MASTER OF SCIENCE (PHYSICS)

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 COURSE:

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.

OBJECTIVE OF THE COURSE

- To impart advanced knowledge in experimental and theoretical Physics.
- To improve skills like analytical and logical thinking, solving problems, interpreting the given data and making relevant conclusions.
- To encourage the students to take research as a career.

SCHEME OF EXAMINATION

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part A							
15PPHM101	Core I : Mathematical Physics	6	3	25	75	100	5
15PPHM102	Core II: Classical Mechanics	6	3	25	75	100	5
15PPHM103	Core III: Statistical Mechanics	6	3	25	75	100	5
15PPHM104	Core IV: Advanced Electronics	6	3	25	75	100	5
15PPHMP101	Core Practical I: Electronics Practical	4	3	40	60	100	3
Non-credit							
15PLS101	Career Competency Skills I	1	-	-	-	-	-
		29				**500**	**23**
Second Semester							
Part A							
15PPHM201	Core V: Quantum Mechanics I	6	3	25	75	100	5
15PPHM202	Core VI : Condensed Matter Physics	5	3	25	75	100	5
	Elective I	5	3	25	75	100	5
15PPHMP201	Core Practical II: Advanced Physics Practical	4	4	40	60	100	3
15PCSPHI201	IDC I: Numerical Methods and Programming in C	4	3	25	75	100	3
15PCSPHIP201	IDC Practical I: Numerical Methods using C	2	3	25	75	100	2
Part B							
15PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non-credit							
15PLS201	Career Competency Skills II	1	-	-	-	-	-
		29				**700**	**25**

Subject code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
Third Semester							
Part A							
15PPHM301	Core VII: Electromagnetic Theory	6	3	25	75	100	5
15PPHM302	Core VIII: Quantum Mechanics II	5	3	25	75	100	5
15PPHM303	Core IX: Microprocessor and Microcontroller (100% Internal Evaluation)	5	3	100	-	100	5
	Elective II	5	3	25	75	100	5
15PPHMP301	Core Practical III: Microprocessor and Microcontroller	4	3	40	60	100	3
Optional papers							
15PECPHI301	IDC II: Biomedical Instrumentation	4	3	25	75	100	4
15PBCPHI301	IDC II: Molecular Biophysics						
		29				**600**	**27**
Fourth Semester							
Part A							
15PPHM401	Core X: Spectroscopy	6	3	25	75	100	5
15PPHM402	Core XI: Nuclear and Particle Physics	6	3	25	75	100	5
15PPHPR401	Project & Viva-Voce	-	-	50	150	200	8
		12				**400**	**18**
			Grand total			**2200**	**93**

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	15PPHEL201	Physics of Nanoscale
2	15PPHEL202	Nonlinear Dynamics
3	15PPHEL203	Modern Optics

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	15PPHEL301	Biomaterials
2	15PPHEL302	Crystal Growth and Thin Film Physics
3	15PPHEL303	Molecular Quantum Mechanics

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	11X100	1100	11 X 5 = 55
Elective	2 X 100	200	2 X 5 = 10
Core practical	3 X 100	300	3 X 3 = 09
Inter Disciplinary Course theory	2 X 100	200	1 X 4 = 04 1 X 3 = 03
Inter Disciplinary Course practical	1 X 100	100	1 X 2 = 02
Project & Viva-Voce	1 X 200	200	1 X 8 = 08
Part B			
Value Education	1 X 100	100	1 X 2 = 02
Total		**2200**	**93**

15PPHM101	CORE I: MATHEMATICAL PHYSICS	SEMESTER - I

Total Hours: **50**

OBJECTIVES:

1. To impart knowledge on Vectors, Tensors, Matrix, Fourier's transforms, group theory, Differential equation and Special functions.
2. To improve the problem solving ability of students.

CONTENTS

UNIT – I **(10 Hours)**

Vectors space and tensors: Vector Space – Definitions - Linear independence of vector – Bilinear and quadratic forms – Change of basis - Schmidt's orthogonalisation 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.

UNIT- II **(10 Hours)**

Matrix: Eigen values and Eigen vectors - Characteristics equation - Cayley Hamilton theorem - Cramer rule.
Fourier's integral transforms: Fourier transform - Properties of Fourier's transform – Fourier transform of a derivative – Fourier's sine and cosine transforms of a derivative – Finite Fourier transforms – Simple Applications of Fourier transforms.

UNIT- III **(10 Hours)**

Special function: Legendre, Bessel, Laugerre and Hermite differential equations: Series solution - Rodrigue formula - Generating functions - Orthogonality relations - Important recurrence relations.

UNIT- IV **(10 Hours)**

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.

UNIT- V **(10 Hours)**

Group theory: Basic definitions - Multiplication table - Subgroups, cosets and classes - Direct product groups - Point groups - Space groups - Representation theory - Homomorphism and isomorphism - Reducible and irreducible representations, Schur's lamma - The great orthogonality theorem - Character table – C_{2v} and C_{3v} as examples - Application for molecular vibration.

TEXT BOOK:

1. *Gupta, B.D.* 1995. **Mathematical Physics**. [Fourth Edition]. Vikas Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. *Satyaprakash.* 2004. **Mathematical Physics.** [First Edition]. Sultan Chand & Sons, New Delhi.
2. *Kreyszig, E.* 1999. **Advanced Engineering Mathematics.** [Eighth Edition]. Wiley, New York.
3. *Dass, H. K.* 1998. **Mathematical Physics.** [First Edition]. S. Chand and Company, New Delhi.
4. *Chattopadhyay, P.K.* 1990. **Mathematical Physics.** [Fourth Edition]. Wiley Eastern Ltd., New Delhi.
5. *Joshi A.W.* **Elements of Group Theory for Physicists**. Wiley Eastern.

