

**GOVT. NAGARJUNA PG COLLEGE OF SCIENCE,
RAIPUR**

DEPARTMENT OF PHYSICS

SYLLABUS AND MARKING SCHEME

**M. Sc.
(IIIrd and IVth Semester System)**

2026-2027

M. Sc. (PHYSICS)
SEMESTER - III (Jul-Dec 2026)
Paper I (COURSE CODE- PHY 301)
(NUCLEAR & PARTICLE PHYSICS)

Unit	Topics
I	1.1 Nuclear Decay : Introduction, determination of q/M for particles (Rutherford and Royd's experiment), Range of particle, energy of particle, energy velocity-energy-life time relation,
	1.2 Alpha particle spectra, some decay schemes, Gamow's theory of particle, its advantages in theory of alpha decay, Geiger Nuttal law, properties of particle.
	1.3 Decay: Introduction, general theory of decay (Flat type spectrometers, Lanse type spectrometer), The neutrino hypothesis and its indirect method, Fermi theory of decay (Coulomb correction, screening by atomic electron,
	1.4 Kurie plot, mass of neutrino, Life time of decay) classification of transitions (selection rules), parity violation of decay, decay schemes of some important nuclides.
II	2.1 Nuclear Reactions and Energy: Introduction, types, Conservation laws, kinematics and general solution of the Q equation, binding energy, nuclear transformations by particles, protons, neutrons, deuterons
	2.2 particle of mass three, radiation, heavy ions with examples), nuclear cross section (partial wave analysis of reaction cross section)
	2.3 Compound Nucleus : Mechanics (formation and breakup), Energy level of nuclei and level width, De-excitation, compound nucleus cross-section (Briet Wigner dispersion formula)
	2.4 Nuclear fission and fusion : Introduction, Neutrons released in fission process; cross sections, nuclear chain reactions, nuclear reactor, four factor formula, critical size of reactor, , fusion, thermonuclear energy, prospect of controlled fusion energy.
III	3.1 Counters: Types of counter, Gas filled counter, Solid State counter, scintillation counter with their principle, working method, applications and advantages & disadvantages.
	3.2 Neutron detection :- introduction, different types, principle, experimental detail with applications.
	3.3 Accelerators : Types of accelerator, Cyclotron, linear accelerators, betatron,
	3.4 Electron synchrotron, proton synchrotron with their principle, working method and applications.
IV	4.1 Elementary Particles : Classification of elementary particles, basic particle interactions, conservation laws, invariance under parity, CP, time, CPT,
	4.2 Electron and positron, proton and antiproton, neutrino and antineutrino, mesons and hyperons: (their masses, decay modes and reactions)
	4.3 Elementary particle symmetry : unitary and eightfold way symmetries.
	4.4 Quark theory: experimental evidence, masses, numbers, mesons and baryons.

Signature of Members Board of Studies:

HOD : _____

HOD : _____

External subject Experts

Departmental Members

Student Members

1 _____ 2 _____ 3 _____
 1 _____ 2 _____ 3 _____ 4 _____ 5 _____
 6 _____ 7 _____ 8 _____ 9 _____
 1 _____ 2 _____ 3 _____

