MASTER OF SCIENCE (PHYSICS)

VISION

To nurture the young minds with unique proficiency in Physics to meet the global challenges.

MISSION

- To offer quality education in Physics by providing scientific inquiry and innovation.
- To kindle research interest by providing an excellent scientific ambience.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To impart advanced knowledge in theoretical and experimental Physics.

PEO 2: To improve analytical skill, logical thinking and problem solving ability through the concept of Physics.

PEO 3: To impart fundamental knowledge in various interdisciplinary subjects and to promote research interest in students for the benefit of society.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO 1: Describe the advanced concepts in theoretical and experimental Physics.

PO 2: Utilize the new concepts in thrust areas of domain to take research as a career.

PO 3: Apply the domain knowledge to understand the nature of Universe.

PO 4: Analyze and create the solutions for real time problems in various areas of physical science.

PO 5: Formulate the multidisciplinary knowledge to kindle research interest for the benefit of society.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

PSO 1: Demonstrate the laws and nature of various physical phenomena.

PSO 2: Explain the advanced theories and models in various areas of physical science.

PSO 3: Apply the theories learnt and the skills acquired to solve multifaceted problems in Physics.

PSO 4: Utilize the analytical and computational skills for solving real time problems.

PSO 5: Formulate the multidisciplinary knowledge for creative synthesis, individual thoughts and collaborative action to face the global challenges.

REGULATIONS

ELIGIBILITY

A candidate who has passed the B.Sc., degree examination in Branch III Physics Main or B.Sc., in Applied Physics or B.Sc., Physics (Vocational) of Periyar University or an examination of some other university accepted by the syndicate as equivalent thereto shall be permitted to appear and qualify for the M.Sc. Physics (CBCS) Degree examination of Periyar University after a course of two academic years.

DURATION OF THE PROGRAMME

The course shall extend over a period of two years comprising of four semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

DURATION OF THE PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

SCHEME OF EXAMINATION

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part A							
18PPHM101	Core I : Mathematical Physics	6	3	25	75	100	5
18PPHM102	Core II: Classical Mechanics	6	3	25	75	100	5
18PPHM103	Core III: Statistical Mechanics	6	3	25	75	100	5
18PPHM104	Core IV: Condensed Matter Physics	6	3	25	75	100	5
18PPHMP101	Core Practical I: Advanced Physics Practical I	5	4	40	60	100	3
Non-credit							
18PLS101	Career Competency Skills I	1	-	-	-	-	-
	Total	**30**				**500**	**23**
Second Semester							
Part A							
18PPHM201	Core V: Quantum Mechanics I	6	3	25	75	100	5
18PPHM202	Core VI : Electromagnetic Theory	6	3	25	75	100	5
	Elective I	5	3	25	75	100	4
18PPHMP201	Core Practical II: Advanced Physics Practical II	5	4	40	60	100	3
18PCSPHI201	IDC I: Computer Graphics and Multimedia	3	3	25	75	100	2
18PCSPHIP201	IDC Practical I: Multimedia Tools	2	3	40	60	100	2
Part B							
18PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non-credit							
18PLS201	Career Competency Skills II	1	-	-	-	-	-
	Total	**30**				**700**	**23**

Subject code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
Third Semester							
Part A							
18PPHM301	Core VII: Quantum Mechanics II	6	3	25	75	100	5
18PPHM302	Core VIII: Advanced Electronics	6	3	25	75	100	4
18PPHM303	Core IX: Microprocessor and Microcontroller	5	3	25	75	100	4
	Elective II	5	3	25	75	100	4
18PPHMP301	Core Practical III: Advanced Electronics Practical	4	3	40	60	100	3
Optional Papers							
18PECPHI301	IDC II: Modern Biomedical Instrumentation	4	3	25	75	100	4
18PBCPHI301	IDC II: Molecular Biophysics						
	Total	**30**				**600**	**24**
Fourth Semester							
Part A							
18PPHM401	Core X: Spectroscopy	6	3	25	75	100	4
18PPHM402	Core XI: Nuclear and Particle Physics	6	3	25	75	100	4
18PPHM403	Core XII : Computational Physics	6	3	25	75	100	4
18PPHMP401	Core practical IV: Computation using MATLAB	3	3	40	60	100	2
18PPHPR401	Project & Viva-Voce	5	-	50	150	200	6
	Total	**26**				**600**	**20**
			Grand total			**2400**	**90**

ELECTIVE I

Students shall choose any one subject as an elective from the following subjects in the second semester.

S.No	Subject code	Subject
1	18PPHEL201	Modern Optics
2	18PPHEL202	Nonlinear Dynamics
3	18PPHEL203	Biomaterials

ELECTIVE II

Students shall choose any one subject as an elective from the following subjects in the third semester.

S.No	Subject code	Subject
1	18PPHEL301	Physics of Nanoscale
2	18PPHEL302	Crystal Growth and Thin Film Physics
3	18PPHEL303	Instrumental Methods of Analysis

FOR COURSE COMPLETION

Students should complete

- Two elective subjects in II and III semester.
- Two IDC in II and III semester.
- Human Rights as value education in II semester.
- Project at the end of IV semester.

TOTAL CREDIT DISTRIBUTION

Components	Total Marks		Credits
Part A			
Core	12X100	1200	7 X 5 = 35 5 X 4 = 20
Elective	2 X 100	200	2 X 4 = 08
Core practical	4 X 100	400	3 X 3 = 09 1 X 2 = 02
Inter Disciplinary Course theory	2 X 100	200	1 X 4 = 04 1 X 2 = 02
Inter Disciplinary Course practical	1 X 100	100	1 X 2 = 02
Project & Viva-Voce	1 X 200	200	1 X 6 = 06
Part B			
Value Education	1 X 100	100	1 X 2 = 02
	Total	**2400**	**90**

18PPHM101	**CORE I: MATHEMATICAL PHYSICS**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To impart knowledge on vectors space, tensors, matrix and Fourier's transforms.
- To provide knowledge on group theory, differential equation and special functions.

Credits: 5 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Vectors space:** Basic definitions - Linear independence of vector – Bilinear and quadratic forms – Change of basis - Schmidt's orthogonalization processes - Schwartz inequality – Application of vector to hydrodynamics - The equation of heat flow in solids. **Tensors**: n-dimensional space – Superscripts – Subscripts – Coordinate transformations - Kronecker delta symbol – Properties - Generalized Kronecker delta - Tensors of higher ranks - Symmetric and asymmetric tensors.	**10**	**CO1**
II	**Matrix**: Eigen values and Eigen vectors - Eigen value problems - Characteristics equation - Cayley Hamilton theorem - Cramer rule. **Fourier series and transforms:** Fourier series **–** Dirichlet's theorem **-** Properties and applications of Fourier series – Fourier transform - Properties of Fourier's transform – Finite Fourier transforms – Simple applications of Fourier transforms.	**10**	**CO2**
III	**Differential equation and special function:** Linear ordinary differential equations of first and second order - Legendre, Bessel, Laugerre and Hermite differential equations: Series solution - Rodrigue formula - Generating functions - Orthogonality relations - Important recurrence relations.	**10**	**CO3**
IV	**Complex variable:** Functions of complex variables - Limit – Continuity - Differentiability - Analytic function – Cauchy – Riemann condition – Differential equation – Cauchy integral theorem - Cauchy integral formula - Taylors series - Laurent's series - Singularities of an analytical function - Residues - Cauchy Residue theorem - Evaluation of definite integrals - Contour integration.	**10**	**CO4**
V	**Group theory**: Basic definitions - Multiplication table - Subgroups, cosets and classes - Direct product groups -	**10**	**CO5**

	Point groups - Space groups - Representation theory - Homomorphism and isomorphism - Reducible and irreducible representations, Schur's lamma - The great orthogonality theorem - Character table – C_{2v} and C_{3v} as examples - Application for molecular vibration.		

TEXT BOOK:

1.	*Gupta, B.D.* 2014. **Mathematical Physics**. [Fourth Edition]. Vikas Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1	*Arfken, G., Weber, H., and Harris F.E.* 2012. **Mathematical methods for Physicist.** [Seventh Edition]. Elesvier, Amsterdam.
2	*Satyaprakash.* 2004. **Mathematical Physics.** [First Edition]. Sultan Chand & Sons, New Delhi.
3	*Kreyszig, E.* 1999. **Advanced Engineering Mathematics.** [Eighth Edition]. Wiley, New York.
4	*Dass, H. K.* 1998. **Mathematical Physics.** [First Edition]. S. Chand and Company, New Delhi.
5	*Chattopadhyay, P.K.* 2018. **Mathematical Physics.** [Second Edition]. New Age International, New Delhi.
6	*Joshi, A.W.* 1997. **Elements of Group Theory for Physicists**. New Age International, New Delhi.

WEB REFERENCES:

1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/courses/115103036/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the concept of vector space and tensor for solving problems in dynamics.
CO 2	Analyze the problems in matrix, Fourier series and transforms.
CO 3	Know the concepts of some special functions and their solutions.
CO 4	Analyze the complex functions for solving complex problems.
CO 5	Apply group theory for understanding the molecular vibrations.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	M	H	H	H	M
CO 2	M	H	H	M	M
CO 3	M	H	H	H	H
CO 4	L	H	H	H	M
CO 5	M	H	H	H	H

H-High; M-Medium; L-Low;

18PPHM102	**CORE II : CLASSICAL MECHANICS**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To impart knowledge on Lagrangian and Hamiltonian formulation,
- To provide knowledge about central force problems
- To impart knowledge on the motion of rigid bodies and small oscillations.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Lagrangian formulation:** System of particles - Constraints and degrees of freedom - Generalized coordinates - Conservation laws - Conservations of linear and angular momenta - D'Alemberts principle of virtual work - Lagrange's equation of motion - Applications of Lagrange equations of motion: Single particle in space - Atwood's machine - Bead sliding in rotating wire.	10	CO1
II	**Hamilton principle**: Hamilton's equation and Canonical Transformation- Hamilton's principle - Applications of Hamilton's equations: Particle moving in EM field - Derivation of Lagrange's equation from Hamilton's principle - Legendre transformation and Hamilton's equation of motion - Cyclic coordinates and conservation theorem - Hamilton's equations from variational principle - physical significance of Hamilton's function - Principle of least action - Canonical transformations - Generating functions - Examples - Poisson brackets and its properties.	10	CO2
III	**Central Force Problem :** Reduction to the equivalent one body problem - Centre of mass - Equation of motion and first integral - Equivalent one dimensional problem and classification of orbits - Kepler problem: Inverse - Square law of force - Proof of Kepler's laws - Newton's law of gravitation from Kepler's laws.	10	CO3
IV	**Kinematics of rigid body:** Independent coordinates of rigid body - Orthogonal transformation - Properties of transformation matrix - Euler angle and Euler's theorem - Infinitesimal rotation - Rate of change of vector - Coriolis force - Angular momentum and kinetic energy of motion about a point - Moment of inertia tensor - Euler's equations of motion - Torque free motion of a rigid body - Heavy symmetrical top.	10	CO4

V	**Hamilton-Jacobi theory and small oscillation:** Hamilton-Jacobi equation for Hamilton's principle function - Example: Harmonic oscillator problem - Hamilton's characteristic function - Action - angle variable in systems of one degree of freedom - Application to Kepler problem - Formulation of the problem - Eigen value equation - Frequencies of free vibrations - Normal coordinates - vibrations of linear triatomic molecule.	**10**	**CO5**

TEXT BOOKS:

1. *Goldstein, H.* 2018. **Classical Mechanics.** [Second Edition]. Narosa Publishing House, New Delhi.
2. *Gupta, S.L. Kumar, V. Sharma, H.V.* 2010. **Classical Mechanics.** [Second Edition]. Pragati Prakasham, Meerut.

REFERENCE BOOKS:

1. *Takwale, R. G. and Puranik, P.S.* 1979. **Introduction to Classical Mechanics.** Tata McGraw-Hill Education, Delhi.
2. *Aruldhas, G.* 2009. **Classical Mechanics,** [Second Edition]. PHI Learning Private Limited, New Delhi.
3. *Rana, N.C. Joag, P.S.* 2015. **Classical Mechanics,** [Twentieth Edition Reprint]. Tata McGraw-Hill, Delhi.

WEB REFERENCES:

1. https://ocw.mit.edu/courses/physics/
2. http://www.feynmanlectures.caltech.edu/
3. http://nptel.ac.in/courses/115106068/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the motion of macroscopic objects through Lagrange equations.
CO 2	Describe the Hamilton's formulation and generating functions
CO 3	Evaluate the central force problems particularly planetary motion.
CO 4	Analyze the kinematics of rigid body and Euler's equations of motion.
CO 5	Apply the Hamilton-Jacobi theory for small oscillations.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	H	L
CO 2	M	H	H	H	M
CO 3	H	H	H	H	M
CO 4	H	H	H	M	M
CO 5	M	H	H	M	M

H-High; M-Medium; L-Low;

18PPHM103	**CORE III: STATISTICAL MECHANICS**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To provide the fundamentals of thermodynamics and statistical mechanics.
- To impart the knowledge on various quantum statistics and advanced physical phenomena.

