SEMESTER - III			
CORE - IX NUCLEAR AND PARTICLE PHYSICS			
Code :17PPHC33	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Course Outcomes

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	List the basic properties of atomic nuclei	PSO1	R
CO 2	Classify the different types of nuclear reactions	PSO5	U
CO 3	Categorize the different types of nuclear models and their properties	PSO6	An
CO 4	Discuss the nuclear forces and the theories related to it	PSO1	C
CO 5	Classify the types of elementary particles	PSO1	U
CO 6	Discuss the Quark theory of Nuclei	PSO1	A

Unit I:Introduction

Basic Properties of atomic nuclei -Gamow's theory of alpha d**e**cay - Fermi theory of beta decay-Shape of the beta ray spectrum-Angular momentum and parity selection rules-Parity violation-detection and properties of neutrino-Gamma decay-Multipole transitions in nuclei-Selections rules-Internal conversion-Nuclear isomerism.

Unit II:Nuclear Reactions

Pick up,break up, knock out and stripping nuclear reactions-Balance of mass and energy in nuclear reactions –Q equation-Solution of the equation- Exoergic and endoergic reactions-Compound nuclear theory-Reciprocity theorem-detailed balance-Breit Wigner one level resonance formula-Optical Model-Hot Nuclei-Statistical theory.

Unit III:Nuclear Models

Liquid drop model-Potential barrier for fission-Bohr Wheeler theory of nuclear fission-Barrier penetration-Decay probabilities for spontaneous fission-Neutron induced fission-Asymmetric fission-Energy released in fission-Fission chain reaction –Nuclear shell model-Evidences that led to the shell model-spin orbit coupling-Angular momenta and parities of nuclear ground states-Magnetic moments-Schmidt line.

Unit IV:Nuclear Forces

Ground and excited states of deuteron-Magnetic dipole and electric quadrupole moments of the deuteron-Exchange forces –Meson theory of nuclear force-Nucleon-nucleon scattering at low energy-Effective range theory-Spin dependence and charge independence of nuclear forces.

Unit V:Elementary Particles

Classification of elementary particles-Conservation laws-Classification of hadrons-SU (2) and SU (3) symmetries-baryon octet-Meson octet-Baryon decuplet - Gellmann-Okubo mass formula-Quark theory of nuclei.

Book for study:

1. D. C. Tayal, Nuclear Physics,Reprint 1985, Himalaya Publishing House.
2. M. L. Pandya and R. P. S. Yadav, Elements of Nuclear Physics, Revised Reprint 2008,Kedar Nath & Ram Nath publications, Meerut.

Unit	Book No.	Sections
I	1	1.3,1.6,1.7,1.8,5.6,6.5,7.4,7.6
	2	8.5,8.6,8.7,9.8
II	1	10.19,10.11,10.14,10.15,10.17
	2	11.2,11.10
III	1	9.3,9.4
	2	12.7,12.8
IV	1	9.4
V	1	16.2,16.4,16.20
	2	13.1,13.9,13.10,13.11

Book for Reference:

1. Irving Kaplan, Nuclear Physics, Nineteenth Reprint, Second Edition,Addision-Wesley publishing company, USA.
2. R.C. Sharma, Nuclear Physics, Sixth revised edition, K.Nath & Co Publications, Meerut.
3. V.Devanathan, Nuclear Physics, Revised Reprint 2008, Narosa Publishing,New Delhi.

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SEMESTER - IV			
CORE XII ATOMIC AND MOLECULAR SPECTROSCOPY			
Code :17PPHC42	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Course Outcomes

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Explain the structure of atoms and the origin of the observed spectra	PSO1	U
CO 2	Interpret rotational spectra, get information about molecular dimension and atomic masses	PSO4	U
CO 3	Explain pure rotational Raman spectra and understand the techniques in instrumentation	PSO3	U
CO 4	Apply knowledge of Mossbauer spectroscopy in solid state physics and nanotechnology	PSO4	A
CO 5	Assess how nuclear spins are affected by magnetic field and able to explain what happens when radio frequency radiation is observed	PSO1	E
CO 6	Discuss the techniques of ESR spectroscopy	PSO1	U

Unit I: Atomic Spectra

Introduction-Different Spectral lines of hydrogen-Origin of Atomic Spectra: Rutherford's explanation-Bohr's theory of Hydrogen Spectrum-Critical potential (excitation & ionization potentials)-vector atom model.

Electronic Spectroscopy: Structure of atoms-electronic angular momentum-The angular momentum of many –electron atoms-The Zeeman effect

Unit II: Microwave Spectroscopy

Microwave Spectroscopy: The rotation of molecules – Rotational spectra – Diatomic molecules – Polyatomic molecules –Techniques and instrumentation –Chemical analysis. Applications(Microwave oven)

Unit III:Infra-Red Spectroscopy and Raman Spectroscopy

Infra Red Spectroscopy: The vibrating diatomic molecule – The Diatomic vibrating rotator- The interactions of rotations and vibrations- The vibrations of polyatomic molecules- Techniques and instrumentations.

Raman spectroscopy: Pure rotational Raman Spectra- vibrational Raman spectra- Techniques and instrumentation.

Unit IV: Electronic Spectroscopy of Molecules and Mossbauer Spectroscopy

Vibrational coarse structure: progressions – intensity of vibrational electronic spectra: The Frank – Condon principle – Dissociation energy and Dissociation products – rotational fine structure of electronic- vibration transition.

Mossobaur Spectroscopy: Principles of Mossbauer-Applications of Mossbauer Spectroscopy

Unit V: Resonance Spectroscopy

NMR – Chemical shift – The coupling constant – Nuclear quadrupole effects – Techniques and instrumentation.

ESR – The hyperfine structure – Double resonance – Fine structure - Techniques of ESR spectroscopy.