15PPHM102	CORE II : CLASSICAL MECHANICS	SEMESTER - I

Total Hours: 50

OBJECTIVE:

To impart knowledge on Lagrangian and Hamiltonian formulation, central force and motion of rigid bodies.

CONTENTS

UNIT-I **(10 Hours)**

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.

UNIT -II **(10 Hours)**

Hamilton principle: Hamilton's equation and Canonical Transformation- Hamilton's principle - 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.

UNIT-III **(10 Hours)**

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.

UNIT-IV **(10 Hours)**

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.

UNIT-V **(10 Hours)**

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.

TEXT BOOKS:

1. *Goldstein, H.* 2001. **Classical Mechanics.** [Second Edition]. Narosa Publishing House, New Delhi. [Unit: I-V].
2. *Gupta, S.L. Kumar, V. Sharma, H.V.* 2010. **Classical Mechanics.** [Second Edition]. Pragati Prakasham, Meerut. [Unit: I, II, III].

REFERENCE BOOKS:

1. *Herbert Goldstein, Charles Poole, John Safko,* 2008. **Classical Mechanics.** [Fifth Edition]. Dorling Kindersley Pvt. Ltd, Delhi.
2. *Aruldhas, G.* 2009. **Classical Mechanics,** [Second printing]. PHI Learning Private Limited, New Delhi.
3. *Rana, N.C. Joag, P.S.* 2006. **Classical Mechanics.** [Twentieth Reprint]. Tata McGraw-Hill, Delhi.

15PPHM103	CORE III: STATISTICAL MECHANICS	SEMESTER – I

Total Hours: 50

OBJECTIVES:

1. To know the fundamentals of Statistical Mechanics.
2. To impart the knowledge on various Quantum Statistics.

CONTENTS

UNIT –I **(10 Hours)**

The fundamentals of statistical physics: Objective of statistical mechanics: Phase space, Microstates and Macrostates, - Density distribution in Phase space - Postulate of equal a priori probability - Ensembles - Boltzmann's postulate of entropy - Classical Ideal gas - Entropy of ideal gas: Gibbs' paradox - Liouville's Theorem.

UNIT - II **(10 Hours)**

Theory of Ensembles: Classification of ensembles - Micro canonical, Canonical and Grand canonical ensembles - Partition function and Thermodynamical quantities for Micro canonical, Canonical and Grand canonical ensembles.

UNIT –III **(10 Hours)**

Quantum statistics: Introduction - Postulates of quantum statistical mechanics - Density matrix - Ensembles in Quantum statistical mechanics - Quantum Liouville theorem - Ideal quantum gases - Bosons - Fermions - BE, FD, MB distributions using GCE partition functions.

UNIT - IV **(10 Hours)**

Approximate methods: Classical Cluster expansion - Quantum Cluster expansion - Virial equations of states, Ising model in one, two, three dimensions - Exact solutions.

UNIT - V **(10 Hours)**

Special topics : Photon gas - Equation of state - Bose - Einstein condensation - Equation of state of ideal gas - Specific heat from lattice vibration - Phase transitions - First and second order phase transitions - Critical points - Landau's theory - Phonon gas - Theory of Super fluidity - Liquid helium.

TEXT BOOK:

1. *Gupta, S L, Kumar, V.* 2014. **Statistical Mechanics**. [Twenty Seventh Edition]. Pragati Prakashan, Meerut.

REFERENCE BOOKS:

1. *Agarwal, B.K.* 1998. **Statistical Mechanics**. [Second Edition]. New Age International, New Delhi.
2. *Laud, B.B.* 2003. **Fundamentals of Statistical Mechanics**. New Age International, New Delhi.
3. *Reif, F.* 2011. **Statistical Physics. Vol V.** McGraw Hill, New Delhi.

15PPHM104	CORE IV: ADVANCED ELECTRONICS	SEMESTER - I

Total Hours: **50**

OBJECTIVES:

1. To know the operating principles of various semiconductor devices devices.
2. To impart the knowledge on IC's and its applications.

CONTENTS

UNIT-I **(10 Hours)**

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.

UNIT-II **(10 Hours)**

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.

UNIT-III **(10 Hours)**

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.

UNIT –IV **(10 Hours)**

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

UNIT –V **(10 Hours)**

D/A and A/D conversions : Variable resistor network – Binary ladder – D/A converter – D/A accuracy and resolution – A/D converter – Simultaneous conversion – Counter method – Continuous A/D conversion – A/D techniques – Dual slop A/D conversion.

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.

15PPHMP101	CORE PRACTICAL I: ELECTRONICS PRACTICAL	SEMESTER-I

(Practical at the end of I Semester)

(Any twelve Experiments)

1. JFET – Characteristics.
2. Design of square wave generator using IC 741.
3. Design of monostable multivibrator using 555 timer.
4. Design of Schmidt's trigger using 555 timer.
5. Construction of Binary counter
6. Construction of BCD counter
7. Multiplexer and Demultiplexer.
8. Encoder and Decoder.
9. RS, D and JK Flip Flops
10. BCD Counter.
11. Design of R/2R ladder and Binary weighted method of DAC using 741 IC.
12. Construction of shift register using IC 7474.
13. Transistor CE characteristics.
14. Design of Active filters (Low pass and High pass filters).
15. Colpitt's oscillator.
16. Construction of voltage controlled oscillator (VCO).
17. Construction of regulated power supply.
18. Wein bridge oscillator and phase shift oscillator.
19. FET Amplifier.