Credits: 5 **Total Hours**: **50**

UNIT	**CONTENTS**	**Hrs**	**CO**
I	**Thermodynamics:** Thermodynamical laws and their consequences – Entropy and disorder – Changes in entropy in reversible processes – Thermodynamic functions – Intrinsic energy, Enthalpy, Helmholtz functions and Gibb's potential – Thermodynamic equilibria – Chemical potential – Nernst's theorem.	**10**	**CO1**
II	**Classical statistics-I:** Phase space – Density distribution in phase space - Postulate of equal a priori probability - Micro and macro states – Maxwell-Boltzmann distribution law - Principal of equipartition energy – Boltzmann's postulate of entropy - Classical Ideal gas - Entropy of ideal gas: Gibbs' paradox.	**10**	**CO2**
III	**Classical statistics-II:** Ensembles - Microcanonical, Canonical and Grand canonical ensembles – Liouville's Theorem – Statistical equilibrium – Connection between statistical and thermodynamical quantities - Partition function and correlation with thermodynamical quantities - Virial equation of state – Van der Waals gas.	**10**	**CO3**
IV	**Quantum statistics-I:** Postulates of quantum statistical mechanics - Maxwell - Boltzmann statistics – Bose Einstein quantum statistics – Fermi Dirac statistics - Blackbody radiations and Plank's distribution law -Bose Einstein gas: Energy and degeneracy – Bose Einstein condensation – Liquid helium – Superfluidity.	**10**	**CO4**
V	**Quantum statistics-II:** Fermi Dirac gas: Energy and degeneracy – Electron gas – Pauli's theory of paramagnetism - Random walk and Brownian motion – Phase transitions - First and second order phase transitions – Critical points - Ising model - Production of low temperature – Adiabatic demagnetization – Measurement of low temperature.	**10**	**CO5**

TEXT BOOK:	
1	*Sears, F.W. and Salinger, G.L.* 1998. **Thermodynamics Kinetic Theory and Statistical Thermodynamics**. [Third Edition]. Narosa Publishing House, New Delhi.
REFERENCE BOOKS:	
1	*Huang, K.* 1987. **Statistical mechanics.** [Second Edition]. John Wiley and Sons, New York.
2	*Laud, B.B.* 2017. **Fundamentals of Statistical Mechanics**. New Age International, New Delhi.
3	*Reif, F.* 2014. **Statistical Physics. Vol V.** McGraw Hill, New Delhi.
4	*Gupta, S. L, Kumar, V.* 2015. **Statistical Mechanics**. [Twenty Seventh Edition]. Pragati Prakashan, Meerut.
5	*Agarwal, B.K., Eisner, M* 2018. **Statistical Mechanics**. [Second Edition]. New Age International, New Delhi.
WEB REFERENCES:	
1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/courses/103103036/9
3	https://www.khanacademy.org/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of thermodynamics and its correlation with classical mechanics.
CO 2	Apply the concepts of phase space, ensembles and Liouville's theorem.
CO 3	Explain the classical distribution law, Gibbs' paradox and Partition function.
CO 4	Know the various statistics and concept of Bosons.
CO 5	Explain the concept of Fermion and advanced phenomena through quantum statistics.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	H	H	M
CO 2	H	M	H	H	M
CO 3	H	H	H	H	M
CO 4	H	H	H	H	M
CO 5	H	H	H	H	M

H-High; M-Medium; L-Low;

18PPHM104	**CORE VI: CONDENSED MATTER PHYSICS**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To impart the fundamental concepts on crystals and its various structures.
- To provide knowledge about various bonds in solids and lattice vibrations.
- To impart knowledge about the various properties of solids.

Credits: 5 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Crystal Physics:** Elementary concepts of crystals - Miller indices - Bravais lattice - Reciprocal lattice and its Properties - Crystal symmetry - Point groups and Space groups - Brillouin zones - Different crystal structure: Simple cubic, BCC, FCC, Hexagonal closed packed structure, NaCl, Diamond structure, ZnS, CsCl - Crystal diffraction: Bragg's law - Laue, powder, and rotation methods - Structure factor – Defects in crystals - Point, line, surface and volume defects - Colour centres.	**10**	**CO1**
II	**Bondings in Solids:** Ionic bond – Covalent bond - Metallic bond – Hydrogen bond – Molecular bond. **Lattice Vibrations and Phonons:** Vibration of one dimensional monoatomic and diatomic linear lattice - Acoustical and Optical branch - Concept of phonon - Momentum of phonon - Umklapp process - Inelastic scattering of neutron by phonon. **Thermal Properties of Solids:** Specific heat capacity of solids - Einstein's Model - Debye model – Debye's T^3 law - Thermal conductivity of solids.	**10**	**CO2**
III	**Free Electron Theory of Metals:** Drude-Lorentz theory– Sommerfield Model – Free electron gas in three dimensions – Fermi-Dirac distribution function – Electronic specific heat – Thermionic emission. **Band theory of Solids and Semiconductors:** Nearly free electron model – Kronig-Penney model - Pure and doped semiconductors - Intrinsic carrier concentrations - Hall Effect.	**10**	**CO3**
	Magnetic properties of Materials: Classification of magnetic materials – Theory of diamagnetism – Langevin theory of paramagnetism - Weiss theory – Quantum theory of paramagnetism – Determination of magnetic		

IV	susceptibility of paramagnetic material by Gouy's method - Quantum theory of ferromagnetism – Weiss Molecular field theory – Curie-Weiss law – Ferromagnetic domains – Domain theory – Ferrites. **Dielectrics and Ferroelectrics:** Polarization - Classification of polarization - macroscopic electric field - Local electric field at an atom - Lorentz field - Dielectric constant and polarizability - Clausius - Mossotti relation - Ferroelectric crystals - Ferroelectric domains - Piezoelectricity.	**12**	**CO4**
V	**Superconductivity:** Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meissner effects - Type I and Type II superconductors - Heat capacity - Electron - phonon interaction - Cooper pairs and BCS theory - London equation - Coherence length - Flux quantization in superconducting ring - Josephson effect - Applications of superconductors - SQUIDS - High temperature superconductivity.	**08**	**CO5**

TEXT BOOKS:

1. *Wahab, M. A*. 2009. **Solid State Physics: Structure and Properties of Materials.** [Second Edition]. Narosa Publishing House, New Delhi. (Unit – I, II, IV, V).
2. *Saxena, B.S., Gupta, R.C.* and *Saxena. P.N. 2015*. **Solid State Physics.** [Twelfth Edition]. Pragati Prakashan, Meerut. (Unit – I, II, III).

REFERENCE BOOKS:

1. *Kittel, C.* 2009. **Introduction to Solid State Physics.** [Eighth Edition]. Wiley Eastern. New Delhi
2. *Gupta, S.L and Kumar. V. 2013*. **Solid State Physics.** [Ninth Edition]. K. Nath & Co, Meerut.
3. *Ashcroft, N W*. 2016. **Solid State Physics**. Cengage Learning, New Delhi.
4. *Pillai, S.O*. 2005. **Solid State Physics.** New Age International, New Delhi.
5. *Rita John*. 2014. **Solid State Physics.** McGraw Hill Education (India) Private Limited, New Delhi.

WEB REFERENCES:

1. https://ocw.mit.edu/courses/physics/
2. http://nptel.ac.in/courses/115105099/
3. https://www.khanacademy.org

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the concepts of crystal structure, X-ray diffraction and crystal defects.
CO 2	Describe the nature of various bonds in solids, lattice vibrations and thermal properties of solids.

CO 3	Apply the free electron theory and band theory to understand the properties of solids.
CO 4	Describe the theories about magnetic and dielectric properties of materials.
CO 5	Explain the impact of superconductivity on scientific world.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	H	H	H
CO 2	H	H	H	H	H
CO 3	M	H	H	H	M
CO 4	H	H	H	H	M
CO 5	H	H	H	H	H

H-High; M-Medium; L-Low;

18PPHMP101	**CORE PRACTICAL I: ADVANCED PHYSICS PRACTICAL I**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To give exposure for understanding the various physical phenomena.
- To develop the experimental skills to determine physical parameters and constants.

Credits: 3 **Total Hours: 50**

Ex.No.	**LIST OF EXPERIMENTS (Any Ten Experiments)**	**Hrs**	**CO**
1	Determination of Young's modulus of glass plate by forming hyperbolic fringes using Cornu's method	**5**	**CO1, CO2**
2	Determination of polarizability of liquids using spectrometer.	**5**	**CO1, CO2**
3	Determination of Hall co-efficient and carrier concentration of given semiconductor using Hall effect four probe setup.	**5**	**CO1, CO2**
4	Determination of the value of Stefan's constant.	**5**	**CO1, CO3**
5	Determination of specific charge of electron by Thomson's method.	**5**	**CO1, CO3**
6	Determination of the energy loss of magnetic material from B-H hysteresis loop.	**5**	**CO1, CO2**
7	Determination of temperature coefficient and band gap energy of a given thermistor.	**5**	**CO1, CO2**
8	Find out the crystalline phase and unit cell parameters of given crystalline material using XRD.	**5**	**CO1, CO2**
9	Determination of magnetic susceptibility of aqueous magnetic solution by Gouy's method.	**5**	**CO1, CO2**
10	Determination of Planck's constant using photocell	**5**	**CO1, CO3**
11	Determination of thermal conductivity of given rod by Forbe's method.	**5**	**CO1, CO2**
12	Determination of resistivity of a semiconductor by Four Probe Method.	**5**	**CO1, CO2**
13	Determination of Rydberg's constant – Hydrogen spectrum and solar spectrum.	**5**	**CO1, CO3**
14	Determination of charge of an electron by spectrometer.	**5**	**CO1, CO3**
15	Determination of dielectric loss using CRO.	**5**	**CO1, CO3**

REFERENCE: M.Sc., Physics Laboratory Manual

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain and analyze the various physical phenomena such as deformation, polarizability, Hall effect, magnetization, X-ray diffraction, thermal and electrical conduction.
CO 2	Apply various methods to determine the different physical parameter of given materials such as young's modulus, Hall co-efficient, band gap, carrier concentration, magnetic energy loss, magnetic susceptibility, crystalline parameters, conductivity, dielectric loss, and resistivity.
CO 3	Apply different methods to determine the various physical constants such as Stefan's constant, Planck's constant, Rydberg's constant and change of electron.

18PLS101	**CAREER COMPETENCY SKILLS I**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To impart knowledge on the aptitude.
- To enhance employability skills and to develop career competency.

Non-credit **Total Hours**: **15**

UNIT	CONTENTS	Hrs	CO
I	Solving Simultaneous Equations Faster – Number System : HCF, LCM – Square roots and Cube roots - Averages	**3**	**CO1**
II	Problems on Numbers – Problems on Ages	**3**	**CO1**
III	Calendar – Clocks – Pipes and Cisterns	**3**	**CO1**
IV	Time and Work – Time and Distance	**3**	**CO2**
V	Ratio and Proportion – Partnership – Chain Rule	**3**	**CO3**

TEXT BOOK:

1 *Aggarwal R.S. 2013.* **Quantitative Aptitude. [Seventh Revised Edition].** S.Chand & Co., New Delhi.

REFERENCE BOOK:

1 *Abhijith Guha,* **Quantitative Aptitude for Competitive Examinations**, 5th Edition, Tata McGraw Hill, 2015, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Carry out mathematical calculations using shortcuts.
CO 2	Calculate Problems on Ages with shortcuts.
CO 3	Understand the core concepts of Pipes & Cisterns, Calendar & Clocks.
CO 4	Obtain knowledge on shortcuts to Time & Work and Time & Distance.
CO 5	Calculate Ratio & Proportion, Partnership with shortcuts.

18PPHM201	**CORE V: QUANTUM MECHANICS I**	**SEMESTER – II**

COURSE OBJECTIVES

The course aims

- To impart knowledge on foundations of wave mechanics, angular momentum.
- To develop knowledge about time independent perturbation theory and identical particles.

Credits: 5 **Total Hours**: **50**

UNIT	**CONTENTS**	**Hrs**	**CO**
I	**Foundations of wave mechanics**: Equation of motion of matter waves - Schrodinger's equation for the free particle - Physical interpretation of the wave function - Normalised and orthogonal wave functions - Expansion theorem - Solution of Schrodinger equation - Stationary state solution - Expectation values of dynamical quantities - Probability current density - Ehrenfest's theorem - Postulates of wave mechanics - Hilbert space - Hermitian operators - Properties - Commutativity and simultaneous eigen function - Parity operator - Commutation relation between momentum and position – Eigen energy states for simple Harmonic Oscillator (Operator formalism).	**12**	**CO1**
II	**Energy Eigen value problems**: The simple Harmonic Oscillator - Energy Eigen values and energy Eigen functions - Schrodinger's equation for spherically symmetric potentials - The Rigid rotator with free axis - The hydrogen atom - Energy Eigen values for hydrogen atom - Degeneracy - Normal state of hydrogen atom – Barrier penetration problem.	**10**	**CO2**
III	**Angular momentum**: Angular momentum operator in position representation – Orbital angular momentum – Spin angular momentum – Total angular momentum operators – Commutation relations of total angular momentum with its components – Ladder operators – Commutation relation of J_z with J_+ and J_- – Eigen values of J^2 and J_z – Matrix representation of J^2, J_z , J_+ and J_- – Additional of angular momenta - Clebsch Gordan coefficients - Properties.	**10**	**CO3**

IV	**Approximation methods**: Time independent perturbation theory – non-degenerate case - Physical applications of non-degenerate perturbation theory - Ground state of Helium atom - Degenerate case - Stark effect in Hydrogen atom - Variation method and its application to hydrogen molecule - WKB approximation.	**10**	**CO4**
V	**Identical particles:** Physical meaning of identity - Symmetrical and anti symmetrical wave functions - Construction of Symmetrical and anti symmetrical wave functions from unsymmetrised functions - Particle exchange operator - Pauli's exclusion principle - Pauli's principle from Slater's determinant - Symmetric and anti symmetric wave functions of hydrogen molecule.	**08**	**CO5**

TEXT BOOK:

1. *Satya Prakash,* 2010. **Advanced Quantum Mechanics.** Kedar Nath Ram Nath & Co. Publications, Meerut.

