and Planck radiation – Specific heat of solids – Liquid Helium.
Ideal Fermi gas : Properties – Degeneracy – Electron gas – Pauli paramagnetism.
Ferromagnetism : Ising and Heisenberg models.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Statistical Mechanics,(K. Huang, Wiley Eastern Limited, New Delhi, 1963).
2. Statistical Mechanics, B. K. Agarwal and M. Eisner, (Wiley Eastern Limited, New Delhi,1994).
3. Thermodynamics, N. Sears and L. Salinger, (Narosa, New Delhi, 1989).

Books for Reference

1. Fundamentals of Statistical and Thermal Physics, F. Reif, (McGraw Hill, Singapore, 1985).
2. Thermodynamics and Statistical Mechnaics, W. Greiner, L. Neise and H. Stocker, (Springer, New York, 1995).

COURSE OUTCOMES:

After completing this course students shall be able to

- Acquire knowledge about different laws of thermodynamics.
- Understand about different thermodynamic Potentials and their importance to deduce reciprocity relations.
- Knowledge about Liouville's theorem and its importance.
- Applications of MB distribution law.
- Applications of BE and FD distribution laws.
- Application of statistical laws to study transport phenomena.
- Acquire knowledge about phase transitions of first and second type.

SEMESTER-II: CORE COURSE-VIII MICROPROCESSOR AND MICROCONTROLLER		
Course Code : P2R1PHCC8		**Max. Marks : 100**
Hours/Week : 5		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- To understand the Microprocessor and Microcontroller architecture.
- To understand the assembly language program of the micro processor and micro controller.
- To understand the hardware components and software programming instructions of INTEL 8086 microprocessors and 8051 microcontroller.
- To understand the concept of interfacing and peripheral devices.

UNIT - I: 8086 MICROPROCESSOR ARCHITECTURE

Organization of 8086 microprocessor-Memory organization - Register structure-Addressing modes in 8086-Pin configuration 8086 microprocessor-Minimum mode configuration-Maximum mode configuration-internal interrupts-External interrupts-Exception handling in 8086

UNIT - II: INSTRUCTION SET AND PROGRAMMING(8086)

Data transfer – Arithmetic - Branch Loop - Flag manipulation - Logical shift and rotate instructions. Programme in 8086-Addition – subtraction – multiplication – division - Choosing the biggest and smallest from a list - Arranging a list of numbers in ascending and descending order. Time delay-Character manipulation.

UNIT - III: MICROCONTROLLER 8051

Overview of 8051 family-pin description of 8051-Registers-Program counter - Romspace-RAM SPACE, Stack, PSW, SFR, Addressing modes-Jump call instruction - Arithmetic and Logic instruction - BIT instruction.

UNIT - IV: MICROCONTROLLER SFRS AND PROG

Basics of Serial communication-RS232 connections and ICSMAX 232-8051serial communication register - Serial communication programmes – Interrupt - Interrupt reg - Internal and External interrupt programming.

UNIT - V: MICROPROCESSOR AND MICROCONTROLLER APPLICATION

Microprocessor interfacing and application - Programmable Peripheral interface Intel 8255 measurement of frequency, voltage current, measurement of temp, microprocessor based TLC, generate square or pulse. - Micro Controller based Interfacing and application: Interfacing steeper motor, keyboard and DAC.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Introduction to Microprocessor 8086 by Aditya P Mathur (1989).
2. Micro Controller and Embedded System by Muhammed Ali Mazidi – 8052 (1997).

Book for Reference

1. Micro processor 8086 by Raffikuzman(1995).
2. Micro processor and Interfacing by Douglas V. Hall (1998 13th Edition).
3. The 8051 Micro Controller Architecture, Programming & Application (2nd Edition) by Kenneth Jayala(1991).

Course Outcomes:

After completing this course students shall be able to

- ❖ Write programs to run on 8086 microprocessor based systems.
- ❖ Design system using memory chips and peripheral chips for 16 bit 8086 microprocessor.
- ❖ Understand and device techniques for faster execution of instructions, improve speed of operations and enhance performance of microprocessors.

SEMESTER-II: CORE COURSE-IX MAJOR PRACTICAL – II GENERAL EXPERIMENTS		
Course Code : P2R1PHCC9P		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 40**
Credit : 5		**External Marks : 60**

Objectives:

To understand a set of physical laws by using appropriate equipments through experiments.