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.

15PLS101	CAREER COMPETENCY SKILLS I	SEMESTER - I

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT-I **(3 Hours)**

Solving Simultaneous Equations Faster - Number System: HCF, LCM - Decimals – Percentages – Averages.

UNIT-II **(3 Hours)**

Powers and Roots - Problems on Trains - Problem on ages - Boats and Streams.

UNIT – III **(3 Hours)**

Calendar - Clocks - Pipes and cisterns - Permutations and Combinations - Seating Arrangements.

UNIT-IV **(3 Hours)**

Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – Identifying strong arguments and weak arguments – Statements and Conclusions.

UNIT-V **(3 Hours)**

Reading comprehension – Self Introduction – News Paper Review – Book Review

15PPHM201	CORE V: QUANTUM MECHANICS I	SEMESTER - II

Total Hours: 50

OBJECTIVE:

To impart knowledge on foundations of wave mechanics, angular momentum and time independent perturbation theory.

CONTENTS

UNIT-I **(10 Hours)**

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 - Ehrenfast's theorem. Postulates of wave mechanics - 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).

UNIT-II **(10 Hours)**

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.

UNIT – III **(10 Hours)**

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.

UNIT-IV **(10 Hours)**

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.

UNIT-V **(10 Hours)**

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.

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.* 2008. **Quantum Mechanics**, [Second Edition]. PHI Learning Pvt. Ltd. New Delhi.

15PPHM202	CORE VI: CONDENSED MATTER PHYSICS	SEMESTER - II

Total Hours: 50

OBJECTIVES:

1. To impart the fundamental concepts on crystals and its various structures.
2. To know the various properties of solids.

CONTENTS

UNIT –I **(10 Hours)**

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.

UNIT –II **(10 Hours)**

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.

UNIT –III **(10 Hours)**

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.

UNIT –IV **(12 Hours)**

Magnetic properties of Materials: Classification of magnetic materials – Theory of diamagnetism – Langevin theory of paramagnetism - Weiss theory – Quantum theory of paramagnetism – Ferromagnetism – Quantum theory of ferromagnetism – Weiss Molecular field theory – Curie-Weiss law – Ferromagnetic domains – Domain theory – Antiferromagnetism – Ferrimagnetism – 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.

UNIT – V **(8 Hours)**

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 - Duration of persistent currents - Quantum interference - Josephson effect and applications - SQUIDS - High temperature superconductivity.

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.* 2008. **Solid State Physics.** [Twelfth Edition]. Pragati Prakashan, Meerut. (Unit – I, II, III).

REFERENCE BOOKS:

1. *Kittel, C.* 2009. **Introduction to Solid State Physics.** [Seventh Edition]. Wiley Eastern. New Delhi
2. *Gupta, S.L and Kumar. V.* 2009. **Solid State Physics.** [Ninth Edition]. K. Nath & Co, Meerut.
3. *Ashcroft*. 2011. **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

15PPHEL201	ELECTIVE I: PHYSICS OF NANOSCALE	SEMESTER – II

Total Hours: 50

OBJECTIVE:

To impart knowledge on NANO field, Nano particles preparation, synthesis and its applications.

CONTENTS

UNIT- I **(10 Hours)**

Introduction to the Nanoworld: Introduction – Historical perspective on Nanomaterial - Classification of Nanomaterials – Nanorods, nanotubes, nanoparticles, Quantum wells, wires and dots – Preparation of quantum nanostructures (lithography) – Size and dimensionality effects – Single electron tunneling.

UNIT - II **(10 Hours)**

Metals, Semiconductors and Ceramics Nanocrystals: Reduction of size – Synthesis of metal nanoparticles and structures – Routes to arrangements – Background on Quantum Dot semiconductors - Background on reverse Micellar solution – Synthesis of Semiconductors – Cadmium Telluride Nanocrystals – Cadmium sulfide Nanocrystals – Alloy Semiconductors – 2D and 3D Superlattices of Silver Sulfide Nanocrystals – Synthesis of Ceramics – Bondings and defects - Chemical, Physical and Mechanical properties of Ceramics.

UNIT – III **(10 Hours)**

Nanoparticles and Magnetism: Magnetism in particles of reduced size and dimensions – Variations of magnetic moment with size – Magnetism in clusters of non magnetic solids – Magnetic behavior of small particles – Diluted magnetic semiconductors (DMS) – Fe – DMS and IV-VI Mn DMS and their applications – Intermetallic compounds – Binary and ternaries and their magnetic properties- Importance of nanoscale magnetism.

UNIT –IV **(10 Hours)**

Chemical and Catalytic Aspects of Nanocrystals: Nanomaterials in Catalysis – Nanostructured Adsorbents – Nanoparticles as new Chemical reagents – Nanocrystal Superlattices.

Specific Heat and Melting Points of Nanocrystalline Materials: Specific Heat of Nanocrystalline materials – Melting points of Nanoparticle materials.