REFERENCE BOOKS:

1. *Mathews, P.M.* and *Venkatesan, K.* 1976. **A Text book of Quantum Mechanics.** Tata McGraw Hill Publications, New Delhi.
2. *Srivastava, R K*. 2007. **Quantum Mechanics**. PHI Learning, New Delhi.
3. *Vasudevan, R*. 2008. **Quantum Mechanics: A Stochastic Approach.** Narosa Publishing House, New Delhi.
4. *Leonard I. Schiff*. 2011 **Quantum Mechanics.** [Third Edition]. Tata McGraw-Hill International Publication, New Delhi.
5. *Aruldhas. G.* 2009. **Quantum Mechanics**, [Second Edition]. PHI Learning Pvt. Ltd. New Delhi.

WEB REFERENCES:

1. https://ocw.mit.edu/courses/physics/
2. http://nptel.ac.in/courses/115102023/
3. https://www.khanacademy.org/
4. http://www.feynmanlectures.caltech.edu/
5. http://nptel.ac.in/courses/122106034/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of wave mechanics
CO 2	Apply the concept of eigen energy values and energy states for real time systems in atomic and nuclear levels.
CO 3	Evaluate the angular momenta of electron systems through operator formalism

CO 4	Analyze the effect of perturbation on quantum systems using approximation methods.
CO 5	Create symmetric and asymmetric functions for identical particles.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	H	H	L
CO 2	H	H	H	H	M
CO 3	H	H	H	H	M
CO 4	M	H	H	H	M
CO 5	M	H	H	H	M

H-High; M-Medium; L-Low;

18PPHM202	**CORE VI: ELECTROMAGNETIC THEORY**	**SEMESTER – II**

COURSE OBJECTIVES

The course aims

- To impart knowledge on electrostatics and boundary value problems.
- To develop knowledge on magnetostatics, electromagnetics, EM waves and waveguides.

Credits: 5 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Electrostatics:** Coulomb's law - Electric field - Gauss' law and its applications - Differential form of Gauss' law – Electric potential - Equipotential surfaces - Poisson and Laplace equations – Green's theorem - Unique theorem - Electric dipoles - Calculation of potential and field - Multipole expansion - Work and energy in electrostatics – Capacitor and electrostatic energy.	**10**	**CO1**
II	**Method of images**: Introduction - Point charge near a conducting plane – Point charge near a conducting sphere. **Dielectrics and boundary value problem:** Polarizability – Field and potential inside a dielectric **-** Dielectric susceptibility, permittivity and dielectric constant - Boundary value problems with dielectrics - Electrostatic energy in dielectric media.	**10**	**CO2**
III	**Magnetostatics:** Magnetic force and field – Biot-Savart law - Differential equations of magneto statics and Ampere's law – Magnetic vector and scalar potential – Magnetic fields of localized current distribution and magnetic dipole moment – Torque and force on magnetic dipoles – Magnetization - Fields of magnetized object – Magnetic susceptibility and permeability – Energy stored in magnetic field.	**10**	**CO3**
IV	**Electrodynamics:** Electromotive force – Faraday's law of induction – Maxwell's equations - Gauge transformation - Lorentz gauge - Coulomb gauge. **Conservation laws:** Equation of continuity – Poynting theorem – Poynting vector –Physical significance - Conservation of energy and momentum. **Retarded potential and radiating systems:** Retarded potential – Radiation from oscillating dipole (qualitative idea only).	**10**	**CO4**

V	**Electromagnetic waves:** EM wave equation – Plane electromagnetic waves – Linear and circular polarization – Reflection and transmission at normal incidence – Reflection and transmission at oblique incidence – Implications: Laws of incidence and reflectance, Snell's law, Brewster law – Freshnel's equations - Wave guides and applications.	**10**	**CO5**

TEXT BOOKS:

1. *David J. Griffiths.* 2000. **Introduction to Electrodynamics.** [Third Edition]. Narosa Publishing, New Delhi.
2. *Sexena, A. K.*2009. **Electromagnetic Theory and Applications.** Narosa Publishing House, New Delhi.

REFERENCE BOOKS:

1. *Jackson, J. D.* 1999. **Classical Electrodynamics.** [Third Edition]. BPB Publisher, New Delhi.
2. *Puri S. P.* 2016.**Classical Electrodynamics.** Narosa Publishing House. New Delhi
3. *Jordan, E.C and Balmin, K.G.* 2011. **Electromagnetic waves and radiating system.** [Second Edition]. Prentice Hall of India, New Delhi.
4. *Danajayan, P.* 2012. **Electromagnetic Theory**. [Ninth Edition]. Lakshmi Publications, Chennai.
5. *Chopra and Agarwal,* 1984. **Electromagnetic Theory.** Kedar Nath & Ram Nath Publishers, Meerut.

WEB REFERENCES:

1. https://ocw.mit.edu/courses/physics/
2. http://nptel.ac.in/courses/115101005/
3. https://www.khanacademy.org/
4. http://www.feynmanlectures.caltech.edu/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Describe the electrostatic force, field and potential for system of statics Charges
CO 2	Apply the concept method of images and boundary value problem to dielectrics.
CO 3	Analyze the magnetics force, field and potential for system of statics charges localized current distribution.
CO 4	Evaluate the relation between electric and magnetic field, conservation laws and radiating systems.
CO 5	Apply electromagnetic theories to explain about electromagnetic waves and its related phenomena.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	H	H	M
CO 2	H	H	H	H	M
CO 3	H	H	H	H	M
CO 4	H	H	H	H	L
CO 5	H	H	H	H	M

H-High; M-Medium; L-Low;

18PPHEL201	ELECTIVE I: MODERN OPTICS	SEMESTER – II

COURSE OBJECTIVES

The course aims

- To impart knowledge on polarization, double refraction and lasers
- To provide knowledge on fibre optics, non-linear optics, electro-optical and magneto-optical effects.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Polarization and double refraction:** Linearly and circularly polarized waves-Transverse character of light waves - Polarizer and analyser - Production of polarized light - The wire grid polarizer and the polaroid- Polarization by reflection - Polarization by scattering – Malu's law - The phenomenon of double refraction - Normal and oblique incidence - Interference of polarized light - Quarter and half-wave plates - Analysis of polarized light - Optical activity.	10	CO1
II	**Laser Physics:** Basic principles - Spontaneous and stimulated emissions, components of a laser, optical amplification - Resonator and lasing action - Types of lasers - Solid state lasers - Ruby laser - Nd:YAG laser - Gas lasers - He-Ne laser - CO_2 laser - Semiconductor lasers - Liquid laser - Dye laser and Chemical lasers – Applications of various laser.	10	CO2
III	**Fiber optics:** Total internal reflection - Optical Fiber - Glass fibers - Coherent bundle - Numerical aperture – Attenuation in optical fibers - Attenuation limit - Single mode and multi-mode fibers – Pulse dispersion in multimode optical fibers - Ray dispersion in multimode step index fibers – Parabolic-index fibers – Material dispersion - Dispersion and maximum bit rates - Fiber-optic sensors.	10	CO3
IV	**Non-linear optics:** Basic principles - Harmonic generation - Second harmonic generation - Phase matching - Third harmonic generation - Optical mixing - Parametric amplification – Self focusing of light.	10	CO4
V	**Magneto-optics and electro-optics:** Magneto-optical effects - Zeeman effect - Faraday effect - Voigt effect or magnetic double refraction - Cotton-Mouton effect - Kerr magneto optic effect - Electro-optical effects - Stark effect - Electric double refraction - Kerr electro-optic effect - Pockels electro-optic effect.	10	CO5

TEXT BOOKS:	
1	*Ajoy Ghatak,* 2005. **Optics,** [Third Edition], Tata McGraw-Hill Publishing, New Delhi [Unit-I, III, V].
2	*Laud, B.B.* 2011. **Laser and Non-Linear Optics**. [Third Edition]. New Age International Publishers, New Delhi. [Unit: II, IV]
REFERENCE BOOKS:	
1	*Silfvast.T, W. 2004.* **Laser Fundamentals**, [Second Edition]. Cambridge University Press, New York.
2	*Jenkins. F.A and White. H.E.,* **Fundamentals of Optics**, [Fourth Edition]. McGraw-Hill International Edition, London, 2001.
3	*Lipson, S.G., Lipson. H., and Tannhauser. D.S.,* 1996. **Optical Physics** [Third Edition]. Cambridge University Press, London.
WEB REFERENCES:	
1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/syllabus/115104041/
3	https://www.khanacademy.org/
4	http://nptel.ac.in/downloads/115101008/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Describe the phenomena of polarization and double refraction.
CO 2	Explain the principle, construction and working of various lasers.
CO 3	Explain the fundamentals of optical fibers and related concepts.
CO 4	Analyze the various optical non-linear phenomena.
CO 5	Analyze the various electro-optical and magneto-optical effects.

MAPPING

PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	H	H	H	H	L
CO 2	H	M	M	M	H
CO 3	H	M	M	M	M
CO 4	H	H	H	H	M
CO 5	H	H	H	H	M

H-High; M-Medium; L-Low;

18PPHEL202	**ELECTIVE I: NONLINEAR DYNAMICS**	**SEMESTER – II**

COURSE OBJECTIVES

The course aims

- To impart knowledge on nonlinear dynamical systems.
- To provide the concept of solitons, chaos and its related phenomena
- To impart knowledge on applications of nonlinear dynamical systems.

Credits: 4 **Total Hours**: **50**

UNIT	**CONTENTS**	**Hrs**	**CO**
I	Introduction to nonlinear dynamical systems - The notion of nonlinearity- Superposition principle and its validity - Linear and nonlinear oscillators- Autonomous and nonautonomous systems - Equilibrium points - Phase space - Classification of equilibrium points - Stability of fixed points.	**10**	**CO1**
II	Chaos- simple bifurcations - Saddle node, pitchfork, transcritical bifurcation- The logistic map - Onset of chaos- Other routes to chaos- Period doubling phenomenon - Quasi periodic route to chaos- Intermittency route to chaos- Bifurcation scenario in Duffing oscillator - Chaos in conservative systems.	**10**	**CO2**
III	Solitons - Birth of soliton - Nonlinear dispersive systems- Cnoidal and solitary waves- Scott Russel phenomenon and KdV equation- Fermi-Pasta-Ulam (FPU) lattice problem - FPU recurrence phenomenon- Asymptotic analysis- Numerical experiment of Zabusky and Kruskal.	**10**	**CO3**
IV	Integrability and methods to soliton equations- The notion of integrability - Painleve analysis and its application to KdV equation, nonlinear Schrödinger equation- Lax pair for KdV equations- Inverse Scattering Method and its application to KdV equation- Hirota's bilinearization method- Examples: KdV and nonlinear Schrödinger equation.	**10**	**CO4**
V	Applications- Chaos and secure communications - Nonlinear optics and biological systems - Role of soliton in condensed matter systems.	**10**	**CO5**

TEXT BOOKS:

1 *Lakshmanan, M and Rajasekar,* S. 2003. **Nonlinear Dynamics, Integrability, Chaos and Patterns.** Springer-Verlag, Berlin.

