16PPH1MC01 – CLASSICAL MECHANICS

Category: MC **Credits:** 6

Semester: I **No. of Hours/Week:** 5

Course Outcomes

CO's	Statements	Bloom's Level
CO1	Apply Lagrangian dynamics to solve two body central force problem.	**L2**
CO2	Use rigid body dynamics to analyze degrees of freedom and study motion in rotational frames.	**L3**
CO3	Discuss Hamiltonian formulation and explain Canonical and Poisson brackets.	**L4**
CO4	Explain Hamilton – Jacobi theory to compute action and angle variable.	**L3**
CO5	Outline the significance of normal co-ordinates, and evaluate eigen value equation for small oscillations.	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	L	S	L	S
CO3	S	S	S	M	M
CO4	S	S	S	L	S
CO5	S	S	S	M	S

* S – Strong; M – Medium; L – Low

UNIT I : : LAGRANGIAN FORMULATION HOURS: 18

Mechanics of a system of particles - Constraints - D'Alembert's principle - Lagrange equations - velocity dependent potentials - applications - Variational principle - Hamilton's principle - Non - holonomic systems - Conservation theorems and symmetry properties. Two - body central force problem - equations of motion - first integrals - classification of orbits - conditions for closed orbits - Kepler's problem - scattering in a central force field - Lab frame - center of mass frame transformation.

UNIT II : RIGID BODY DYNAMICS HOURS: 18

Kinematics - degrees of freedom - Euler angles - Euler's theorem on the motion of a rigid body - Rotations - finite and infinitesimal. Angular momentum and kinetic energy - Inertia tensor -

Principal axes - Euler's equations - Torquefree motion of a rigid body - Symmetric top - Precession and nutation - applications – Motion in rotational frames – centrifugal and coriolis forces.

UNIT III : HAMILTONIAN FORMULATION HOURS: 18

Legendre transformation and Hamiltonian equations - Cyclic coordinates and conservation theorems - Hamiltonian equations from Variational principle - Canonical transformations - Poisson brackets - equations of motion - conservation theorems in Poisson bracket formulation - angular momentum Poisson brackets - generation of canonical transformations.

UNIT IV : CANONICAL TRANSFORMATIONS HOURS:18

Hamilton-Jacobi theory - Hamilton - Jacobi equation - Hamilton's principal function - free particle in Cartesian coordinates - central force in spherical polar coordinates - application to harmonic oscillator problem - Action- angles - Kepler's problem - action - angle variables - simple harmonic oscillator.

UNIT V : SMALL OSCILLATIONS HOURS: 18

the eigenvalue equation - the principal axis transformation - free vibrations - normal coordinates - linear triatomic molecule – double pendulum – triple pendulum – triple parallel pendulum.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Classical Mechanics, 3rd edition, (2002)	H.Goldstein, Charles Poole and John Sabko,	Pearson Education India,	-	-
2	Lagrangian and Hamiltonian mechanics, 1st Indian Reprint, (2000)	M.G.Calkin	Allied Publishers	2003	1st Edition

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Classical Mechanics	P.V.Panat,	Alpha Science International	2005	5th Edition,
2	Classical Mechanics	K.N.Srinivasa Rao	Universities Press (India)	2003	2nd Edition

			Private Limited		
3	Lagrangian dynamics.	Dare A. Wells	McGraw – Hill Education (India) Pvt Ltd	2005	4th Edition
4	Problems and solutions on Mechanics	Yung – Kuo Lim, Sarat	Book House	2001	6th Edition
5	Classical Mechanics,	Rana & Joag, Rana, ,	Tata McGraw-Hill Education	2001	24th Reprint
6	Classical Dynamics of Particles and Systems,	Stephen T. Thornton, Jerry B. Marion.	Brooks/Cole	2004	5th Edition,
7	Classical Mechanics: An Undergraduate Text	R. Douglas Gregory	Cambridge University Press,	2006	8th Edition

Teaching Methodology

Chalk and Talk Lectures; Seminar; ICT based presentations; Video Lectures; Group Discussions; Interactive activities; Mini – project; MCQs.

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100 External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH1MC02 – ELECTRODYNAMICS

Category: MC **Credits:** 4

Semester: I **No. of Hours/Week:** 6

Course Outcomes

Cos	Statements	Bloom's Level
CO1	Discuss the relation between Electrostatic field and Electrostatic Potential	**L1**
CO2	Make use of Ampere's law to calculate the magnetic fields	**L2**
CO3	Use Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.	**L1**
CO4	Explain Special Relativity, especially as applied to electrodynamics.	**L1**
CO5	Analyze charged particle dynamics and radiation from localized time varying electromagnetic sources.	**L3**
CO6	Generalize the concepts of guided structures like transmission line, means of transporting energy or information, commonly used in power distribution and communication	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S
CO2	S	S	S	S	L
CO3	S	S	S	M	M
CO4	S	S	M	S	L
CO5	S	S	S	M	S
CO6	S	S	M	S	S

* S – Strong; M – Medium; L – Low

UNIT 1: Electric and Magnetic potential

Divergence and curl of E - Electric scalar potential - Poison's and Laplace's equations - uniqueness theorems - potential of a localised charge distribution - electric potential - energy of a continuous charge distribution - multi pole expansion: approximate potentials at large distances - monopole and dipole terms - electric dipole moment - electric field of a dipole.

Divergence and curl of B - Energy in the magnetic fields due to current carrying elements - Magnetic vector potential - magnetic potential at any point due to current carrying elements - multipole expansion of the vector potential - magnetic dipole moment - magnetic field of a dipole.

UNIT 2: Electrodynamics

Maxwell's equation in free space and in matter, displacement current, boundary conditions, Gauge transformations - Coulomb and Lorentz gauge - momentum - Poynting's theorem, - Polarisation - monochromatic plane waves - energy and momentum in electromagnetic waves. Propagation in linear media - reflection and transmission at (i) normal incidence (ii) oblique incidence - laws of geometrical optics - Fresnel's equation - Brewster's angle - boundary conditions - absorption and dispersion in conductors - skin depth - reflection at a conducting surface - dispersion and anomalous dispersion - Cauchy's formula

UNIT 3: Relativistic electrodynamics

Four vectors - tensor algebra, Lorentz transformation - invariance of Maxwell's equations under Lorentz transformation - transformation of electromagnetic field intensities - electromagnetic field tensor - electromagnetic field invariants - covariant form of Maxwell's equations - electromagnetic energy - momentum tensor, conservation laws of vacuum electrodynamics. Relativistic Lagrangian for a free particle - energy - momentum of a free particle - Lagrangian and Hamiltoninan for a charged particle in an electromagnetic field.

UNIT 4: Electromagnetic radiation

Retarded scalar and vector potentials - Lienard - Wiechert potentials for a moving point charge - electric and magnetic fields of a moving point charge, velocity and acceleration fields. Electric dipole radiation - magnetic dipole radiation - radiation from an arbitrary source - power radiated by a point charge - Larmor formula - Lienard's generalization of the Larmor formula - radiation reaction - Abraham Lorentz formula.

UNIT 5: Guided waves and magneto hydrodynamics (MHD)

Essential conditions for guided waves - TEM waves in coaxial cables- TE waves - rectangular wave guide - electric and magnetic fields on the surface and inside rectangular wave guide - TE and TM waves in rectangular wave guide - cut - off frequency and wavelength - circular waveguides - energy flow and attenuation in wave guides - cavity resonators - phase and group velocity MHD - Definitions - magneto hydrodynamic equations - magnetic diffusion - viscosity and pressure.

Books for study:

Title	Author	Publisher	Year	Edition
Introduction to electrodynamics	David Jeffery Griffiths	Prentice Hall	1999	3rd Edition
Classical electrodynamics	John David Jackson	Wiley Eastern Ltd	1999	3rd Edition

Electrodynamics	Gupta SL, Kumar V, Singh SP	Pragati Prakashan	2001	2nd

Books for reference:

Title	Author	Publisher	Year	Edition
Electromagnetic waves and fields	R.N.Singh	Tata McGraw-Hill publishing, New Delhi (1991)	1991	5th Edition
Introduction to Electrodynamics	Anton Z. Capri., , P. V. Panat.	Narosa Publishing house, New Delhi	2002	3rd Edition
Electromagnetic fields and waves	V. V. Sarwate.	New Age International (P) Publishers (formerly Wiley Eastern limited)	2006	4th Edition

Teaching Methodology

Chalk and Talk Lectures; Seminar; ICT based presentations; Video Lectures; Group Discussions; Interactive activities; Mini – project; MCQs.

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100 External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH1MC03 – ELECTRONICS AND PROGRAMMING

Category: MC **Credits:** 4

Semester: I **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Solve simultaneous and differential equations using operational amplifiers	**L3**
CO2	Compare the working of A/D and D/A converters and its applications.	**L2**
CO3	Write assembly language programs for arithmetic operations using microprocessor 8086.	**L4**
CO4	Incorporate macros and procedures in assembly language programming in microprocessor 8086.	**L2**
CO5	Design and interface the processor to external devices and write programs using microprocessor 8086.	**L3**
CO6	Develop programs to solve problems in numerical methods using C++ programming.	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	S	S	S	S	L
CO3	S	S	S	M	S
CO4	S	S	S	M	L
CO5	S	S	S	L	M
CO6	S	S	M	L	M

* S – Strong; M – Medium; L – Low

UNIT I : OPERATIONAL AMPLIFIERS AND A/D & D/A CONVERTERS
HOURS: 18

Ideal Op - Amp - inverting, non - inverting, logarithmic, summing and difference amplifiers - integrator and differentiator - as a comparator - CMRR – differential amplifier – A/D and D/A converters. Applications: Solving simultaneous and differential equations - weighted resistor and R - 2R D/A converters - parallel, binary counter and successive approximation A/D converters.

