SYLLABUS

MANONMANIAM SUNDARANAR UNIVERISTY, TIRUNELVELI-12

PG COURSES – AFFILIATED COLLEGES

M.Sc. PHYSICS

(Choice Based Credit System)
(with effect from the academic year 2021-2022 onwards)

Semester-I				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
III	Core	Mathematical Physics-II	ZPHM21	4
III	Core	Electromagnetic Theory	ZPHM22	4
III	Core	Microprocessor 8085 & Microcontroller 8051	ZPHM23	4
III	Core	Statistical Mechanics	ZPHM24	4
III	FW/ST	Field Work / Study Tour	ZPHT21	2
III	Practical	General Physics Experiments-II	ZPHL21	3
III	Practical	Electronic Experiments - II	ZPHL22	3

MATHEMATICAL PHYSICS – II

Preamble:

This course introduces knowledge about matrix formulation, applicative knowledge of complex numbers and special functions. It also gives basic idea of fourier series, Laplace transform and group theory

Unit1:

Matrices

Introduction to Matrix – Special types of matrices – transpose – conjugate – transposed conjugate – symmetric and antisymmetric matrices – Hermitian and skew Hermitian matrices – determinant – adjoint – orthogonal and unitary matrices – inverse of a matrix – Rank of matrix and some of its theorems – Cramer's rule – Characteristic equation – Cayley Hamilton theorem and related problems – Eigen values and eigenvectors of a matrix – Diagonalization of Matrices - Solving differential equations.

Unit II:

Complex Analysis

Introduction – Some definitions – Functions of complex variable – Limit, continuity and differentiability – Analytic function – Cauchy-Riemann differential equation – Harmonic functions – line integrals – Cauchy's integral theorem – Cauchy's integral formula – derivatives of an analytic function – Taylor's theorem – Laurent's theorem – Residues and their evaluations – Cauchy's residue theorem – evaluation of definite integrals – definite integrals of trigonometric functions of $\cos\theta$ and $\sin\theta$ – certain improper real integrals.

Unit III:

Special functions – II

Bessel differential equation and solution – Bessel functions of first and second kind – Limiting values of Jn(x) and Yn(x)– Evaluation of Jn(x) for various n values– recurrence relations – generating function – Orthogonal property – Modified Bessel functions – Spherical Bessel functions and its orthogonal property – Hermite differential equation and solution – Hermite polynomials – Rodrigue's formula – recurrence formula – Orthogonal property of Hermite polynomials.

Unit 1V:

Fourier series, Fourier Transform and Laplace's transform

Introduction – Fourier series – Related problems and uses – Fourier transform –

properties of Fourier's transform – Fourier transform of a derivative – Fourier sine and cosine transforms of derivatives – Laplace transform (LT) – properties of LT – LT of derivative and integral of a function – LT of periodic function – inverse LT – properties of inverse LT – application of LT to electrical circuits.

Unit V:

Group Theory

Basic definition of group – Multiplication table – Subgroups, cosets and classes –Point groups and space groups – Homomorphism and Isomorphism – Reducible and Irreducible representations – Theorems on representation – Schur's lemma I and II – Thegreat Orthogonality Theorem – Character table – Construction of character tables for C2V and C3Vgroups–Rotation groups SO(2) and SO(3) – Special Unitary group SU(2).

Books for study:

1. Mathematical Physics, Satya Prakash, Sultan Chand & Sons, Reprint (2006).
2. Mathematical Physics, B. D. Gupta, Vikas Publishing House Pvt. Ltd., Reprint (2013).

Books for Reference:

1. Mathematical Physics, S. L. Kakaniand C. Hemarajini, II Edition, CBS Publishers and Distributers Pvt. Ltd., (2010).
2. Elements of group theory for Physicists, A. W. Joshi, 3rd Edition, Wiley Eastern Ltd., (1988).
3. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, Wiley, (2014).
4. Essential Mathematical Methods for Physicists, George B. Arfken, Hanes J. Weber, Frank E. Harris, 7th Edition, Elsevier (2012).
5. Mathematical Physics, H. K. Dassand R.Verma, S. Chand & Co Pvt. Ltd. (1997).
6. Vector Spaces and Matrices in Physics, M. L. Jain, Alpha Science International (2001).
7. Special Functions for Scientists and Engineers, W.W. Bell, Dover Publications (2004).

