MANONMANIAM SUNDARANAR UNIVERSITY -TIRUNELVELI
PG PROGRAMMES

OPEN AND DISTANCE LEARNING (ODL) PROGRAMMES

(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023–2024)

M.Sc. Physics

Semester	Course	Title of the Course	Course Code
II	Core IV	Statistical Mechanics	SPHM21
	Core V	Quantum Mechanics – I	SPHM22
	Core VI	Practical - II	SPHP23
	Elective - III	Advanced Optics	SPHE21
	Elective – IV	Sewage and Waste Water Treatment and Reuse	SPHE22
	Skill Enhancement	Physics for Competitive Examinations	SPHS21

STATISTICAL MECHANICS

UNIT	DETAILS
I	**PHASE TRANSITIONS**: Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters – Landau's theory of phase transition-Critical indices-Scale transformations and dimensional Analysis.
II	**STATISTICAL MECHANICS AND THERMODYNAMICS**: Foundations of statistical mechanics - Specification of states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an idealgas using the micro canonicalensemble - Entropyo fmixing and Gibb's paradox.
III	**CANONICALAND GRAND CANONICAL ENSEMBLES**: Trajectories and density of states - Lowville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.
IV	**CLASSICALAND QUANTUM STATISTICS**: Density matrix - Statistics of ensembles - Statistics of indistinguishable particles-Maxwell-Boltzmann statistics -Fermi-Dirac statistics – Ideal Fermi gas–Degeneracy-Bose-Einstein statistics-Plank radiation Formula-Ideal Bose gas-Bose-Einstein condensation.
V	**LOW TEMPERATURE**, **ISINGMODEL AND FLUCTUATIONS:** Production of Low Temperature – Measurement of Low temperature - Ising model - Mean-field theories of the Ising model in two and one dimensions - Fluctuations and transport phenomena - Brownianmotion-Langevin'stheory-Fluctuation-dissipationtheorem-The Fokker-Planck equation
VI	**PROFESSIONAL COMPONENTS :** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
Recommended Text	
1	Dr.S.L.Gupta and Dr.V.Kumar, 2008, Elementary Statistical *Mechanics*, 22nd Edition, Pragati Prakashan, Meerut.
2	S.K.Sinha, 1990, Statistical *Mechanics*, TataMcGrawHill, New Delhi.
3	B.K.AgarwalandM.Eisner, 1998, StatisticalMechanics, Second Edition New Age International, New Delhi.
4	J.K.Bhattacharjee,1996,*StatisticalMechanics*:AnIntroductoryText, Allied Publication, New Delhi.
5	F.Reif,1965,*Fundamentalsof StatisticalandThermalPhysics*,McGraw -Hill, NewYork
6	M.K.Zemansky, 1968, HeatandThermodynamics, 5thedition, McGraw- Hill New York.

QUANTUMMECHANICS – I

UNIT	Course Details
I	**BASIC FORMALISM** :Wave Mechanical Concepts: Wave packet - Time dependent Schrodinger equation –Interpretation of the wave function –Ehrenfest's theorem-Time independent Schrodinger equation-Stationary states—Linear vector space Linear operator–Eigen functions and Eigen Values – Hermitian Operator Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation.
II	**GENERAL FORMALISM**: Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation –Momentum representation – Symmetries and conservation laws: Conservation of linear momentum, Energy and Angular momentum–Parity conservation and time reversal.
III	**ONE DIMENSIONAL AND THREE- DIMENSIONAL ENERGYEIGEN VALUE PROBLEMS**: Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-Penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles –Rigid rotator– Hydrogen atom.
IV	**APPROXIMATION METHODS :** Time independent perturbation theory: on-degenerate energy levels – Ground state of Helium atom – First order Stark effect in Hydrogen atom – Degenerate energy levels - Excited state of Hydrogen atom - WKB approximation–Connection formulae(no derivation)–Application of WKB method: Barrier penetration–Alpha emission.
V	**ANGULAR MOMENTUM:** The Eigen value spectrum– Ladder operators – Matrix representation of J – Spin angular momentum – Addition of angular momenta – CG Coefficients –Angularmomentumcommutationrelations–EigenvaluesofJ^{2}andJ$_z$-Spinangular momentum-Pauli's exclusion principle.
VI	**PROFESSIONAL COMPONENTS ;** Expert Lectures, Online Seminars - Webinars on Industrial Interactions / Visits, Competitive Examinations, Employableand Communication Skill Enhancement, Social Accountability and Patriotism
Recommended Text	
1	P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2ndedition (37th Reprint), Tata McGraw-Hill, New Delhi, 2010.
2	G.Aruldhas, QuantumMechanics, 2ndedition, PrenticeHallof India, New Delhi, 2009.
3	David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
4	SLGupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.
5	A.GhatakandS.Lokanathan, QuantumMechanics: Theoryand Applications, 4thEdition, Macmillan, India, 1984.