UNIT – V **(10 Hours)**

Application of Nanomaterials: Molecular Electronics and nano electronics, nanoboats, Biological applications, band gap engineered quantum devices –

Nanomechanics – carbon nanotube emitters, photoelectrochemical cells – Photonic crystal and Plasmon wave guides.
Characterization of Nanomaterials: XRD - SEM - TEM – AFM.

TEXT BOOKS:

1. *Charles P.Poole* and *Frank J. Owens.* 2009. **Introduction to Nanotechnology**. Wiley-Interscience, USA. (Unit - I)
2. *Kenneth J. Klabunde.* 2001. **Nanoscale Materials in Chemistry.** A John Wiley & Sons, Inc., Publication. (Unit – II, III, IV, V)

REFERENCE BOOKS:

1. *Guozhong Gao.* 2010. **Nanostructures and Nanomaterials Synthesis, Properties and Applications**. [Second Edition]. Cambridge University Press India Pvt Ltd.
2. *De Jongh, J.* 1994. **Physics and Chemistry of Metal Cluster Compounds**. Kluwer Academic Publishers, Dordrecht.
3. *Henrich, V* and *Cox, P.A. 1994.* **Metal Oxides.** Cambridge University Press, New York.

15PPHEL202	ELECTIVE I: NONLINEAR DYNAMICS	SEMESTER – II

Total Hours: 50

OBJECTIVE:

To impart knowledge on Nonlinear Dynamical Systems, Solitons, Chaos and its applications.

CONTENTS

UNIT- I **(10 Hours)**

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.

UNIT- II **(10 Hours)**

Chaos- simple bifurcations - Saddle node, pitchfork, transcritical bifurcation- The logistic map - Period doubling phenomenon- Onset of chaos- Other routes to chaos- Quasi periodic route to chaos- Intermittency route to chaos- Bifurcation scenario in Duffing oscillator- Chaos in conservative systems.

UNIT – III **(10 Hours)**

Solitons- Nonlinear dispersive systems- Cnoidal and solitary waves- Scott Russel phenomenon and KdV equation- Fermi-Pasta-Ulam lattice problem- FPU recurrence phenomenon- Asymptotic analysis- Numerical experiment of Zabusky and Kruskal- Birth of soliton.

UNIT – IV **(10 Hours)**

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.

UNIT – V **(10 Hours)**

Applications- Chaos and secure communications- role of soliton in condensed matter systems- Nonlinear optics and biological systems.

TEXT BOOK:

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. *Drazin, P.G. and Johnson, R.S.* 1989. **Solitons: An introduction**, Cambridge University Press, Cambridge.
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.

15PPHEL203	ELECTIVE I: MODERN OPTICS	SEMESTER – II

Total Hours: 50

OBJECTIVE:

To impart knowledge on polarization, double refraction, lasers, Fibre optics, Non-linear optics, magnet.

CONTENTS

UNIT- I **(10 Hours)**

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.

UNIT- II **(10 Hours)**

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 - Central features and laser action- Liquid laser - Dye laser and Chemical lasers.

UNIT – III **(10 Hours)**

Fiber Optics Total Internal Reflection - The Optical Fiber - Glass fibers- The coherent bundle - The numerical aperture- Attenuation in Optical Fibers - The 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.

UNIT – IV **(10 Hours)**

Non-Linear Optics: Basic Principles - Harmonic Generation - Second Harmonic Generation - Phase Matching - Third Harmonic Generation - Optical Mixing - Parametric Amplification - Self-Focusing of Light.

UNIT – V **(10 Hours)**

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.

TEXT BOOKS:

1. *Ajoy Ghatak,* 2005. **Optics,** [3rd Edition], Tata McGraw-Hill Publishing Co., New Delhi [Unit-I, III, V].
2. *Laud, B.B.* 2005. **Laser and Non-Linear Optics**. [Third Edition]. New Age International Publishers, New Delhi. [Unit: V]

REFERENCE BOOKS:

1. *Silfvast. W.* 1996. **Laser Fundamentals**, [Second Edition]. Cambridge University Press, London.
2. *Jenkins. F.A and White. H.E.,* **Fundamentals of Optics**, 4th Edition, McGraw-Hill International Edition, London, 1981.
3. *Lipson, S.G., Lipson. H, and Tannhauser. D.S.,* 1996. **Optical Physics**, 3rd Edition, Cambridge University Press.

15PPHMP201	CORE PRACTICAL II: ADVANCED PHYSICS PRACTICAL	SEMESTER - II

(Practical at the end of II Semester)

(Any twelve Experiments)

1. Young's modulus by Hyperbolic or Elliptical fringes.
2. Determination of polarizability of liquids.
3. Determination of wavelength of He-Ne laser using grating and find the thickness of a wire by He-Ne laser.
4. Hall Effect by four probe method.
5. Michelson's interferometer.
6. Stefan's Constant.
7. Determination of e/m by Thomson's method.
8. B.H. Curve- Energy loss of the magnetic material.
9. Solar Cell I-V Characteristics and efficiency.
10. Determination of Self Inductance of a coil by Anderson's method.
11. Determination of band gap by Thermistors.
12. Hartmann's formula-Determination of wavelength.
13. Magnetic susceptibility- Quincke's method.
14. Magnetic susceptibility- Guoy's method.
15. Determination of thermal conductivity-Forbe's method.
16. Millikan's oil drop experiment.
17. GM Counter.
18. Determination of Ultrasonic velocity for the given liquid.