REFERENCE BOOKS:	
1	*Drazin, P.G.* 1992. **Nonlinear systems**, Cambridge University Press, Cambridge.
2	*Leon, G and Kaplan, D. 1995.* **Understanding Nonlinear Dynamics.** Springer, New York.
3	*Ablowitz, M.J. and Clarkson, P.A*. 1991. **Solitons, Nonlinear Evolution Equations and Inverse Scattering**, Cambridge University Press, Cambridge.
4	*Dodd, R. Eilbeck, J. Gibbson J. and Morris, H.* 1982. **Solitons and Nonlinear Wave Equations,** Academic, New York.
WEB REFERENCES:	
1	http://nptel.ac.in/courses/108101002/
2	https://ocw.mit.edu/courses/physics/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of nonlinear dynamical systems.
CO 2	Apply the concept of chaos and related theories.
CO 3	Analyze the solitons and related phenomena.
CO 4	Create the different equations to describe non-linear systems.
CO 5	Apply solitons and chaos for various real time applications.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	H	L
CO 2	H	H	H	H	M
CO 3	H	H	H	H	M
CO 4	M	H	H	H	H
CO 5	L	H	H	M	H

H-High; M-Medium; L-Low;

18PPHEL203	ELECTIVE I: BIOMATERIALS	SEMESTER – II

COURSE OBJECTIVES

The course aims

- To impart knowledge on materials used for clinical applications.
- To provide knowledge on various biomedical implants.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Introduction to biomaterials - Classification- Impact of biomaterials- Tissue response to various biomaterials - Mechanical properties of biomaterials and its importance - Surface properties: Surface energy, Contact angles and critical surface tension - Surface improvements - Thermal treatments – Sterilization - Safety and efficacy testing of biomaterials.	10	CO1
II	Metals and alloys - Stainless steel - Cobalt-chromium alloys - Titanium based alloys- Nitinol - Metallic corrosion – Biological tolerance of metal implants – Polymers - Polyurethanes – Hydrogels - Polyamides - Silicone – Collagens – Cellulose – Chitin - Alginates - Polymers in biomedical use.	10	CO2
III	Ceramics - Bioinert ceramics – Carbon - Alumina- Yatria stabilized zirconia - Surface reactive ceramics - Bioglass - Resorbable ceramics – Hydroxyapatite: Properties and applications - Tricalcium phosphate: Properties and applications - Composites.	10	CO3
IV	Tissue graft – Tissue engineering –Bulk space fillers – Maxillofacial implants – biomaterials in urological practice - Vascular implants – Synthetic blood vessel – Cardiac valve replacement – Blood substitutes – Artificial kidney – Biomaterials in ophthalmology – Contact lenses – Optical implants - Eye shields – Artificial tears –Biosensors – Drug delivery systems.	10	CO4
V	Biomaterials in orthopedics – Bone: Composition, Structure and Mechanical properties – Osteoblasts – Osteoclasts – Bioelectric effect – Bone healing – Osteoporosis – Bone regeneration with resorbable materials – Teeth: Structure, Composition and Mechanical properties – Biomaterials in dentistry.	10	CO5

TEXT BOOKS:	
1	*Sujata V. Bhat. 2010.* **Biomaterials** [Second Edition]. Narosa Publishing House, New Delhi.
REFERENCE BOOKS:	
1	*Park. J, Lakes. R. S.* 2007. **Biomaterials: An Introduction** [Third Edition]. Springer Publication.
2	*Reema Shukla,* 2014. **Biomaterials** [First Edition]. Nandu Printers & Publishers Pvt. Ltd. Chennai.
WEB REFERENCES:	
1	http://nptel.ac.in/courses/113104009/
2	https://ocw.mit.edu/index.htm

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the basics of biomaterials, their classification, properties and efficacy testing.
CO 2	Know about properties and applications of metallic and polymeric materials.
CO 3	Describe the properties and applications of various ceramics biomaterials
CO 4	Create various implants for biomedical applications.
CO 5	Analyze the structure of bone and teeth and apply the various materials for orthopedics and dentistry.

MAPPING

PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	H	M	M	M	H
CO 2	M	H	H	M	H
CO 3	M	H	H	L	H
CO 4	M	H	H	L	H
CO 5	M	M	M	L	H

H-High; M-Medium; L-Low;

18PPHMP201	**CORE PRACTICAL II: ADVANCED PHYSICS PRACTICAL II**	**SEMESTER – II**

COURSE OBJECTIVES

The course aims

- To give exposure for understanding the various physical phenomena.
- To develop the experimental skills to determine physical parameters and constants.

Credits: 3 **Total Hours: 50**

Ex.No.	**LIST OF EXPERIMENTS (Any Ten Experiments)**	**Hrs**	**CO**
1	Determination of wavelength of He-Ne laser using grating and find out the thickness of a wire using He-Ne laser.	**5**	**CO1, CO2**
2	Determination of wavelength of light using Michelson's interferometer. .	**5**	**CO1, CO2**
3	Determination of charge of electron by Millikan's oil drop experiment.	**5**	**CO1, CO3**
4	Determination of compressibility of the given liquid by ultrasonic interferometer.	**5**	**CO1, CO2**
5	Determination of ultrasonic velocity of sound in the given liquid using Aqua grating.	**5**	**CO1, CO2**
6	Determination of Young's modulus of glass plate by forming elliptical fringes using Cornu's method	**5**	**CO1, CO2**
7	Determination of magnetic susceptibility of aqueous magnetic solution by Quincke's method.	**5**	**CO1, CO2**
8	Verification of Hartmann's Interpolation formula.	**5**	**CO1, CO2**
9	Characteristics of photosensitive devices.	**5**	**CO3**
10	Study the polarization of light by reflection and verify the Brewster & Malus law.	**5**	**CO1**
11	Determination of band gap of semiconductors using UV-DRS.	**5**	**CO1, CO2**
12	Determination of particle size of lycopodium powder using He-Ne laser.	**5**	**CO1, CO2**
13	Determination of refractive index of a given liquid using laser.	**5**	**CO1, CO2**
14	Study the characteristic of GM counter.	**5**	**CO3**
15	Study the characteristic of optical fiber: (i) NA, (ii) Bending loss and (iii) Attenuation.	**5**	**CO1, CO3**

REFERENCE: M.Sc., Physics Laboratory Manual

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Understand the various physical phenomena such as absorption, interference, polarization, reflection, dispersion and diffraction of EM wave as well as electrostatic attraction of charges, compressibility of liquid, photosensitivity.
CO 2	Apply various methods to determine the different physical parameter of given materials such as ultrasonic velocity, magnetic susceptibility, and dielectric constant.
CO 3	Analyze the characteristics of GM counter, optical fibers and photosensitive devices.

18PCSPHI201	**INTER DISCIPLINARY COURSE I: COMPUTER GRAPHICS AND MULTIMEDIA**	**SEMESTER – II**

COURSE OBJECTIVES

The course aims

- To provide better knowledge of display systems, image synthesis and shape modeling of 3D applications
- To understand the basic concepts related to multimedia including data standards, algorithms and design.

Credits: 3 **Total Hours**: **40**

UNIT	CONTENTS	Hrs	CO
I	2D transformations – Clipping – Point clipping – Line clipping – Polygon clipping – Text clipping – Exterior clipping – Window to view port mapping – Interactive input methods – Picture construction techniques.	**8**	**CO1**
II	3D concepts – 3D transformations – 3D viewing – Visible surface detection methods – Back face detection method – Depth buffer method – Scan line method – Virtual reality environment.	**8**	**CO2**
III	Introduction to multimedia – Applications – Hypermedia – Authoring – File formats – Color models – Digital audio – Digital music making – MIDI – Digital video – Video compression techniques – Video performance measurements –Multimedia databases – Animation.	**8**	**CO3**
IV	Multimedia network services – Network protocols – Requirements for multimedia communications – Multimedia conferencing architectures – Quick time movie file format – MHEG – Multimedia file sharing – Multimedia & Internet – Real time interchange.	**8**	**CO4**
V	Design of a multimedia system – Content based information retrieval – HDTV, ATV, EDTV, IDTV standards – Development of user interface design – Multimedia broadcasting – Social media sharing – Multimedia development issues – Sample multimedia project.	**8**	**CO5**

TEXT BOOKS:

1 *Donald Hearn and M. Pauline Baker,* 2012. **Computer Graphics C Version.** [Second Edition]. Pearson Education, India.

2 *David Hillman,* 2008. **Multimedia: Technology and applications.** Delmar Cengage Learning, USA.

REFERENCE BOOKS:	
1	*John F. Koegel Buford.* 2009. **Multimedia Systems.** [Sixth Edition]. Pearson Education, India.
2	*Tom Mcreynolds and David Blythe*. 2005. **Advanced Graphics Programming Using OpenGL.** Amsterdam, Netherlands.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Know the concept of 2D transformations, image clipping methods and picture construction techniques.
CO 2	Describe the 3D concepts and 3D modeling.
CO 3	Know the fundamentals of multimedia and its various applications.
CO 4	Describe the various multimedia network services and real time interchange.
CO 5	Explain the design of various multimedia systems.

MAPPING

PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	M	L	H	H	H
CO 2	M	M	H	H	H
CO 3	M	L	H	H	H
CO 4	M	M	H	H	H
CO 5	M	L	H	H	H

H-High; M-Medium; L-Low;

18PCSPHIP201	INTER DISCIPLINARY COURSE PRACTICAL I: MULTIMEDIA TOOLS	SEMESTER – II

COURSE OBJECTIVE:

The course aims

- To give practice in multimedia tools for making combination such as text, audio, images, animations, video and interactive element.

Credits: 2 **Total Hours: 20**

Ex.No.	LIST OF EXPERIMENTS	Hrs	CO
1	Retouching of images	**2**	**CO 1**
2	Gray scale to color conversion of an image	**2**	**CO 2**
3	Image optimization	**2**	**CO 1**
4	Image manipulation using filters	**2**	**CO 1**
5	Image compression	**2**	**CO 1**
6	Guide layer effects in an image.	**2**	**CO 3**
7	Frame by Frame animation	**2**	**CO 3**
8	Interactive animation	**2**	**CO 3**
9	Object and motion tweening	**2**	**CO 3**
10	Video and audio effects	**2**	**CO 3**

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Work with retouch, manipulate and compress the given images using multimedia tools.
CO 2	Practice on converting gray image to color image.
CO 3	Practice on various kinds animation as well as video and audio effects.

18PVE201	**VALUE EDUCATION: HUMAN RIGHTS**	**SEMESTER – II**

COURSE OBJECTIVE:

The course aims

- To make the students to understand the concepts of human rights.

Credits: 2 **Total Hours**: **25**

UNIT	CONTENTS	Hrs	CO
I	**Human Rights:** Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights - Fundamental Rights - Directive Principles of the State Policy - Indian Constitution.	**5**	**CO1**
II	**Civil and Political Rights:** Right to Work - Right to Personal Freedom - Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality-Right to Religion - Right to Form Associations and Unions - Right to Movement-Right to Family - Right to Contract - Right to Constitutional Remedies-Right to Vote and Contest in Elections - Right to Hold Public Offices-Right to Petition-Right to Information - Right to Criticise the Government-Right to Democratic Governance.	**5**	**CO2**
III	**Economic Rights:** Right to Work - Right to Adequate Wages - Right to Reasonable Hours of Work - Right to Fair Working Conditions - Right to Self Government in Industry - Customer Rights - Social and Cultural Rights - Right to Life - Right to Clean Environment.	**5**	**CO3**
IV	**Women's Rights:** Right to Inheritance - Right to Marriage - Divorce and Remarry -Right to Adoption - Right to Education - Right to Employment and Career. Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care – Right to Education - Issues Related with Infanticide - Street Children – Child Labour-Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights-Tribal Rights-Nomads Rights.	**5**	**CO4**
V	**Human Rights Violation:** International, National, Regional Level Organizations to Protect Human Rights - UNO -	**5**	**CO5**

	National Commission for Human Rights - State Commissions - Non Governmental Organizations and Human Rights - Amnesty Terrorism and Human Rights - Emergency and Human Rights - Judiciary and Human Rights - Media and Human Rights - Police and Human Rights.		

REFERENCE BOOK:

1	*Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO 1	Understand the core principles of human rights philosophy.
CO 2	Know the importance and functions of human rights commission.
CO 3	Apply their rights for democracy, human rights and gender equality
CO 4	Know the rights from the Governance, economic and social development through various Acts.
CO 5	Understand the right to information Act, rights for women, children, Nomads, refugees and various sector of people in our country.

18PLS201	**CAREER COMPETENCY SKILLS II**	**SEMESTER – II**

COURSE OBJECTIVE:

The course aims

- To enhance employability skills and to develop career competency.

Non-credit **Total Hours**: **15**

UNIT	**CONTENTS**	**Hrs**	**CO**
I	Interview Skills – Types of Interview – Groundwork before Interview – Abide by the dress code – Importance of Body language in Interviews – Tell Us about yourself – Do's and Don'ts of an interview – Concluding an Interview – A Mock Interview.	**3**	**CO1**
II	Resume Preparation – Difference between a Resume and CV – The main body of Resume – The Career objective in Resume – A Fresher's Resume – Antiquity of Soft Skills – Classification of Soft Skills – Personality Analysis – Interpersonal Skills.	**3**	**CO1**
III	Body Language – Emotion displayed by Body Language – Group Discussion – Group Discussion types – Guidelines Do's and Don'ts during a Group Discussion – Concluding the Discussion – The technique of Summing Up.	**3**	**CO1**
IV	Speaking Skills – Effective Speaking Guidelines – Reading Skills – Types of Reading Skills – Barriers to Speed Reading – Listening Skills – Stages of Listening – Types of Listening – Barriers to Listening – Beware of Pitfalls – Avoid Errors : Indianisms in English – Most common errors in the world – Similar but not Quite the same – Words that are Singular or Couple.	**3**	**CO2**
V	Avoid Pitfalls: of Beware Self-improvement - Facilitating Laboratory: Language Techniques and Concepts E-learning	**3**	**CO3**

TEXT BOOK:

1 *Barun K. Mitra.* 2011. **Personality Development and Soft skills**. [Second Edition]. Oxford University Press, New Delhi.