M. Sc. (PHYSICS)
SEMESTER - III (July-Dec 2020)
Paper II (COURSE CODE- PHY 302)
(STATISTICAL MECHANICS)

Unit	Topics
I	1.1 Phase space, Volume in Phase space, Boltzmann entropy relation ,Liouville's Theorem,Postulate of equal or prior probability. Different types of equilibrium(statistical, thermal, mechanical,Particle). Connection between statistical and thermodynamic quantities.
	1.2 Ensembles, Microcanonical ensemble , perfect gas in microcanonical ensemble,Gibbs paradox, partition function and its correlation with thermodynamic quantities
	1.3 Canonical ensemble as approximation to microcanonical ensemble.partition function for canonical ensemble, Thermodynamic quantities for canonical ensemble.
	1.4 Grand canonical ensemble: Partition function and thermodynamic function for grand canonical ensemble.
II	2.1 Classical Maxwell Boltzmann distribution law, Transition from classical statistical mechanics to quantum statistical mechanics, indistinguishability and quantum statistics. Bose Einstein distribution law, Fermi Dirac distribution law. Planck's radiation formula from Bose Einstein Distribution law.
	2.2 Magnetic behaviour of an ideal Fermi gas, Pauli paramagnetism, Landau diamagnetism.
	2.3 Ideal Bose Einstein gas , Gas degeneracy , Bose Einstein condensation.
	2.4 Ideal Fermi Dirac gas , Energy and pressure of the gas , case of slight degeneracy and strong degeneracy.
III	3.1 Theory of imperfect gases –Cluster expansion for a classical gas. Virial expansion of equation of state, evaluation of virial coefficients.
	3.2 Phase transition, phase transition of first and second kind,Ginzburg Landau Theory, Phase transition in ferromagnetic materials.
	3.3 The Ising model, Bragg William Approximation ; The standard mean field approximation, exact solution of Ising model in one dimensions.
	3.4 Irreversible Process: Onsager relation , Proof of Onsager Reciprocal relations.
IV	4.1 Fluctuations – Fluctuation in Energy and pressure.Probability of one dimensional random walk.
	4.2 Langevin theory of the Brownian motion. Einstein relation for mobility.
	4.3 Approach to equilibrium : Fokker Planck equation,
	4.4 Spectral analysis of fluctuations: the Wiener –Khinchine theorem

Signature of Members Board of Studies:

HOD : _____

External subject Experts

Departmental Members

Student Members

1 _____ 2 _____ 3 _____

1 _____ 2 _____ 3 _____ 4 _____ 5 _____

6 _____ 7 _____ 8 _____ 9 _____

1 _____ 2 _____ 3 _____

5

(CONDENSED MATTER PHYSICS – I)		
Unit		Topics
I	1.1	Crystalline and amorphous solids:-Unit cells and direct lattice. Bravais Lattice Types of lattice:-Two and three dimensional Bravais lattices,
	1.2	Fundamental elements of symmetry(Translation, Rotation, Reflection ,Inversion), Symmetry groups(Point Groups, space Groups) concept of point group and space groups, crystal planes and Miller indices, simple crystal structure : closed packed structures (Hexagonal closed packed Structure, Face centered cubic Structure), Loose packed Structures: (Body Centered Cubic Structure, Simple cubic Structure)
	1.3	X-Ray Diffraction(Laue's Equation, Bragg's law), Interaction of X rays, electrons and neutrons with matter, Electron Elastic scattering from an perfect lattice, Reciprocal lattice Vectors, Reciprocal lattice vectors to SC lattice, Reciprocal lattice to BCC lattice, Reciprocal lattice vectors to FCC Lattice, Properties of Reciprocal Lattice
	1.4	Brillouin Zones :- Brillouin Zone for Simple cubic lattice, Brillouin Zone for Body centered cubic lattice, Brillouin Zone for Face Centered Cubic Lattice
II	2.1	Defects or imperfections in crystals and their classification Defects : Introduction, Classification of Defects ,Point defects,
	2.2	Line Defect, Plane Defect, Schottky and Frenkel defects, vacancies, interstitial Colour center & their production:- Introduction, classification of Colour centre, Formation of F-centre, in ionic crystals, their types and production,
	2.3	Deformation (Plastic Deformation-Slip & Yield, Shear strength of Single Crystal
	2.4	line defects or Dislocations:-Introduction to Disslocation, Edge and Screw dislocations, Burger Vectors, the role of dislocations in Plastic deformation and crystal growth.
III	3.1	Electron's in a periodic lattice, The Periodic potential ,Block theorem, First Proof of Bloch theorem The Born Von Karman boundary condition, second Proof of Bloch theorem, General remarks of Bloch theorem
	3.2	Kroning-Panny model, Band theory, Origin of the energy Gap, magnitude of energy Gap, Band gap, holes . Width of bands, Constant energy curve & surfaces, Classification of solids, Distinction between metal semiconductors & insulators, effective mass, equation of motion, velocity of electron, E-K curve, k-space, negative effective mass & holes, physical interpretation of effective mass , effective mass in semiconductors,
	3.3	Tight bonding:-general formulation remarks on calculating the band Structure, cellular and pseudo potential methods,
	3.4	Fermi surface and its construction, de Haas von Alfen effect, cyclotron resonance, magnetoresistance , quantum Hall Effect, Hall coefficient , hall resistance, Bloch Wave.
IV	4.1	Magnetism, Ferromagnetism, Weiss theory of ferromagnetism, curie's temperature, Paramagnetic region nature & Origin of weiss molecular field
	4.2	Exchange interaction, Heisenberg model and molecular field theory, Curie-Weiss law for susceptibility, concept of Domains & hysteresis ,Domains, Bloch wall energy origin of domains single domain particle, magnetic bubble domain, curie temperature & suscepibility of ferrimagnets from garnets,.
	4.3	Antiferromagnetic order, Antiferromagnetic magnons, Antiferromagnetic resonance, Doman's and Block wall energy.
	4.4	Quantization of Spin waves, Neutron magnetic scattering magnons , susceptibility below Neel temperature