(Any Twelve Experiments)

1. Four probe method – Determination of resistivity of powdered samples.
2. Determination of carrier concentration and Hall coefficients in semiconductors.
3. Determination of magnetic susceptibility of liquid by Guoy method.
4. Determination of magnetic susceptibility of liquids by Quincke's method.
5. Determination of dielectric constant of a liquid by RF Oscillator method.
6. Determination of wavelength and thickness of a film by using Michelson's Interferometer.
7. Brass spectrum – Determination of composition.
8. Salt analysis by using Spectrograph.
9. ALO band spectrum.
10. Charge of an electron by spectrometer.
11. Polarizability of liquids by finding the refractive indices at different wavelengths.
12. Determination of wavelength of monochromatic source using Biprism.
13. Determination of refractive index of liquids using Biprism (by scale & telescope method).
14. Determination of specific rotatory power of a liquid using Polarimeter.
15. Rydberg's constant using spectrometer.
16. Determination of coefficient of coupling by AC bridge method.
17. Magneto resistance of powder samples using CE bridge.
18. Forbe's method of determining thermal conductivity.
19. Determination of dielectric loss using CRO.
20. Particle size determination using He-Ne Laser.
21. Laser diode characteristics.

SEMESTER-III: CORE COURSE-X CONDENSED MATTER OF PHYSICS		
Course Code : P3R1PHCC10		Max. Marks : 100
Hours/Week : 6		Internal Marks : 25
Credit : 5		External Marks : 75

Objectives:

- To study the structure of crystalline solids.
- To study the carrier movement, lattice vibration and thermal property in solids.
- To understand the concepts of Free Electron and Band Theory of Solids.
- To study the dielectric and magnetism in solids.
- To study the super conductivity and its applications.

UNIT – I: CRYSTAL PHYSICS

Crystals - Crystal lattice and translation vectors - Types of lattices (2D & 3D) - Point group – Space groups - Lattice direction and planes - Simple crystal structures - Close packed and loose packed structures - Structure of Diamond, Zinc Blend and Sodium chloride- X-ray diffraction - X-ray diffraction methods (Laue's method, Power crystal method) - Reciprocal lattice and its Properties - Imperfections in crystals - Point defects - line defects.

UNIT – II: SEMICONDUCTORS, LATTICE VIBRATIONS AND THERMAL PROPERTY

Intrinsic and Extrinsic semiconductors - General study of carrier movement - Fermi level and conductivity – Lattice vibrations - One dimensional Monatomic lattice and diatomic lattice - Phonons - Phonon momentum - Lattice heat capacity - Classical theory (Dulong and Petit Law) - Einstein theory - Debye's model - Density modes.

UNIT – III: FREE ELECTRON THEORY AND BAND THEORY OF SOLIDS

Drude - Lorentz's classical theory of free electron gas – Relation between thermal and electrical conductivity (Wiedemann-Franz Law) – Free electron Gas in a 1-D - Free electron Gas in a 3-D- Application of free electron gas model – Bloch theorem – Kronig-Penny model – effective mass of electron.

UNIT – IV: DIELECTRICS AND MAGNETISM IN SOLIDS

Polarization and Susceptibility – Local field - Dielectric constant and Polarizability (Clausius-Mosotti Equation) - Sources of Polarizability - Ferro electricity - Piezo electricity - Classical and Quantum theory of Dia and Para magnetism - Weiss theory of ferromagnetism - Hund rules-Concepts of Domains – Antiferromagnetism – Ferrimagnetism.

UNIT – V: SUPERCONDUCTIVITY

Introduction – The Meissner effect – Soft and hard superconductors –Thermo dynamical and optical properties – Type -I and Type-II superconductors - London equations – BCS theory-Quantum tunneling-Josephson tunneling- Theory of DC Josephson effect – Theory of AC Josephson effect- High Tc super conductors – SQUIDS – Applications of super conductors.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Introduction to Solid State Physic, C. Kittel, Wiley Eastern, New Delhi, 2008.
2. Solid State Physics, A. J. Dekker, McMillan, Madras, 1971.
3. Solid State Physics, S. O. Pillai, New Age International (P) Ltd, Revised 6th Edition, 2008.
4. Solid State Physics, Gupta and Kumar, K.Nath & Co, Meerut, 2011.