Books for study:

1. M.K.Dutta, Atomic and Molecular Spectroscopy, Ist Edition 2010, IVY Publishing House, Delhi.

2. C.N.Banwell, Fundamentals of Molecular spectroscopy, 4th Edition, Tata McGraw hill Publishing Company, NewDelhi.

Unit	Book No.	Sections
I	1	1-4
	2	5.1,5.2,5.4,5.6
II	2	2.1-2.7
III	2	3.1,3.2,3.4,3.5,3.8,4.2,4.3,4.6
IV	2	6.1.2-6.1.5,9.1,9.2
V	2	7.2, 7.2.1 - 7.2.2,7.3.4,7.4,7.5.1,7.5.3-7.5.6

Books for Reference:

1. G.M.Barrow, Introduction to Molecular Spectroscopy, 17thprint, MGH Publishing Company.
2. Gary M.Lampman, Donald L.Pavaia, George S.Keiz, James R.Vyvyan, Spectroscopy, 4th Edition, Cengage Learning India P Ltd, Delhi.
3. G.Aruldhas, Molecular structure & Spectroscopy, Second edition,Prentice hall Private Ltd.
4. Suresh Chandra, Molecular Spectroscopy, Narosa Publishing House Ltd, Newdelhi.

SEMESTER - II			
Elective II (IDE) BIO-MEDICAL INSTRUMENTATION			
Code : 17PPHE21	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- To make the students acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical important.
- To know the fundamental principles of equipments those are actually in use at present day.

Unit I: Human physiological systems and transducers

Cells and their structure-resting and action potentials-design of medical instruments-Design of medical instruments-Components of the bio-medical instrument system

Electrodes: electrode potential-purpose of electrode paste-electrode material-micro electrodes-depth and needle electrodes-surface electrodes.

Transducers Types: active -magnetic induction type-piezoelectric-photovoltaic-thermo electric-passive-resistive-magnetostirctive ultrasonic-pioezoelectric ultrasonic.

Unit II: Bio-Potential Recoders

Introductions-characteristics

ECG: origin-lead configuration-recording setup-practical consideration-analysis

EEG: origin-brain waves-placement of electrodes-recording set up-analysis

EMG: recording set up-determination of conduction velocities in motor nerves

Unit III: Physiological Assist Devices and Operation Theatre Equipments

Pacemakers: energy requirements to excite heat muscle-methods of stimulation-different modes of operation:Ventricular synchronous pacemaker-Atrial synchronous pacemaker

Kidney Machine: Renal function-dialysis-hemodialysis-peritoneal dialysis

Ventilators-anesthesia machine.

Unit IV: Safety Instruments

Radiation Safety Instrumentation-Physiocological Effect due to 50 Hz current passage – Microshock and Macroshock – Electrical accidents in hospitals – Devices to protect against electrical hazards.

Unit V: Advances in Biomedical Instrumentation

Computers in medicine – Lasers in medicine – Endoscopes – cryogenic surgery – Nuclear Imaging techniques – Computer Tomography – Thermography-MRI – Biomaterials.

Book for Study:

1. Biomedical Instrumentation, Dr.M.Arumugam, Tenth reprint 2013, Anuradha publications, Chennai.

Unit	Book no.	Sections
I	1	1.2,1.5,2.2,2.32.4 -2.4.7,2.5-2.5.7.2.5.18,2.5.19
II	1	4.1,4.2,4.3-4.3.5,4.4-4.4.5,4.5-4.5.2
III	1	5.2,5.8,6.8,6.9
IV	1	9.1 – 9.6
V	1	10.1-10.6,10.7, 10.8, 10.10,10.14

SEMESTER - II			
Self study Paper I (Compulsory) Physics for Lectureship-I			
Code :17PPHSS1	**Hrs/Week: -**	**Hrs/Semester: -**	**Credits: 2**

Unit I : Mathematical Methods of Physics

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

Unit II: Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions-scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non- inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity-Lorentz transformations, relativistic kinematics and mass–energy equivalence.Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton - Jacobi theory.

Unit III: Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar

and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation-from moving charges and dipoles and retarded potentials.

Unit IV: Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro-and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.First-and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation.

Unit V:Electronics and Experimental Methods

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo-and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similarcircuits). A/D and D/A converters. Microprocessor and microcontroller basics. Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting.

Book for Study:

1. Truman’s Series UGC-CSIR JRF/NET Physical Sciences, Danika Publishing Company,New Delhi

SEMESTER - III			
Self study Paper II (Optional) Physics for Lectureship-II			
Code :17PPHSS2	**Hrs/Week: -**	**Hrs/Semester: -**	**Credits: 2**

Unit I: Mathematical Physics

Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory: SU(2), O(3).

Unit II :Quantum Mechanics

Wave-particle duality. Schrödinger equation (time- dependent and time independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac
notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation
theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection.Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

Unit III: Atomic & Molecular Physics

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemicalshift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

Unit IV: Condensed Matter Physics

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

Unit V: Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotationalspectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions.

Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

Book for Study:

1. Truman's Series UGC-CSIR JRF/NET Physical Sciences, Danika Publishing Company,New Delhi

SEMESTER - I			
Core - IV	**Crystal Growth & Thin films**		
Code :19PPHC14	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Vision

To enable the study of different methods of crystal formation for various types of crystals with different symmetries and thin films along with their applications.