Signature of Members Board of Studies:

HOD :

External subject Experts:

Departmental Members

Student Members:

M. Sc. (PHYSICS)
SEMESTER - III (July-Dec 2026)
Paper IV (COURSE CODE- PHY 304)
Special Paper II (ELECTRONICS)
(Photonics & Op Amp)

Unit	Topics
I	1.1 Radiative and non-radiative transitions , Optical Absorption, bulk and thin film, photoconductive devices (LDR) , Emission spectra , Luminescent efficiency , method of excitation
	1.2 Light emitting diode (LED) : high frequency limit, effect of surface and indirect combination current , operation of LED,
	1.3 Visible LEDs and Infrared LEDs.
	1.4 Diode Laser (Condition for population inversion in active region, light confinement factor , optical gain and threshold current for lasing, Fabry-Perrot Cavity Length for lasing and the separation.
II	2.1 Photo detectors: Photoconductor, equivalent circuit of photoconductor. Solar cells, Solar radiation
	2.2 Phototransistor. Bipolar phototransistor, photo – Darlington transistor, V-I characteristic of bilateral hetero structure phototransistor,
	2.3 solar spectrum, ideal conversion efficiency, Energy band diagram of solar cell, IV characteristics of solar cell
	2.4 PN junction solar cells, Hetero junction, Interface thin film solar cells.
III	3.1 Basic Op-amp. Differential amplifier – circuit configurations, dual input, balanced output, differential amplifier –DC analysis, Ac analysis,
	3.2 inverting and non-inverting inputs, CMRR, Constant current bias level transistor. Block diagram of a typical Op-amp. Analysis,
	3.3 open loop configuration, inverting and non-inverting amplifier, Op-amp. With negative feedback, Voltage series feed back, effect of feed back on closed loop gain input persistence output , resistance bandwidth and output offset voltage , voltage follower
	3.4 Practical Op-amp. Input offset voltage, Input offset current, total output offset voltage, CMRR frequency response
IV	4.1 DC and AC amplifier - summing scaling and averaging amplifiers instrumentation amplifier, integrator and differentiator
	4.2 Oscillators - principles, oscillator types, frequency stability response, The phase shift oscillator
	4.3 Wein bridge oscillator, LC tunable oscillators – Multivibrators - Monostable and Astable
	4.4 Comparators, square wave and triangle wave generators.

Signature of Members Board of Studies:

HOD : _____

External subject Experts

Departmental Members

Student Members

1 _____ 2 _____ 3 _____
 1 _____ 2 _____ 3 _____ 4 _____ 5 _____
 6 _____ 7 _____ 8 _____ 9 _____
 1 _____ 2 _____ 3 _____

M.Sc. (PHYSICS)
SEMESTER – III Sem.(JUL - DEC 2026)
PAPER – V (COURSE CODE - 307)
SKILL ENHANCEMENT COURSE (SEC)