UNIT II : INTEL 8086 **HOURS: 18**

Architecture, Instruction set and Introduction to Macro Assembler (ASM86) CPU architecture - addressing modes - instruction formats - instruction set - execution timing – Assembler directives – assembler operators - assembly process - translation of assembler instructions - simple programs.

UNIT III : MODULAR PROGRAMMING AND MULTIPROGRAMMING
HOURS: 18

Linking and relocation - access to external identifiers – procedures - interrupts and their routines –macros - process management and IRMX86 - semaphore operations - common procedure sharing.

UNIT IV : I/O CONSIDERATION, INTERRUPTS AND SYSTEM BUS STRUCTURE
HOURS: 18

Programmed I/O - Interrupt I/O - block transfer and DMA - basic 8086 bus configuration - minimum and maximum modes - system bus timings - interrupt priority management - single and multiple 8259. Applications (Units II to IV): Assembly language programs involving arithmetic and logical operations - use of subroutines - manipulating arrays - solving equations - keys and LEDs interface –delays - interfacing D/A and D/A converters - generation of waveforms - simulation of counter and successive approximation A/D converters.

UNIT V : PROGRAMMING IN C++ **HOURS: 18**

Basic program structure - Simple data types, variables, constants, operators, comments - Control Flow; if, while, for, do - while, switch – Functions, Types, parameters, prototypes, recursion - Array usage Pointers, addresses and types, call by reference Pointer - array duality, Strings - Arrays of pointers - Structures - Member accessing - pointers to structures - Arrays of structures, linked lists.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Electronic fundamentals and applications	John Douglas Ryder	Prentice - Hall	1976	5th edition
2	Digital principles and applications	Donald P. Leach Albert Paul Malvino	McGraw - Hill	1986	4th Edition
3	Microcomputer systems: the 8086/8088 family: architecture, programming, and design	Yu - cheng Liu, Glenn A. Gibson	Prentice - Hall	2006	2nd Edition
4	Microprocessors and Interfacing: Programming and Hardware, Intel Version	Douglas V. Hall	Tata McGraw - Hill	2005	2nd Edition
5	Fundamentals of Microprocessor - 8086	V Vijayendran	Viswanathan, S., Printers &	2009	3rd Edition

			Publishers Pvt Ltd		
6	Teach yourself C++	Herbert Schildt	Tata McGraw Hill	2008	3rd Edition

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Electronic Devices & Circuits	Millman Jacob, Christos Halkias, Satyabrata Jit	McGraw - Hill	2010	-
2	Microprocessor architecture, programming, and applications with the 8085/8080A	Ramesh S. Gaonkar	Merrill Pub. Co.	1989	2nd Edition
3	The Intel microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro processor	Barry B. Brey	Prentice - Hall of India, New Delhi	1997	4th edition
4	The 8086/8088 Family - Design, Programming and Interfacing, Software, Hardware and Applications	Uffrenbeck J	Prentice - Hall of India, New Delhi	1987	-
5	The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications	Tribel W.A., Avtar Singh	Prentice - Hall of India, New Delhi	2000	3rd Edition

Teaching Methodology

Chalk and Talk Lectures; Seminar; ICT based presentations; Video Lectures; Group Discussions; Interactive activities; Mini – project; MCQs.

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100 External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH1MC04 – MATHEMATICAL PHYSICS - I

Category: MC **Credits:** 4

Semester: I **No. of Hours/Week:** 5

Course Outcomes

CO's	Statements	Bloom's Level
CO1	Developing skills for sketching graphs for various functions.	**L6**
CO2	Evaluating the importance of analytical functions and the use of complex analysis techniques to solve complex integrals.	**L5**
CO3	Empower with various numerical methods to solve the differential equations.	**L3**
CO4	Analysis of tensor properties and its operation in various branches of physics.	**L3,L4**
CO5	Apply the fundamental concepts of special functions and their application to complicated integrals.	**L3,L5**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	S	S	M	S	S
CO3	S	S	S	L	S
CO4	S	S	S	S	M
CO5	S	S	S	S	L

* S – Strong; M – Medium; L – Low

UNIT 1: NUMERICAL METHODS: HOURS: 9

Solution of Nonlinear equations: Newton - Raphson method – Regula Falsi method Solutions of system of linear equations: Gauss elimination method with and without pivoting - Gauss - Siedel iterative method Solution of ordinary differential equations: Euler method - Euler modified method – Runge - Kutta method (2nd order)

UNIT 2: COMPLEX ANALYSIS: HOURS: 9

Analytic function - Cauchy - Riemann equations - Laplace equation and harmonic function - Line integral in complex plane - Cauchy's theorem - multiply connected regions - Cauchy integral formula - Derivatives of analytic function - Taylor and Laurent series - Singularities - Residue theorem - Evaluation of real integrals Application: Potential theory - (1) Electrostatic

fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders.

UNIT 3: LINEAR VECTOR SPACE: HOURS: 9

Basic concepts – examples of vector spaces – scalar product: orthogonality – Schmidt orthogonalization procedure – linear operators – Dual space: ket and bra notation – basis – orthogonal basis – change of basis – Isomorphism of vector spaces – projection operator – Eigen values and eigen functions – Direct sum and invariant subspaces – orthogonal transformations and rotation.

UNIT 4 : TENSOR ANALYSIS: HOURS: 9

Tensors in Physics - Notation and conventions - Contra and covariant tensors of rank one and two - Transformation from Cartesian to polar coordinates - Algebra of tensors - outer and inner products - Contraction - Symmetric and anti-symmetric tensors - Quotient law - Conjugate tensors - Metric tensor - Raising and lowering of indices Cartesian tensors - Rotation and translation - Orthogonal transformations - Transformation of divergence and curl of vectors - Stress, strain and Hooke's law - Piezoelectricity and dielectric susceptibility - Moment of inertia tensor

UNIT 5: SPECIAL FUNCTIONS – I

Series solution with simple examples - Gamma and Beta functions - Properties - Legendre polynomial and function - Generating function - Rodrigue formula – Orthogonality property - Associated Legendre function - Recurrence relations - spherical harmonics - Graphs of Legendre functions - Bessel function - Generating function – Hankel function - Recurrence relations - Spherical Bessel function - Graphs - Orthonormality relation.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Advanced Engineering Mathematics	Erwin Kreyzig	Wiley Eastern Ltd.	1991	8th Edition,
2	Mathematical Physics	H. K. Dass,	S. Chand Publishing.	2010	First edition
3	Mathematical methods in Classical and Quantum Physics (Unit – 3)	Tulsi Dass, Sathish K Sharma	University Press	1998	First edition
4	Matrices and tensors in Physics (unit 4)	A. W. Joshi	New Age International	1995	3rd Edition

5	Special functions for scientists and engineers (Unit 5)	W. W. Bell	Courier Dover Publications	2004	First edition

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Mathematical methods for Physicists,	George Arfken, Hans Weber,	Academic Press	2003	6^{th} Edition
2	Mathematical Physics with Applications, Problems and solutions	V.Balakrishnan	Ane books	2019	First edition
2	Mathematical methods in Physical Sciences	Mary L. Boas	Wiley	2006.	3^{rd} Ed
3	Mathematical methods for Physical Sciences	Riley & Hobson,	Cambridge University Press,	2011	Third

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH1MC05 – PRACTICAL - I

Category: MC **Credits:** 4

Semester: I **No. of Hours/Week:** 8

Course Outcomes

CO's	Statements	Bloom's Level
CO1	Construct A/D and D/A converters and troubleshoot the circuits.	**L3**
CO2	Demonstrate the applications of operational amplifiers.	**L2**
CO3	Explain the operation of 555 timer as astable multivibrator.	**L4**
CO4	Solve simple arithmetic relations using μP 8086.	**L4**
CO5	Write programs for arithmetic and logical operations using C++ language.	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	L
CO2	S	S	S	M	M
CO3	S	S	S	M	L
CO4	S	S	S	S	M
CO5	S	S	S	S	L

* S – Strong; M – Medium; L – Low

List of Experiments

1. Transistorised Amplifier - RC coupled
2. Power Amplifier – IC
3. Design of Gates - transistor (NOT, AND, OR, NAND)
4. A/D converter - Parallel conversion using LM339
5. 7 segment display - 2 digit optically controlled counter
6. 555 Timer - Astable Multivibrator
7. 555 Timer - Temperature control (thermistor)
8. Op - Amp 741 - Introduction (basic functionality)
9. Op - Amp 741 - Solving Simultaneous Equations
10. Op - Amp 741 - Second order filters
11. Op - Amp 741 - Astable Multivibrator
12. Op - Amp 741 - D/A converter (R - 2R & Weighted)

13. Microprocessor 8086 - Introduction I (arithmetic – immediate mode)
14. Microprocessor 8086 - Introduction II (arithmetic and logical - all modes)
15. Microprocessor 8086 - Introduction III (code conversions and arrays)
16. Microprocessor 8086 - Solving equations
17. Microprocessor 8086 – Subroutines
18. "C++" - Language - Introduction I (simple programs)
19. "C++" - Language - Introduction II (arrays & matrices)
20. Elastic constants of glass - Cornu's method
21. Iodine absorption spectrum - Spectroscopic constants
22. Arc Spectra - Hartman's Interpolation
23. Susceptibility - Quincke's method
24. Stefan's Constant - determination

The staff in - charge shall select any 15 from this list. The remaining 3 experiments can be chosen from this list or can be new experiments included by the staff in - charge with prior approval of the department.