REFERENCE BOOK: M.Sc., Physics lab manual

15PCSPHI201	INTER DISCIPLINARY COURSE I: NUMERICAL METHODS AND PROGRAMMING IN C	SEMESTER - II

Total Hours: 50

OBJECTIVE:

To impart knowledge in C programming, solution of Numerical Algebric & Transcendental Equations and Numerical Integration.

CONTENTS

UNIT – I **(12 Hours)**

Overview of C: History of C - Importance of C – Sample Programs - Basic Structure of C Programs- Executing a 'C' program. **Constants, Variables, and Data Types :** Introduction - Character Set - C Tokens - Keywords and Identifiers - Constants - Variables - Data Types - Declaration of Variables – Declaration of Storage Class- Assigning Values to Variables- Defining Symbolic Constants - Overflow and Underflow of Data. **Operators and Expressions**: Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise, Special Operators - Arithmetic Expressions - Evaluation of Expressions - Precedence of arithmetic operators - Type conversions in expressions.

UNIT - II **(12 Hours)**

Managing Input and Output Operations: Reading and writing a character - Formatted input- Formatted output. **Decision Making and Branching:** Decision making with IF statement– Different forms of IF statement - Switch statement– The **?:** Operator - The GOTO statement. **Decision Making and Looping:** Introduction- The WHILE statement - The DO statement - The FOR statement – Jumps in Loops.

UNIT - III **(13 Hours)**

Arrays: Declaration and initialization of one dimensional array – Initializing two dimensional arrays – Multi-dimensional Arrays - Dynamic arrays. **Character Arrays and Strings:** Declaring and initializing string variables - Reading strings from terminal - Writing strings to screen - Arithmetic operations on characters- Putting strings together - Comparison of two strings- String handling functions.

UNIT - IV **(7 Hours)**

Numerical Methods – I

Solution of Numerical Algebraic & Transcendental Equations: Bisection Method - False Position Method - Iteration Method – Newton-Raphson Method.

Solution of Simultaneous Linear Equations: Direct Method - Gauss Elimination Method - Gauss Jordan Method -Inversion of Matrix by using Gauss Elimination Method - Iterative Method - Gauss Seidal Method.

UNIT - V **(6 Hours)**

Numerical Methods –II

Numerical integration by Trapezoidal and Simpson's rules – algorithms - Numerical solution of differential equations: Euler method - Runge-Kutta second order method - Runge-Kutta fourth order method.

TEXT BOOKS:

1. *Balagurusamy, E.* 2013. **Programming in ANSI C**, Sixth Edition, Tata Mc-Graw Hill, New Delhi. [Unit-I, II, III].
2. *Kandasamy, P, Thilagavathy. K and Gunavathi. K*. 2010. **Numerical Methods**, S. Chand & Co Ltd, India. [Unit-IV, V].

REFERENCE BOOKS:

1. *Yashavant Kanetkar.* 1999. **Let Us C**. Third Edition, BPB Publications, New Delhi,.
2. *Stephen Kocha, G.* 1994. **Programming in ANSI C**, Revised Edition, Macmilan Computer Publishing, USA.
3. *Suresh Srivastav, K.* 1999. **C in Depth**, First Edition, BPB Publications, New Delhi.
4. *Singaravelu, A*. 1996. **Numerical Methods**, First Edition, Galgotia Publications Pvt. Ltd., New Delhi.

15PCSPHIP201	INTER DISCIPLINARY COURSE PRACTICAL I: NUMERICAL METHODS USING C	SEMESTER-II

List of Practical:

1. Program to find the following sum of series

$$1-\frac{x^2}{2!}+\frac{x^4}{4!}-\frac{x^2}{6!}+.....$$

2. Program for finding the numbers which are divisible by n.
3. Program to read a set of 'n' numbers and find their Arithmetic mean, Geometric mean and Harmonic mean.
4. Program for finding the maximum and minimum number in a given array.
5. Program for finding matrix multiplication.
6. Program for solving linear algebraic equation using Gauss Elimination Method
7. Program for solving linear algebraic equation using Gauss Seidel Method.
8. Program for numerical integration using composite Trapezoidal Rule.
9. Program for numerical differentiation using Euler Method.
10. Program for finding roots of algebraic equation using Newton Raphson Method.

15PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER-II

Total Hours: 25

OBJECTIVE:

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

UNIT – I **(5 Hours)**

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.

UNIT – II **(5 Hours)**

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.

UNIT – III **(5 Hours)**

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.

UNIT – IV **(5 Hours)**

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.

UNIT – V **(5 Hours)**

Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights – UNO – 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.

15PLS201	CAREER COMPETENCY SKILLS II	SEMESTER - II

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT-I **(3 Hours)**

Assertiveness and Self Confidence-Career Opportunities-Industry expectations (Skill set).

UNIT-II **(3 Hours)**

Campus to Corporate-Effective Communication.

UNIT – III **(3 Hours)**

Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations - Prepared -'Just A Minute' Sessions (JAM).

UNIT-IV **(3 Hours)**

Body Language- Dress code - Telephone etiquettes - Email etiquettes - Group Discussion - Creativity - Presentation skills.

UNIT-V **(3 Hours)**

Interviewing Techniques - Do's and Don'ts of Interview - Mock Interview.

15PPHM301	CORE VII: ELECTROMAGNETIC THEORY	SEMESTER – III

Total Hours: 50

OBJECTIVE:

To impart knowledge on electrostatics, boundary value problems, Magnetostatics, Electromagnetics, EM waves and its applications.