UNIT -1	Electricity : Basic Quantities, Circuits and the AC Supply	No. of Lectures
1.1	Basic Electrical Quantities :- Charge, Current, Voltage, Resistance, Power, Energy – SI units and everyday quantities behind them. Ohm's law.	7
1.2	The Multimeter :- The multimeter as primary instrument – voltage, current, resistance, continuity and diode test; the meter in parallel for volts and in series for amps, and the one mistake that blows its fuse.	
1.3	Resistor Networks :- Series and parallel resistance, the voltage divider, Kirchhoff's current and voltage laws.	
1.4	AC – DC Supply System :- DC vs AC, Indian supply, RMS, peak value, three-phase supply.	
UNIT -2	Electricity : Domestic Installation, Protection and Safety	
2.1	Domestic Wiring :- Domestic wiring anatomy – Phase, Neutral, Earth; switch the phase; two-way switching.	8
2.2	Earthing and Electrical Protection :- Earthing and why it exists. Protection devices – fuse, MCB, RCCB/ELCB, Isolator – what each one protects and what none of them protect. The clamp meter and earth continuity check.	
2.3	Electrical Energy :- Energy in kWh, reading the meter, computing a month's bill from an appliance list and a slab tariff.	
2.4	Electrical Shock, Rescue and First Aid :- Electric shock – the physiological effect is set by current, not voltage; the rescue sequence and first aid.	
UNIT -3	Electronics : Components, Soldering and Instruments	
3.1	Electronic Components and their Characteristics :- Resistors – types and power rating. Capacitors – Ceramic and electrolytic.	7
3.2	Diodes and Rectification :- Diodes – PN junction, LED, Zener Diode. Half wave, full wave and bridge rectification.	
3.3	Soldering Techniques and Circuit Assembly :- Soldering – Iron selection and tip care, 60/40 solder, Desoldering; breadboard, Veroboard, PCB.	
3.4	Laboratory Instruments :- The Oscilloscope, function generator and bench power supply.	
UNIT -4	Electronics : Switching, Logic and Control	
4.1	Electronic Switches :- BJT as switch, Saturation and cut-off, base	8

Aditi

Pratish

Kej

Ge

Palak

Palak

	resistor, MOSFET.	
4.2	Digital Logic and Logic Gates :- Analog vs Digital, Binary and hexadecimal counting. Gates – AND, OR, NOT, NAND, NOR, XNOR, XOR – Truth tables, TTL vs CMOS supply rules.	
4.3	The 555 Timer and Op-Amp Applications :- The 555 timer in astable and monostable mode – the RC timing equation used as a recipe, not derived; setting frequency and duty cycle by choosing R and C. The Op-Amp as a comparator – applications.	
4.4	Sensors and Actuators :- Sensors as variable resistance and voltage – LDR, Thermistor, Potentiometer, Ultrasonic module. Actuators – LED, Buzzer, Relay, DC Motor, servo – why a motor never runs straight off a logic pin.	

Laboratory Exercises :-

1. LED Flasher : To make an LED blink continuously using IC 555.
2. Burglar Alarm : To produce an alarm sound when unauthorized entry is detected.
3. Clap Switch : To switch an LED or Load ON/OFF using a clap sound.
4. Water level alarm : To produce an alarm when water reaches a certain level.
5. Police Siren : To generate a police siren like sound using IC 555.
6. Automatic Night lamp : To automatically switch ON a light in darkness.
7. Rain Alarm : To produce an alarm when rain droplets are detected.
8. Simple Timer : To generate a time delay using IC 555.

Text Book and Reference :

1. Basic Electrical Engineering – V.K. Mehta and Rohit Mehta.
2. Electronic Devices and Circuit Theory – Boylestad and Nashelsky.
3. Practical Electronics for Inventors – Scherz and Monk.