Online References:

1. https://youtu.be/yimILa0m008
2. https://youtu.be/qTDDFMAt7j4
3. https://youtu.be/DotPCf6srlk
4. https://youtu.be/7UvtU75NXTg
5. https://youtu.be/JYxNC5DgdXc

ELECTROMAGNETIC THEORY

Preamble:

The scope of this course is to understand the connection between the electric and magnetic force fields thereby gaining knowledge about the applications of Maxwell's equations in electromagnetic wave propagation and electromagnetic radiation.

Unit I:

Electrostatics

Coulomb's law–Gauss law and its applications –Poisson's equation and Laplace's equation – work done to move a point charge – energy of a point charge and continuous charge distribution – method of images – electric field in dielectric materials – induced dipoles and polarizability – susceptibility, permittivity and dielectric constant of linear dielectrics –Boundary value problems with linear dielectrics.

Unit II:

Magneto statics

Lorentz force law – Biot - savart's law and Ampere's law – magnetic vector potential Multipole expansion of the vector potential – Effects of a magnetic field on atomic orbits – magnetization – bound currents and its physical interpretation – magnetic field inside matter – Ampere's law in magnetized materials -a deceptive parallel – boundary conditions– magnetic susceptibility and permeability in linear and non-linear media.

Unit III:

Electrodynamics

Electromagnetic induction – Faraday's law – induced electric field – Neumann formula –Energy in magnetic fields - Maxwell's equation – differential and integral form – Boundary conditions on field vectors D, E, B and H – the continuity equation - Poynting's theorem–Maxwell's stress tensor – Conservation of momentum.

Unit IV:

Electromagnetic waves

The wave equation – sinusoidal waves – polarization - wave equation for E and B –monochromatic plane waves – energy and momentum in electromagnetic waves – propagation in linear media – reflection and transmission at normal and oblique incidence – electromagnetic waves in conductors – reflection at conducting surface –

frequency dependence of permittivity – waveguides –TE waves in rectangular wave guides–coaxial transmission line.

Unit V:

Potentials, fields and radiation

Scalar and Vector Potentials – Gauge Transformations –Lorentz and Coulomb Gauge – Retarded potential – Lienard – Wiechert potentials – What is radiation? - Electric dipole radiation – magnetic dipole radiation – power radiated by a point charge – Larmor formula and Lienard's generalization.

Book for Study:

1. Introduction to Electrodynamics, David J Griffiths. Prentice Hall of India. IV Edition, 2014.

Books for Reference:

1) Classical electrodynamics, J. D. Jackson.,Wiley Eastern Publication. II
2) edition, 1975.
3) Foundations of electromagnetic theory, J. R. Reitz, E. J. Milford and R. W. Christy, Addison– Wesley publishing company, II edition, 2008.
4) Electromagnetic fields and waves, P. Lorrain and D. Corson, CBS Publishers and distributors, II edition, 1986.
5) Electromagnetics, B. B. Laud, New Age International Pvt. Ltd. 1987.
6) Electromagnetic Waves and Radiating Systems, E. C. Jordon and K. G. Balmain, II edition, Prentice Hall of India, 1998.

Related online resources:

1. https://nptel.ac.in/courses/115/101/115101005/#https://nptel.ac.in/courses/108/104/108104087/
2. https://nptel.ac.in/courses/115/104/115104088/https://nptel.ac.in/courses/117/103/117103065/

MICROPROCESSOR 085 AND MICROCONTROLLER 8051

Preamble:

This course imparts knowledge about basics about Microcomputers, microprocessors architecture, instruction set with timing cycle by executing simple programs, with peripheral interfacing and microcontrollers.

Unit I:

Introduction to 8085

Introduction to Microcomputers, microcomputer organization - assembly, machine and high level languages. Microprocessor 8085 - Pin diagram and description - Bus System, Control Signals, Status Signals- Clock System - Latching of Address Bus - Interrupt System - Direct Memory Access - Internal architecture - ALU- Registers organization -Special Purpose Registers and Counters - Flags –Program Status Word.