Books for Reference

1. An Introduction to X-ray Crystallography, M. M. Woolfson, Cambridge University Press, Cambridge, 1991.
2. Solid State Physics N. W. Ashcrof and N. D. Mermin, Holt, Rinehart and Winston, Philadelphia.
3. Solid State Physics J. S. Blakemore, Cambridge University Press, Cambridge, 1985.

Course Outcomes:

After completing this course students shall be able to

- Understand the basic ideas of crystals, its periodic structure and defects.
- Empathize the properties that result from the distribution of electrons in metals, semiconductors and insulators.
- Able to comprehend the dielectric and magnetic properties of solids.
- Identify with the concepts of defects and dislocations in crystals and its consequences.
- Acquire the knowledge about the theories underlying the superconducting properties of materials.

SEMESTER-III: CORE COURSE-XI ATOMIC AND MOLECULAR SPECTROSCOPY		
Course Code : P3R1PHCC11		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- ❖ To acquire the knowledge of interaction electromagnetic radiation with atoms and molecules and study the different types of spectra
- ❖ To understand the behavior of the atoms in external fields and quantum chemistry
- ❖ To know the spectroscopic techniques to be used in finding the molecular structure, bond angles, bond length etc.

UNIT -I : ATOMIC SPECTRA

Quantum states of electron in atoms – Hydrogen atom spectrum – Electron spin – Stern-Gerlach experiment – Spin-orbit interaction – Two electron systems – LS-JJ coupling schemes – Fine structure – Spectroscopic terms and selection rules – Hyperfine structure - Alkali type spectra – Equivalent electrons – Hund's rule.

UNIT -II : ATOMS IN EXTERNAL FIELDS AND QUANTUM CHEMISTRY

Atoms in External Fields : Zeeman and Paschen-Back effect of one and two electron systems -- Selection rules – Stark effect.

Quantum Chemistry of Molecules : Covalent, ionic and van der Waals interactions – Born-Oppenheimer approximation – Heitler-London and molecular orbital theories of H_2 – Bonding and anti-bonding MOs – Huckel's molecular approximation.

UNIT -III : MICROWAVE AND IR SPECTROSCOPY

Rotational spectra of diatomic molecules – Effect of isotopic substitution – The non-rigid rotor - Rotational spectra of polyatomic molecules – Linear, symmetric top and asymmetric top molecules - Diatomic vibrating rotator – Analysis by infrared techniques – Characteristic and group frequencies

UNIT -IV: RAMAN SPECTROSCOPY AND ELECTRONIC SPECTROSCOPY OF MOLECULES

Raman spectroscopy : Raman effect - Quantum theory of Raman effect – Rotational and vibrational Raman shifts of diatomic molecules – Selection rules.

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

UNIT -IV: RESONANCE SPECTROSCOPY

NMR: Basic principles –Bloch equations - Chemical Shift – Relaxation process – Instrumentation: Fourier transform method – NMR Imaging.

ESR: Basic Principles – Nuclear interaction and hyperfine structure –'g' characteristics – ESR Spectrometer.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Fundamentals of Molecular Spectroscopy, C. N. Banwell, (McGraw Hill, New York, 1981).
2. Spectroscopy Vol.I.,B. P. Straughan and S. Walker, (Chapman and Hall, New York, 1976).
3. The Feynman Lectures on Physics Vol. III. R. P. Feynman et al. (Narosa, New Delhi, 1989).
4. Introduction to Modern Physics H. S. Mani and G. K. Mehta, (Affiliated East West, New Delhi,1991).
5. Introductory Quantum Chemistry,A. K. Chandra, (Tata McGraw Hill, New Delhi, 1989).

Books for Reference

1. High Resolution NMR, Pople, Schneiduer and Berstein, (McGraw Hill, New York).
2. Atomic Stucture and Chemical Bond, Manas Chanda, (Tata McGraw Hill, New Delhi, 1991).
3. Quantum Chemistry, Ira N. Levine, (Prentice-Hall, New Delhi, 1994).
4. Concepts of Modern Physics, Arthur Beiser, (McGraw Hill, New York, 1995).
5. Principles of Magnetic Resonance, C.P. Slitcher, (Harper and Row).