REFERENCE BOOK:

1 *S.P. Dhanavel. 2015,* **English and Soft Skills**. [Second Edition]. Orient Black Swan Publishers, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Understand the types of Interviews, Dress Code and Styles.
CO 2	Develop Resume content and structures.
CO 3	Improve body language skills.
CO 4	Know how to represent self through communication.
CO 5	Attain the different level of Learning Skills.

18PPHM301	CORE VII: QUANTUM MECHANICS II	SEMESTER – III

COURESE OBJECTIVES:

The course aims

- To impart knowledge on time dependent perturbation theory and its applications.
- To provide knowledge on relativistic quantum mechanics and quantum field theory.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Time dependent perturbation theory**: Time dependent perturbation theory - First and second order transitions - Transition to the continuum (Fermi Golden rule) - Harmonic perturbation - Adiabatic approximation - Sudden approximation.	10	CO1
II	**Scattering theory**: Scattering of free particle by potential energy - Application of time dependent theory to Alpha scattering - Rutherford scattering formula - Application of time dependent theory to ionization of hydrogen atom.	10	CO2
III	**Theory of radiation:** Application of time dependent perturbation theory to semi classical theory of radiation – Induced absorption, spontaneous emission and stimulated emission – Einstein's coefficients - Einstein's transition probabilities (Absorption and emission) - Quantum mechanical treatment - selection rule for simple harmonic oscillator.	10	CO3
IV	**Relativistic quantum mechanics**: Schrodinger's relativistic equation - probability and current densities - Klein-Gordan equation in the presence of electromagnetic field - Application of Klein - Gorden equation to hydrogen atom - Dirac's relativistic equation for a free electron - Free particle solution - Negative energy states (discovery of Positron).	10	CO4
V	**Quantum field theory**: Quantisation of real scalar field - Quantisation procedure for particles - Lagrangian formulation - Hamiltonian formulation - Quantum field equations - Second quantization - Quantisation of Schrodinger equation (Non relativistic case) - Quantum equations - Creation, annihilation and number operators.	10	CO5

TEXT BOOK:	
1	*Gupta, Kumar and Sharma.* 2010. **Quantum Mechanics**. [Twenty ninth Edition]. Jai Prakash Nath & Co., Meerut.
REFERENCE BOOKS:	
1	*Mathews P. M.* and *Venkatesan K*. 1976 **A Text book of Quantum Mechanics.** Tata McGraw–Hill Publications, New Delhi.
2	*Satya Prakash.* 2010. **Advanced Quantum Mechanics.** Kedar Nath, Ram Nath & Co., Publications.
3	*Srivastava R K*. 2007. **Quantum Mechanics.** PHI Learning Pvt. Ltd., New Delhi.
4	*Vasudevan, R*. 2008. **Quantum Mechanics: A Stochastic Approach.** Narosa Publishing House, New Delhi.
5	*Leonard I. Schiff.* 2011. **Quantum Mechanics.** [Third Edition]. Tata McGraw-Hill International Publication, New Delhi.
WEB REFERENCES:	
1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/courses/115102023/
3	https://www.khanacademy.org/
4	http://www.feynmanlectures.caltech.edu/
5	http://nptel.ac.in/courses/122106034/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the methods for solving time dependent perturbation systems.
CO 2	Demonstrate the scattering phenomena of alpha particles.
CO 3	Utilize the quantum concept to realize the radiation phenomena.
CO 4	Apply the quantum concepts for relativistic case.
CO 5	Analyze the fields that have more number of identical systems.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	M	H	H	H	M
CO 2	H	H	H	H	L
CO 3	M	H	H	H	M
CO 4	M	H	H	H	M
CO 5	M	H	H	H	M

H-High; M-Medium; L-Low;

18PPHM302	**CORE VIII: ADVANCED ELECTRONICS**	**SEMESTER – III**

COURESE OBJECTIVES:

The course aims

- To impart knowledge on operating principles of various semiconductor devices.
- To provide knowledge on various IC's and its applications.

Credits: 4 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Special semiconductor devices:** Field effect transistor – JFET – Characteristic of JFET – MOSFET - Characteristic of MOFET – FET parameter – FET amplifier – Unijunction transistor – Characteristic of UJT – Tunnel diode - Gunn diode - PIN diode – Varactor diode – Silicon controller rectifier (SCR) – Operation and characteristics – TRIAC – DIAC. **Optoelectronic devices:** Photoconductive cell – Photodiode – Phototransistor - Photovoltaic cells – Light emitting diode – Laser diode.	**10**	**CO1**
II	**Integrated circuit (IC) fabrication:** IC technology - Monolithic IC technology – Basic process used in monolithic technology: Epitaxial growth – Masking and etching – Diffusion of impurities – Isolation techniques – Fabricating monolithic resistors, capacitors, diodes and transistors. **Operational amplifier:** Basics of operational amplifier - IC 741 OPP-AMP – Internal structure - Operational amplifier parameters – Effect of offset - Frequency response and stability.	**10**	**CO2**
III (self study)	**Applications of operational Amplifier:** Summing, Scaling and Averaging amplifier – Subtractor – Voltage follower – Voltage to current converter – Current to voltage converter – Integrator – Differentiator - Analog computation – Logarithmic and antilogarithamic amplifier – Voltage comparator – Schmitt trigger- Crossing detector – Sample and Hold circuits – Voltage regulator – Sawtooth generator –Ramp generator –Active filters – Multivibrator – IC 555 timer – Astable and monostable operations.	**10**	**CO3**

IV	**Flip-flops:** RS Flip-flops – Clocked RS Flip-flops – D Flip-flop – JK Flip-flop – JK master slave flip-flop **Shift registers:** Types of Registers – Serial in – Serial out, Serial in – Parallel out, Parallel in - Serial out, Parallel in – Parallel out – Ring counter. **Counters:** Asynchronous counters – Synchronous counters – Shift counters.	**10**	**CO4**
V	**D/A and A/D conversions :** D/A converter – Variable resistor network – Binary ladder – D/A accuracy and resolution – A/D converter – Simultaneous conversion – Counter method – Continuous A/D conversion – Dual slop A/D conversion.	**10**	**CO5**

TEXT BOOKS:

1. *Gupta, S.L., and Kumar, V*. 2013. **Hand Book of Electronics** [39th Edition]. Pragatti Prakashan Publication, Meerut. [Unit – I, II, III].
2. *Albert baul Malvino* and *Donald* P. *Leach*. 1995. **Digital Principles and Applications.** [Fourth Edition]. Tata McGraw Hill Publication, New Delhi. [Unit – IV, V].

REFERENCE BOOKS:

1. *Jacob Millman, Christos Halkias, Chetan D. Parikh.* 2011. **Integrated Electronics.** [Second Edition]. Tata McGraw Hill Education Private Ltd., New Delhi.
2. *David Bell*. 2004. **Electronic devices and circuits**. [Fourth Edition]. PHI India, New Delhi.
3. *Floyd, T.L.* 1993. **Digital Fundamentals.** [Fifth Edition]. Macmillan Publication, New Delhi.
4. *Roy chouchury, Sahil Jain, D*. 2003. **Linear Integrated circuits.** [First Edition]. New Age international, New Delhi.
5. *Basavaraj, B. 2003*. **Digital Fundamentals.** [First Edition]. Vikas Publishing House Pvt., Ltd., Noida.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117103063/24#
2. https://ocw.mit.edu/index.htm
3. https://epgp.inflibnet.ac.in/ahl.php?csrno=28
4. https://epgp.inflibnet.ac.in/ahl.php?csrno=574

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Describe the operating principles of special semiconductor devices and Optoelectronic devices.
CO 2	Explain the fabrication of IC's and basic parameters of IC 741.
CO 3	Design the circuit using IC 741 and IC 555 for various applications.

CO 4	Analyze the working of various flip-flops, registers and counters
CO 5	Design the circuits for analog to digital conversion or *vice versa*.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	L	M
CO 2	H	H	H	L	M
CO 3	M	L	H	H	M
CO 4	M	M	H	H	H
CO 5	M	H	H	H	H

H-High; M-Medium; L-Low;

18PPHM303	CORE IX: MICROPROCESSOR AND MICROCONTROLLER	SEMESTER – III

COURESE OBJECTIVES:

The course aims

- To impart knowledge on 8085 microprocessor, their design, programming and applications in various fields.
- To provide knowledge on 8051 microcontroller, their design, programming and applications in various fields.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**8085 Microprocessor:** Microprocessor architecture and its operation – 8085 pin out and signals – Microprocessor communication and bus timings – Demultiplexing the bus AD7 - AD0 – Generating control signals – Decoding and Executing an instruction - Functional block diagram of 8085 – 8085 Vectored interrupts.	10	CO1
II	**8085 Assembly Language Programming:** 8085 machine language – 8085 assembly language – Instruction classification – Instruction word size – Instruction format – Op code format – Data format – Addressing modes – 8085 Instructions: Data transfer operations – Arithmetic operations – Logic operations – Branch operations – Machine control operations - Simple programs – Debugging a program.	10	CO2
III	**Applications of Microprocessors:** Microprocessor based process control – Closed loop control – Open loop control – Example for closed loop control – Crystal growth control – Microprocessor based temperature monitoring systems – Limit setting – operator panel – Block diagram – Analog to digital conversion using ADC 0809 interfacing through PPI 8255 – Block diagram.	10	CO3
IV	**8051 Microcontroller:** Introduction – Comparison between Microcontroller and Microprocessors - Architecture of 8051 – Memory organization – Data memory and program memory – Special function registers – Pins and signals – Port operation - Timers /Counters – Serial interface - Interrupts.	10	CO4

V	**Programming the Microcontroller 8051:** Programmers model of Intel 8051 – Memory – SFR – PSW – Operand types - Operand addressing – Register, Direct, Indirect and immediate addressing – Data transfer instructions – Arithmetic Instructions – Logic Instructions – Control transfer instructions - Simple programs to illustrate arithmetic and logical operations (Sum of numbers, biggest and smallest in an array).	**10**	**CO5**

TEXT BOOKS:

1. *Ramesh S. Gaonkar*. 1996. **Microprocessor Architecture, Programming and Application with 8085.** [Second Edition]. Wiley Eastern, New Delhi. [Unit: I, II, III].
2. *Krishna Kant.* 2010. **Microprocessors and Microcontrollers architecture, programming and system.** [First Edition]. PHI Learning Private Ltd., New Delhi. [Unit: IV, V].

REFERENCE BOOKS:

1. *Aditya P. Mathur.* 1995**. Introduction to Microprocessors.** [Third Edition]. Tata McGraw Hill Company, New Delhi.
2. *Leventhal, Lance A*. 1990. **Introduction to Microprocessors: Software, Hardware, Programming,** [First Edition]. PHI, New Delhi.
3. *Rafiquzzaman. M*. 2002. **Microprocessors Theory and Applications: INTEL and MOTOROLA.** [Third Edition]. Tata Mc Graw Hill Company. New Delhi.
4. *Muhammad Ali Mazidi and Janice Gillispie* Mazidi. 2009. **The 8051 microcontroller and Embedded System.** [Fourth Edition]. Pearson International Publishing Pvt. Ltd., New Delhi.
5. *Ram. B.* 2008. **Fundamentals of Microprocessor and Microcontrollers**, Dhanpat Rai Publications, New Delhi.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108107029/
2. https://ocw.mit.edu/index.htm
3. https://epgp.inflibnet.ac.in/ahl.php?csrno=574

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals and architecture 8085 microprocessor.
CO 2	Describe the 8085 instruction set and addressing modes through simple programs.
CO 3	Apply the8085 microprocessor to interface the various peripheral devices.
CO 4	Describe the architecture, programming and interfacing of 8051 microcontroller.
CO 5	Design the simple program based on microcontroller 8051.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	H	H	L
CO 2	M	M	H	H	M
CO 3	M	H	H	H	M
CO 4	M	H	H	H	M
CO 5	M	M	H	M	H

H-High; M-Medium; L-Low;

18PPHEL301	**ELECTIVE II: PHYSICS OF NANOSCALE**	**SEMESTER – III**

COURESE OBJECTIVES:

The course aims

- To impart knowledge on basics of nanoscience, preparation and properties, of nanomaterials
- To inculcate knowledge on various characterization methods and applications of nanomaterials.