Unit II:

Programming 8085

Assembly Language Programming - Assembler - Instruction Format of 8085- Instruction Set – Addressing Modes - Instruction Cycle, Machine Cycle and T-Slates - Timing Diagram of Read, Write machine Cycles and some basic Instructions – 8 bit and 16 bit addition and subtraction – Loops and Branching - Multiplication and Division in 8085 - Searching and Sorting - Finding smallest/biggest number in an array –Time delay calculation – Stack and Subroutines – Software Interrupts and ISR- Data Transfer Schemes.

Unit III:

Interfacing and peripheral devices

Address Space of 8085- Address space partition- Memory Interfacing - Memory map and Address decoding- Interfacing of RAM (2K x 8 & 4K x 8) and ROM (2R x 8 & 4K x 8) - I/O mapped I/O and Memory Mapped I/O interfacing Schemes – Ports – Interfacing chips: Non programmable Port 8212 – Programmable Peripheral Interface (PPI) 8255 architecture, Control Signals and operating Modes – Programmable Interval Timer (PIT) 8253.

Unit IV:

Microcontroller 8051

Introduction - Comparison of Microcontroller & Microprocessor - Pin Diagram

and description – Block Diagram of 8051 and Internal Architecture - Clocks - Registers- Flags Internal Memory, SFR and I/O Ports -External Memory and decoding- Instruction Set and Addressing Modes of 8051- Features available in 8051: Timer and Counters, Timer Modes Serial Port and Serial Data Transfer.

Unit V:

Microprocessor based system design and Applications

Design considerations - Sensors and Transducers - Sample and Hold Circuits- Interfacing Keyboard and multiplexed seven segment displays - DAC and ADC interfacing - Square, Rectangular and Ramp Wave Generation- Temperature measurement and control -Digital Clock-Stepper Motor Control.

Books for Study:

1) Fundamentals of Microprocessor and Microcontrollers by B. Ram - Dhanpat Rai Publications, 5thEdition.
2) Microprocessor and microcontroller system (First Edition) by Godse and Godse, TechnicalPublication, Pune.
3) The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2nd Ed. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. Mc Kinlay, Pearson India.

Books for Reference:

1) Microprocessor Architecture, Programming and Applications with the 8085, Ramesh S. Gaonkar -4th Ed. Penram International.
2) The 8051Microcontroller Architecture, Programming and Applications – Kenneth J. Ayala –Penram International Publishing.

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_ee18/preview
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee42/
3. http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html
4. https://www.digimat.in/nptel/courses/video/108105102/L01.html

STATISTICAL MECHANICS

Preamble:

The basic concepts involved in statistical mechanics, classical and quantum statistics, applications of quantum statistics, phase transition in certain physical problems is expected to study. The theory of statistics and quantum ideas are prerequisites. Postulates of quantum mechanics, Maxwell Boltzmann distribution law, theory and applications of quantum statistics are studied.

Unit 1:

Basic concepts

Phase space - Phase space diagram of an oscillator - Volume in phase space - Ensemble –Micro canonical ensemble - Canonical ensemble - Grand canonical ensemble - Density of distribution in phase space -Liouvilles theorem - Postulate of equal a priori probability - statistical, mechanical, thermal and particle equilibrium - Connection between statistical and thermodynamics quantities.

Unit 2:

M-B Distribution law

Microstates and Macrostates - Stirling's approximation - Thermodynamic probability - General statistical distribution law - Classical Maxwell Boltzmann distribution law - Evaluation of constants in the Maxwell Boltzmann distribution law - Maxwell's law of distribution of velocities- Principle of equipartition of energy - Boltzmann entropy relation- Probability of magnetic moment distribution of independent atoms.

Unit 3:

Quantum Statistics

Postulatory foundations of quantum mechanics - Transition from classical statistical mechanics to quantum statistical mechanics - Indistinguishability and quantum statistics -Exchange symmetry of wave functions- Bose Einstein statistics, Fermi Dirac statistics, Maxwell Boltzmann statistics results of three statistics - Thermodynamics interpretation of the parameters and - Black body radiation and the Planck radiation law.