Course Outcome:

After completing this course students shall be able to

- ❖ List different types of atomic spectra and related instrumentation.
- ❖ Describe theories explaining the structure of atoms and the origin of the observed spectra.
- ❖ Identify atomic effect such as space quantization and Raman effect.
- ❖ Describe the molecular bonding and molecular energies.

SEMESTER-IV: CORE COURSE-XII MAJOR PRACTICAL - III		
Course Code : P3R1PHCC12P		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 40**
Credit : 5		**External Marks : 60**

Objective:

To motivate and educate the students to acquire skill in Analog and Digital Experiments.

Any Fifteen only

1. Logic gates – Universality of NAND gates Using IC's
2. Logic gates – Universality of NOR gates Using IC's
3. Verification of Demorgans theorems and Boolean Expressions
4. Astable, bistable and monostable multivibrator using IC 555
5. Phase shift network and Oscillator using IC 741
6. Wien's bridge oscillator using IC 741
7. Construction of dual regulated power supply
8. Half and Full wave precision rectifier using IC 741
9. Characteristics of LVDT
10. Study of the characteristics of torque transducer
11. Digital to analog converter - R-2R method and Weighted method
12. Study the function of multiplexer and demultiplexer
13. Study the function of decoder and encoder
14. Flip flops
15. Half adder and Full adder (using only NAND & NOR gates)
16. Half subtractor and Full Subtractor (using only NAND & NOR gates)
17. Digital comparator using XOR and NAND gates
18. BCD to seven segment display
19. Study of counter using IC 7490 (0-9 and 00-99)
20. Measurement of Resistance using AC Wheatstone bridge

SEMESTER-IV: CORE COURSE-XIII MAJOR PRACTICAL - IV (MICROPROCESSORS 8086 AND C- PROGRAMMING)		
Course Code : P4R1PHCC13P		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 40**
Credit : 5		**External Marks : 60**

Objectives:

- To understand microprocessor through digital process and also application of microprocessor.
- To understand the concept of interfacing.
- To understand the concept of computational method in C- language

(Choosing minimum of six experiments from each part)

A. Microprocessor Practicals

1. 8 - bit addition, subtraction, multiplication and division using 8085/Z80.
2. Conversion from decimal to octal and hexa systems.
3. Conversion from Octal, Hexa to Decimal systems.
4. Sum of series
5. Data transfer
6. Table of square
7. ASCII to decimal conversion
8. Decimal to ASCII conversion
9. Display of names
10. Study of Seven Segment Display
11. Study of DAC interfacing (DAC 0900).
12. Study of ADC interfacing (ADC 0809).
13. Study of timer interfacing (IC 8253).
14. Traffic control system using microprocessor.
15. Generation of square, triangular, saw-tooth staircase and sine waves using DAC 0800.
16. Control of stepper motor using microprocessor.

B. Computer practicals (by C- Language)

1. Roots of algebraic equations – Newton – Raphson method
2. Least - squares curve fitting – straight-line fit
3. Least – squares curve fitting – Exponential fit.
4. Solution of simultaneous linear algebraic equations-Gauss elimination method
5. Interpolation – Lagrange method
6. Numerical integration – Composite trapezoidal rule
7. Numerical integration – Composite Simpson’s rule
8. Numerical differentiation – Euler method
9. Solution of ordinary differential equations – Runge – Kutta second order method
10. Solution of ordinary differential equations – Runge – Kutta fourth order method

SEMESTER-IV: CORE COURSE-XIV NUCLEAR AND PARTICLE PHYSICS		
Course Code : P4R1PHCC14		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- To understand the basic structure and properties of the nucleus.
- To differentiate different types of nuclear reactions and nuclear models
- To know the causes and mechanism of natural radioactivity.
- To understand the fission, fusion energy and reactors
- To study about the properties of elementary particles

UNIT -I: BASIC NUCLEAR PROPERTIES

Nuclear size, shape, mass – Charge distribution – Spin and parity – Binding energy – Semi empirical mass formula – Nuclear stability – Mass parabola -- Nature of nuclear forces – Ground state of deuteron – Magnetic dipole moment of deuteron – Proton-neutron scattering at low energies – Properties of nuclear forces – Spin dependence – Exchange forces.