Credits: 4 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Introduction to the nanoworld:** History of nanoscience – Nano and nature – Classification of Nanomaterials – Nanorods, nanoparticles, nanotubes – Size and dimensionality effects. **Quantum mechanics of nanosystems:** Density of states and quantum confinement – Quantum wells – Quantum wires – Quantum dots – Superlattices.	**10**	**CO1**
II	**Basic aspects of synthesis of nanomaterials:** Bottom-Up approach: Sol-gel synthesis – Hydrothermal growth – Thin film growth: Physical vapor deposition – Chemical vapor deposition – Top-Down approach: Ball milling – Microfabrication – Lithography – Ion-beam lithography.	**10**	**CO2**
III	**Properties of nanostructured materials:** Nanoscale magnetism – Optoelectronic property of bulk and nanostructures – Electronic structure of nanomaterials and Fermi surface – Luminescence properties of nanomaterials **-** Specific heat of nanocrystalline materials – Melting points of nanomaterials – Mechanical properties of nanostructured materials.	**10**	**CO3**
IV	**Nanoscale characterization techniques:** X-ray diffraction and Scherrer method –Scanning electron microscopy – Transmission electron microscopy – Energy Dispersive X-ray analysis – Scanning probe microscopy – Atomic Force microscopy– X-ray photoelectron spectroscopy – Diffuse reflectance spectra - Photoluminescence spectroscopy – IR and Raman spectroscopy - DC magnetization measurements: SQUID – VSM.	**10**	**CO4**

V	**Prime materials in nanoworld:** Carbon nanotubes – Graphene – Metal nanoparticles – Semiconducting nanoparticles. **Application of nanomaterials:** Impact of nanoscience in materials science – Nanoelectronics – Nanophotonics – Nanocatalyst – Applications of nanomaterials in textiles – Applications of nanomaterials in biology and medicine – Nanocosmetics – Nanosensors – Drug delivery – Cancer therapy – Tissue engineering – Impact of nanomaterials in energy and environment.	**10**	**CO5**

TEXT BOOKS:

1	*M.S. Ramachandra Rao and Shubra Singh.* 2013. **Nanoscience and Nanotechnology: Fundamentals to Frontiers.** [First Edition]. John-Wiley & Sons, USA.
2	*C.N.R. Rao.* 2013. **Nanoworld: Introduction to Nanotechnology and Nanotechnology**. [Third Edition]. Navakarnataka Publications Private Limited, Bangalore.

REFERENCE BOOKS:

1	*Charles P.Poole* and *Frank J. Owens.* 2009. **Introduction to Nanotechnology**. John-Wiley & Sons, USA.
2	*Guozhong Gao.* 2010. **Nanostructures and Nanomaterials Synthesis, Properties and Applications**. [Second Edition]. Cambridge University Press India Pvt Ltd.
3	*De Jongh, J.* 1994. **Physics and Chemistry of Metal Cluster Compounds**. Kluwer Academic Publishers, Dordrecht.
4	*Kenneth J. Klabunde.* 2001. **Nanoscale Materials in Chemistry.** John-Wiley & Sons, USA.

WEB REFERENCES:

1	https://epgp.inflibnet.ac.in/ahl.php?csrno=831
2	https://nptel.ac.in/courses/118102003/
3	https://nptel.ac.in/courses/118104008/
4	https://www.sciencedaily.com/news/matter_energy/nanotechnology/
5	http://www.understandingnano.com/index.htm

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of nanoscience.
CO 2	Describe the various methods for synthesis of nanoparticles.
CO 3	Analyze the various properties of nanomaterials.
CO 4	Apply the different analytical method for the characterization of nanoparticles
CO 5	Utilize the nanostructured materials for various applications

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	M	M	H
CO 2	H	L	M	M	H
CO 3	H	M	H	H	H
CO 4	H	H	H	H	H
CO 5	L	L	M	H	H

H-High; M-Medium; L-Low;

18PPHEL302	**ELECTIVE II: CRYSTAL GROWTH AND THIN FILM PHYSICS**	**SEMESTER – III**

COURESE OBJECTIVES:

The course aims

- To impart knowledge on crystal growth theory and techniques
- To provide knowledge on thin films deposition and characterization methods.

Credits: 4 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Nucleation theory:** Nucleation – Homogenous and heterogeneous nucleation - Concept of formation of critical nucleus – Theory of nucleation. **Solution Growth Techniqu**e: Low temperature solution growth: Solution - Solubility and super solubility – Expression of super saturation – Miers T-C diagram - Crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.	**10**	**CO1**
II	**Gel Growth Technique:** 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 – Solubility reduction method – Advantages of gel method.	**10**	**CO2**
III	**Melt technique:** Bridgman technique - Basic process – Various crucibles design - Thermal consideration –Vertical Bridgman technique - Czochralski technique – Experimental arrangement – Growth process. **Vapour technique:** Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical Vapour Transport.	**10**	**CO3**
IV	**Thin Film Deposition Techniques :** Thin Films – 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 – Spin coating method.	**10**	**CO4**
V	**Characterization Technique:** Powder and single crystal X–ray diffraction – Fourier transform infrared analysis – EDX analysis - Scanning electron microscopy (SEM) – Atomic force microscopy (AFM) – UV-Vis NIR spectrometer – Photoluminescene (PL) spectrometer – Microhardness.	**10**	**CO5**

TEXT BOOKS:	
1.	*Santhana Ragavan, P. Ramasamy, P.* 2001. **Crystal Growth Processes and Methods,** KRU Publications, Kumbakonam. [Unit- I to III]
2.	A. *Goswami, A.* 1996. **Thin Film Fundamentals,** [First Edition]. New Age International (P) Limited, New Delhi [Unit-I, IV, V].
REFERENCE BOOKS:	
1	*Brice, J.C.* 1986. **Crystal Growth Processes,** John Wiley and Sons, New York.
2	*Sangawal, K.*1994. **Elementary crystal growth**, Shan Publisher, UK.
3	*Maissel. L.I. and clang, R.* 1970. **Hand Book of Thin Films Technology,** McGraw-Hill, New York.
4	*William, M. and Steve, D.* 1986. **Instrumental Methods of analysis,** CBS Publishers, New Delhi.
WEB REFERENCES:	
1	https://epgp.inflibnet.ac.in/ahl.php?csrno=831
2	https://nptel.ac.in/courses/113104004/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of crystal and thin film growth.
CO 2	Describe the various solution growth and gel growth techniques for grow single crystals.
CO 3	Demonstrate the various melt and vapour growth techniques for grow single crystals.
CO 4	Apply the different deposition techniques to prepare thin films.
CO 5	Utilize the various analytical methods for characterizing the crystalline materials.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	M	M	M
CO 2	H	M	H	H	M
CO 3	H	M	H	H	M
CO 4	H	M	H	H	H
CO 5	H	M	H	H	H

H-High; M-Medium; L-Low;

18PPHEL303	**ELECTIVE II: INSTRUMENTAL METHODS OF ANALYSIS**	**SEMESTER – III**

COURESE OBJECTIVES:

The course aims

- To impart knowledge on different errors, analysis of experimental data and concept of stress analysis.
- To impart knowledge on the basic theories, construction and working of various analytical instruments for analyze the materials.

Credits: 4 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Errors and analysis of experimental data:** Types of errors – Mean, variance and standard deviation - Sampling techniques – Chi square test. **Experimental stress analysis:** Stress analysis by strain gauging - high temperature strain gauge techniques – Photoelasticity and holography.	**10**	**CO1**
II	**Thermal analysis**: Thermogravimetric analysis - Instrumentation and applications – Differential scanning calorimetric – Instrumentation – Specific heat capacity measurements – Determination of thermochemical parameters – Differential thermal analysis – Basic principles – Melting point determination and analysis.	**10**	**CO2**
III	**X-ray analysis:** Single crystal and powder X-ray diffraction – Interpretation of diffraction patterns – Indexing – Unknown and phase identification – Thin film characterization – Energy dispersive X-ray analysis – X- ray fluorescence method and its applications.	**10**	**CO3**
IV	**Optical methods and electron microscopy:** IR and Raman spectroscopy - X-ray photoelectron spectroscopy – Diffuse reflectance spectra - Photoluminescence spectroscopy – Near field scanning optical microscopy – Transmission electron microscopy – Scanning probe microscopy – Atomic force microscopy.	**10**	**CO4**
V	**Electrical methods :** Hall Effect – Carrier density – Resistivity - Two probe and four probe methods – CV characteristics – Schottky barrier capacitance – Impurity concentration – Electrochemical CV profiling – Limitations. **Magnetic methods:** SQUID – VSM**.**	**10**	**CO5**

TEXT BOOKS:	
1	*Sivasankar, B.* 2012**. Instrumental Methods of Analysis,** Oxford University Press, Oxford.
2	*Belk, J.A.* 1979. **Electron microscopy and Microanalysis of Crystalline Materials**, Applied Science Publishers, London.
REFERENCE BOOKS:	
1	*Willard, Merritt, Dean and Settle.* 2012. **Instrumental Methods of Analysis**, CBS Publishers, New Delhi.
2	*Philips, V.A.* 1971. **Modern Metallographic Techniques and their Applications**, Wiley Interscience, USA.
WEB REFERENCES:	
1	https://nptel.ac.in/syllabus/103108100/
2	https://epgp.inflibnet.ac.in/ahl.php?csrno=831
3	https://nptel.ac.in/courses/113104004/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the different errors, analysis of experimental data and concept of stress analysis.
CO 2	Describe the principle and working of different analytical methods for thermal analysis.
CO 3	Utilize the X-ray diffraction technique for characterizing the crystals and thin films.
CO 4	Explain the fundamentals of various optical and electron microscopic techniques.
CO 5	Apply the various analytical methods for measuring the electrical properties of materials.

MAPPING

PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	M	H	H	H	M
CO 2	H	H	H	H	L
CO 3	H	H	H	H	M
CO 4	H	H	H	H	H
CO 5	H	M	H	H	M

H-High; M-Medium; L-Low;

18PPHMP301	CORE PRACTICAL III: ADVANCED ELECTRONICS PRACTICAL	SEMESTER – III

COURSE OBJECTIVES

The course aims

- To give exposure for understanding the characteristics of various electronic devices.
- To develop skill in circuit construction for simple applications.
- To develop program skill for simple applications based on 8085 and 8051.

Credits: 3 **Total Hours**: **48**

Ex.No.	LIST OF EXPERIMENT	Hrs	CO
	Semiconductor devices and IC's (Any six experiments)		
1	Characteristics of JFET	**4**	**CO 1**
2	Characteristics of SCR	**4**	**CO 1**
3	Construct RS, D and JK Flip Flops using NAND gates and verify their truth tables.	**4**	**CO 2**
4	Design BCD Counter.	**4**	**CO 2**
5	Design R/2R ladder and binary weighted method of DAC using IC 741	**4**	**CO 2**
6	Construct the shift register using IC 7474.	**4**	**CO 2**
7	Design multivibrators using 555 timer.	**4**	**CO 1, CO 2**
8	Design differentiator, integrator and Schmidt's trigger using IC 741.	**4**	**CO 1, CO 2**
	Microprocessor 8085 (Any three experiments)		
9	Temperature Conversions (F to C & C to F).	**4**	**CO 3**
10	Determination of factorial of the given number.	**4**	**CO 3**
11	Display interfacing.	**4**	**CO 3**
12	Square and square root of the given number.	**4**	**CO 3**
13	DAC interfacing.	**4**	**CO 3**
	Microcontroller 8051 (Any three experiments)		
14	Traffic control system Interfacing.	**4**	**CO 3**
15	Finding of Biggest and Smallest number.	**4**	**CO 3**
16	Stepper motor interfacing.	**4**	**CO 3**
17	Seven segment display interfacing.	**4**	**CO 3**
18	ADC Interfacing.	**4**	**CO 3**

REFERENCE BOOKS:	
1	*Poorna Chandar. S* and *Sasikala, B.* 2006. **Electronics Laboratory Primer, A Design approach.** S. Chand, New Delhi.
2	*Botkar, K.R,* 1983. **Integrated Circuits.** [Second Edition]. Khanna Publishers, New Delhi.
3	*Swami. G.T.* 2006. **Microprocessor 8085 lab manual**. [First Edition]. Firewall Media, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the characteristics of various electronic devices.
CO 2	Design the electronic circuits for simple applications using IC's.
CO 3	Create the program for simple applications based on 8085 and 8051.

18PECPHI301	**INTER DISCIPLINARY COURSE II: MODERN BIOMEDICAL INSTRUMENTATION**	**SEMESTER – III**

COURESE OBJECTIVES

The course aims

- To impart knowledge on the human physiological systems, operation theatre and medical imaging equipments.
- To impart basic knowledge on modern instruments used in biomedical field, their construction and working.

Credits: 4 **Total Hours**: **40**

UNIT	CONTENTS	Hrs	CO
I	**Human physiological systems:** Cells and their structures – Nature of cancer cells -Transport of ions through cell membrane - Resting and action potential - Bioelectric potentials – Different systems of human body.	**8**	**CO1**
II	**Electrodes and transducers:** Components of the biomedical instrument system- Electrodes: Microelectrodes - Depth and Needle electrodes - Surface electrodes - Half cell potential – Transducers: Active and Passive.	**8**	**CO2**
III	**Biopotential recorders:** Electrocardiography (ECG) - Lead configuration - Recording setup - Electroencephalogram (EEG) – Brain waves – Placement of electrodes – EEG recording set up - Electromyography (EMG) – ERG – EOG - Audiometer.	**8**	**CO3**
IV	**Physiological assist devices:** Pacemakers – Defibrillators: AC defibrillator – DC defibrillator - Heart Lung Machine – Ventilators- Blood pressure measurement - Blood flow meters: LASER blood flow meters- – Blood pH measurement - Measurement of Respiration rate –Thermometer.	**8**	**CO4**
V	**Diathermy and Modern Imaging:** Surgical diathermy – Shortwave & Microwave diathermy – Ultrasonic diathermy – Electron Microscope – Ultrasonic Imaging – Angiography- X-ray machine – CT Scan – Magnetic Resonance Imaging.	**8**	**CO5**

TEXT BOOKS:

1 *Arumugam, M.* 2011. **Biomedical Instrumentation.** [Second Edition]. Anuradha Publications, Kumbakonam.