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Introduction To Microprocessors For Engineers And Scientists	P. K. Ghosh, P. R. Sridhar	Prentice - Hall of India, New Delhi	2001	2nd Edition
2	Microcomputer systems: the 8086/8088 family: architecture, programming, and design	Yu - cheng Liu, Glenn A. Gibson	Prentice – Hall	2006	2nd Edition
3	The Intel microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro processor	Barry B. Brey	Prentice - Hall of India, New Delhi	1997	4th edition
4	The C programming language	Brian W. Kernighan, Dennis M. Ritchie	Prentice Hall	1988	2nd Edition
5	Teach yourself C++	Herbert Schildt	Tata McGraw Hill	2008	3rd edition

16PPH2MC01 – EMBEDDED SYSTEMS

Category: MC **Credits:** 4

Semester: II **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Apply knowledge and demonstrate programming using the various modes of addressing in microcontroller 8051.	**L3**
CO2	Differentiate timer and counter programming in microcontroller 8051.	**L4**
CO3	Explain the various arithmetic and logic instructions and its implementation in PIC microcontroller.	**L2**
CO4	Identify the different I/O ports and write simple programs in PIC microcontroller.	**L3**
CO5	Use the various modes of addressing in solving arithmetic problems using ARM processor.	**L3**
CO6	Interface external devices to the ARM processor and write assembly language programs and C programs.	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	L
CO3	S	S	S	M	M
CO4	S	S	S	M	L
CO5	S	S	S	M	M
CO6	S	S	L	M	L

* S – Strong; M – Medium; L – Low

UNIT 1 : 8051 ARCHITECTURE AND PROGRAMMING **HOURS: 20**

Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication - Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions. Applications: Timer Counter Programming – Serial Communication Programming – Interrupt Programming – LCD digital clock /thermometer.

UNIT II : PIC18/24 ARCHITECTURE **HOURS: 18**

Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MP – LAB

UNIT III : PIC18/24 PERIPHERALS **HOURS: 20**

Peripherals - Timers – Interrupts - I/O ports - I2C bus - A/D converter – UART - CCP modules. Applications: Interfacing ADC, DAC, Sensor, LCD Display and Keypad - Generation of Gate signals for converters and Inverters - Motor Control – Controlling AC appliances – Measurement of frequency - Stand-alone Data Acquisition System.

UNIT IV : ARM ARCHITECTURE **HOURS: 16**

Advanced RISC Machine – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co - processors. Instruction set – Thumb instruction set – Instruction cycle timings

UNIT V : ARM PROGRAMMING **HOURS: 16**

The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming and 'C' compiler programming – simple programs – debugging.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Programming and customizing the 8051 microcontroller	Michael Predko	McGraw – Hill	1999	3rd Edition
2	The 8051 microcontroller and embedded systems	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay	Pearson Prentice Hall	2011	2nd edition
3	PIC microcontroller and embedded systems: using Assembly and C for PIC18	Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey	Pearson Prentice Hall	2009	2nd Edition
4	ARM System Developer's Guide: Designing and Optimizing	Andrew N. Sloss, Dominic Symes, Chris Wright, Morgan Kaufmann	Elsevier	2004	-

	System Software				

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	PIC microcontroller project book	John Lovine	Tata McGraw Hill	2000	1st Edition
2	Arm System - On - Chip Architecture	Steve Furber	Pearson Education India	2001	2nd Edition
3	ARM Architecture Reference Manual	-	-	-	-
4	www.arm.com	-	-	-	-

Chalk and Talk Lectures; Seminar; ICT based presentations; Video Lectures; Group Discussions; Interactive activities; Mini – project; MCQs.

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100 External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH2MC02 – MATHEMATICAL PHYSICS – II

Category: MC **Credits:** 5

Semester: II **No. of Hours/Week:** 5

Course Outcomes

COs	Statements	Bloom's Level
CO1	Explain the integral transformation techniques and study their application.	**L1, L2**
CO2	Evaluating the solutions of different partial differential equations.	**L5**
CO3	Analysing various recurrence relations, orthogonality properties and generating functions in special functions.	**L4**
CO4	Analysis of several properties and theorems in group theory.	**L4**
CO5	Demonstrate the knowledge about the probability density functions and properties.	**L3**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	M	M
CO5	S	S	L	S	L

UNIT I: INTEGRAL TRANSFORM: HOURS: 9

Laplace transform and its inverse - Transforms of derivatives and integrals - Differentiation and integration of transforms - Transforms of Heavy side and Dirac delta functions. Application: (1) Response of an RC circuit to a single square wave (2) Response of a damped vibrating system to a single square wave and to a unit impulse (3) Systems of two differential equations - two masses connected by a spring. Fourier transform and its inverse - Fourier transform of elementary functions - Transform of Gaussian function and Dirac delta function - Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem.

Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string - Laplace equation: Potential problem in a semi - infinite strip

UNIT II: PARTIAL DIFFERENTIAL EQUATIONS: HOURS : 9

Solution of partial differential equations of first order - Solution of initial boundary value problem by Laplace transform method: Diffusion equation, wave equation - Finite Fourier sine and cosine transform methods

UNIT III: SPECIAL FUNCTION - II HOURS : 9

Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations - Laguerre polynomials - Generating function - Orthogonality properties - Recurrence relation - Associated Laguerre polynomial - Properties - The error function and related functions

UNIT IV: GROUP THEORY HOURS : 9

Groups - Symmetry transformation of a square - Conjugate element and classes - multiplication of classes - Subgroups - cyclic group - Normal subgroups and factor groups - Direct product of groups - Isomorphism and homomorphism - Permutation groups - Distinct groups - representation theory of finite groups - Molecular point groups - irreducible representation of point groups - reducible representation - Schur's lemma and the orthogonality theorem - character of the representation - the example of C4V – irreducible representation and regular representation - Continuous groups and their representations - Lie groups - Axial rotation group SO (2) - Three dimensional rotation groups SO (3) and SU (2).

UNIT V: PROBABILITY HOURS : 9

Definitions - Laws of probability - Mean, Standard deviation – Poisson distribution - Binomial distribution - Normal distribution - Moments of distribution - Recurrence relations - Sampling of variables - Variance - The t - distribution - The Chi - Square distribution.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Introduction to Partial Differential Equations(Unit 1 and 2)	Rao Sankara	Prentice – Hall of India(2005)	2005	2nd Edition
2.	Advanced Engineering Mathematics partly for unit 1	Erwin Kreyszig	John Wiley & Sons	2011	10th Edition First edition
3.	Special functions for scientists and engineers(Unit 3)	W. W. Bell,	Courier Dover Publications	2004	2nd Edition

4.	Elements of group theory for physicists(Unit 4)	A.W. Joshi	New Age International	2007	4th Edition
5.	Mathematical Physics(Unit 5)	H.K.Dass	S. Chand & Company Limited	2010	4th Edition

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Applied mathematics for engineers and physicists	Louis Albert Pipes, Lawrence R. Harvill	McGraw - Hill	1970	3rd Edition
2.	Advanced Engineering Mathematics	Greenberg	Pearson Education India	1998	2nd Edition
3.	Engineering mathematics Vol I - III	Isaac A. Thangapandi Somasundaram A. Arumugam S	Scitech Publications (India) Pvt. Ltd		1st edition
4.	Group theory and quantum mechanics	Michael Tinkham	Courier Dover Publications, Tata McGraw Hill	2003	
5.	Mathematical Methods for Physicists	George Arfken, Hans-Jurgen Weber	Academic Press	2003	6th Edition
6.	Mathematical Methods for Physics and Engineering A Comprehensive Guide	K. F. Riley, M. P. Hobson, S. J. Bence,	Cambridge University Press	2006	3rd Edition
7.	Mathematical Methods in the Physical Sciences	Mary L. Boas, , Wiley		2006	3rd Edition
8.	Special Functions and Their Applications	Nikolaĭ Nikolaevich Lebedev, Courier	Dover Publications	1972	

9.	Mathematical Methods In Classical And Quantum Physics	Tulsi Dass, S.K. Sharma,	Universities Press	1998	

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH2MC03 – QUANTUM MECHANICS - I

Category: MC **Credits:** 5

Semester: II **No. of Hours/Week:** 5

Course Outcomes

COs	Statements	Bloom's Level
CO1	Acquire the knowledge of preliminary mathematical tools required in quantum mechanics.	**L1**
CO2	Capacity to solve simple one-dimensional systems and their time evolution.	**L3**
CO3	The ability to use different methodologies for perturbed systems.	**L4**
CO4	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.	**L3**
CO5	To solve scattering problems for different types of scatterers and compare theoretical and experimental results	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L
CO2	S	S	L	S	L
CO3	S	S	M	S	M
CO4	S	S	S	S	S
CO5	S	S	S	M	M

* S – Strong; M – Medium; L – Low

Unit – 1: General Formalism

Linear vector space – linear operators – postulates – uncertainty principle – Dirac's notation – equations of motion – momentum representation. Free particle – finite potential well – potential barrier– linear harmonic oscillator (operator method alone) – Hydrogen atom.