UNIT -II: NUCLEAR REACTIONS AND NUCLEAR MODELS

Q-values and kinematics of nuclear cross sections – Energy and angular dependence – Reciprocity theorem – Breit-Wigner formula – Compound nucleus – Resonance theory – Optical model -- Shell model – Liquid drop model – Collective model.

UNIT -III : RADIOACTIVE DECAYS AND REACTORS

Alpha emission – Geiger-Nuttal law – Gamow theory – Neutrino hypothesis – Fermi theory of beta decay – Selection rules – Non conservation of parity – Gamma emission – Selection rules - Interaction of charged particles and X-rays with matter – Basic principles of particle detectors – Ionization chamber – Proportional counter and G.M counters – Solid state detectors – Scintillation and semiconductor detectors.

UNIT -IV: ACCELERATORS AND PARTICLE DETECTORS

Cyclotron – Synchrocyclotron – Synchrotron – Linear accelerators --Characteristics of fission – Mass distribution of fragments – Radioactive decay processes – Fission cross section – Energy in fission – Bohr-Wheeler's theory of nuclear fission – Fission reactors – Thermal reactors – Homogeneous reactors – Basic fusion processes - Characteristics of fusion – Solar fusion – Controlled fusion .

UNIT -V: ELEMENTARY PARTICLES

Building blocks of nucleus – Nucleons, leptons, mesons, baryons, hyperons, hadrons, strange particles - Classification of fundamental forces and elementary particles – Basic Conservation laws – Additional Conservation laws : Baryonic, leptonic, strangeness and iso spin charges/quantum numbers –– Gell-Mann-Nishijima formula –TCP theorem -- Parity non conservation in weak interactions – CP violation –– SU(3) symmetry and quark model.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Introductory Nuclear Physics, K. S. Krane, (John-Wiley, New York, 1987).
2. Nuclear Physics, V. Devanathan, Naroso Publishing House (2006)
3. Nuclear Physics: An Introduction, S. B. Patel, (Wiley-Eastern, New Delhi, 1991).
4. Concepts of Nuclear Physics, B. L. Cohen, (Tata McGraw Hill, New Delhi, 1988).
5. Nuclear and Particle Physics , D.G. Dhayal

Books for Reference:

1. Nuclear Physics: Experimental and Theoretical, H. S. Hans, (New Age International Publishers, New Delhi, 2001).
2. Elementary Particle Physics: An Introduction, D. C. Cheng and G. K. O'Neill, (Addison- Wesley, 1979).
3. Introduction to Elementary Particles, D. Griffiths, Introduction to Elementary Particles (Wiley International, New York, 1987).

Course Outcome:

After completing this course students shall be able to

- list different types of atomic spectra and related instrumentation.
- describe theories explaining the structure of atoms and the origin of the observed spectra.
- Identify atomic effect such as space quantization and Raman effect.
- describe the molecular bonding and molecular energies.
- work in the laboratory, analysis of experimental data, theoretical calculations, computational simulations, or a combination of those tasks.
- collaborate with others in an international team, take responsibility for own project, and present scientific results both in writing and orally.

SEMESTER-IV: CC XV: PROJECT WORK		
Course Code : P4R1PHCC15PW		Max. Marks : 100
Hours/Week : 18		Credit : 8

Elective Course papers:

SEMESTER-I: EC – I : NUMERICAL METHODS AND COMPUTATIONAL PHYSICS		
Course Code : P1R1PHEC1		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 3		**External Marks : 75**

Objectives:

- To understand the numerical computations for algebraic, transcendental and linear simultaneous equations.
- To understand the concept of linear interpolation and curve fitting.
- To understand the numerical differentiation and integration.

UNIT -I: ERRORS AND THE MEASUREMENTS

General formula for errors – Errors of observation and measurement – Empirical formula – Graphical method – Method of averages – Least square fitting – curve fitting – parabola, exponential.

UNIT -II: NUMERICAL SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

The iteration method – The method of false position – Newton – Raphson method – Convergence and rate of convergence – C program for finding roots using Newton – Raphson method. Simultaneous linear algebraic equations - Gauss elimination method – Jordon's modification – Gauss–Seidel method of iteration – C program for solution of linear equations.