Aditi
Palak
Prakriti
Pratik
20/9/18
20/9/18
20/9/18
20/9/18
20/9/18
20/9/18

(M. Sc. (PHYSICS))
SEMESTER - IV (Jan –June 2027)
Paper I (COURSE CODE- PHY 401)
(ATOMIC AND MOLECULAR PHYSICS)

Unit	Topics
I	1.1 Atomic spectra, Bohrs postulates, Bohrs model of one electron atom: explanation of spectra of hydrogen like atom, correction of finite nuclear mass, variation in rydberg constant due to infinite nuclear mass.
	1.2 Sommerfeld quantisation rules, de Broglies interpretation of Bohr quantisation law. Bohrs correspondence principle, Sommerfelds extention of Bohrs model, sommerfeld relativistic correction.
	1.3 Orbital magnetic dipole moment: Bohrs magneton, Larmor precession, Space quantisation, electro spin, vector model of atom, coupling of orbital and spin angular momenta.
	1.4 L-S coupling, lande interval rule, determination of spectral terms for l-s coupling j-j coupling. Spectra of alkali elements: Broad feature of alkali spectra, Fine structure of alkali spectra. Intensity ratio of doublets.
II	2.1 Explation of normal zeeman effect and anomalous zeeman effect. Example of zeeman effect in some transition.
	2.2 Paschen- Back effect, weak field and strong field stark effect in Hydrogen.
	2.3 Hyperfine structure of spectral lines: Isotope effect, nuclear spin and hyperfine splitting, intensity ration and determination of nuclear spin.
	2.4 Zeeman effect of hyperfine structure, Back- Gouldsmit effect in Hyperfine struture. The breadth of spectral lines. Doppler effect.
III	3.1 Separation of electronic and nuclear motion: The Born –oppenheimer approximation. Types of molecular spectra. Types of molecular energy states and associated spectra.
	3.2 Pure rotational spectra. The molecule as a rigid rotator: Explanation of rotational spectra, The non-rigid rotator, Isotope effect on rotational spectrum.
	3.3 Vibrational- Rotational spectra, The molecule as a Harmonic oscillator, molecule as anharmonic oscillator.
	3.4 Vibration frequency and force constant for Anharmonic oscillator. Isotop effect on vibrational levels. Fine structure of infra-red boards.
IV	4.1 The Raman spectra: Classical Theory of Raman effect, quantum theory of Raman effect, Raman spectra and molecular structure.
	4.2 Electronic spectra: formation of electronic spectra, vibrational structure of electronic band system in emission. Electronic band spectra in absorption.
	4.3 Fine structure in in electronic bands, Rotational structure of Three-branch bands.
	4.4 Franck –condon principle, Quantum mechanical formulation of franck condon principle. Explanation of intensity distribution in absorption bands and emmission bands from Franck- Condon Principle.

Signature of Members Board of Studies:

HOD : _____

External subject Experts

Departmental Members

Student Members

1 _____ 2 _____ 3 _____
1 _____ 2 _____ 3 _____ 4 _____ 5 _____
6 _____ 7 _____ 8 _____ 9 _____
1 _____ 2 _____ 3 _____ Palak _____

M. Sc. (PHYSICS)
SEMESTER - IV (Jan –June 2027)
Paper II

Elective Paper (COURSE CODE- PHY 402A)
(PHYSICS OF NANOMATERIALS AND DEVICES)