Unit – 2: Matrix Formalism (Representation theory)

Matrix representation of state vectors – operators – continuous case – change of representation – eigen value problems – different representations – unitary transformations involving time – Heisenberg method – Harmonic oscillator – matrix representation of spin – spinors-expectation values – magnetic moment of an electron – precision of electron in magnetic field.

Unit – 3: Approximation methods

Time independent perturbation theory – non-degenerate energy levels- anharmonic oscillator – ground state of Helium – degenerate levels- Stark effect – spin-orbit interaction – variational method – Hydrogen molecule.

Unit – 4: Angular momentum

Angular momentum operator – commutation relation – eigen values nad eigen functions of L2 and Lz – general angular momentum – eigen states and eigen values of J2 and Jz – angular momentum matrices – spin angular momentum – spin - 1/2 systems – addition of angular momentum

Unit – 5: Scattering theory and applications

Scattering cross section – scattering amplitude – partial waves – scattering by a central potential – partial wave analysis – scattering by a square well potential – Breit – Wigner formula – scattering length –phase shifts – Born approximation – scattering by screened Coulomb potential – validity of Born approximation – laboratory and centre of mass coordinate systems.

Books for study:

Title	Author	Publisher	year	Edition
Quantum Mechanics	G Aruldhas	Prentice Hall India Learning Pvt. Ltd	2004	4th
Quantum Mechanics	B. K. Agarwal	Hari Prakash Prentice Hall India Learning Pvt. Ltd	2004	5th
Quantum Mechanics	S L Kakani, H M Chandalia	Sultan Chand	2007	3rd
Quantum Mechanics	V.K. Thankappan	New Age International	1993	2nd

Books for reference:

Title	Author	Publisher	year	Edition
A text book of Quantum Mechanics	Piravonu Mathews Mathews, K. Venkatesan	Tata McGraw - Hill Education	1978	36th
Quantum Mechanics: Concepts and Applications	Nouredine Zettili.	John Wiley & Sons	2009	2nd
Quantum mechanics Vol.	Claude Cohen., Tannoudji,	Wiley	1977	2nd

	Bernard Diu, Franck Laloël			
Quantum mechanics: an introduction.	Walter Greiner	Elsevier Springer	2001	4th
Introduction to Quantum Mechanics	David J. Griffith	Pearson Education India.	2005	2nd
Principles of Quantum Mechanics	Ramamurti Shankar	Springer,	1994	2nd
Modern Quantum Mechanics	J.J. Sakurai	Pearson Education India	1998	7th

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH2MC04 – PRACTICAL - II

Category: MC **Credits:** 4

Semester: I **No. of Hours/Week:** 8

Course Outcomes

COs	Statements	Bloom's Level
CO1	Design circuits to interface LEDs, switches, D/A converter to μP 8086 and obtain the desired output**.**	**L4**
CO2	Verify the operation of GM counter using various sources.	**L2**
CO3	Compile programs in C++ to solve problems in numerical methods.	**L3**
CO4	Compute the elastic constants of glass by Cornu's method.	**L3**
CO5	Determine the spectroscopic constants using Iodine Absorption Spectrum	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	L
CO2	S	S	M	M	L
CO3	S	S	S	S	L
CO4	S	M	S	S	S
CO5	S	M	S	L	S

* S – Strong; M – Medium; L – Low

List of Experiments

1. 7 segment display - 2 digit optically controlled counter
2. Op - Amp 741 - Solving Simultaneous Equations
3. Op - Amp 741 - Second order filters
4. Microprocessor 8086 – Subroutines
5. Microprocessor 8086 - Interface I (LEDs)
6. Microprocessor 8086 - Interface II (LEDs & switches)
7. Microprocessor 8086 - Interface III (Freq. generation)
8. Microprocessor 8086 - Interface IV (Waveform generation)
9. Microprocessor 8086 - Interface V (Traffic lights simulation)
10. "C++" - Language - Introduction III (use of library functions)
11. "C++" - Language - Introduction IV (Numerical methods)

12. MASM - Introduction I (using DOS interrupt 21h)
13. Turbo Debugger - Introduction I (simple programs – Trace mode)
14. Elastic constants of glass - Cornu's method
15. Dielectric studies
16. Electrical conductivity studies - Four Probe Method
17. GM counter – Feather Analysis.

The staff in - charge shall select any 15 from this list. The remaining 3 experiments can be chosen from this list or can be new experiments included by the staff in - charge with prior approval of the department.

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Introduction To Microprocessors For Engineers And Scientists	P. K. Ghosh, P. R. Sridhar	Prentice - Hall of India, New Delhi	2001	2nd Edition
2	Microcomputer systems: the 8086/8088 family: architecture, programming, and design	Yu - cheng Liu, Glenn A. Gibson	Prentice – Hall	2006	2nd Edition
3	The Intel microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro processor	Barry B. Brey	Prentice - Hall of India, New Delhi	1997	4th edition
4	The C programming language	Brian W. Kernighan, Dennis M. Ritchie	Prentice Hall	1988	2nd Edition
5	Teach yourself C++	Herbert Schildt	Tata McGraw Hill	2008	3rd edition

16PPH2ES01 – ASTROPHYSICS

Category: ES **Credits:** 3

Semester: I **No. of Hours/Week:** 4

Course Outcomes

COs	Statements	Bloom's Level
CO1	Define Astronomical terms used in space Technology.	**L1**
CO2	Handle telescopes to observe celestial objects.	**L3**
CO3	Interpret Stars and their Properties.	**L3**
CO4	Explain formation of Stars and Galaxies and their classification.	**L2**
CO5	Discuss black holes, star formation and death.	**L2**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	S	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	S	M	L	S	L

* S – Strong; M – Medium; L – Low

Unit 1: General Astronomy **HOURS : 9**

System of Coordinates - Altazimuth, Equatorial (local and Universal), Ecliptic and Galactic systems. Magnitude scale and magnitude systems - correction for observed magnitudes. The proper motion - stellar parallax - Trignometric, cluster and secular parallaxes. Method of Luminosity distance.

Unit 2: Stellar temperatures and sizes **HOURS : 9**

Colour and effective temperatures - defining stellar temperatures by matter laws - HR diagram - Spectral and luminosity classification of stars. Measurement of stellar radii - Relation of luminosity with mass, radii and surface temperature. Binary stars – visual, spectroscopic and eclipsing binaries.

Unit 3: Stellar structure **HOURS : 9**

Equations of stellar structure - Russel - Vogt theorem - Ideas of polytropic model - stellar opacity - Free - Free transitions, Bound - Free transitions and electron scattering. Eddington's standard model. Homologous model for main sequence stars - Schwarzchild's model for real stars.

Unit 4: Stellar evolution **HOURS : 9**

The virial theorem - application to an isothermal gas sphere - evolution of stars near the main sequence - effect of hydrogen depletion - Schoenberg - Chandrasekhar limit of an isothermal core - nuclear time scale - ages of clusters - Star formation - Jean's criterion.

Unit 5: Stellar energy sources **HOURS : 9**

Thermonuclear fusion - CN cycle - pp chain - simple formulae for the energy generation rates - abundances for the elements in the stars structure of the sun from helioseismology - problems of nucleosynthesis.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Astrophysics: Stars and Galaxies	Abhyankar K D	Tata Mc Graw Hill	1992	2nd Edition
2	Text Book of Astronomy and Astrophysics with elements of Cosmology.	V.B.Bhatia	Narosa Publishing House.	2011	10th Edition
3	An Introduction to Astrophysics	Baidyanath Basu	Prentice Hall India Learning Pvt. Ltd	2003	First edition

Books for references

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	An Introduction to the Sun and Stars	Simon F. Green, Mark H. Jones, S. Jocelyn Burnell	Cambridge University Press	2004	4th Edition
2	Compendium of practical astronomy	Günter Dietmar Roth	Springer	1994	Volume 1

3	The physics of stars	A. C. Phillips	John Wiley	1999	2nd Edition

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH2ES01 – GEOPHYSICS

Category: ES **Credits:** 4

Semester: II **No. of Hours/Week:** 6

Course Outcomes

CO's	Statements	Bloom's Level
CO1	Discuss the physics and geology of the earth through geophysical observation and measurements.	**L2**
CO2	Comprehend the broad scale structure of the Earth and the physical processes governing the Earth's interior	**L3**
CO3	Empower students to understand the principles of applying geophysical methods to socially relevant problems, including natural hazards, ground water resource management and other environmental issues.	**L4**
CO4	Create the ability to interpret the data obtained from the geoelectrical, geochemical, magnetic and seismic methods.	**L3**
CO5	Investigate the models by solving the equations with the use of both analytical and computational methods.	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	L	S	L	S
CO3	S	S	S	M	M
CO4	S	S	S	L	S
CO5	S	S	S	M	S

* S – Strong; M – Medium; L – Low

UNIT I : PHYSICS OF THE EARTH HOURS: 18

Introduction to Geophysics- Earth as a member of the solar system-Atmosphere-Ionosphere-Asthenosphere-Lithosphere- Hydrosphere and Biosphere-Meteorology-Oceanography and Hydrology.