UNIT -III: INTERPOLATION

Linear interpolation – Lagrange interpolation Gregory – Newton forward and backward interpolation formula – Central difference interpolation formula – Gauss forward and backward interpolation formula – Divided differences – Properties – Newton's interpolation formula for unequal intervals – C programming for Lagrange's interpolation.

UNIT -IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Newton's forward and backward difference formula to compute derivatives – Numerical integration : the trapezoidal rule, Simpson's rule – Extended Simpson's rule – C program to evaluate integrals using Simpson's and trapezoidal rules.

UNIT -V: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Nth order ordinary differential equations – Power series approximation – Pointwise method – Solutions of Taylor series – Euler's method – Improved Euler's method – Runge-Kutta method – second and fourth order –– C program for solving ordinary differential equations using RK and Eulers method.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for study

1. Introductory Methods of Numerical analysis – S.S. Sastry, Prentice – Hall of India, New Delhi (2003) 3rd Edition.
2. Numerical Methods in Science and Engineering – The National Publishing Co. Madras (2001).
3. Numerical Methods in C and C++, Veerarajan, S.Chand, New Delhi (2006).

Books for Reference :

1. Numerical Recipes in C, W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling, Cambridge University (1996).
2. Monte Carlo : Basics, K.P.N. Murthy, ISRP, Kalpakkam, 2000.

Course Outcome:

After completing this course students shall be able to

- ❖ Use numerical methods to model physical systems on different length and time scales.
- ❖ Critically select different numerical methods to solve different types of physical and technical problems.
- ❖ Describe different methods to compute the electron structure of solid materials.
- ❖ Enable students to both broaden and deepen our understanding of physics by vastly increasing the range of mathematical calculations.

SEMESTER-II: EC – II : CRYSTAL GROWTH AND THIN FILMS		
Course Code : P2R1PHEC2		**Max. Marks : 100**
Hours/Week : 4		**Internal Marks : 25**
Credit : 3		**External Marks : 75**

Objectives:

- ❖ To learn the crystal growth and characterization techniques
- ❖ To study the formation of thin film and its analysis

UNIT -I: NUCLEATION AND CRYSTAL GROWTH

Nucleation – Different kinds of nucleation - Concept of formation of critical nucleus – Classical theory of nucleation - Spherical and cylindrical nucleus - Low temperature solution growth: Solution - Solubility and super solubility – Expression of super saturation – Miers T-C diagram - Growth Kinetics of Thin Films – Thin Film Structure – Crystal System and Symmetry.

UNIT -II: GEL AND SOLUTION GROWTH TECHNIQUES

Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.

Principle – Various types – Structure of gel – Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method –Complex and decomplexion method – Advantages of gel method.

UNIT –III : MELT AND VAPOUR GROWTH TECHNIQUES

Melt technique:

Bridgman technique - Basic process – Various crucibles design - Thermal consideration – Vertical Bridgman technique - Czochralski technique – Experimental arrangement – Growthprocess.

Vapour technique:

Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical Vapour Transport.

UNIT -IV: THIN FILM DEPOSITION TECHNIQUES

Thin Films – Introduction to Vacuum Technology - Deposition Techniques - Physical Methods – Resistive Heating, Electron Beam Gun, Laser Gun Evaporation and Flash Evaporations, Sputtering - Reactive Sputtering, Radio-Frequency Sputtering - Chemical Methods – Spray Pyrolysis – Preparation of Transparent Conducting Oxides.

UNIT -V: CHARACTERIZATION TECHNIQUE

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier transform Infrared analysis (FT-IR) – Elemental analysis – Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vickers Micro hardness.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Crystal Growth Processes and Methods, P. SanthanaRagavan and P. Ramasamy, KRU Publications, Kumbakonam (2001)
2. Thin Film Fundamentals, A. Goswami, New Age International (P) Limited, New Delhi (1996)

Books for Reference

1. Crystal Growth Processes, J.C. Brice, John Wiley and Sons, New York (1986)
2. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS, Publishers and Distributors, New Delhi

Course Outcome:

After completing this course students shall be able to

- ❖ learn about the crystal growth mechanisms and techniques.
- ❖ Learn about various thin films deposition techniques and thin film characterisation techniques.