Mission

To introduce characterization methods, thin films and other types of materials such as polymers, ceramics & glass.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	generate an understanding of self-assembly during the process of growth	1	Un
CO - 2	apply the process skills of scientific inquiry during experimentation	4	Ap
CO - 3	understand the foundation of SEM, TEM	4	Un
CO - 4	apply the techniques of SEM and TEM to their own research projects	5	Ap
CO - 5	distinguish the differences and similarities between different deposition techniques.	1	An
CO - 6	categorize selection of deposition techniques for various applications	1	An
CO - 7	use more techniques for the preparation of crystals and thin films	4	Ap
CO - 8	recognise appropriate material for the fabrication of a device	4	Un

SEMESTER - I			
Core - IV	**Crystal Growth & Thin films**		
Code :19PPHC14	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Unit I: Introduction

Crystal growth – significance of Single crystals - crystal growth techniques – chemical physics of crystal growth. Nucleation – Theories of nucleation - classical theory of nucleation – Heterogeneous nucleation.

Unit II: Growth Techniques

Solution growth: Low temperature solution growth – crystal growth system – High temperature solution growth. Gel growth: various types of gel – Experimental procedure.

Unit III: Characterization Technique

Diffraction analysis – X-ray diffraction- electron & neutron diffraction - TEM, instrumental details - SEM – AFM. Microhardness (Nano hardness) – Classification of hardness test – Vickers hardness test – Knoop hardness test.

Unit IV: Thin film

Preparation of thin films: thermal evaporation- flash evaporation -electron gun beam method – cathodic sputtering- chemical vapour deposition. Thickness measurements – ellipsometry – interferometry.

Unit V: Technological application of thin film

Thermistor-varistor-strain gauge element-capacitor - active devices-microelectronics, IC and other applications

Text Books:

1. Dr.P. SanthanaRagavan and P.Ramasamy,Crystal growth processes and methods.
2. V.Rajendran, Material Science, Mcgraw hill, First reprint 2012, New Delhi.
3. A.Goswami, Thin film fundamentals, First Edition 1996, New age international, (p), Ltd. New Delhi.

Unit	Book No.	Section
I	1	1.1, 1.2, 1.4, 1.5, 2.2, 2.2.1- 2.2.3
II	1	4.1, 4.2, 4.8, 5.4.3, 5.4.6
III	2	3.3, 3.19, 3.4.3, 3.11, 3.10, 3.18, 3.13, 3.14, 3.15.1,3.15.2
IV	3	4.1, 4.2, 5, 7, 9.2.2, 9.2.3
V	3	3.1, 3.2, 3.3, 4, 6, 7

Books for Reference:

1. J.C.Brice, Crystal growth processes
2. B.R.Pamplin, Crystal growth, second edition
3. D.T.J.Hurle , Crystal pulling from melt
4. V.Raghavan, Material science & Engineering – A first course
5. William D.Callister,Jr., Martial science & Engineering an introduction ,V edition.

SEMESTER – II			
Core VII	**Nanoscience and Technology**		
Code : 19PPHC21	**Hrs / Week : 5**	**Hrs / Semester : 75**	**Credits : 4**

Vision

To synthesize the nanomaterial by eco-friendly methods, characterize the synthesized nanomaterials and apply in different fields for the welfare of society.

Mission

To introduce and give an insight into the fascinating area of Nanoscience.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	recall a thorough knowledge of basic underline disciplines of nanoscience and nanotechnology	4	Re
CO - 2	explain the preparation, characterization and properties of nanomaterials	6	Un
CO - 3	analyze the types and properties of carbon nanotubes	1	An
CO - 4	assimilate existing and new concepts, methodology and researches and apply them in their academic research environment	7	Ev
CO - 5	aware of challenges, risks and promises of nano technological development	6	An
CO - 6	synthesise the nanomaterials by physical, chemical and biological methods and evaluate their properties.	6	Ev
CO - 7	characterise the synthesized nanomaterials by various techniques.	5	Ev
CO - 8	apply the nanomaterials in energy storage, food and in day-to-day life.	8	Ap

SEMESTER – II			
Core VII	**Nanoscience and Technology**		
Code : 19PPHC21	**Hrs / Week : 5**	**Hrs / Semester : 75**	**Credits : 4**

Unit I- Synthesis and Characterization of Nanoparticles

History of Nanotechnology- Nano structures - Synthesis of oxide nano particles-Synthesis of metallic nano particles - Synthesis of semiconductor nanoparticles - Aerosol synthesis- Structural characterization (X-Ray Diffraction, Scanning Tunneling Microscopy, Atomic Force Microscopy).

Unit II- Carbon nanotube

Carbon nanotube - Carbon allotropes (Diamond ,Graphite, Carbon nanotubes) - Types of Carbon nanotubes – Graphene sheet to single walled nanotube - Synthesis of carbon nanotubes(Electric arc - Discharge method, Laser method, Fluidised bed CVD method, Solar production of Carbon nanotubes) - Purification and properties of Carbon nanotubes.

Unit III-Quantum well, Quantum wire and Quantum dots

Introduction - preparation of Quantum nanostructures - Fermi gas and Density of states – Calculation of the density of states in 1,2 and 3 dimension- Infrared detector -Quantum wire (Production ,Structure, Use), Quantum dot - Application of Quantum dots – Quantum dot information storage, Infrared photodetectors, Lasers.

Unit IV-Magneto electronics

Magneto electronics **:**Nano crystalline soft magnetic materials-Permanent magnetic materials-Theoritical background-Super para magnetism-Coulomb blockade-Single electron transistor-Spintronics-Giant magneto resistance-Quantum Hall Effect-fractional Quantum Hall Effect .