UNIT II :GEOPHYSICAL AND GEOCHEMICAL METHODS HOURS: 18

Geophysical methods: Geo referencing using Arc GIS software. Electrical methods-Quantitative interpretation of Vertical Electrical Sounding curves –Preparing pseudo cross section for electrical resistivity data and interpretation. Geochemical methods: Introduction-Principles of groundwater chemistry-Sources of contamination- Ground water quality analysis using geochemical methods.

UNIT III : INTRODUCTION TO SEISMOLOGY HOURS: 18

The earth's interior and crust as revealed by earthquakes- Rayleigh waves and Love waves-Elastic rebound theory- Continental drift-Earthquake magnitude and intensity- Horizontal seismograph and seismograph equation-Tsunami- Causes and Impacts-Tsunami warning systems.

UNIT IV : GEOMAGNETISM AND GRAVITY HOURS:18

Historical introduction –The physical origin of magnetism- Causes of the main field-Dynamo theory of earth's magnetism. Gravitational potential-Laplace's equation and Poisson's equation-Absolute and relative measurements of gravity- Worden gravimeter.

UNIT V : GEOCHRONOLOGY AND GEOTHERMAL PHYSICS HOURS: 18

Radioactivity of the earth-Radioactive dating of rocks and minerals-Geological time scale-The age of the earth. Flow of heat to the surface of the earth –Sources of heat within the earth-Process and heat transport and internal temperature of earth.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Water quality data -Analysis and Interpretation	Arthur W. Hounslow	Lewis publishers ,Washington D.C	1995	11th Edition
2	Physics of the Earth and Planets	Cook. A.H	McMillan Press, London	1973	4th Edition
3	Field geophysics-The geophysical	John Milsom	Wiley publications ,England		6th Edition

	field guide III edition				
4	Introduction to Geochemistry	Krauskopf. K.B	McGraw Hill.	1967	6th Edition
5	Outline of geophysical prospecting-a manual for geologists	Ramachandra Rao	University of Mysore	1975.	5th Edition

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Introduction to Geophysics	Garland	WB Saunder Company, London,	1979	5th Edition
2	Fundamentals of Geophysics	William Lowrie	Cambridge press,UK	1984	11th Edition
3	Geochronology-Methods and case studies .	Nils-Axel Morne	INTECH publications	1989	5th Edition
4	Geochronology – Dating and Precambrian time –The beginning of the world as we know it	John Raferty	Britannica Educational publishers, New York.	2011	7th Edition
5	Theory of the Earth,	Don L.Anderson	Blackwell scientific Publications-,UK	1989	6th Edition

Teaching Methodology

Chalk and Talk Lectures; Seminar; ICT based presentations; Video Lectures; Group Discussions; Interactive activities; Mini – project; MCQs.

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100 External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH3MC01 – STATISTICAL MECHANICS

Category: MC **Credits:** 5

Semester: III **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Apply statistical techniques to thermo-dynamical problems such as ideal gas, real gases and harmonic oscillator.	**L3**
CO2	Obtain various distribution functions for different ensembles, averaging, fluctuations for classical and quantum statistics.	**L1**
CO3	Compare different ensembles and study their limitations.	**L4**
CO4	Use the statistical tools on quantum systems such as phonon gas, photon gas and electron gas and study their signature features.	**L3**
CO5	Compute Einstein's theory of specific heat capacity of gas.	**L1**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	S	S	S	M	M
CO3	S	S	M	L	L
CO4	S	S	S	M	L
CO5	S	S	M	L	L

* S – Strong; M – Medium; L – Low

Unit 1: Ensemble Theory

Foundation of statistical Mechanics – connection between statistical mechanics and thermodynamics – classical ideal gas – Gibb's paradox – phase space – Liouville's theorem, microcanonical ensemble – classical gas in microcanonical ensemble – linear harmonic oscillator – coarse graining of phase space

Unit 2: Canonical Ensembles

Classical Canonical ensembles –partition function – connection with thermodynamics – energy fluctuation – classical ideal gas in canonical ensembles - calculation of statistical quantities – equipartition theorem – classical harmonic oscillator – two level system – concept of negative temperature – particle in a box – linear harmonic oscillator – system with internal degrees of freedom – rigid rotator – Einstein's theory of specific heat capacity

Unit 3: Grand Canonical ensemble

Particle reservoir – grand partition function – connection with thermodynamics – classical gas in grand canonical ensemble – symmetry aspect of many particle wave function – photons – number fluctuation – parametric equation of states – virial expansion – critical fluctuation – pair production – elements of quantum statistics – density matrix – pure and mixed states – properties of density matrix
density operators for quantum statistics.

Unit 4: Bose – Einstein statistics

Ideal Bose gas – its thermal properties – statistics of ensembles – black body radiation – phonons – Debye's theory of specific heat – BE condensation – Liquid helium – super fluidity

Unit 5: Ideal Fermi gas

Ideal Fermi gas – Fermi Dirac distribution –thermodynamic properties of Fermi gas – electrons in metals – electronic heat capacity – paramagnetic susceptibility – white dwarf – Chandrasekhar limit – nuclear matter.

Books for study

Title	Author	Publisher	Year	Edition
Thermodynamics and Statistical Mechanics	Walter Greiner	Springer	1995	4th
Statistical Mechanics	R K Pathria	Elsevier	1996	second edition
Introduction to statistical mechanics	Kerson Huang	CRC press	2001	3rd

Books for reference

Title	Author	Publisher	Year	Edition
Fundamentals of Statistical and thermal Physics	F Reif	McGraw Hill	1965	4th
Statistical Physics	Laundu and Lifshitz	Butterworth – Heinemann	1980	3rd
Statistical Mechanics-Principles and selected applications	Terrell Hill	Courier Dover Publications,	1987	4th
Introduction to modern statistical	David Chandler	Oxford University	1987	6th

mechanics		Press–		
Statistical Mechanics	Agarwal and Eisner	New Age International Press	2011	8th

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH3MC02 – SPECTROSCOPY

Category: MC **Credits:** 5

Semester: III **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Understand microwave spectroscopy and applications	**L2**
CO2	Understand vibrational spectroscopy and applications	**L3**
CO3	Study microwave spectroscopy and uses	**L4**
CO4	Explore electronic spectroscopy and its information	**L3**
CO5	Understand surface spectroscopy and device-oriented applications	**L2**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	L	S	L	S
CO3	S	S	S	M	M
CO4	S	S	S	L	S
CO5	S	S	S	M	S

* S – Strong; M – Medium; L – Low

UNIT 1: MICROWAVE SPECTROSCOPY

Rotation of molecules-Rotational spectroscopy-Rigid and non-rigid diatomicrotator-Intensity of spectral lines-Isotopic substitution-Poly atomic molecules (Linear and symmetric top)-Hyperfine structure and quadrupole effects-Inversion spectrum of ammonia-Chemical analysis by microwave spectroscopy-Techniques and instrumentation- microwave oven.

UNIT 2: VIBRATIONAL SPECTROSCOPY

Infrared spectroscopy-Vibration of molecules-Diatomic vibrating rotator- Vibrational rotational spectrum-Interactions of rotations and vibrations-Influence of rotation on the Vibrational spectrum of linear and symmetric top and poly atomic molecules-Analysis by infrared techniques-Instrumentation-FTIR spectroscopy.

Raman spectroscopy: Classical and quantum mechanical picture of Raman effect-Polarizability –Pure rotational Raman spectrum- Vibrational Raman Spectrum-Raman activity of vibrations of CO2 and H2O-Rule of mutual exclusion-Overtones and combination- Rotational fine structure - Depolarization ratio-Vibrations of spherical top molecule-structural determination from IR and Raman spectroscopy-techniques and instrumentation-FT Raman spectroscopy.

UNIT 3: ELECTRONIC SPECTROSCOPY

Electronic spectra- Frank-Condon principle-Dissociation energy and dissociation products-Fortrat diagram-predissociation-shapes of some molecular orbits-Chemical analysis by electronic spectroscopy-Techniques and instrumentation-Mass spectroscopy-ESR spectroscopy- Introduction- techniques and instrumentation- Electronic angular momentum in diatomic molecules.

UNIT 4: NUCLEAR SPECTROSOPY

Nuclear magnetic resonance spectroscopy-Introduction-Interaction of spin and magnetic field-population of energy levels-Larmor precession-Relaxation times- Double resonance- Chemical shift and its measurement- Coupling constant-Coupling between several nuclei- Quadrupole effects-C13 NMR spectroscopy- Interpretation of simple spectrum - Mossbauer spectroscopy: Principle-instrumentation- Isomer shift- Effect of electric and magnetic fields- Magnetic hyperfine interaction.

UNIT 5: SURFACE SPECTROCOPY AND DEVICES

Electron energy loss spectroscopy (EELS)-Reflection absorption spectroscopy (RAIRS)-Photoelectron spectroscopy (PES) – Instrumentation – interpretation of spectrum; XPES, UPES-Auger electron spectroscopy (AES) - X-ray Flourescence spectroscopy (XRF)- SIMS - Surfaces for SERS study-SERS Microbes-Surface selection rules- SEM- TEM- AFM.