CONTENTS

UNIT- I **(10 Hours)**

Electrostatics: Coulomb's law - Electric field - Gauss' law - Differential form of Gauss' law - Surface distributions of charges and dipoles - Poisson and Laplace equations - Green's theorem - Solution of boundary value problem with green's function - Electrostatic potential energy and capacitance.

UNIT- II **(10 Hours)**

Boundary value problems in Electrostatics: Method of Images - Point charge in the presence of a – Grounded conducting sphere - Conducting sphere in a uniform electric field by method of Images - Laplace equations in spherical co - ordinates - Multipole expansion - Boundary value problems with dielectrics - Molecular polarizability and electric susceptibility - Electrostatic energy in dielectric media.

UNIT- III **(10 Hours)**

Magnetostatics: Biot-Savart law - Differential equations of magneto statics and Ampere's law - Vector potential - Magnetic fields of localized current distribution and magnetic moment - Force, torque and energy of a localized current distribution - Macroscopic equations and boundary conditions of B and H - Methods of solving boundary value problems in magneto statics - Uniformly magnetized sphere.

UNIT- IV **(10 Hours)**

Electromagnetics: Faraday's law of induction - Maxwell's equations - Vector and scalar potentials - Gauge transformation - Lorentz gauge - Coulomb gauge - Poynting's theorem and conservation of energy and momentum - Electromagnetic waves - Plane electromagnetic waves in a non - Conducting medium - Linear and circular polarization - Reflection and refraction of EM waves - wave guides .

UNIT-V **(10 Hours)**

Applications of EM waves in plasma: Introduction to plasma - Plasma behavior in magnetic field - Plasma as a conducting field - Pinch effect - Instabilities in Plasma - Hydromagnetic waves - Alfen waves.

TEXT BOOKS:

1. *Jackson, J. D.* 1999. **Classical Electrodynamics.** [Third Edition]. BPB Publisher, New Delhi. [Unit: I-IV]

2. *Puri S. P.* 2013. **Classical Electrodynamics.** Narosa Publishing House. New Delhi. [Unit: V]

REFERENCE BOOKS:

1. *David J. Griffiths.* 2000. **Introduction to Electrodynamics.** [Third Edition]. Narosa Publishing, New Delhi.
2. *Jordan, E.C* and *Balmin, K.G.* 2011. **Electromagnetic waves and radiating system.** [Second Edition]. Prentice Hall of India, New Delhi.
3. *Danajayan, P*. 2012. **Electromagnetic Theory**. [Ninth Edition]. Lakshmi Publications, Chennai.
4. *Chopra and Agarwal,* 1984. **Electromagnetic Theory.** Kedar Nath & Ram Nath Publishers, Meerut.

15PPHM302	CORE VIII: QUANTUM MECHANICS II	SEMESTER - III

Total Hours: 50

OBJECTIVE:

To impart knowledge on time dependent perturbation theory and its applications, Relativistic Quantum mechanics and Quantum field theory.

CONTENTS

UNIT –I **(10 Hours)**

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.

UNIT-II **(10 Hours)**

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.

UNIT-III **(10 Hours)**

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.

UNIT-IV **(10 Hours)**

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).

UNIT-V **(10 Hours)**

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.

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.

15PPHM303	CORE IX: MICROPROCESSOR AND MICROCONTROLLER (100% INTERNAL EVALUATION)	SEMESTER – III

Total Hours: 50

OBJECTIVE:

To impart knowledge on Intel 8085 microprocessor, 8051 microcontroller its design, programming and applications in various fields.

CONTENTS

UNIT – I **(10 Hours)**

Intel 8085: 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.

UNIT – II **(10 Hours)**

Introduction to 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.

UNIT – III **(10 Hours)**

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.

UNIT – IV **(10 Hours)**

Intel 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.

UNIT – V **(10 Hours)**

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).

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 Mc Graw 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 (I) Pvt. Ltd., New Delhi.
5. *Ram. B.* 2008. **Fundamentals of Microprocessor and Microcontrollers**, Dhanpat Rai Publications, New Delhi.

15PPHEL301	ELECTIVE II: BIOMATERIALS	SEMESTER – III

Total Hours: 50

OBJECTIVE:

To impart knowledge on materials used in clinical applications.

CONTENTS

UNIT- I **(10 Hours)**

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.

UNIT- II **(10 Hours)**

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.

UNIT – III **(10 Hours)**

Ceramics - Bioinert ceramics – Carbon - Alumina- Yatria stabilized zirconia - Surface reactive ceramics - Bioglass - Resorbable ceramics – Hydroxyapatite: Properties and applications - Tricalcium phosphate: Properties and applications - Composites.

UNIT – IV **(10 Hours)**

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.

UNIT – V **(10 Hours)**

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.

TEXT BOOK:

1. Sujata V. Bhat. 2005. **Biomaterials** [2nd Edition]. Narosa Publishing House, New Delhi.

REFERENCE BOOKS:

1. *Park. J, Lakes. R. S.* 2007. **Biomaterials: An Introduction** [3rd Edition]. Springer Publication.
2. *Reema Shukla,* 2014. **Biomaterials** [1st Edition]. Nandu Printers & Publishers Pvt. Ltd. Chennai.