Unit V- Applications of Nanotechnology

Applications of Nanotechnology:Chemistry and Environment - Energy applications of Nanotechnology -Information and Communication- Heavy industry - Consumer goods - Nano medicine - medical applications of molecular nanotechnology (Nanorobots, Cell repair machines, nanonephrology)

Text Book:

1. Nano Physics, Dr.Sr.GeraldinJayam

Unit	Book no.	Section5,1.7,1.9
I	1	1.1-1.5,1.7,1.9
II	1	2.1,2.2,2.3,2.4,2.6-2.6.1,2.6.2,2.6.5
III	1	4.1-4.5,4.8,4.9,4.12
IV	1	5.1-5.6,5.9,5.10
V	1	5.14,5.15

Books for Reference:

1. Shanmugam S, Nanotechnology, MJP Publishers, Chennai, 2011.
2. Parthasarathy. B.K, Nanostructure and Nanomaterials, Isha Books, Delhi, 2007.
3. Uday Kumar, Concepts in Nanochemistry, Anmol Publications Pvt. Ltd, New Delhi, 2013.
4. Bandyopadhyay A K, Nano Materials, New Age International Publishers, 2nd Edn, 2012.
5. Viswanathan B, Nano Materials, Narosa Publishing House, New Delhi, 2013.

SEMESTER - II			
CORE VI THERMODYNAMICS AND STATISTICAL MECHANICS			
Code : 21PPHC23	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- Enable the students to understand different ensembles
- Make them to understand different microscopic system

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	Understand working knowledge of the zeroth, first, second and third law of thermodynamics	1	Un
CO 2	Apply statistics in different systems containing atoms and molecules	2	Ap
CO 3	Inspect the partition function for the microcanonical, canonical, grand canonical ensemble	1	An
CO 4	Recall the loss of thermodynamics and equipartition theorem from the statistical description using microstates	1	Re
CO 5	Assess about phase transitions and black body radiation	5	Ev
CO 6	Apply energy changes in chemical reaction using the first law of thermodynamics	2	Ap
CO 7	Estimate the Statistical properties of Random Walks and fluctuations in ensembles	1	Cr
CO 8	Determine the physical properties of the system using various correlation functions in Ising Model	6	Ev

SEMESTER - II			
CORE VI THERMODYNAMICS AND STATISTICAL MECHANICS			
Code : 21PPHC23	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Thermodynamics

Thermodynamics –System and its surroundings- Zeroth, First, Second and Third law of thermodynamics-applications-Reversible and irreversible process-heat engines-Kelvin Planck statement of the second law – Entropy –change of entropy in a reversible & irreversible process-Joule Thompson expansion– Maxwell's thermodynamic relations – Thermodynamic potentials – Chemical potential and Gibbs Duhem equation

UNIT II: Thermodynamics of Magnetism

Chemical potential – phase equilibrium and the phase rule-dependence of vapour pressure on total pressure-surface tension- vapour pressure of a liquid drop – The Reversible voltaic cell- black body radiation- Thermodynamics of magnetism.

UNIT III: Basis of Statistical Mechanics

Phase space – Ensemble – Liouville theorem – Conservation of extension in phase – Equation of motion – Equal a priori probability – Statistical Equilibrium – Micro canonical Ensemble – Quantisation of Phase space – Symmetry of wave functions – Effect of symmetry of counting – Various distributions using micro canonical ensemble.

UNIT IV: Ensemble & Statistical Thermodynamics

Gibbs paradox – Sackur- Tetrode equation – Entropy of a system in contact with a heat reservoir- Ideal gas in canonical ensemble – Grand canonical ensemble – Ideal gas in grand canonical ensemble – Comparison of various ensembles – Quantum distributions using other ensembles Macro states and microstates – Bose-Einstein distribution function – Fermi-Dirac distribution function – Maxwell-Bolltzman distribution function – Partition function

UNIT V: Ising model and Fluctuations

Phase transitions of the second kind – Ising model – Bragg-Williams approximations – Kirkwood method-One dimensional Ising model-Fluctuations in ensembles – concentration fluctuations in quantum statistics – One dimensional random walk – Brownian motion.

Text Books:

1. Dass V N. *Heat and thermodynamic.*Delhi: Dominant Publishers. 1st Edition 2005.
2. Gupta M C. *Statistical Thermodynamics.* New Delhi: New Age International P Ltd. Reprint 2009.
3. Sears Salinger. *Thermodynamics, Kinetic Theory and Statistical Thermodynamcis.* New Delhi: Narosa publishing house pvt Ltd.3rd Edition 2017.
4. Agarwal B K, Melvin Eisner. *Statistical Mechanic.* New Delhi: New age international P Ltd. Reprint 2002.

Books for reference:

1. Kerson Huang. *Statistical Mechanics.* New York: John Wiley & Sons, Inc. Second edition. 1987.
2. Dasgupta A K. *Fundamentals of Statistical Mechanics. Culcutta:* New Central Book Agency (P) Ltd. 2000.
3. Sears and Zymanski. *Statistical Mechanics.* New York: McGraw Hill Book Company.1961.
4. Federick Reif. *Fundamentals of Statistical and thermal Physics,* Singapore: McGraw Hill International Editions.1985.

SEMESTER – IV			
CORE X	**QUANTUM MECHANICS – II**		
Code: 21PPHC41	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- To enable students, acquire a thorough understanding about advanced quantum mechanics and their relevance in solving advanced quantum mechanical problems.

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Describe time independent perturbation theory and its application to the first order Stark effect in Hydrogen atom	1	Re
CO 2	Discuss time dependent perturbation theory and transition probability	1	Un
CO 3	Derive Fermi- Golden rule	2	An
CO 4	Write the Relativistic theory in quantum mechanics	1	Cr
CO 5	Describe scattering by a square well potential using Born approximation and Partial wave analysis	1	Un
CO 6	Employ WKB approximation in quantum problems	1	Ap
CO 7	Explain Dirac's equation for a free particle	1	Ev
CO 8	Apply approximation methods to solve problems	1	Ap

SEMESTER – IV			
CORE X	**QUANTUM MECHANICS – II**		
Code: 21PPHC41	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Independent Quantum Approximation Methods I

Stationary perturbation theory – non-degenerate case – I and II order degenerate case-perturbed harmonic oscillator – Zeeman Effect (without electron spin) – first order stark effect in hydrogen atom – Application of variation method: ground state of helium – zero point energy of one dimensional harmonic oscillator.