SEMESTER-III: EC – III : NANOSCIENCE AND NANOTECHNOLOGY		
Course Code : P3R1PHEC3		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 3		**External Marks : 75**

Objectives:

- ❖ To learn the nano technology and nano materials
- ❖ To study the application of nano materials in medicine
- ❖ To understand Evaluation techniques and Green technology

UNIT - I: BACKGROUND TO NANOTECHNOLOGY

Scientific revolution- Atomic structures-Molecular and atomic size-Bohr radius – Emergence of Nanotechnology – Challenges in Nanotechnology - Carbon age–New form of carbon. (from Graphene sheet to CNT)

UNIT - II: NUCLEATION

Influence of nucleation rate on the size of the crystals- macroscopic to microscopic crystals and nano crystals - large surface to volume ratio, top-down and bottom-up approaches-self assembly process-grain boundary volume in nanocrystals-defects in nanocrystals-surface effects on the properties.

UNIT - III: TYPES OF NANOSTRUCTURES

Definition of a Nano system - Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D) nanostructured materials - Quantum dots - Quantum wire- Core/Shell structures.

UNIT - IV: NANOMATERIALS AND PROPERTIES

Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO_2, ZnO) - Semiconductors (Si, Ge,) - Ceramics and Composites - Dilute magnetic semiconductor- Biological system - DNA and RNA - Lipids - Size dependent properties - Mechanical, Physical and Chemical properties.

UNIT - V: APPLICATIONS OF NANOMATERIALS

Molecular electronics and nanoelectronics – Quantum electronic devices - CNT based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane based water purification.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Book for Study

1. Nanotechnology: Basic science and Emerging technologies, M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
2. The chemistry of nanomaterials: Synthesis, properties and applications, C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.
3. Nanoscale Materials Science, Kenneth J. Klabunde (Eds), John Wiley & Sons, InC, 2001.
4. Nanofabrication towards biomedical applications, C.S.S.R.Kumar, J.Hormes, C.Leuschner, –VCH Verlag GmbH & Co, Weinheim, 2004.

Books for Reference

1. Nano Electronics and information Technology,W. Rainer, Wiley, 2003.
2. Nano systems, K.E.Drexler, Wiley, 1992.
3. Naostructures and Nanomaterials: Synthesis, properties and applications, G.Cao, Imperical College Press, 2004.

Course Outcome:

After completing this course students shall be able to

- ❖ Explain the fundamental principles of nanotechnology and their application to biomedical engineering.
- ❖ Apply engineering and physics concepts to the nano-scale and non-continuum domain.
- ❖ Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature.
- ❖ Evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.

SEMESTER-III: EC – IV : ADVANCED PHYSICS		
Course Code : P3R1PHEC4		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 3		**External Marks : 75**

Objectives

- To understand the different types of Lasers.
- To study the different harmonic generations
- To study the Fiber optical communication systems.
- To study the Non linear optical materials.

UNIT - I: LASERS

Gas lasers – He-Ne, Az + ion lasers – Solid state lasers – Ruby – Nd- YAG, Ti Sapphire – Organic dye laser – Rhoda mine – Semiconductor lasers – Diode laser, Ga-As laser

UNIT - II: FIBER OPTICS

Step – Graded index fibers – wave propagation – Fiber modes – Single and multimode fibers – Numerical aperture – Dispersion – Fiber bandwidth – Fiber loss – Attenuation coefficient – Material absorption.

UNIT -III: INTRODUCTION TO 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 – disability – self focusing

UNIT -IV: MULTIPHOTON PROCESSES

Two photon process – Theory and experiment – Three photon process Parametric generation of light – Oscillator – Amplifier – Stimulated Raman scattering – Intensity dependent refractive index optical Kerr effect – photorefractive, electron optic effects

UNIT -V: NONLINEAR OPTICAL MATERIALS

Basic requirements – In organics – Borates – Organics – Urea, Nitro aniline – Semi organics – Thio urea complex – X-ray diffraction – FT-IR - FT-NMR- Second harmonic generation – Laser induced surface damage threshold.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Study