PRACTICAL II
Course Details

(Choose any SIX experiments from Part A and SIX from Part B)

PART A

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Study the beam divergence, spot size and intensity profile of Diode/He-Nelaser.
4. B-H curve using CRO
5. Measurement of Magnetic Susceptibility - Guoy's method
6. Arc spectrum: Copper
7. Miscibility measurements using ultrasonic diffraction method
8. Determination of Thickness of thin film.- Michelson Interferometer
9. Determination of Refractive index of liquids using diode Laser/He–Ne Laser
10. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
11. Hall Effect in Semi conductor. Determine the Hall coefficient, carrier concentration and carrier mobility.
12. Interpretation of vibrational spectra of a given material
13. Measurement of dielectric constant of liquids– LCR circuit.
14. Equipotential lines of different shapes.

PART B

1. Determination of I-V Characteristics and efficiency of solar cell.
2. IC7490 as scalar and seven segment display using IC7447
3. Solving simultaneous equations – IC741 / ICLM324
4. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Butter worth filter
5. Construction of Current to Voltage and Voltage to Current Conversion using IC741
6. Realization of analog to digital converter (ADC) using4-bit DAC and synchronous counter IC74193
7. Construction of square wave generator using IC555 – Study of VCO
8. Construction of Schmidt trigger circuit using IC555 fore given hysteresis – Application as squarer
9. Construction of pulse generator using the IC555–Applicationas frequency divider
10. BCD to Excess -3 and Excess 3 to BCD code conversion
11. Study of binary up / down counters - IC 7476 /IC7473
12. Shift register and Ring counter and Johns on counter- IC7476/IC7474
13. Construction of Multiplexer and Demultiplexer using ICs.
14. Construction of series voltage regulator.

Recommended Text

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Kit Developed for doing experiments in Physics-Instruction manual, R.Srinivasan K.R Premolar, Indian Academy of Sciences.
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K A Navas, Rajath Publishing
5. Electronic lab manual Vol II, K A Navas, PHI eastern Economy Edition

ADVANCED OPTICS

UNITS	DETAILS
I	**POLARIZATION AND DOUBLE REFRACTION**: Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light –Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light : Quarter and half wave plates – Analysis of Polarized light–Optical activity
II	**LASERS**: Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Rubylaser – Nd : YAG laser – gas lasers –He-Nelaser–CO_2laser–Chemicallasers–HCllaser– Semiconductor laser.
III	**FIBEROPTICS**: Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers –Ray dispersion in multimode step index fibers –Parabolic- index fibers – Fiber-optic sensors: precision displacement sensor– Precision vibration sensor
IV	**NON-LINEAR OPTICS**: Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light.
V	**MAGNETO- OPTICS AND ELECTRO-OPTICS:** Magneto - optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect – Voigt effect – Cotton-mouton effect – Kerr magneto- optic effect – Electro-optical effects – Stark effect – Inverse stark effect – Electric double refraction – Kerrelectro – optic effect–Pockelselectro-optic effect.
VI	**PROFESSIONAL COMPONENTS :** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.
Recommended Text	
1	B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2	Ajoy Ghatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3	WilliamT.Silfvast,1996,Laser Fundamentals Cambridge University Press, New York
4	J. Peatros, Physics of Light and Optics, a good (and free!) electronic book.
5	B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley- Inter science,