UNIT II: Approximation Methods II

Application of variation method: ground state of Hydrogen atom- Deuteron problem- Vander Waals interaction- WKB Approximation – principle of the method – connection formulas of penetration of a barrier - Application of WKB method: probability of penetration of barrier – theory of alpha decay, Geiger -Nuttel law – application to bounce state – potential state.

UNIT III: Time Dependent Quantum Approximation Method & Semi-Classical Theory of Radiation

Time dependent perturbation theory – first order perturbation – Fermi Golden rule – harmonic perturbation – second order perturbation theory – absorption and induced emission– electric dipole approximation– transition probability.

UNIT IV: Scattering Theory

Scattering Cross – section– Scattering amplitude- Partial waves– Scattering by central potential– Optical theorem- Ramsaur Townsend Effect- Scattering by an attractive square well potential– Breit – Wignar formula– Scattering length– Phase Shift– Integral equation– Born approximation and its validity – Laboratory and centre of mass co – ordinate systems.

UNIT V: Relativistic Quantum Mechanics

Klein Gordon Equation– Interpretation of Klein Gordon equation– particle in a Coloumb field– Dirac's equation for a free particle– Dirac matrices– Probability density– Negative Energy states– Spin of a Dirac particle– Magnetic Moment of the electron– Spin – Orbit interaction– Radial equation for an electron in a central potential– The Hydrogen atom– Lamb Shift

Text Books:

1. L. Schiff. *Quantum Mechanics.* New Delhi: Tata Mc-Graw Hill Education Private Limited. Second reprint, 4th Edition 2019.
2. G. Aruldhas. *Quantum Mechanics.* Delhi: Prentice Hall of India Learning Private Limited.Twenty First Print,2nd Edition 2019.
3. Satya Praksh. *Advanced Quantum Mechanics*.Meerut: Kedar Nath Ram Nath Publications. 5th Edition 2021

Books for Reference:

1. P. M. Mathews and K. Venkatesan. *A Text Book of Quantum Mechanics*. NewDelhi: Tata McGraw Hill Publishing Company Limited. 16th reprint ,2nd Edition 2007
2. R. Shankar. *Principles of Quantum Mechanics.* New York: Plenum Publishers. 2nd Edition 1994.
3. J. J. Sakurai. *Modern Quantum Mechanics.* Addison- Wesley Publishing Company. Revised edition 1994.
4. S. Rajasekar and R. Velusamy. *Quantum Mechanics I: Fundamentals.* London: CRC Press. Taylor and Francis group- Boca Raton. e-book version 2015.

SEMESTER - IV			
CORE XI	**SOLID STATE PHYSICS- II**		
Code:21PPHC42	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- To enhance knowledge and understanding of the properties of condensed materials.

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Understand the properties of solids	1	Un
CO 2	Demonstrate the types of Polarizability	2	Ap
CO 3	Compare the magnetic properties of solid materials	1	An
CO 4	Reason the working of magnetic mirror and SQUID	1	An
CO5	Identify theproperties of insulators and ferro electricity.	1	An
CO 6	Develop the research work in the field of material science and nanotechnology	1	Cr
CO7	Solve the problems related basic crystallography.	1	Cr
CO8	Discuss the quantum theory of magnetic materials	1	Ap

SEMESTER - IV			
CORE XI	**SOLID STATE PHYSICS- II**		
Code:21PPHC42	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Dielectrics

Review of basic formulas – Local field of an atom – Clausius-Mossotti relation – Polarizability – Electronic Polarizability – Ionic Polarizability – Orientational Polarizability – Dipolar relaxation – Dielectric loss – Dielectric breakdown – Frequency and Temperature dependence on Polarization.

UNIT II: Superconductivity

Introduction – Properties of superconductivity – Meissner effect – Thermal properties – Type I and type II superconductors – London Equation –BCS Theory – Quantum Tunneling **–** Josephson tunneling- Applications: Magnetic mirror, SQUID, High Tc Superconductors

UNIT III: Magnetic properties of Materials

Basic terms, Formulas – Classification of Materials – Magnetic Materials -Langevin's Theory of Diamagnetism– Langevin's Theory of Paramagnetism – Quantum Theory of Paramagnetism – Ferromagnetism – Weiss Molecular Field Theory – Ferromagnetic Domains – Domain Theory – Anti Ferromagnetism – Ferri magnetism.

UNIT IV: Ferroelectrics and Piezoelectric

Ferroelectric crystals – Displacive Transition – Landau Theory of Phase Transition – Second Order Transition – First Order Transition – Ferroelectric Domain – Piezoelectricity.

UNIT V: Smart Materials

Metallic Glasses: Preparation- Properties- Applications- Shape Memory Alloys (SMA): Phases of SMA- Characteristics- Properties of Ni-Ti Alloy- Applications- Advantages and Disadvantages-Bio materials: Classifications- Applications- ceramics- Bio-polymers.

Text Books:

1. Pillai S O. *Solid State Physics.* New Age International (P) Limited. Reprint, 8th edition. 2018.
2. Charles Kittel. *Introduction to Solid State Physics*. Wiley Publications. Reprint. 2019.
3. Dr. Mani P. *Engineering Physics II.* Chennai: Shri Dhanam Publishers. 10th Edition 2016.

Books for Reference:

1. Puri R K, Babbar V K. *Solid State Physics*. New Delhi: S Chand Publications. Reprint,First Edition. 2021.
2. Palanisamy P K. *Solid State Physics.* Chennai: Scitech publications Private Ltd. Reprint. 2013.
3. Wahab M A. *Numerical Problems in Solid State Physics.* Narosa Publishing house Pvt. Ltd. Reprint.2019.
4. Ali Omar M, *Elementary Solid-State Physics Principle and Applications.* Pearson Publication. Reprint. 2019.