UNIT	Topics
I	1.1 (PHYSICAL AND CHEMICAL PROPERTIES) Introduction: Emergence of Nanotechnology, Challenges in Nanotechnology, Nano Hazards; Societal and Ethical Implications;
	1.2 Physical Properties of Nanomaterials: Melting points and lattice constants, Mechanical properties Optical properties, Surface plasmon resonance, Quantum size effects.
	1.3 Electrical and Magnetic Properties: Surface scattering, Change of electronic structure, Quantum transport, Effect of microstructure, Ferroelectrics and dielectrics, Superparamagnetism.
	1.4 Chemical Properties : Surface Energy, Chemical Potential as a Function of Surface Curvature, Electrostatic Stabilization, Surface charge density, Electric potential at the proximity of solid surface, Van der Waals attraction potential, Interactions between two particles: DLVO theory.
II	2.1 (NANO FABRICATION TECHNIQUES) Bottom-Up and Top-Down Approaches; Lithography: Photolithography, Electron beam lithography, X-ray lithography, Focused ion beam (FIB) lithography ;
	2.2 Nanomanipulation and Nanolithography: Scanning tunneling microscopy (STM) , Atomic force microscopy (AFM) , Soft Lithography: Microcontact printing, Dip-pen nanolithography; Self Assembly of NanoMaterials,
	2.3 Semiconductor quantum dots synthesis, electronic structure and characterization, Synthesis of 1-D nanowires VLS (Vapour- Liquid –Solid)growth, and SLS (Solid – Liquid – Solid) growth.;
	2.4 Thin Films (2-D) growth by Chemical Vapor Deposition (CVD) , Atomic Layer Deposition (ALD), Langmuir-Blodgett Films, Sol-Gel Films.
III	3.1 (MATERIALS AND CHARACTERIZATION) Structural Characterization: X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning probe microscopy (SPM),
	3.2 Chemical Characterization: Optical spectroscopy, Electron spectroscopy, Ionic spectrometry
	3.3 Special Nanomaterials: Carbon fullerenes, Fullerene-derived crystals, Carbon nanotubes, ,
	3.4 Ordered and random mesoporous structures, Crystalline Microporous Materials: Zeolites, Intercalation Compounds, Types, Properties and Applications of Core – Shell Nanoparticles.
IV	4.1 (DEVICES AND APPLICATIONS) Band Gap Engineered Quantum Devices, Quantum well devices, Quantum dot devices Active Photonic Crystals and Plasmon Waveguides
	4.2 Nanobots, Catalysis by Gold Nanoparticles, Micro-fluidic Devices , Smart Passive Micro-fluidic Devices
	4.3 Lab-on-a-Chip for Biochemical Analysis, Targeted Drug Delivery mechanism, principle and working of Nano Sensors and nanobio Sensors.
	4.4 Molecular Switches and Logic Gates, Pressure Sensor, Inertial Sensor, Optical MEMS , RF MEMS, Current Challenges and Future Trends of NEMs.

Signature of Members Board of Studies:

HOD : _____

External subject Experts

Departmental Members

Student Members

1 _____ 2 _____ 3 Kal

1 Shiv 2 Pratik 3 Pratik 4 Pratik 5 _____

6 Shiv 7 Shiv 8 Shiv 9 Shiv

1 Shiv 2 Pratik 3 Pratik 4 Pratik 5 Pratik

M. Sc. (PHYSICS)
SEMESTER - IV (Jan – June 2027)
Paper II
Elective Paper (COURSE CODE- PHY 402B)
(Laser Physics and Applications)

UNIT	Topics
I	1.1 Spontaneous and stimulated emission, Einstein's quantum theory of radiation, theory of some optical processes, coherence and monochromaticity, kinetics of optical absorption,
	1.2 line broadening mechanism, Basic principle of lasers, population inversion, laser pumping,
	1.3 two & three level laser systems,
	1.4 resonator, Q-factor, losses in cavity, threshold condition, quantum yield
II	2.1 Solid state lasers- the ruby laser, Nd:YAG laser, ND: Glass laser,
	2.2 semiconductor lasers – features of semiconductor lasers, intrinsic semiconductor lasers,
	2.3 Gas laser -neutral atom gas laser, He-Ne laser, molecular gas lasers, CO2 laser
	2.4 Liquid lasers, dye lasers and chemical laser,
III	3.1 Production of giant pulse -Q-switching, giant pulse dynamics,
	3.2 laser amplifiers, mode locking and pulling,
	3.3 Non-linear optics, Harmonic generation, second harmonic generation, Phase matching,
	3.4 Third harmonic generation, optical mixing, parametric generation and self-focusing of light.
IV	4.1 Multi-photon processes; multi-quantum photoelectric effect, Theory of two-photon process, three- photon process.
	4.2 second harmonic generation, parametric generation of light,
	4.3 Laser spectroscopy : Rayleigh and Raman scattering, Stimulated Raman effect,
	4.4 Hyper-Raman effect, Coherent anti-stokes Raman Scattering, Photo-acoustic Raman spectroscopy

Signature of Members Board of Studies:

HOD :