Books for study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Molecular and Structure and Spectroscopy	G. Aruldhas	PHI Learning Private Limited	2007	2nd Edition
2	Fundamentals of molecular spectroscopy	Colin Banwell and Mc Cash	TMH publishers	2004	5th edition

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Recent Advances in Spectroscopy: Theoretical, Astrophysical and Experimental Perspectives	Rajat K. Chaudhuri, M.V. Mekkaden, A. V. Raveendran, A. Satya Narayanan	Springer	2010	**NA**
2	Principles of Laser Spectroscopy and Quantum Optics	Berman Paul R, Malinovski Vladimir S.	Princeton University Press	2011	**NA**
3	Accelerator Mass Spectrometry	Tuniz C., Kutschera W., Fink D., Herzog G.F	CRC press	2011	**NA**
4	Quantum Chemistry and Spectroscopy	Thomas Engel	Pearson Publications	2012	3rd Edition
5	Light Absorption in Sea Water	Wozniak Bogdian, Dera Jerzy	Springer Publications	2011	-
6	www.ups.edu/faculty/hanson/chemwebsites/organicwebsites. html www.rsc.org/.../InterestGroups/ESRSpectroscopy/index.asp				

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100

External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH3MC03 – PRACTIAL – III

Category: MC **Credits:** 4

Semester: III **No. of Hours/Week:** 8

Course Outcomes

COs	Statements	Bloom's Level
CO1	Construct circuits to interface stepper motor, 7 segment display, 7×5 LED dot matrix display etc to μP 8086**.**	**L3**
CO2	Solve simple arithmetic relations using μC 8051.	**L2**
CO3	Execute programs for interfacing LEDs and switches using Embedded ARM7 & Embedded PIC.	**L4**
CO4	Compile programs in C++ related to numerical methods and graphics.	**L2**
CO5	Design circuits to interface water level converter, home appliances to μC 8051.	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	L
CO2	S	S	S	S	L
CO3	S	S	S	M	L
CO4	S	M	S	S	M
CO5	S	M	S	L	L

* S – Strong; M – Medium; L – Low

List of Experiments

1. Microprocessor 8086 - Interface (A/D - Counter)
2. Microprocessor 8086 - Interface (A/D - Successive approx.)
3. Microprocessor 8086 - Interface (Calculator - 16 switches)
4. Microprocessor 8086 - Interface (Stepper motor control)
5. Microprocessor 8086 - Interface (7 segment display multiplexing)
6. Microprocessor 8086 - Interface (Stop clock - light operated)
7. Microprocessor 8086 - Interface (7x5 LED dot matrix display)
8. Microprocessor 8086 - Interface (Rolling display)
9. Microprocessor 8086 - Interface (LCD display)
10. Micro controller 8051 - Introduction I
11. Micro controller 8051 - Introduction II

12. Micro controller 8051 - Interface (LCD display)
13. Embedded ARM7 – Introduction I
14. Embedded ARM7 – Introduction II
15. Embedded ARM7 – Introduction III
16. Embedded PIC – Introduction I
17. Embedded PIC – Introduction II
18. Embedded PIC – Introduction III
19. Inverter - Low D.C. to High A.C. converter
20. A/D - Binary counter - IC 7493
21. PLL - remote control applications
25. MASM - 2 digits arithmetic operations
26. Turbo Debugger - Arrays manipulations
27. "C++" - Language - Introduction to graphics
28. "C++" - Language - Interface (Stepper motor control)

The staff in - charge shall select any 10 from this list. The remaining 8 experiments can be chosen from this list or can be new experiments included by the staff in - charge with prior approval of the department.

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Introduction to Microprocessors For Engineers And Scientists	P. K. Ghosh, P. R. Sridhar	Prentice - Hall of India, New Delhi	2001	2nd Edition
2	Microcomputer systems: the 8086/8088 family: architecture, programming, and design	Yu - cheng Liu, Glenn A. Gibson	Prentice – Hall	2006	2nd Edition
3	The Intel microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro processor	Barry B. Brey	Prentice - Hall of India, New Delhi	1997	4th edition
4	The C programming language	Brian W. Kernighan, Dennis M. Ritchie	Prentice Hall	1988	2nd Edition
5	Teach yourself C++	Herbert Schildt	Tata McGraw Hill	2008	3rd edition

16PPH3ID01 – NANO SCIENCE

Category: ID **Credits:** 5

Semester: III **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Understand the rapidly developing field of nanoscience and technology	**L2**
CO2	Classify nanoparticles based on their properties.	**L3**
CO3	To understand physical and chemical synthesizing techniques	**L4**
CO4	Explore characterization methods	**L3**
CO5	Study applications of nanomaterials with interdisciplinary approach involving Physics and Chemistry	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	L	S	L	S
CO3	S	S	S	M	M
CO4	S	S	S	L	S
CO5	S	S	S	M	S

* S – Strong; M – Medium; L – Low

Unit 1: Fundamentals of Nanoscale Science

1.1. Introduction - nano and nature - background to nanotechnology - scientific revolutions opportunities at the nanoscale - time and length scale in structures - surfaces and dimensional space - evolution of band structures and Fermi surfaces - electronic structure of nanocrystals - bulk to nano transition - size and shapes - dimensionality and size dependent phenomena.

1.2. Energy landscapes basic intermolecular forces - interdynamic aspects of intermolecular forces.

Unit 2: Classification of nanoparticles and its properties

2.1. Metal Nanoparticles: Size control of metal nanoparticles, Structural, Surface, electronic and optical properties.

Semiconductor Nanoparticles: solid state phase transformation, Excitons, Quantum confinement effect, Semiconductor quantum dots (SQDs), Correlation of properties with size, Quantum Well, Quantum Wires, Super lattices band and Band offsets, Quantum dot lasers.
Magnetic nanomaterials: Fundamentals of magnetic materials, Dia, Para, Ferro, Ferric, and Superpara magnetic materials, Nanostructured Magnetism.
2.2. Semiconductor Nanocomposites: Types of Nanocomposites (Metal oxides, ceramic and Glass), Core - Shell nanoparticles - Types of systems - properties of nanocomposites.
Carbon Nanostructures: Introduction, Fullerenes, C60, CNT, mechanical, optical and properties.

Unit 3: Synthesis of Nanomaterials

3.1. Physical methods: Thermal evaporation, Spray pyrolysis, Molecular beam epitaxy (MBE), Physical vapour deposition (PVD), Microwave heating, Electric arc deposition, Ion implantation.
3.2. Chemical methods: Chemical and co - precipitation, Sol fundamentals - sol - gel synthesis of metal oxides, Micro emulsions or reverse micelles, Solvothermal, Sonochemical synthesis, Electrochemical synthesis, Photochemical synthesis, Langmuir - blodgett (LB) technique, Chemical vapour deposition (CVD)

Unit 4: Characterization Techniques

4.1. Powder X - Ray Diffraction, Scanning electron microscope (SEM), Transmission electron microscope (TEM), Scanning tunnelling microscope (STM), Atomic force microscope (AFM), Scanning probe microscopy (SPM), UV - Visible absorption, Impedance measurement, V - I characteristics, Vibrating sample magnetometer (VSM).
4.2. Brunauer - Emmett - Teller (BET) Surface Area Analysis, Energy dispersive X - ray (EDX), X - ray photoelectron spectroscopy (XPS) and Photoluminescence.

Unit 5: Applications of Nanomaterials and Nanocomposites

5.1. Nanophotonics and Devices: ID, 2D, 3D Photonic crystals, Couplers, Waveguides, Photonic crystal fibres, Optical data storage systems and Quantum computing
Medical applications: Imaging of cancer cells, Biological tags and Targeted nano drug delivery system.
5.2. Nanosensors: Sensors based on physical properties - Electrochemical sensors, Sensors for aerospace, defence and Biosensors.
Energy: Solar cells, LEDs and Photovoltaic device applications.
Photocatalytic applications: Air purification, Water purifications and Volatile organic pollution degradation.
Carbon nanotubes: Field emission, Fuel cells and Display devices.

Books for Study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Structure and properties of solid state materials	B. Viswanathan	Alpha Science Internationa	2006	2nd Edition
2	Nano - The essentials	T.Pradeep	Tata McGraw - Hill publishing company limited	2007	-

Books for Reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Nanocomposite Science and Technology	Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun	John Wiley & Sons	2006	-
2	Nanoparticles: From Theory to Application	Günter Schmid	John Wiley & Sons	2011	2nd Edition
3	Nanotechnology: Principles And Practices	Sulabha K.Kulkarni	Capital publishing company	2007	-
4	Nanomaterials	B.Viswanathan	Narosa Publishing House Pvt. Ltd., New Delhi,	2009	-
5	Nano Materials	A. K. Bandyopadhyay	New Age International Publishers Ltd., New Delhi	2007	2nd Edition
6	Encyclopedia of Materials Characterization: Surfaces, Interfaces, Thin Films	C. R. Brundle, Charles A. Evans, Shaun Wilson	Butterworth - Heinemann publishers	1992	-
7	Introduction to nanotechnology	Charles P.Poole, Frank J. Owens	John Wiley & Sons publication	2003	-
8	Synthesis of inorganic materials	Ulrich Schubert	Nicola Husing, , John Wiley & Sons	2012	3rd Edition

9	Cluster beam synthesis of nanostructured materials	Paolo Milani, Salvatore Iannotta	Springer	1999	-

Note: The first part of all sections will be handled by the Physics faculty and the second part will be handled by Chemistry faculty.