SEMESTER - IV			
CORE XII	**NUCLEAR AND PARTICLE PHYSICS**		
Code:21PPHC43	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- To enhance the knowledge of nuclear reactor, bombs and the elementary particles
- To extend the knowledge about different nuclear models, nuclear decay, properties of nuclear forces and elementary particles.

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	List the basic atomic properties of nuclei	1	Re
CO 2	Classify the different types of nuclear reactions	5	Un
CO 3	Examine the different types of nuclear models and their properties	6	An
CO 4	Categorize the nuclear forces and the theories related to it	1	An
CO 5	Classify the types of elementary particles	1	Ev
CO 6	Distinguish the fission and fusion	1	An
CO 7	Relate the deuteron properties and reactions	2	Ap
CO 8	Examine the origin of various terms in nuclear physics	1	An

SEMESTER - IV			
CORE XII NUCLEAR AND PARTICLE PHYSICS			
Code:21PPHC43	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Theories of Decay

Gamow's theory of alpha decay - General features of beta ray spectrum - Fermi's theory of beta decay-Forms of interaction and selection rules- parity selection rules-Parity in beta decay-The neutrino (Helicity of Neutrino) - electron capture.

UNIT II: Nuclear reaction

Introduction of nuclear reaction-Conservation laws-Q value equation -Theories of nuclear reaction- Particle induced nuclear reactions-Electromagnetic radiation induced nuclear reactions-Compound Nucleus-Reciprocity theorem- Direct reactions- Theory of stripping and pick up reactions-Statistical theory of nuclear reaction.

UNIT III: Nuclear models & Nuclear Energy

Liquid drop model- The Shell model- nuclear fission- Mass and energy of Fission Fragments-Neutron emission in fission Process-Prompt and Delayed Neutrons- Spontaneous Fission- Barrier Penetration-Theory of Spontaneous Fission-The Nuclear Chain Reaction.

UNIT IV: Nuclear Forces

The Deuteron -Ground state of Deuteron -Excited states of deuteron- Meson theory of nuclear force - Nucleon-nucleon scattering - Neutron proton scattering at low energies- Spin dependence of n-p scattering- Effective range theory of n-p scattering.

UNIT V: Elementary Particles

Classification of elementary particles- Fundamental Interactions-Conservation laws- C-P-T Theorem-SU (2) and SU (3) symmetries-baryon octet-Meson Octet-Baryon decouplet - Gellmann-Okubo mass Formula-Quarks.

Text Books:

1. Pandya M L and Yadav R P S. *Elements of Nuclear Physics*.Meerut : Kedar Nath& Ram Nath publications .Revised Reprint. 2008.
2. Tayal D C. *Nuclear Physics.* Himalaya Publishing House. Reprint 1985.

Books for reference:

1. Irving Kaplan. *Nuclear Physics.* USA: Wesley publishing company. Nineteenth Reprint, Second Edition.
2. Sharma R C. *Nuclear Physics.* Meerut : KedarNath& Ram Nath publications .6th revised edition.

3.Devanathan V. *Nuclear Physic.* New Delhi: Narosa Publishing. Revised Reprint. 2008.

SEMESTER - I & II			
CORE PRACTICAL I	**ELECTRONICS**		
Code : 21PPHCR1	**Hrs/Week:- 3**	**Hrs/Semester:- 45**	**Credits:3**

(Any 12 Experiments)

1. Modulus counters 2 to 9
2. FET Characteristics
3. Construction of constant current source
4. D/A converter
5. Triangular wave and Ramp generator
6. A/D converter
7. $RS, \overline{R}\,\overline{S}$ flip flops using NAND and NOR gates
8. JK, D and T flip flops using NAND and NOR gates.
9. JK Master Slave flip flop
10. Serial in Parallel out shift register
11. Multiplexer and Demultiplexer
12. K map simplification and implementation of basic and universal gates by SOP and POS
13. BCD adder subtractor
14. Design of asynchronous counter
15. Verification of Boolean algebra
16. SCR Characteristics and power control

SEMESTER - III			
CORE PRACTICAL - III C++, MICROPROCESSOR& MICROCONTROLLER			
Code :21PPHCR3	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 3**

C++(Any 6 Experiments)

1. The Discrete Fourier transform
2. Currents in a network
3. Area under a curve using Monte Carlo and Simpsons rule
4. RungeKutta solution to radioactive decay problem
5. Euler solution to two-dimensional motion of a particle in a gravitational field
6. Roots of a transcendental equation
7. Curve fitting to a Gaussian, an exponential function, Cauchy's constant problem to a straight line
8. Eigen value and Eigen vectors of a matrix
9. Solution of linear harmonic oscillator and anharmonic oscillator
10. Frequency response of a series/parallel LCR Resonance circuit –Evaluation of Q- factor and bandwidth

MICROPROCESSOR& MICROCONTROLLER (Any 6 Experiments)

1. A/D converter using Microprocessor
2. D/A converter using Microprocessor
3. Rolling Display using Microprocessor
4. Stepper motor control using Microprocessor
5. Addition, Subtraction, Multiplication and Division (using various address. modes)
6. Data manipulation using Microprocessor (Ascending, descending, max and min)
7. Counters using Microprocessor
8. Display of any character
9. Traffic controller
10. Voltage/Temperature measurement
11. Digital clock
12. Wave form generator 13.Frequency measurement
14. Addition, Subtraction, Multiplication, Division-Microcontroller

SEMESTER - IV			
CORE PRACTICAL IV ELECTRONICS -II			
Code:21PPHCR4	**Hrs/Week: - 6**	**Hrs/Semester: - 90**	**Credits:3**

(Any 12 Experiments)