External subject Experts

Departmental Members

Student Members

1 2 3
1 2 4 5
6 7 8 9
1 2 3

M. Sc. (PHYSICS)
SEMESTER - IV (Jan -June 2027)
Paper II
Elective Paper (COURSE CODE- PHY 402C)
(Characterization of Materials)

Unit	Topic
I	1.1 Thermal Analysis- Introduction-thermogravimetric analysis (TGA), instrumentation, determination of weightloss and decomposition products,
	1.2 Differential thermal analysis (DTA), and cooling curves,
	1.3 Differential scanning calorimetry (DSC), instrumentation, specific heat capacity measurements,
	1.4 Determination of thermomechanical parameters and determination of phase transitions.
II	2.1 Structural Analysis-X-rays Diffraction, Bragg's law, reciprocal lattice concept, Laue diffraction,
	2.2 Interpretation of diffraction patterns, cell parameter determination, Powder diffraction: Debye-Scherrer method, uses,
	2.3 SEM, FESEM, EDX, TEM: working principle and Instrumentation, sample preparation, scanning probe microscopy,
	2.4 STM, AFM, working principle, Instrumentation and modes of operation.
III	3.1 Optical Characterization-Photoluminescence (PL), classification of photoluminescence, matter interaction, instrumentation,
	3.2 Electroluminescence (EL), instrumentation, applications,
	3.3 Thermoluminescence (TL): models, mechanism, methods of analysis: heating rate method, half width method, initial rise method and applications,
	3.4 Mechanoluminescence (ML) characteristics.
IV	4.1 Spectroscopy Techniques-Introduction, regions of spectrum, characterization of electromagnetic radiations,
	4.2 Quantization of energy, Principles and instrumentation for UV-visible spectroscopy,
	4.3 IR, FTIR spectroscopy, Raman spectroscopy,
	4.4 ESR, NMR and proton induced X-ray Emission spectroscopy (PIXE), applications, and spectroscopy.

Signature of Members Board of Studies:

HOD : _____

External subject Experts

Departmental Members

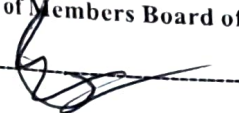
Student Members

1 _____ 2 _____ 3 _____
 1 _____ 2 _____ 3 _____
 4 _____ 5 _____
 6 _____ 7 _____ 8 _____ 9 _____
 1 _____ 2 _____ 3 _____
 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ 9 _____

M. Sc. (PHYSICS)
SEMESTER - IV (Jan-June 2027)
Paper III (COURSE CODE- PHY 403)
Special Paper III
(CONDENSED MATTER PHYSICS - II)

UNIT	Topics
I	1.1 Superconductivity, critical temperature, persistent current, Destruction of Superconductivity by magnetic Field,
	1.2 Meissner effect, heat capacity, Isotopic effect, and flux penetration, type I and type II superconductors, single particle tunneling,
	1.3 thermodynamics of superconducting transitions, London's equations, Coherence length Interaction of electrons with acoustic and optical phonon, Cooper pairing due to phonons, BCS theory of superconductivity (qualitative). Flux quantization in superconducting ring.
	1.4 Manifestation of energy gap in superconductors, superconducting tunneling, A.C./D.C. Josephson effect, Microscopic quantum interference, high temperature superconductivity (elementary).
II	2.1 Polarization, depolarization field, local electric field at an atom, Lorenz field, dielectric constant and polarizability,
	2.2 Electronic polarizability, Ionic and orientational polarizability. Debye equation for gases, the complex dielectric constant, dielectric relaxation time,
	2.3 Normal and anomalous dispersion, classical theory of electronic polarizability.
	2.4 Ferro electric crystal, classification, ferro-electric domains, structural phase transition, Landau theory of phase transition, first and second order phase transition, anti Ferro electricity
III	3.1 Energy bands in semiconductor, Intrinsic and Extrinsic semiconductors
	3.2 Drift velocity, mobility, carrier concentration and Fermi level for intrinsic and extrinsic semiconductors
	3.3 Electrical conductivity of semiconductors, semimetals.
	3.4 P-N junction, junction transistors, The tunnel diode, Zener diode, Gunn diode, photovoltaic effect, Quantum wells and super lattices.
IV	4.1 Interatomic forces and lattice dynamics of simple metals
	4.2 ionic and covalent crystals, lattice dynamics of linear monoatomic and diatomic lattices, optical and acoustical modes.
	4.3 Quantization of elastic waves, phonons, momentum of phonons, inelastic neutron scattering by phonons,
	4.4 Anharmonicity, thermal expansion, lattice thermal conductivity