15PPHEL302	ELECTIVE II: CRYSTAL GROWTH AND THIN FILM PHYSICS	SEMESTER – III

Total Hours: 50

OBJECTIVE:

To impart knowledge on crystal growth theory, techniques, thin films deposition, and characterization.

CONTENTS

UNIT –I **(10 Hours)**

Nucleation and Growth : Nucleation – Different kinds of nucleation - Concept of formation of critical nucleus – Classical theory of nucleation - Spherical and cylindrical nucleus - Growth Kinetics of Thin Films – Thin Film Structure – Crystal System and Symmetry.

UNIT –II **(10 Hours)**

Solution Growth Technique: Low temperature solution growth: Solution - Solubility and super solubility – Expression of super saturation – Miers T-C diagram - Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.

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 – Advantages of gel method.

UNIT –III **(10 Hours)**

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.

UNIT –IV **(10 Hours)**

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

UNIT –IV **(10 Hours)**

Characterization Technique: X–Ray Diffraction (XRD) – Powder and single crystal - Fourier transform Infrared analysis (FT-IR) – Elemental analysis – Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – AFM - UV-Vis-Spectrometer –Photoluminescene (PL) spectrometer – Vickers microhardness.

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,** Mc Graw–Hill, New York.
4. *William, M. and Steve, D.* 1986. **Instrumental Methods of analysis,** CBS Publishers, New Delhi.

15PPHEL303	ELECTIVE II: MOLECULAR QUANTUM MECHANICS	SEMESTER – III

Total Hours: 50

OBJECTIVE:

To impart knowledge in the basic theories and methods of molecular quantum mechanics to perform electronic structure calculation.

CONTENTS

UNIT – I **(10 Hours)**

Many Electron System: Introduction to quantum mechanics – Schrödinger equation (only concept and its drawback) – Born-Oppenheimer Approximation – Valence Bond Theory - Molecular Orbital Theory – The Hartree-Fock Self Consistent Field Method.

UNIT – II **(10 Hours)**

Electron Correlated Methods: Møller-Plesset perturbation theory (only MP2) – Configuration Interaction (CI) wave function; multiconfiguration SCF (MCSCF), multireference CI (MRCI) – Coupled Cluster Methods.

UNIT – III **(10 Hours)**

Semi-empirical method: Huckel MO Method – CNDO, INDO, MNDO, AM1 and PM3 methods

Basis Set : Introduction – Slater type orbitals (STO) – Gaussian type orbitals (GTO)

Molecular Properties: Molecular geometry and conformations – Dipole moment – Vibrational frequency – Population analysis

UNIT –IV **(10 Hours)**

Density Functional Theory (DFT) : Electron density **-** The Hohenberg-Kohn theorems – Kohn-Sham equations – Approximate exchange correlation energy functionals – Local density approximation (LDA) – Generalized gradient approximation (GGA) – Hybrid functionals – Time dependent density functional theory (TDDFT).

UNIT –V **(10 Hours)**

Molecular Mechanics Method: Introduction **-** Force Field – Morse Potential Model – Energy terms in force field : Bond stretch – Bond angle – Torsional terms – Non-bonded interactions – Commonly Available Force Field – Molecular dynamics: Introduction - Newton's equation of motion – Phase space trajectories Determination of properties: Potential energy surface – Single point energy calculation

TEXT BOOKS:

1. Levine, Ira. N. 2000. **Quantum Chemistry.** [Fifth Edition]. Prentice-Hall of India.

2. *Ramachandran, K. I. Deepa, G. Namboori, K*. 2008. **Computational Chemistry and Molecular Modelling Principles and Applications**. Springer.

REFERENCE BOOKS:

1. *Szabo, A. Ostlund, N. S.* 1996. **Intorduction to Advanced Electronic Structure Theory**. Dover publications INC, New York.
2. *Cramer, J.* 2004. **Essential of Computational Chemistry- Theories and Models** [Second Edition]. John Wiley & Sons, England.
3. *Parr, R.G. and Yang, W.* 1989. **Density Functional Theory of Atoms and Molecules**. New York.
4. *Leach, A. R.* 2001. **Molecular Modelling Principles and Applications**. [Second Edition]. Pearson Education Ltd, England.

15PPHMP301	CORE PRACTICAL III: MICROPROCESSOR AND MICROCONTROLLER	SEMESTER - III

(Practical at the end of III Semester)

Microprocessor 8085 (Any eight experiments)

1. Arithmetic operations- 8 bit.
2. Arithmetic operations-16 bit.
3. Code conversion (BCD to Binary, Binary to BCD).
4. Arranging numbers in ascending and descending orders.
5. Temperature Conversions (F to C & C to F).
6. Determination of factorial of the given number.
7. Display interfacing.
8. Square and square root of the given number.
9. Stepper motor interfacing.
10. ADC interfacing.
11. DAC interfacing.

Microcontroller 8051 (Any four experiments)

12. Real time clock interfacing.
13. Arithmetic operations- 8 bit.
14. Traffic control system Interfacing.
15. Finding of Biggest and Smallest number.
16. Stepper motor interfacing.
17. Seven segment display interfacing.
18. ADC Interfacing.

REFERENCE BOOK:

1. Swami. G.T. 2006. **Microprocessor 8085 lab manual**. [First Edition]. Firewall Media, New Delhi.

15PECPHI301	INTER DISCIPLINARY COURSE II: BIOMEDICAL INSTRUMENTATION	SEMESTER – III

Total Hours: 50

OBJECTIVE:

To impart basic knowledge on instruments used in medical field, their construction and working.