REFERENCE BOOKS:

1 *Khandpur R.S.*, 2010. **Hand book of Biomedical Instrumentation**, Tata McGraw Hill, New Delhi.

2	*Leslie Cromwell, Fred J. Webell., Erich A. Pfeffer*. 2006, **Bio-medical Instrumentation and Measurements**, Prentice Hall of India, New Delhi.
WEB REFERENCES:	
1	http://biomedikal.in/2009/12/lecture-notes-on-biomedical-instrumentation/
2	https://epgp.inflibnet.ac.in/ahl.php?csrno=1174

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Know the fundamentals of human physiological systems and bioelectric potentials.
CO 2	Describe the operations of electrodes and transducers.
CO 3	Explain the types of bioelectric signals and instruments to be used to detect.
CO 4	Evaluate the operation of physiological assist devices.
CO 5	Describe the operation theatre and medical imaging equipments.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	L	M	H
CO 2	H	H	M	H	H
CO 3	H	H	M	H	H
CO 4	M	H	L	H	H
CO 5	M	M	L	H	H

H-High; M-Medium; L-Low;

18PBCPHI301	**INTER DISCIPLINARY COURSE II: MOLECULAR BIOPHYSICS**	**SEMESTER – III**

COURESE OBJECTIVES

The course aims

- To impart knowledge about the physics of biomolecules and cells.

Credits: 4 **Total Hours**: **40**

UNIT	CONTENTS	Hrs	CO
I	**Water and its interaction:** Structure, physical and unusual properties of water molecule - Weak interactions in aqueous system - hydrogen bonding between water molecules, types of hydrogen bond in biological system, electrostatic interaction of water with charged solute, interaction of water with nonpolar compound - Formation of hydrogen bonds with polar solutes - Vander waal's interaction - Role of weak interactions in biological system - Hydrophobic effect - Molecular complementarity.	**8**	**CO1**
II	**Carbohydrates:** Introduction and classification - Asymmetry and isomerism. Structure and conformation of monosaccharide - Structure and properties of disaccharides (Sucrose & Lactose) - Structure and functional relationships of polysaccharides - Storage polysaccharides (Starch & Glycogen) - Structural polysaccharides (Cellulose & Chitin), glycosaminoglycans, proteoglycans and glycoproteins.	**8**	**CO2**
III	**Amino acids**: Classification, structure and properties (physical and chemical) of amino acids - **Protein:** functions - Primary and secondary structure- conformation of peptide group, α-helix and β-pleated sheets - Fibrous protein- structure and functions of α-keratin and silk fibroin - Tertiary structure – organization of globular proteins and forces stabilize the tertiary structure - Quaternary structure - subunit interaction and symmetry - **Identification and determination of proteins:** MS, MALDI - TOF, X- ray crystallography and NMR spectroscopy.	**8**	**CO3**
IV	**Lipids:** General classification, physical and chemical properties of lipids - Properties of lipid aggregates - Miscelles, bilayers and liposomes - **Biological membranes:** Fluid Mosaic model - role of lipids and proteins in cell membranes - **Membrane transport:** simple and facilitated diffusion - Movement of water across the cell membrane - Active transport (Na^+- K^+ ATPase).	**8**	**CO4**

V	**Nucleic acids:** Structure of nitrogenous bases, nucleosides and nucleotides – **DNA:** Structural features of B-DNA (Watson and Crick model), A-DNA and Z- DNA. Properties of DNA - Buoyant density, viscosity, denaturation, renaturation, Tm, hypo and hyperchromism - Super Coiled DNA - superhelix topology-linking number-twist-writhing number – **RNA**: Structure and functions of mRNA, tRNA and rRNA.	**8**	**CO5**

TEXT BOOKS:

1. *Nelson David, L. and Cox, M. M.* 2011. **Lehninger Principles of Biochemistry.** [Fifth Edition]. Macmillan/ Worth, New York. (Unit I)
2. *Donald Voet* and *Judith, G. Voet.* 2011. **Biochemistry**. [Fourth Edition]. John Wiley and Sons, New York**.** (Unit I-V).

REFERENCE BOOKS:

1. *Lodish*, *H et al.,* 2008. **Molecular Cell Biology**. [Sixth Edition]. W.H. Freeman and Company, New York.
2. *Avinash Upadhyay, Kakoli Upadhyay* and *Nirmalendhe Nath*. 2003. **Biophysical Chemistry: Principles and Techniques**. Himalaya Publishers, Mumbai.

WEB REFERENCES:

1. https://epgp.inflibnet.ac.in/ahl.php?csrno=1174
2. https://nptel.ac.in/syllabus/syllabus.php?subjectId=102101006
3. https://phys.org/physics-news/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Know the interaction of water molecules with physiological
CO 2	Explain the structure and properties of different carbohydrates molecules
CO 3	Describe about amino acids, protein, methods for determination of proteins
CO 4	Know about lipids and biological membrane.
CO 5	Describe the structure of nucleic acids, DNA and RNA.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	L	M	H	H
CO 2	M	L	M	H	H
CO 3	M	H	H	H	H
CO 4	M	M	M	H	H
CO 5	M	M	H	H	H

H-High; M-Medium; L-Low;

18PPHM401	CORE X: SPECTROSCOPY	SEMESTER – IV

COURESE OBJECTIVES

The course aims

- To impart knowledge on different spectroscopic techniques to characterize the materials.
- To provide knowledge on working of various spectrometers.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Microwave Spectroscopy:** Rotation of molecules and their spectra – Diatomic molecules – Rigid rotator – Non-rigid rotator and their spectra – Rotational spectra of polyatomic molecules – Microwave spectrometer – Chemical analysis by microwave spectroscopy. **Infrared Spectroscopy:** Vibrating diatomic molecules- The energy of diatomic molecules – Simple Harmonic oscillator – Anharmonic oscillator – Diatomic vibrating rotator – Vibrations of polyatomic molecules – IR spectrometer – FT-IR technique – Chemical analysis by IR spectroscopy	10	CO1
II	**Raman Spectroscopy:** Raman effect – Characteristics of Raman lines - Classical theory – Quantum theory – Rotational Raman spectra - Vibrational Raman spectra – Mutual exclusion principle – Structure determination from Raman and IR spectroscopy - Raman spectrometer- Sample handling – Resonance Raman scattering – Coherent Anti-stokes Raman scattering (CARS) – Surface enhanced Raman scattering (SERS) and its applications.	10	CO2
III	**UV Spectroscopy:** Origin and theory – Franck-Condon principles – Transition probability – Types of transition – Chromophore and related terms – Instrumentation – sample preparation and solvent effects – Measurement of the spectrum - UV-Diffusion reflectance spectroscopy – Applications of UV spectroscopy. **Photoluminescence Spectroscopy:** Basics of photoluminescence – Fluorescence – Phosphorescence – Instrumentation – Applications.	10	CO3
IV	**NMR Spectroscopy:** Quantum mechanical theory of NMR – Relaxation Times - Spin-spin and spin lattice – Chemical shift – Spin-spin coupling between two and more nuclei – NMR spectrometer- Chemical analysis by NMR	10	CO4

	spectroscopy. **ESR Spectroscopy:** Quantum mechanical theory of ESR – Hyperfine structure study – Triplet states study of ESR – Design of ESR spectrometer - Application of ESR.		
V	**NQR Spectroscopy:** General principles of NQR – Energy levels of quadruple transitions for half-integral spins – Design of NQR Spectrometer – Application of NQR. **Mossbauer Spectroscopy:** Principle of Mossbauer Effect – Schematic arrangement of Mossbauer spectrometer – Isomer shift – Quadruple interaction – Magnetic hyperfine interactions – Applications of Mossbauer spectroscopy.	**10**	**CO5**

TEXT BOOKS:

1. *Aruldhas, G. 2013.* **Molecular Structure and Spectroscopy.** [Second Edition]. PHI, New Delhi.
2. *Kaur, H. 2018*. **Spectroscopy**, [Fourteenth Edition]. Pragati Prakashan, Meerut.

REFERENCE BOOKS:

1. *Banwell, C.N.* 1972. **Fundamentals of Molecular Spectroscopy.** [Fourth Edition]. Tata Mc Graw Hill, New Delhi.
2. *Straughan, B.P.* and *Walkar, S.* 1976. **Spectroscopy. Vol. II.** [Second Edition]. Chapman & Hall, New York.
3. *Gupta, S.L., Kumar, V. and Sharma, R.C.* 1993. **Elements of Spectroscopy.** [Ninth Edition]. Pragathi Prakasahan, Meerut.
4. *Sathyanarayana, D.N.* 2001. **Electronic Absorption Spectroscopy and Related Techniques.** University Press, India.
5. *Chatwal, G.R. and Anand, S.K. 2018*, **Spectroscopy**, [Fifth Edition]. Himalaya Publishing, Mumbai.

WEB REFERENCES:

1. https://epgp.inflibnet.ac.in/ahl.php?csrno=5
2. https://nptel.ac.in/courses/102103044/
3. https://en.m.wikipedia.org/wiki/Spectroscopy
4. https://nptel.ac.in/downloads/122101001/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the about IR and microwave spectroscopy.
CO 2	Describe the principle, working and application of Raman spectrometer.
CO 3	Analyze the materials using UV and photoluminescence spectroscopy.
CO 4	Analyze the interaction of EM wave with mater under magnetic field.
CO 5	Apply NQR and Mossbauer spectroscopy methods to characterize the materials.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	H	H
CO 2	H	H	H	H	H
CO 3	H	H	H	H	H
CO 4	H	H	H	H	H
CO 5	H	H	H	H	M

H-High; M-Medium; L-Low;

18PPHM402	CORE XI: NUCLEAR AND PARTICLE PHYSICS	SEMESTER – IV

COURESE OBJECTIVES

The course aims

- To impart knowledge on nuclear structure, radioactivity, nuclear fission, nuclear fusion and elementary particles.
- To motivate the students to analyze the utility of nuclear energy, reactors, and detectors.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Nuclear structure:** Constituents of nuclei – Nuclear radius, charge, spin, mass and magnetic moment – Determination of nuclear charge and mass – Binding energy – Nuclear stability – Liquid drop model – Semi-empirical mass formula – Mass parabolas – Nuclear shell model- Collective model - Optical model –Nuclear Forces - Exchange forces – Yukawa's meson theory – Yukuwa potential – Ground state of deuteron – Magnetic moment – Tensor forces – Spin dependence and charge independence of nuclear forces.	10	CO1
II	**Radioactive decays:** Properties of radioactive rays – Alpha decay – Gamow's theory of alpha decay – Geiger Nuttall law – Alpha particle spectra – Neutrino hypothesis – Fermi's theory of beta decay – Beta ray spectra - Selection rules – Gamma decay - Selection rules – Internal conversion – Nuclear isomerism. **Detection of Nuclear Radiation:** Interaction of charged particles and γ-rays with matter – Ionization chamber – Proportional counters – Geiger-Muller counters – Semiconductor detectors – Scintillation counters.	10	CO2
III (Self study)	**Neutron Physics:** Properties of neutron – Classification of neutrons according to energy – Sources of neutron – Neutron detectors. **Nuclear Fission:** Characteristics of fission – Mass and energy distribution of nuclear fragments – Nuclear chain reactions – Four factor formula – Bohr Wheeler's theory of nuclear fission – Fission reactors – Power and breeder type reactors. **Nuclear Fussion:** Basic fusion processes – Source of stellar energy– Controlled thermonuclear reactions – Pinch effects – Laser fusion techniques.	10	CO3

IV	**Nuclear Reactions:** Types of Nuclear reactions- Conservation laws in nuclear reactions – Q-equation – Nuclear transmutation by deuterons, alpha particles, neutrons and photons - Level widths in nuclear reaction – Nuclear reaction cross sections and partial wave analysis – Compound nucleus model – Resonance scattering – Breit Wigner one level formula –Direct reactions – Stripping and pick up reactions.	**10**	**CO4**
V	**Elementary Particles :** Four types of interactions and classifications of elementary particles – Isospin – Isospin quantum numbers – Strangeness and hyper charge – Hadrons – Baryons – Leptons – Invariance principles and symmetries – Invariance under chage-parity (CP), time (T) and CPT – CP violation in neutral K-meson decay – Quark model – SU(3) symmetry – Gell-Mann Nishijma formula – Gauge theory of weak and strong interactions – Charm, bottom and top quarks.	**10**	**CO5**

TEXT BOOK:

1 *Tayal, D.C.* 2017. **Nuclear Physics**. [Fifth Edition]. Himalaya Publishing House, New Delhi.

REFERENCE BOOKS:

1 *Sharma, R.C.* 2007. **Nuclear Physics**. [Sixth Edition]. K. Nath & Co., Meerut.

2 Ghosal, S.N. 2010. **Nuclear Physics**. [Third Edition]. S. Chand Company Ltd, New Delhi.

3 *Kenneth S. Krane.* 1987. **Introductory Nuclear Physics.** [Third Edition]. Wiley India Ltd., New Delhi.

4 *Wong Samuel, S. M.* 2010. **Introductory Nuclear Physics**. Prentice-Hall of India, New Delhi.