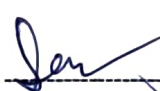
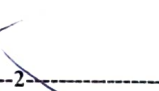
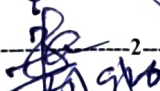
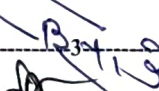
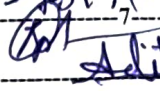
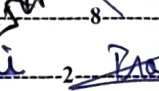
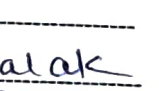
Signature of Members Board of Studies:

HOD : 

External subject Experts

Departmental Members

Student Members

1  2  3 
 1  2  3  4  5 
 6  7  8  9 
 1  2  3  4 

M. Sc. (PHYSICS)
SEMESTER - IV (Jan - June 2027)
Paper IV (COURSE CODE- PHY 404)

Special Paper IV
(Microprocessor and Communication)

UNIT	Topics
I	1.1 Microprocessor & Micro Computers : Evolution of Microprocessor, Internal Microprocessor, Architecture, Architecture of digital Computer
	1.2 Memory : - Semiconductor memories (RAM, ROM, PROM, EPROM, Shift register).
	1.3 Magnetic Memory: - Floppy disks, Hard disks, Optical Disks, Magnetic Bubble Memory.
	1.4 Networking : Types of network, Design features of a communication network ,Examples, TYMNET, ARPANET, ISDN, LAN , LAN topology (Bus, Star, Ring) .
II	2.1 Intel 8085 : ALU, Timing and Control Unit, Registers, Data and Address Bus, Pin Configuration. Instruction Cycle : Op-code and Operands, Fetch Operation, Execute Operation, Machine Cycle, Instruction and Data flow.
	2.2 Time Diagram : Opcode Fetch Cycle, Memory read, I/O Read, Memory write, I/O Write.
	2.3 Addressing Modes : Direct Addressing, Register addressing, Register Indirect Addressing, Immediate Addressing, Implicit Addressing. Instruction set of 8085 : Data transfer group, Arithmetic group, Logical group.
	2.4 Assembly Language Programs: Addition of Two 8-bit number, Sum 8-bit . Addition of Two 8-bit number, sum 16-bit, 8-bit subtraction, Find the largest number in a data array, To arrange a series of numbers in Descending order, Find the smallest number in a data array, To arrange a data array in ascending order,.
III	3.1 Digital Communications Pulse modulation system: Sampling theorem- Low pass and Band pass signals, PAM, Channel BW for a PAM signal
	3.2 Natural sampling. Flat top smapling. Signal recovery through Holding. Quantization of signals,
	3.3 Quantization, Differential PCM, Delta Modulation, Adaptive Delta Modulation, CVSD
	3.4 Digital Modulation Techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK
IV	4.1 Optical Fibers: Introduction, Structure, Classification, Refraction and Snell's law, Total internal refraction,
	4.2 Light propagation through and optical fiber, Acceptance angle for incident ray, Numerical Aperture, number of modes and cut-off parameter,
	4.3 single mode propagation, comparison of step and graded index fiber. Types of Optical Fiber : HPSUU, HPSIR, Halide fiber
	4.4 Optical fiber cables : Multifibre cable, Splicing and connectors. Advantage and Disadvantage of optical fiber.

Signature of Members Board of Studies:

BOD: _____

External subject Experts

Departmental Members

Student Members

1. _____ 2. _____ 3. _____

1. _____ 2. _____ 3. _____ 4. _____ 5. _____

6. _____ 7. _____ 8. _____ 9. _____

1. Additi 2. Prakriti 3. Palak