SEWAGE AND WASTE WATER TREATMENT AND REUSE

UNITS	DETAILS
I	**RECOVERY & REUSE OF WATER:** Recovery & Reuse of water from Sewage and Waste water: Methods of recovery: Flocculation - Sedimentation - sedimentation with coagulation - Filtration - sand filters - pressure filters - horizontal filters - vector control measures in industries-chemical and biological methods of vector eradication.
II	**DISINFECTION:** Introduction to disinfection and sterilization: Disinfectant -UV radiation - Chlorination - Antisepsis - Sterilant - Aseptic and sterile - Bacteriostatic and Bactericidal - factors affecting disinfection.
III	**CHEMICAL DISINFECTION:** Introduction - Theory of Chemical Disinfection - Chlorination Other Chemical Methods - Chemical Disinfection Treatments Requiring - Electricity - Coagulation/Flocculation Agents as Pretreatment - Disinfection By-Products(DBPs)
IV	**PHYSICAL DISINFECTION:** Introduction - Ultraviolet Radiation - Solar Disinfection - Heat Treatment - Filtration Methods -Distillation - Electro chemical Oxidation Water Disinfection by Microwave Heating.
V	**INDUSTRIAL VISIT:** –data collection and analysis- presentation
VI	**PROFESSIONAL COMPONENTS** : Expert Lectures, Online Seminars – Webinars on Industrial Interactions / Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
Recommended Text	
1	Drinking water and disinfection technique, Anirudhha Balachandra. CRC press (2013)
2	Design of Water and Wastewater Treatment Systems (CV-424/434), Shashi Bushan,(2015) Jain Bros
3	Integrated Water Resources Management, Sarbhukan MM,CBS PUBLICATION (2013)
4	C.S.Rao, Environmental Pollution Control Engineering, New Age International, 2007
5	S.P. Mahajan, Pollution control in process industries, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.

PHYSICS FOR COMPETITIVE EXAMINATIONS

UNIT	DETAILS
I	**GENERAL MECHANICSAND PROPERTIES OF MATTER**: Physical quantities - SI system of units - dimensions - scalars and vectors (Concepts) - Newton's equations of motion - impulse - principle of conservation of linear momentum - projectile motion - Kepler's laws - Newton's law of gravitation –acceleration due to gravity-escape velocity- angular momentum- banking of roads-simple harmonic motion-viscosity-surface Tension.
II	**HEATAND THERMODYNAMI CS**: Different scales of temperatures - thermal expansions - calorimetry - specific heat - latent heat - triple point - transmission of heat - heat conductivity - Black body radiation - Stefan Boltzmann law - Wien's displacement law – Gas equation - Boyle's law-Charle's law-Law of Equipartition of energy.
III	**LIGHTAND SOUND**: Reflection and refraction - Snell's law - total internal reflection - polarization - Brewster's Law - Huygen's principle – Young's double slit interference and single slit diffraction - longitudinal and transverse waves - velocity of sound - Newton's formula, Laplace correction, effects of pressure-beats-laws of vibrating strings – open and closed organ pipes-resonance.
IV	**ELECTRICITY AND MAGNETISM**: Coulomb's Law-Electric field due to charged particles: appoint charge, a dipole, a line of charge-electric flux - Gauss' law and applications – Biot Savart law, magnetic field due to a current in : a long straight wire, a circular arc of wire-Ampere's Law-magnetic field outside and inside a long straight wire-solenoids and to roids - Faraday's laws and Lenz's law
V	**MODERN PHYSICS** : Postulates of Einstein's theory of relativity - Galilean and Lorentz transformation - time dilation - length contraction - Planck's radiation - photoelectric effect - Compton shift, matter waves - Bohr's atomic theory. Nuclear properties-binding energy and mass defect-radioactive decay-Alpha decay, beta decay and gamma decay – Radioactive dating.
VI	**PROFESSIONAL COMPONENTS** : Expert Lectures, Online Seminars - Webinars on Industrial Interactions / Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
Recommended Text	
1	J. Walker, D. Halliday, R. Resnick, Fundamentals of Physics, 10th Edition, Wiley, United states of America, 2007
2	H.C Verma, Concept of Physics, (Volume I), 1st Edition, Bharati Bhawan Publishers & Distributors, New Delhi, 2008.
3	H.C Verma, Concept of Physics, (Volume II), 1st Edition, Bharati Bhawan Publishers & Distributors, New Delhi, 2008.