Teaching Methodology:
Chalk and Talk Lectures, Tutorials, Video Lectures
Evaluation Pattern:
Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**
External: **100 marks (20+30 +50)**

16PPH3ES01 – CRYSTAL PHYSICS

Category: ES **Credits:** 3

Semester: III **No. of Hours/Week:** 4

Course Outcomes

COs	Statements	Bloom's Level
CO1	Acquire a qualitative idea on the fundamentals of growing crystals	**L2**
CO2	Understand low temperature growth techniques	**L3**
CO3	To understand melt and vapour techniques	**L4**
CO4	Study optical analysis of crystals	**L3**
CO5	Explore crystal characterization	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	L	L
CO4	S	S	S	L	L
CO5	S	S	S	M	M

* S – Strong; M – Medium; L – Low

UNIT 1: NUCLEATION

Different kinds of nucleation – equilibrium stability and metastable 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.

UNIT 2 : LOW TEMPERATURE GROWTH TECHNIQUES

Low temperature solution growth - slow cooling and slow evaporation methods - temperature gradient 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.

UNIT 3 : MELT AND VAPOUR TECHNIQUES

Growth from melt – Bridgman, Czochralski, zone melting, Verneuil techniques - physical vapour deposition - flux growth - chemical vapour deposition - chemical vapour transport - hydrothermal growth - epitaxial growth

UNIT 4 : OPTICAL STUDIES

Atomic absorption spectroscopy - UV - Visible - NIR spectroscopy - Experimental set ups for Fourier Transform Infrared analysis, FT - Raman vibrational spectroscopy - Illustrations with selected crystals - Nonlinear optical phenomenon (qualitative) - Kurtz powder SHG method - photoconductivity and schematic set up for measurements - negative photoconductivity.

UNIT 5 : 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.

Books for study and reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Crystal growth processes	James Coble Brice	John Wiley and Sons, New York	1986	-
2	The growth of crystals from liquids	John Chadwick Brice North	Holland Pub. Co.,	1973	-
3	Crystal growth	Harold Eugene Buckley	John Wiley and Sons, New York	1951	-
4	Crystal growth	Brian R. Pamplin,	Pergamon	1980	2nd Edition
5	Crystals in Gels and Liese gang Rings	Heinz K. Henisch	Cambridge University Press	2005	-
6	Thermal Analysis: Theory and Applications	R. T. Sane, Jagdish K. Ghadge,	Quest Publications	1997	-
7	Handbook of Nonlinear Optical Crystals	Valentin G. Dmitriev, Gagik G. Gurzadyan, David N. Nikogosyan,	Springer	2010	3rd Edition

8	Photoconductivity: Art, Science, and Technology	N. V. Joshi, Marcel Dekker		1990	-
9	Crystal growth Process and Methods	Santhanaraghavan P. and Ramasamy P.,	KRU Publications, Kumbakonam	2000	-
10	Springer Handbook of Crystal Growth	Govindhan Dhanaraj, Kullaiah Byrappa, Vishwanath Prasad	Springer	2010	-
11	Advances in technologically important crystals	Binay Kumar, R. P. Tandon, University of Delhi. Dept. of Physics and Astrophysics	Macmillan	2007	-

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH3ES02 – DATA COMMUNICATION AND COMPUTER NETWORKS

Category: ES **Credits:** 3

Semester: III **No. of Hours/Week:** 4

Course Outcomes

COs	Statements	Bloom's Level
CO1	Explore the latest techniques in data communication and computer networks.	**L4**
CO2	Discuss the concepts of analog and digital transmission and its impairments.	**L2**
CO3	Analyse the transport layer design issues with its corresponding protocols.	**L4**
CO4	Implement the idea of elementary data link protocols from error detection and correction.	**L5**
CO5	Apply the concept of synchronous and asynchronous transmission in line interfacing and configurations.	**L3**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	L
CO2	S	S	L	S	M
CO3	M	S	S	S	S
CO4	S	S	S	S	S
CO5	S	M	M	S	S

* S – Strong; M – Medium; L – Low

UNIT 1 : DATA TRANSMISSION AND ENCODING - Concepts HOURS : 12

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.

UNIT 2 : DATA LINK CONTROL HOURS : 6

Flow control, Error control - HDLC, Multiplexing.

UNIT 3 : INTRODUCTION TO COMPUTER NETWORKS HOURS : 9

AND THE PHYSICAL LAYER - Introduction: The uses of computer networks - Network hardware - Network software - Reference models - Example of networks - Network standardization. The physical layer: The theoretical basis for data communication - Guided Transmission media - Wireless transmission.

UNIT 4 : THE DATA LINK AND THE NETWORK LAYERS - HOURS : 9

The Data Link Layer: Data link layer design issues - 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.

UNIT 5 : THE TRANSPORT AND THE APPLICATION HOURS : 9

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.

Books for study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Data and Computer Communications	William Stallings	Prentice - Hall of India	2008	8th Edition
2	Computer Networks	Andrew S. Tanenbaum	Prentice - Hall of India, New Delhi	2005	4th edition
3	Introduction to Data Communication and Networking	Behrouz Forouzan	Tata McGraw - Hill	2000	3rd edition

Books for reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Internetworking with TCP/IP	Douglas Comer	Prentice - Hall of India	2006	Volume 1/ 5th Edition
2	Principles Of Communication Systems	Taub and Schilling	McGraw Hill	1986	4th Edition
3	Computer Networking: A Top - Down Approach	James F. Kurose, Keith W. Ross, Julie C. Meloni	Pearson Education, Asia	2006	3rd Edition

	Featuring the Internet				

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: **C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks**

External: **100 marks (20+30 +50)**

16PPH3ES03 – REACTOR PHYSICS

Category: ES **Credits:** 3

Semester: III **No. of Hours/Week:** 4

Course Outcomes

COs	Statements	Bloom's Level
CO1	Discuss the physics of neutrons, reactions induced by neutrons and nuclear fission	**L4**
CO2	Calculate the energy released in a reactor and reactor power for the known quantity of a particular fuel.	**L3**
CO3	Analyze slowing down of neutrons in different media based on diffusion theory.	**L3**
CO4	Solve reactor problems relating the optimum reactor size and design.	**L3**
CO5	Understand the fission-product poisoning and reactor safeguards	**L5**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	S	S	S	S	M
CO3	S	S	S	M	L
CO4	S	S	S	S	L
CO5	S	S	S	M	M

* S – Strong; M – Medium; L – Low

Unit 1: Nuclear Energy

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

Unit 2: Neutron diffusion

Multiplication factor - neutron balance and conditions for criticality - Conversion and breeding - Classification of reactors Diffusion of neutrons: Flux and current density - Equation of continuity - Fick's law - Diffusion equation - Boundary conditions and solutions - Diffusion length - Reciprocity theorem.

Unit 3: Neutron Moderation

Energy loss in elastic collision - moderation of neutrons in Hydrogen-lethargy - Space dependent slowing down - Fermi's age theory - Moderation with absorption-Fermi theory of Bare thermal reactor: Criticality of an infinite reactorOne region finite thermal reactor - Critical equation - Optimum reactor shape.

Unit 4: Reactor Kinetics

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

Unit 5: Control and Shielding

Reactor control : Road worth - One control rod - modified one group, two group theory - ring of rods-Radiation shielding : Reactor safeguards - Reactor properties over lifecore life estimation.

Books/ website for study and reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1.	Introduction to Nuclear Reactor Theory	John R. Lamarsh	American Nuclear Society	2002	-
2.	The Elements of Nuclear Reactor Theory	Samuel Glasstone, Milton C. Edlund	Van Nostrand,	1965	-
3.	Introductory Nuclear Reactor Theory	H.S. Isbin	Reinhold, New York	1963	-

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

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks

External: 100 marks (20+30 +50)

16PPH4MC01 – QUANTUM MECHANICS II

Category: MC **Credits:** 5

Semester: IV **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Derive the principle of time dependent perturbation and relate them to LASERs	**L2**
CO2	Discuss the basic principles of the special theory of relativity and apply the same to solve real time problems	**L3**
CO3	Demonstrate an understanding of the founding principles of relativistic quantum mechanics	**L4**
CO4	Derive Klein-Gordon and Dirac equations, and the concept of quantum mechanical spin	**L3**
CO5	Demonstrate an understanding of field quantization and the explanation of the scattering matrix.	**L4**
CO6	Carry out practical calculations based on Feynman diagrams	**L3**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO5	PSO6	PSO7
CO1	S	S	M	S
CO2	S	M	M	L
CO3	S	M	S	L
CO4	S	S	L	L
CO5	S	S	M	M
CO6	S	S	L	L

* S – Strong; M – Medium; L – Low

Unit – 1: Time dependent perturbation theory

Introduction – first order perturbation – constant perturbation – harmonic perturbation – interaction of atom with electro-magnetic field – dipole approximation – selection rules – Einstein coefficients and spontaneous emission

Unit – 2: Relativistic Mechanics

Relativistic addition of velocities – structure of space-time – metric tensor – contra & covariant vectors – proper time and proper velocity - relativistic energy and momentum – momentum 4-vector – momentum transformation – Compton scattering – work energy theorem – Minkowski force.

Unit – 3: Relativistic Quantum Mechanics

K – G equation – interpretation – particles in a Coulomb field – Dirac's equation for a free particle – Dirac's matrices – covariant form of Dirac's equation – negative energy states – probability density – plane wave solution – spin of Dirac's particle – magnetic moment of electron – spin-orbit interaction – radial equation for electron in a central potential – Hydrogen atom – Lamb shift.