1. OP-AMP: Basic circuits (Inverting amplifier, non-Inverting amplifier, Summing amplifier and Difference amplifier)
2. Wien's Bridge oscillator OP-AMP
3. Op-amp: I to Vconverter, V to I converterand square wave generator
4. OP-AMP parameter calculation
5. Synchronous counter using IC 7476
6. Digital comparator IC based
7. Schmitt trigger using IC 555
8. Code converter
9. Parity Checker/generator and comparator using gates
10. Op-amp: Phase shift operator
11. Op-amp: Solving I order simultaneous equations
12. Construction of a series voltage regulator using transistor
13. Construction of II order active filters (low pass,high pass and band pass) using IC 741
14. UJT Characteristics and relaxation oscillator
15. Application of Flip flop
16. Triggering circuit if SCR
17. AC power control TRIAC
18. Switching characteristics of power MOSFET

SEMESTER - II			
ELECTIVE - II A. BIO-MEDICAL INSTRUMENTATION			
Code :21PPHE21	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

- Give the students basic knowledge about different life saving machines
- Enable the students to understand the principle behind the working of these instruments

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Define resting and action potentials	1	Re
CO 2	Classify the uses of electrode paste	1	Ap
CO 3	Discuss the principle of operation of different types of transducers	1	Un
CO 4	Interpret the output of bio potential recorders such as ECG, EEG and EMG	1	Ev
CO 5	Investigate internal and external pacemakers	1	An
CO 6	Illustrate the working of different kinds of radiation monitoring instruments	1	Ap
CO 7	Recognise the importance of computers in medicine	1	Un
CO 8	Evaluate the need for various imaging techniques such as Computer Tomography, Thermography and MRI	1	Ev

SEMESTER - II			
ELECTIVE - II A. BIO-MEDICAL INSTRUMENTATION			
Code :21PPHE21	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: Human physiological systems and transducers

Cells and their structure-resting and action potentials – Design of medical instruments – Components of the Bio-medical instrument system – Electrodes: electrode potential-purpose of electrode paste-electrode material-Types of electrodes – Transducers Types: active – magnetic induction type-piezoelectric-photovoltaic-thermo electric-passive-resistive

UNIT II: Bio-Potential Recorders

Introductions- characteristics- ECG: origin-lead configuration-practical consideration- analysis – EEG: origin-brain waves –analysis – EMG:recording set up-determination of conduction velocities in motor nerves

UNIT III: Physiological Assist Devices And Operation Theatre Equipments

Pacemakers: energy requirements to excite heat muscle-methods of stimulation-different modes of operation:Ventricular synchronous pacemaker-Atrial synchronous pacemaker Kidney Machine: Renal function-dialysis-hemodialysis-peritoneal dialysis – Ventilators – Anesthesia machine

UNIT IV: Safety Instruments

Radiation Safety Instrumentation-Physiocological Effect due to 50 Hz current passage – Microshock and Macroshock – Electrical accidents in hospitals – Devices to protect against electrical hazards.

UNIT V: Advances In Biomedical Instrumentation

Computers in medicine – Lasers in medicine – Endoscopes – cryogenic surgery – Nuclear Imaging techniques – Computer Tomography –MRI

Text Books:

1. Dr. Arumugam M. *Biomedical Instrumentation.* Chennai: Anuradha publications. 10th Edition 2013.

SEMESTER - II			
ELECTIVE II B. MICROPROCESSOR AND MICROCONTROLLER			
Code :21PPHE22	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Objectives:

- Enable the students to understand microprocessor and microcontroller
- Enable them to write simple programs
- Enable them to interface microprocessor and microcontroller with other simple devices

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Understand the architectures and instruction sets of microprocessors and microcontrollers	1	Un
CO 2	Verify bus transactions, memory organisation and address decoding, basic I/O interfaces and port addressing	1	Ev
CO 3	Apply and implement learned algorithm design techniques and data structures to solve the problems	2	Ap
CO 4	Understand the interfacing of peripheral devices like I/O ports, keyboards, displays, ADCs, DACs, stepper motor	1	Un
CO 5	Analyze concepts associated with interfacing a microprocessor to memory and to I/O devices	6	An
CO 6	Estimate how to control components of a microprocessor based system through the use of interrupts	4	Cr
CO 7	Recall a microprocessor programming model at a level that enables to write assemble language programs for the processor meeting given specifications	6	Re
CO 8	Understand the popular 8051 Microcontroller ,the processor family and Time delay	1	Un

SEMESTER - II			
ELECTIVE II B. MICROPROCESSOR AND MICROCONTROLLER			
Code :21PPHE22	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

UNIT I: Microprocessor Architecture and Instruction set

Intel 8085 Architecture-Instruction format-8085 programming model-instruction classification-8085Instructionset – Data transfer operations –Arithmetic instructions – Logic operations-Branch operations.

UNIT II: Microprocessor Programming & Counters and Time Delays

Writing assembly language programs-Programming techniques: Looping, Counting and Indexing –Stack-Subroutine- -8085 Interrupt-counters and time delays

UNIT III: Microprocessor Interfacing

Techniques for time delay-Basic interfacing concept-8255(PPI)-Interfacing Keyboard and Seven Segment Display- Microprocessor based stepper motor-waveform generator using ADC and DAC

UNIT IV: Microcontroller Programming

Addressing mode of microcontroller 8051-arithmetic and logical instruction-8051 assembly language programmes: addition, subtraction, division, multiplication- interfacing 8051 with LED display and keyboard.

UNIT V: Addressing Modes & Delay

Register Addressing -Direct byte addressing- Register indirect addressing-Immediate addressing-Logical Instructions-Time delay for 8051-Assembling and running an 8051 program

Text Books:

1. Ramesh Gaonkar. *Microprocessor Architecture Programming and Applications with The 8085.* India: Penram International Publishing Private Limited. Fifth edition. 2011.
2. Karuna Sagar D, *Microcontroller, 8051.* Delhi: Narosha publishing house PVT Ltd, Print.2011.
3. Dr.Godse A P. *Microprocessor and Microcontroller.* Technical Publications. Fourth Revised edition.2017.