Unit 4:

Applications of Quantum Statistics

Specific heat of solids - Dulong and Petit’s law –Einstein theory of specific heat of solid - Debye theory of specific heat of solid - Criticism of the Debye’s theory - Ideal Bose Einstein gas- Energy and Pressure of the gas - Gas degeneracy -

Bose-Einstein condensation- Thermal properties of Bose Einstein gas- Ideal Fermi Dirac gas – Energy and pressure of the gas -Thermodynamics functions of degenerate Fermi Dirac gas.

Unit 5:

Phase Transition and low temperature

Phase transition - Phase transitions of first and second kind- Critical exponent - One dimensional Ising model - Production of low temperature - Measurement of low temperature.

Book for Study:

1) Elementary Statistical Mechanics Dr. S.L. Gupta and Dr. V. Kumar, Pragati Prakashan, Meerut 22nd Edition 2008.

Books for Reference:

1. Fundamentals of statistical mechanics B. B. Laud New Age International Publishers 2005
2. An Introductory course of Statistical Mechanics Palash B. Pal Narosa First reprint 2009
3. Statistical Mechanics by Kerson Huang
4. Statistical Mechanics by Sears and Salinger.

Related online resources:

1. Phase space: https://youtu.be/emte489vQfg
2. Phase transition: https://youtu.be/WPYlC_StUOQ

FIELD WORK / STUDY TOUR

Field Work / Study Tour

GENERAL PHYSICS EXPERIMENTS – II

Any FIVE Experiments

1. Hyperbolic fringes

Determination of Young's modulus, Bulk modulus, Rigidity modulus, poisson's ratio and compressibility of the given material by forming Hyperbolic fringes.

2. Ultrasonic Interferometer

Determination of velocity of ultrasonic sound in the given liquid and compressibility of the liquid.

3. Young's Double Slit

Determination of wave length of the light source or width of the double slit using LASER source for

a) standard kit b) lab/custom made double slit

4. Mutual Inductance

Determination of mutual inductance between a pair of coils. Study of variation of mutual inductance for various distances and angles between the coils and determination of coefficient of coupling in each case. Graphical determination of break in coupling for distance and angle.

5. XRD -Crystallographic Parameters

a) Braggs' Law of Diffraction - derivation,
b) Definition of Crystallographic Parameters – d - Spacing and lattice parameters.
c) Relation between d - Spacing and lattice parameters in cubic and hexagonal crystal systems.
d) Crystal parameters for the given XRD spectra (cubic and hexagonal)

6. Optical Fibre Characteristics

Determination of

a. Numerical aperture and acceptance angle
b. Attenuation in the fibre and
c. Loss due to air gaps and coupling.

7. Temperature co-efficient of a forward biased diode

Measure the resistance of a forward biased diode at different temperatures and hence find the temperature co-efficient. Plot the necessary graph for the determination of band gap energy.

ELECTRONICS EXPERIMENTS – II

Any FIVE Experiments

1. Filters

Design and construction of II order Active Filters (Low pass, High Pass and band pass) using IC 741 for a particular frequency -Draw frequency response curve for each case.

2. UJT Characteristics and Relaxation Oscillator

Characteristics study of UJT -construction of a relaxation Oscillator using UJT to produce the saw tooth wave. Frequency response of the output for various R and C values.

3. Phase Shift and Phase Shift Circuit

Design a Phase shifter circuit using Op-Amp -Measurement of the Phase shift of the input wave for various R and C combinations -Comparison of the experimental output with theoretical values.

4. Digital to Analog Conversion

Construction of Weighted Resistor and R-2R Ladder Network D/A converters using IC 741-Graphing input and output voltages -Resolution Measurement.

5. SCR Characteristics and power control

Characteristics study of SCR -Construction of a power controller device using SCR.

6. Code Converters

Construction of Code converters using ICs -Tabulate input and output for various decimal numbers

a. BCD to Excess-3
b. BCD to Gray
c. Excess-3 to BCD
d. Gray to Excess-3

7. Analog Computation.

Solve the given 2 variable simultaneous equations by constructing the Analog computers using Op-Amps.