5 *David Griffiths.* 2008. **Introduction to Elementary Particles.** [Second Revised Edition]. Wiley, New York.

WEB REFERENCES:

1 https://phys.org/physics-news/

2 https://nptel.ac.in/courses/115104043/

3 https://nptel.ac.in/syllabus/115101006/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the nuclear structure, binding energy, stability and forces acting on Nucleons
CO 2	Know the various radioactive decay process and the devices which are used to detect them.

CO 3	Analyze the process of nuclear fission and fusion as well as the characteristics of neutron.
CO 4	Analyze the various nuclear reactions and related theories.
CO 5	Know the different types of elementary particles and their interactions.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	H	H
CO 2	H	H	H	H	H
CO 3	H	H	H	H	H
CO 4	H	H	H	H	H
CO 5	H	H	H	H	M

H-High; M-Medium; L-Low;

18PPHM403	**CORE XII: COMPUTATIONAL PHYSICS**	**SEMESTER – IV**

COURESE OBJECTIVE

The course aims

- To impart knowledge on numerical differentiation, integration and MATLAB for computation.

Credits : 4 **Total Hours**: **50**

UNIT	CONTENTS	Hrs	CO
I	**Numerical differentiation:** Finding roots of a polynomial – Bisection method – Newton Raphson method – Solution of simultaneous linear equation by Guass elimination method – Solution of ordinary differential equation by Euler, Runge-Kutta fourth order method for solving first order ordinary differential equations.	**10**	**CO1**
II	**Numerical integration:** Newton's cotes formula – Trapezoidal rule – Simpson's 1/3 rule – Simpson's 3/8 rule – Boole's rule – Gaussian quadrature method (2 point and 3 point formula) – Giraffe's root square method for solving algebraic equation.	**10**	**CO2**
III	**Matlab fundamentals:** Introduction – Matlab features – Desktop windows: Commands, workspace, command history, array editor and current directory – Matlab help and demos – Matlab functions, operators, and commands. Basic arithmetic in Matlab – Basic operations with scalars, vectors and arrays – Matrices and matrix operations – Complex Numbers - Matlab built – In functions - Illustrative Examples.	**10**	**CO3**
IV	**Matlab programming:** Control flow statements *: if, else, else if, switch* statements – *for, while* loop structures – *break* statement –Input/output commands – Script M-files – function M-files – Controlling output.	**10**	**CO4**
V	**Matlab graphics:** 2D plots – Planar plots, log plots, scatter plots, Contour plots – Multiple figures, graph of a function – Titles, labels, text in a graph – Line types, marker types, colors – 3D graphics – Curve plots – Mesh and surface plots – Illustrative examples.	**10**	**CO5**

TEXT BOOKS:

1 *Venkataraman, M.K.* 1996, **Numerical methods in science and Engineering**. [5th Edition]. National Publishing Co., Chennai.

2	*Rudra Pratap,* 2016. **Getting Started with MATLAB. [Seventh edition].** Oxford University Press, New Delhi.
REFERENCE BOOKS:	
1	*Sastry, S.S.,* 2005. **Introductory methods of Numerical analysis**. [Fourth Edition] Prentice Hall of India, Delhi.
2	*John Mathews and Kurtis Fink*, 2006. **Numerical Methods to using MATLAB**. [Fourth Edition], Prentice Hall, New Jersey.
3	*Sergey E. Lyshevski,* 2005. **Engineering and Scientific Computations using MATLAB**, [First Edition],John Wiley & Sons, USA.
4	*Kuncicky, D.C.* 2003. **Matlab Programming.** [Fourth Edition]. Pearson Education.
WEB REFERENCES:	
1	https://epgp.inflibnet.ac.in/ahl.php?csrno=25
2	https://nptel.ac.in/courses/103106118/
3	https://www.mathworks.com/discovery/scientific-computing.html

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Solve the problems using various numerical differentiation methods.
CO 2	Solve the problems using various numerical integration methods.
CO 3	Explain the fundamentals of Matlab.
CO 4	Design the simple Matlab program.
CO 5	Create the different 2D and 3D graphics using Matlab.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	L	H	H	H	H
CO 2	L	H	H	H	H
CO 3	M	H	H	H	H
CO 4	M	H	H	H	H
CO 5	M	H	H	H	M

H-High; M-Medium; L-Low;

18PPHMP401	**CORE PRACTICAL IV: COMPUTATION USING MATLAB**	**SEMESTER – IV**

COURSE OBJECTIVES

The course aims

- To develop computation skill for computing simple equations through Matlab programming.

Credits: 3 **Total Hours: 36**

Ex.No.	**LIST OF EXPERIMENT (Any twelve experiments)**	**Hrs**	**CO**
1	Matlab Programming – Charging of a capacitor in an RC circuit with three time constants.	**3**	**CO 1**
2	Matlab programming – Full wave rectifier – Determination of (a) peak-to-peak value of ripple voltage (b) DC output voltage (c) Discharge Time of the Capacitor (d) period of ripple voltage.	**3**	**CO 1**
3	Matlab programming – Frequency response of a low pass Op-Amp filter circuit.	**3**	**CO 1**
4	Matlab programming – Plot of voltage and current in RLC circuit under steady state conditions.	**3**	**CO 2**
5	Matlab programming – NPN Transistor – plotting Input & Output characterisitics.	**3**	**CO 2**
6	Matlab Programming – Roots of a quadratic equation and solution of a system of linear equations.	**3**	**CO 2**
7	Matlab Programming – Solution of ordinary differential equations.	**3**	**CO 2**
8	Matlab programming – Diode – Plot of forward characteristics & load line plot- estimation of operating point.	**3**	**CO 2**
9	Matlab Programming – Solutions of roots of polynomial equations by graphic method	**3**	**CO 3**
10	Matlab Programming – Runge-Kutta method.	**3**	**CO 3**
11	Matlab Programming – Newton – Raphson method.	**3**	**CO 3**
12	Matlab Programming – Solutions Mean, median & standard deviation.	**3**	**CO 3**
13	Matlab Programming – Curve fitting & Interpolation.	**3**	**CO 3**
14	Matlab Programming – Matrix summation, subtraction and multiplication.	**3**	**CO 4**
15	Matlab Programming – Matrix inversion and solution of simultanuous Equations.	**3**	**CO 4**

REFERENCE: M.Sc., Physics lab manual

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Compute simple equations such as charging of a capacitor and full wave rectifier equation through Matlab program.
CO 2	Plot the characteristic curve of NPN transistor, diode, RLC circuit, Frequency response curve of low pass filter
CO 3	Find out the solution for differential equation as well as numerical problems.
CO 4	Compute matrix and find out the solution.

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project Viva-Voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-Voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-Voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

(i) THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Theory paper with a passing minimum of 38 marks in External out of 75.

Internal Marks Distribution [CA- Total Marks: 25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

(ii) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks (10-12 Experiments)
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

External Marks distribution [CE - Total Marks: 60]

Formula, symbol representation	: 10 Marks
Circuit , model graph	: 10 Marks
Observation	: 20 Marks
Calculation	: 10 Marks
Viva-Voce	: 05 Marks
Result	: 05 Marks
Total	**: 60 Marks**

(iii) PROJECT WORK/DISSERTATION

- The project work shall be carried out by each student in the IV semester and has to complete the work at the end of the Semester.
- Upon completion of the project work/dissertation the candidate will be required to appear for a Viva-Voce conducted by an external examiner.
- The student has to attend 2 reviews before completing his/her Project.
- A candidate failing to secure the prescribed passing minimum in the dissertation shall be required to re-submit the dissertation with the necessary modifications.

Mark Distribution Pattern [Total Marks: 200]

Comprehensive Examination (CE) : 150 Marks
Continuous Assessment (CA) : 50 Marks
Total : 200 Marks

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 100 marks put together out of 200 in the Comprehensive Examination in each Project with a passing minimum of 75 marks in External out of 150.

Internal Mark Distribution [CA - Total Marks: 50 Marks]

Research work done	: 20 Marks
Attendance	: 5 Marks
Observation note	: 10 Marks
Review	: 15 Marks (Three reviews)
Total	**: 50 Marks**

External Mark Distribution [CE - Total Marks: 150 Marks]

Project report	: 100 Marks
Presentation	: 25 Marks
Viva-Voce	: 25 Marks
Total	**: 150 Marks**

3. QUESTION PAPER PATTERN AND MARK DISTRIBUTION (THEORY)

Question Paper Pattern and Mark Distribution (For 75 marks)

1. PART – A (5 x 5 = 25 Marks)

Answer ALL questions (One question from each UNIT with Internal Choice)

2. PART – B (5 x 10 = 50 Marks)

Answer ALL questions (One question from each UNIT with Internal Choice)

Question Paper Pattern and Mark Distribution (For 100 marks)

1. PART – A (5 x 5 = 25 Marks)

Answer ALL questions (One question from each UNIT with Internal Choice)

2. PART – B (5 x 15 = 75 Marks)

Answer ALL questions (One question from each UNIT with Internal Choice)

CAREER COMPETENCY SKILLS- METHODOLOGY OF ASSESSMENT

- **On Line Objective Examination (Multiple Choice questions) – Semester I**
  - 100 questions-100 minutes
  - Twenty questions from each UNIT.
  - On line examination will be conducted at the end of I Semester.

- **Viva Voce – Semester II**
  - The student has to come in proper dress code and he/she should bring 2 copies of resume for the Viva Voce
  - The student may be asked to
    - Give Self introduction
    - Submit the resume to the examiner(s) and answer the questions based on it.
    - Speak on any given topic for at least two minutes.
    - Give a presentation for 10 minutes on a topic of their choice.
    - Sit with other students in a group for a discussion.

IDC OFFERED BY THE DEPARTMENT

S.No	Subject code	Subject	Semester	Offered to
1.	18PPHCHI301	Solid State Physics	III	M.Sc., Chemistry

18PPHCHI301	**IDC I: SOLID STATE PHYSICS**	**SEMESTER – III**

COURSE OBJECTIVES

The course aims

- To impart knowledge on the structure of crystals, X-ray diffraction and theories of Magnetism.
- To provide basic concepts regarding dielectrics and modern engineering materials.

Credits: 4 **Total Hours: 45**

UNIT	CONTENTS	Hrs	CO
I	**Introduction to crystal systems:** Crystal Lattice - Unit cell - Seven classes of crystals - Bravais lattice - Miller indices - Structure of crystals - Simple cubic structure - Hexagonal close packed structure - Face centered cubic structure - Body centered cubic structure - Sodium chloride structure - Zinc blende structure - Diamond structure.	9	CO1
II	**X-ray diffraction and crystal defects :** Diffraction of X-rays by crystals - Bragg's law in one dimension - Experimental method of X-ray diffraction - Laue method - Rotating crystal method - Powder photograph method - Point defects - Line defects - Surface defects - Volume defects - Effects of crystal imperfections.	9	CO2
III	**Theory of magnetism:** Different types of magnetic materials - Classical theory of diamagnetism (Langevin's theory) - Langevin's theory of paramagnetism - Weiss theory of paramagnetism - Qualitative explanation of Heisenberg's internal field and quantum theory of ferromagnetism.	9	CO3
IV	**Dielectrics:** Fundamental definitions in dielectrics - Different types of dielectric polarization - frequency and temperature Effects on polarization - Dielectric loss - Qualitative study of local field or internal field - Clausius-Mossotti relation - Determination of dielectric constant - Dielectric breakdown - Properties of different types of insulating materials.	9	CO4
V	**Modern engineering materials:** Polymers – Plastics – Ceramics – Super strong materials – Cermets - High temperature materials – Thermo electric materials – Pizoelectric and pyroelectric materials – Electrets - Nuclear engineering materials - Metallic glasses - Optical materials – Fiber optic materials and uses - Super conductors - Properties - Types and applications – Shape memory alloys.	9	CO5

TEXT BOOK:	
1	*Arumugam, M.* 2008. **Materials Science.** [Third Edition]. Anuradha Publications, Kumbakonam.
REFERENCE BOOKS:	
1	*Kittel, C.* 1996. **Introduction to Solid State Physics.** [Seventh Edition]. John Wiley & Sons (Asia) Pvt. Ltd., New Delhi.
2	*Pillai, S.O*. 2005. **Solid State Physics.** New Age International, New Delhi.
3	*Rita John*. 2014. **Solid State Physics.** McGraw Hill Education (India) Private Limited, New Delhi
4	*Saxena, B.S., Gupta, R.C.* and *Saxena. P.N. 2015*. **Solid State Physics.** [Twelfth Edition]. Pragati Prakashan, Meerut.
WEB REFERENCES:	
1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/courses/115105099/
3	https://www.khanacademy.org
4	https://epgp.inflibnet.ac.in/ahl.php?csrno=28

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the concepts crystal and structure.
CO 2	Describe the different types of X-ray diffraction methods and crystal defects.
CO 3	Describe the theories about magnetic materials
CO 4	Know the fundamentals of dielectric materials and their behavior.
CO 5	Evaluate the properties and applications of various modern engineering materials.

MAPPING

PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	H	H	H	H	H
CO 2	M	M	M	H	H
CO 3	L	M	M	L	M
CO 4	L	M	L	L	M
CO 5	M	H	M	M	M

H-High; M-Medium; L-Low;