CONTENTS

UNIT -I **(10 Hours)**

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.

UNIT –II **(10 Hours)**

Electrodes and Transducers: Components of the biomedical instrument System- Electrodes- Half cell potential- Purpose of the Electrode Paste- Types of Electrodes – Microelectrodes- Depth and Needle electrodes- Surface Electrodes- Transducers

UNIT –III **(10 Hours)**

Biopotential Recorders: Electrocardiography (ECG) - Lead Configuration- Recording setup - Electroencephalogram (EEG) – Brain waves – Placement of electrodes – EEG recording set up - Electromyography (EMG) – ERG – EOG.

UNIT –IV **(10 Hours)**

Physiological Assist Devices: Pacemakers – Methods of stimulation- Defibrillators – Different types of defibrillators – AC defibrillator – DC defibrillator - Heart Lung Machine – Blood Pressure Measurement- Blood Flow meters – Electromagnetic Blood Flow meters – Ultrasonic Blood Flow meters – LASER Blood Flow meters.

UNIT –V **(10 Hours)**

Operation Theatre and Medical Imaging Equipments: Surgical diathermy– Shortwave diathermy – Microwave diathermy – Ultrasonic diathermy – Electron Microscope – X-Ray Machine – CT Scan – Magnetic Resonance Imaging.

TEXT BOOK:

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.

15PBCPHI301	INTER DISCIPLINARY COURSE II: MOLECULAR BIOPHYSICS	SEMESTER - III

Total Hours: 50

OBJECTIVE:

To impart knowledge about the physics of biomolecules and cells.

CONTENTS

UNIT - I **(10 Hours)**

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 non polar compound. Formation of hydrogen bonds with polar solutes. Vander waal's interaction. Role of weak interactions in biological system. Hydrophobic effect. Molecular complementarity.

Unit - II **(10 Hours)**

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.

UNIT – III **(10 Hours)**

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.

UNIT – IV **(10 Hours)**

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).

UNIT - V **(10 Hours)**

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.

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.

15PPHM401	CORE X: SPECTROSCOPY	SEMESTER – IV

Total Hours: 50

OBJECTIVE:

To impart knowledge on various spectroscopy, their principles and interaction with molecules.

CONTENTS

UNIT-I **(10 Hours)**

Microwave Spectroscopy: Rotation of molecules and their spectra – Diatomic molecules – Rigid rotator – Non-rigid rotator and their spectra – 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 – Chemical analysis by IR spectroscopy- IR spectrometer – FT-IR technique.

UNIT-II **(10 Hours)**

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 – Surface enhanced Raman scattering (SERS) and its applications – Coherent Anti-stokes Raman scattering (CARS).

UNIT – III **(10 Hours)**

UV-Visible Spectroscopy: Principles and theory – Diffuse Reflectance spectroscopy - Franck-Condon principles – Singlet and triplet states – Measurement of light absorption – Instrumentation – Sample preparation - Applications.

Photoluminescence Spectroscopy: Fluorescence – Phosphorescence – Characteristic of luminescence – Factors affecting luminescence – Solvent effect – Instrumentation – Applications.

UNIT – IV **(10 Hours)**

NMR Spectroscopy: Interaction of spin and applied magnetic field - Quantum mechanical description – Relaxation Times - Spin-spin and spin lattice –Chemical shift – Spin-spin coupling between two and more nuclei – NMR spectrometer- Chemical analysis by NMR spectroscopy.

ESR Spectroscopy: Quantum mechanical theory of ESR – Hyperfine structure study – Triplet states study of ESR – Design of ESR spectrometer - Application of ESR.

UNIT – V **(10 Hours)**

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.

TEXT BOOKS:

1. *Aruldhas, G. 2013,* **Molecular Structure and Spectroscopy,** [Second Edition], PHI, New Delhi. [Unit: I, II, IV, V]
2. *Sathyanarayana, D.N.* 2001. **Electronic Absorption Spectroscopy and Related Techniques.** University Press, India. [Unit: III]

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.

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15PPHM402	CORE XI: NUCLEAR AND PARTICLE PHYSICS	SEMESTER - IV

Total Hours: 50

OBJECTIVES:

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

CONTENTS

UNIT- I (**10 Hours)**

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 – Semiempirical 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.

UNIT- II **(10 Hours)**

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.

UNIT- III **(10 Hours)**

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.

UNIT- IV **(10 Hours)**

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.

UNIT- V **(10 Hours)**

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.

TEXT BOOK:

1. *Tayal, D.C.* 2005. **Nuclear Physics**. 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.

GUIDELINES

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) A. 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**

B. THEORY (If Internal Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks out of 100 in the Comprehensive Examination (Internal Evaluation only).

Internal Marks Distribution [CA- Total Marks: 100]

Attendance	: 10 Marks
Assignment	: 20 Marks (2 Assignments Compulsory)
Seminar	: 10 Marks
Internal Examinations	: 60 Marks
Total	**: 100 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**

(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 3 reviews before completing his/her Project.
- Two reviews will be reviewed by Internal Resource Person and one review by External Resource Person.
- 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)

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- On line examination will be conducted at the end of the III Semester.

Viva-Voce

- A Student has to come in proper dress code and he/she should bring 2 copies of Resume for the Viva-Voce.
- A 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.	15PPHCHI301	Solid State Physics	III	M.Sc., Chemistry