1. Nonlinear Optics, Robert W. Boyd, 2nd Edn., Academic Press, New York, 2003
2. Laser Fundamentals, William T. Silvast, Cambridge University Press, Cambridge 2003

Books for Reference

1. Lasers and Nonlinear Optics,B.B. Laud, 2nd Edn. New Age International (P) Ltd., New Delhi, 1991
2. Fiber-Optics Communication Systems, Govind P. Agarwal, , 3rd Edn. John Wiley & Sons, Singapore 2003

3. Nonlinear Optics – Basic Concepts D.L. Mills, Springer, Berlin 1998.

Course Outcome:

After completing this course students shall be able to

- Understand and be able to explain the principles and operation of a laser;
- Understand and be able to apply the principles of optical modulation and detection as well as evaluate its performance;
- Understand nonlinear optics and photonics phenomena and how they impact modern advanced technological systems;
- Generate succinct laboratory reports based on experimental observations and theoretical analysis.

SEMESTER-IV: EC – V : MEDICAL PHYSICS		
Course Code : P4R1PHEC5		**Max. Marks : 100**
Hours/Week : 6		**Internal Marks : 25**
Credit : 5		**External Marks : 75**

Objectives:

- ❖ To acquire knowledge of forces, pressure and the importance of temperature in human body.
- ❖ To understand the physics principles involved in respiration and cardiovascular system.
- ❖ To understand how electric signals generate in human body and the working of EMG and ECG.
- ❖ To understand the application of sound and light in medicine and medical imaging.
- ❖ To understand the use of X – rays and radioactivity for diagnosis and treatment.

UNIT - I: MECHANICS OF HUMAN BODY

Static, Dynamic and Frictional forces in the Body – Composition, properties and functions of Bone – Heat and Temperature – Temperature scales – Clinical thermometer – Thermography – Heat therapy – Cryogenics in medicine – Heatlosses from Body – Pressure in the Body – Pressure in skull, Eye and Urinary Bladder.

UNIT -II: PHYSICS OF RESPIRATORY AND CARDIOVASCULAR SYSTEM

Body as a machine – Airways – Blood and Lungs interactions – Measurement of Lung volume –Structure and Physics of Alveoli – Breathing mechanism – Airway resistance – Components and functions of Cardiovascular systems –work done by Heart – Components and flow of Blood – Laminar and Turbulent flow – blood Pressure – direct and indirect method of measuring –Heart sounds.

UNIT - III: ELECTRICITY IN THE BODY

Nervous system and Neuron – Electrical potentials of Nerves – Electric signals from Muscles, Eye and Heart – Block diagram and working to record EMG - Normal ECG wave form – Electrodes for ECG – Amplifier and Recording device – Block diagram and working to record ECG – Patient monitoring – Pace maker.

UNIT - IV: SOUND AND LIGHT IN MEDICINE

General properties of sound – Stethoscope - Generation, detection and characteristics of Ultrasound –Ultrasound imaging technique – A scan and B scan methods of ultrasound imaging – properties of light – Applications of visible UV, IR light, and Lasers in medicine – Microscope – Eye as an optical system – Elements of the Eye – Ophthalmology Instruments.

UNIT - V: DIAGNOSTIC X-RAYS AND NUCLEAR MEDICINE

Production and properties of X-rays – Basic Diagnostic X-ray Machine – X-ray image – Live X-ray image – X-ray computed Tomography – Characteristics of Radio activity – Radioisotopes and Radio nuclides – Radioactivity sources for Nuclear medicine – Basic Instrumentation and clinical applications – Principles of Radiation Therapy – Nuclear medicine imaging devices – Radiation sources.

UNIT-VI: LATEST LEARNING

Latest development related to the course during the semester concerned (CIA purpose only, not for question setting)

Books for Reference

1. Medical Physics, John R. Cameron and James G. Skofronick, John Wiley & SonsWiley – Interscience Publications, 1978.
2. Hand book of Biomedical Instrumentation, R.S.Khandpur - Tata McGraw Hill Publication Co., Delhi, 1987.

Course Outcome:

After completing this course students shall be able to

- The concept of forces, pressure and the importance of temperature in human body.
- The physics principles involved in respiration and cardiovascular system.
- The application of sound and light in medicine and medical imaging.
- The use of X-rays and radioactivity for diagnosis and treatment.

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