Unit – 4: Identical particles, Symmetries and conservation laws

Identical particles in quantum mechanics – exchange degeneracy – permutation operators – two - particle system – symmetric and antisymmetric kets – system with arbitrary number of particles – parity - Symmetry transformations – conservation laws and degeneracy – discrete symmetries – parity or space inversion – parity conservation - time reversal.

Unit – 5: Elements of field quantization

Introduction – quantization of free electromagnetic field – creation and annihilation operators – Lagrangian field theory – non-relativistic fields – relativistic fields – Klein - Gorden field – Dirac's field – electromagnetic field – interacting fields – Feynmann diagrams – electron-photon interaction (optional – scattering – Coulomb scattering – Moller scattering – Bhabha scattering – Bremstrauhlung and pair production.

Books for study

Title	Author	Publisher	year	Edition
Quantum Mechanics	G Aruldhas	Prentice Hall India Learning Pvt. Ltd	2004	4th
Quantum Mechanics	B. K. Agarwal	Hari Prakash Prentice Hall India Learning Pvt. Ltd	2004	5th
Quantum Mechanics	S L Kakani, H M Chandalia	Sultan Chand	2007	3rd

Quantum Mechanics	V.K. Thankappan	New Age International	1993	2nd

Books for reference

Title	Author	Publisher	year	Edition
A text book of Quantum Mechanics	Piravonu Mathews Mathews, K. Venkatesan	Tata McGraw - Hill Education	1978	36th
Quantum Mechanics: Concepts and Applications	Nouredine Zettili.	John Wiley & Sons	2009	2nd
Quantum mechanics Vol.	Claude Cohen., Tannoudji, Bernard Diu, Franck Laloël	Wiley	1977	2nd
Quantum mechanics: an introduction.	Walter Greiner	Elsevier Springer	2001	4th
Introduction to Quantum Mechanics	David J. Griffith	Pearson Education India.	2005	2nd
Principles of Quantum Mechanics	Ramamurti Shankar	Springer,	1994	2nd
Modern Quantum Mechanics	J.J. Sakurai	Pearson Education India	1998	7th

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks

External: 100 marks (20+30 +50)

16PPH4MC02 – NUCLEAR PHYSICS

Category: MC **Credits:** 5

Semester: IV **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Acquire knowledge on nuclear size, shape and forces like physical properties	**L2**
CO2	Understand nuclear model and reactors	**L3**
CO3	Study nuclear reactions and background concepts	**L4**
CO4	Understand radioactive concepts and theories	**L3**
CO5	Explore elementary particles and their models	**L2**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	L	S	L	S
CO3	S	S	M	M	M
CO4	S	S	S	L	S
CO5	S	M	S	M	S

* S – Strong; M – Medium; L – Low

UNIT 1: Nuclear size, shapes and forces

Nuclear size determination by different methods - Electron scattering method - Electric - moments - magnetic moments. Nuclear forces: Two - nucleon potentials - Tensor forces - Ground state of the deuteron - Neutron Proton scattering at low energies - Singlet state - magnetic moment - Charge independence of nuclear forces - ISO - spin formalism - Meson theory of nuclear forces.

UNIT 2: Nuclear Models

Liquid drop model - Semi - empirical mass formulas and nuclear fission - Binding energy - Weizsacker mass formula - Levy's formula - Atomic masses and its significance - Shell model - Magic numbers - Optical model - Unified model - Barrier penetration - Basic ideas of reactors.

UNIT 3: Nuclear reactions

Nuclear reactions and cross - sections - Breit - Weigner single - level formula - Resonance scattering - The compound nucleus - Continuum theory - Optical model - Absorption cross - section at high energies. - Stability of heavy nuclei - Relativistic heavy ion collision – Controlled chain reaction – basic ideas of reactors.

UNIT 4: Radioactivity: Introduction

Gamow theory of alpha decay - Beta decay - Energy spectrum - Fermi theory - Fermi and Gamow - Teller selection rules - Non - conservation of parity - Pion condensation - Neutron stars.

UNIT 5: Elementary particles

Classification – types of interaction hadrons and leptons – symmetries and conservation laws – CP andCPT invariance – CPT theorem – classification of hadrons – Lie algebra – SU(2) and SU(3) multiplets – quark model – Gellman Okubo mass formula for octets and decuplet hadrons – charm, bottom, top quarks.

Books for study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Nuclear physics: theory and experiment	Radha Raman Roy, B.P. Nigam	New Age International, Chennai.	2008	1st Edition
2	Introduction to elementary particles	David Jeffery Griffiths	Wiley VCH	2008	2nd Edition
3	Nuclear and Particle Physics: An Introduction	B R Martin	John Wiley & Sons	2011	2nd Edition
4	Elementary Particle Physics in a Nutshell	Christopher G Tully	Princeton University Press	2011	NA

Book for reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Principles of nuclear reactor engineering	Samuel Glasstone, Van Nostrand	ACS Publications	1956	NA

Evaluation Pattern

Internal: CIA I (30) + CIA II (30) + Component I (20) + Component II (20) = 100
External: Part A (20) + Part B (30) +Part C (50) = 100

16PPH4MC03 – SOLID STATE PHYSICS

Category: MC **Credits:** 5

Semester: IV **No. of Hours/Week:** 6

Course Outcomes

COs	Statements	Bloom's Level
CO1	Understand crystal structure and its dynamics	**L2**
CO2	Understand theoretical backgrounds of metals and semiconductors	**L3**
CO3	Study transport phenomena and dielectric properties of matter	**L4**
CO4	Acquire knowledge in magnetism in solids	**L3**
CO5	Explore superconductivity of solids	**L4**

Mapping of COs – PSOs

Course Outcomes	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	S	S	S	M	L
CO3	S	S	S	M	M
CO4	S	S	S	L	S
CO5	S	S	S	M	L

* S – Strong; M – Medium; L – Low

UNIT 1: Crystal structure and lattice dynamics

Lattice - translation symmetry - 3D crystal systems - Bravias lattices - Reciprocal lattice - Miller indices; X Ray Diffraction - Bragg's law (Vector form) - atomic scattering factor - structure factor - extinction rules for BCC, FCC, ZnS and diamond structure. Lattice vibrations for a linear mono atomic lattice - linear diatomic lattice – acoustical and optical modes - extinctions and optical branch in ionic crystals - quantisation of lattice vibrations - lattice dynamics of a BCC three dimensional solid - inelastic scattering of phonons.

UNIT 2: Theory of metals and semiconductor

Brillouin zones - electrons in periodic potential - Bloch's theorem – Kronig - Penney model - nearly free electron model - effective mass - zone schemes - band model of metal, semiconductor and insulator. Intrinsic semiconductor - carrier concentration - impurity

semiconductors (n and p type) - carrier concentration - steady state diffusion - pn junction - homogeneous semiconductors.

UNIT 3: Transport phenomena and dielectric properties

Thermal conductivity: of lattice - of free electrons - Fermi surface - effect of electric field on Fermi surface - effect of magnetic field on Fermi surface - mobility of charge carriers in semiconductors: intrinsic region and impurity range - Hall effect. dipole moment - atomic polarisability - Classius - Mossotti equation - theory of electronic polarisation - frequency dependent polarisability - ferro electricity

UNIT 4: Magnetism

Larmor diamagnetism - Langevin's theory of para magnetism - Hund's rules- origin of magnetic interaction - molecular field theory of ferromagnetism - failure of independent electron approximation Spin Hamiltonian and Heisenberg model - Magnons and thermal excitation of magnons - domain theory of hysteresis and anti ferromagnetic magnons - types of magnetic structure

UNIT 5: Superconductivity

Historical survey of superconductivity - critical parameters - Isotope effect - Meissner effect - type I and II superconductors - thermodynamics of superconducting transition - other properties. London's theory - elements of BCS theory - flux quantisation - DC and AC Josephson effect - SQUID - High temperature superconductivity.

Books for study

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Solid State Physics	Mircea S. Rogalski, Stuart B. Palmer	Gordan & Breach	2000	-
2	Solid State Physics: Structure and properties of materials	Mohammad Abdul Wahab	Alpha science International	2005	2nd edition
3	Introduction to Solid State Physics	Charles Kittel	John Wiley & sons	2007	7th edition
4	Solid state Physics	Neil. W. Ashcroft, N. David Mermin	Harcourt Asia PTE Ltd	2001	First reprint
5	Solid state Physics	H.C. Gupta	Vikas publishing house Pvt Ltd	2009	2nd edition

Books for reference

S.No.	Title of the Book	Author	Publisher	Year	Vol./Edition
1	Solid State Physics	R.K. Puri and V.K. Babber,	S. Chand and company Ltd	2005	3rd edition
2	Solid State Physics	P.K. Palanisamy	Scitech Publication Pvt Ltd	2003	-
3	Solid State Physics	John Sydney Blakemore	Cambridge University press	1985	2nd edition
4	Principles of the Solid State	H.V. Keer	New age International	1993	-
5	Solid State Physics	Dr. Ajay Kumar Saxena	MacMillan India Ltd	2005	-

Teaching Methodology:

Chalk and Talk Lectures, Tutorials, Video Lectures

Evaluation Pattern:

Internal: C1:30, C2:30, C3a:20 (MCQ and Assignment), C3b:20 (MCQ and Seminar) =100 marks

External: 100 marks (20+30 +50)