Books for reference:

1. Aditya.P.Mathur. *Introduction to Microprocessors.* New Delhi: Tata Mc Graw Hill Education P Ltd. Third Edition.
2. Ram B and Sanjay Kumar. *Fundamental of microprocessors and micro controllers.* New Delhi: Dhanpat rai Publications (P) Ltd. seventh revised Edition.

SEMESTER – IV			
CORE	**PROJECT**		
Code :21PPHP41	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 6**

FORMAT FOR PREPARATION OF PROJECT REPORT FOR M.Sc. Physics

1. IDENTIFICATION OF THE PROBLEM:

Students are given the freedom of choosing the topic of the project. It may be theoretical or practical and may be from any one of the following areas.

a) Physics-Theoretical
b) Physics-Practical
c) Electronics
d) Computational Physics
e) Micro Processor
f) Interdisciplinary projects involving concepts of physics

2. ARRANGEMENT OF CONTENTS:

The sequence in which the project report material should be arranged and bound should be as follows:

Cover page and Title page
Bonafide Certificate
Abstract
Table of contents
List of Tables
List of Figures
List of Symbols, Abbreviations& Nomenclature
Chapters
Appendices
References

3. PAGE DIMENSION AND BINDING SPECIFICATIONS:

The dimension of the project report should be in A4 size. The project report should be bound using flexible cover of the thick white art paper. The cover should be printed in black letters and the text for printing should be identical.

Total number of pages should not exceed 70.

4. PREPARATION FORMAT:

Cover page & Title page-A specimen copy of the cover page &Title page of the project report are given in Appendix 1.

Bonafide Certificate –The Bonafide Certificate shall be in double line spacing using Font Style Times New Roman and Font Size 14.

The Certificate shall carry the supervisor's signature and shall be followed by the supervisor's name, academic designation (not any other responsibilities of administrative nature), department and full address of the institution where the supervisor has guided the student. The term SUPERVISOR must be typed in capital letters between the supervisor's name and academic designation.

Preface- preface should be one page synopsis of project report typed double line spacing Font Style Times New Roman and Font Size 14.

Table of contents-The table of contents should list all material it as well as any material which precedes the title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents but the page numbers of which are in lower case Roman letters. One and a half spacing should be adopted for typing the matter under this head.

List of Tables- The list should use exactly the same caption as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head. The table should be introduced in the appropriate places in the text.

List of Figures-The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head. The figures should be introduced in the appropriate places in the text.

List of Symbols, Abbreviation & Nomenclature- One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviation should be used.

Chapters-The chapters may be divided into 5 parts

1. Introduction to project
2. Literature survey
3. Method and methodology/Working/ Experimental Techniques
4. Result Analysis
5. Conclusion

1. The main text will be divided into several chapters and each chapter may be further divided into several divisions and subdivisions.
2. Each chapter should be given an appropriate title.
3. Tables and figures in the chapter should be placed in the immediate vicinity of the reference where they are cited.
4. Footnotes should be sparingly. They should be typed single space and placed directly underneath in the very Same page, which refers to the materials they annotate.

Appendices- Appendices are provided to give supplementary information, which is included in the main text may serve as a distraction and cloud the central theme

1. Appendices should be numbered using numerals, Eg. Appendix 1, Appendix2 etc.
2. Appendices tables and references appearing in the Appendices should be numbered and referred to at appropriate places just as in the case of chapters.
3. Appendices shall the title of the work reported and the same title shall be made in the contents page also.

List of references: The listing of references should be typed 4 spaces below the heading "REFERENCES "in alphabetical order in single spacing left- justified. The reference material should be listed in the alphabetical order of the first author. The name of the author / authors should be immediately followed by the year and other details.

A typical illustrative list given below relates to the citation examples coated above

REFERENCES

1. Ariponnammal, S. and Natrajan, S.(1994)'transport phenomena of SmSel – X Asx',Pramana- journal of physics vol. 42 , No.1,pp 421-425.
2. Bernard R.W and Kellogg, C. (1980)'applications of convolution operators to problems in univalent function theory ', Michigan Mach, J., Vol.27,pp.81-94 .
3. Shin, K.G.&Mckay, N.D.(1984) "Open loop minimum time control of mechanical manipulations & its applications", Proc. Amer. Contr. Conf., San Diego, C A, pp. 1231-1236.

Tables and Figures- By the word table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non- verbal materials used in the body of the project work and appendices such as charts , graphs, maps, photos& diagrams may be designated as figures .

5. TYPING INSTRUCTIONS

The impression on the typed copies should be black in colour.

One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style "Times New Roman" & Font size 14.

Book For Reference :

1. Kothari C R. *Research Methodology-Methods and Techniques*. New Delhi: New Age International Publishers. 2nd Edition 2005.

SEMESTER – III			
SELF STUDY COURSE (Optional) PHYSICS FOR LECTURESHIP II			
Code :21PPHSS1	**Hrs/Week:**	**Hrs/Semester:**	**Credits: +2**

UNIT I: Mathematical Methods of Physics

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley- Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

UNIT II: Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions-scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non- inertial frames and pseudo forces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of Relativity-Lorentz transformations, relativistic kinematics and mass–energy equivalence. Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton - Jacobi theory.

UNIT III: Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magneto statics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar

and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation-from moving charges and dipoles and retarded potentials.

UNIT IV: Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro-and macro-states. Micro- canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. First-and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation.

UNIT V: Electronics and Experimental Methods

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo-and hetero- junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics. Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting.

Book for Study:

1. Melemnganba Chenglei W. *UGC-CSIR JRF/NET Physical Science.* India: Arihant Publications. 2015.