

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY, HYDERABAD
M. Sc. (Physics) and M.Sc. (Appl. Electronics) Courses under CBCS
(with effect from the academic year 2022–2023)

SEMESTER-I

S.No.	Sub. Code	Paper No.	Subject	Instructions/week	Credits
01	101T	Core Paper-I	Mathematical Physics	3	3
02	102 T	Core Paper-II	Classical Mechanics	3	3
03	103T	Core Paper-III	Quantum Mechanics-I	3	3
04	104T	Core Paper-IV	Electronics	3	3
05	151P+152P	Practicals	C-Programming Lab & Electronics Lab	8	4
06	153P+154P	Practicals	Heat & Acoustics Lab & Optics Lab	8	4
					20

Total Credits: 20

SEMESTER-II

S.No.	Sub. Code	Paper No.	Subject	Instructions/week	Credits
01	201T	Core Paper-I	Electromagnetic Theory	3	3
02	202 T	Core Paper-II	Statistical Mechanics	3	3
03	203T	Core Paper-III	Quantum Mechanics-II	3	3
04	204T	Core Paper-IV	General Solid State Physics	3	3
05	251P+252P	Practicals	C-Programming Lab & Electronics Lab	8	4
06	253P+254P	Practicals	Heat & Acoustics Lab & Optics Lab	8	4
					20

Total Credits: 20

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-I Syllabus**

(For the batch admitted from 2023-2024 onwards)

Core Paper – I (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-101T	MATHEMATICAL PHYSICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the basic concepts of differential and transformation mathematical equations
COB2	To classify different types of mathematical functions and its properties
COB3	To understand importance of power series
COB4	To understand the concept of Laplace and Bessel functions
COB5	To understand the concept of Fourier theorem pertaining to physics-problems.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to evaluate conditions for generating functions and solutions of power series
COC2	Able to apply different linear and differential equations to applied physics problems
COC3	Able to identify the parameters of different series functions
COC4	Able to distinguish between polynomial, differential and partial equations
COC5	Able to evaluate Eigenvalues for matrices and basic concepts of tensors

UNIT-I:(15 Hrs)

Linear Differential Equations with variable coefficients: **Legendre's Differential Equation:** The Power series Solution—Legendre Functions of the first and second kind —Generating Function—Rodrigue's formula—Orthogonal Properties—Recurrence Relations.

Bessel's Differential Equation: Power series Solution —Bessel Functions of First and Second kind—Generating Function—Orthogonal Properties —Recurrence Relations; Elements of complex analysis.

UNIT-II:(15Hrs)

Beta and Gamma functions – Properties and their relations; **Hermite Differential Equation:** Power series Solution—Hermite polynomials—Generating Function—Orthogonality—Recurrence relations—Rodrigues formula.

Laguerre Differential Equations: The Power series Solution—Generating Function—Rodrigue's formula—Recurrence Relations, Orthogonal Properties— Integral representation of Laguerre differential equations; Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions).

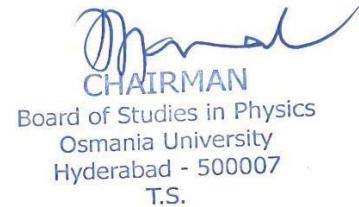
UNIT-III:(15 Hrs)

Fourier Transform: Introduction, Infinite Fourier Sine and Cosine transforms—Fourier Sine and Cosine

transform of derivatives-Finite Fourier transforms—
Applications of Fourier Transforms; **Laplace Transform:** Introduction, Properties of Laplace transforms Inverse Laplace transform and its properties
—Inverse Laplace theorem—Convolution theorem.
Matrices— Eigen values- Eigen vectors -Characteristic equation of a matrix- Cayley Hamilton theorem; **Tensors** –Order and rank of the tensors –transformation laws of covariant, contra-varient and mixed tensors – properties of tensors: Addition, subtraction and multiplication of tensors, Outer and inner products-contraction of tensors and quotient law

Recommended Books:

1. Applied Mathematics for Engineers and Physicists—Louis A. Pipes and Lawrence R. Harvill.
2. Mathematical Physics—AK Ghatak, ICG Goyal and SL Chua—Macmillan India Ltd.
3. Vector and Tensor Analysis—Schaum Series.
4. Mathematical Physics—Satya Prakash



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-I Syllabus**

(For the batch admitted from 2023-2024 onwards)

Core Paper – II (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-102T	CLASSICALMECHANICS	3	0	0	3

CourseObjectives: This course enables the students:

COB1	To study Inertial Frames, Non-Inertial Frames, Pseudo and Rotational Frames
COB2	To study the Principle of Virtual work and D'Alembert's
COB3	To understand the basic concept of Lagrangian and Hamilton-Jacobi equations
COB4	To understand the concept of canonical coordinates and canonical transformations
COB5	To study the Lagrange and Poisson brackets

CourseOutcomes: After the completion of this course the student will be:

COC1	Able to understand the motion of rigid body and importance of conservation theorems
COC2	Able to understand the concept of four-space, Four velocity, and Energy-momentum vectors.
COC3	Able to understand the Lagrangian equation for a charged particle in Electromagnetic field.
COC4	Able to identify different types of frequencies and modes of vibrations
COC5	Able to understand the theory of small oscillations.

UNIT- I (15 Hrs)

Inertial Frames and Galilean Transforms, Non-Inertial Frames, Pseudo Forces, Rotational Frames, Rotational Transforms and Conservation Theorems, Rotations in terms of Euler Angles-Euler's Equation of motion for a Rigid body

Minkowski space, Space-Time diagrams, World point, World line – relativistic motion and Lorentz transforms as rotation in four-space, Four velocity, Energy-momentum vectors with few examples

UNIT- II(15Hrs)

Constraints, Generalized Coordinates, Principle of Virtual work, D'Alembert's Principle, Lagrange's equation from D'Alembert's Principle, Examples of Lagrangian Equations: Simple Pendulum, Compound Pendulum, Spherical Pendulum, L-C circuit, Velocity dependent potentials- Lagrangian for a charged particle in Electromagnetic field.

Theory of small oscillations, stable, unstable and neutral equilibrium, Free vibrations of a Linear Triatomic molecule, Eigenvalue equations, Principal axis transformation- Frequencies and Normal modes

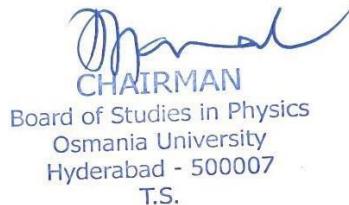
UNIT- III(15Hrs)

Euler-Lagrange Equations, Hamilton's Principle, Lagrange equation from Hamilton's principle, Principle of Least Action, Examples of Hamilton equations – motion of a particle in a central force field, projectile motion of a body, charged particle moving in an electromagnetic field, Cyclic coordinates and Conservation theorems.

Canonical coordinates and canonical transformations, Conditions for the transformations to be canonical, Generating functions, Lagrange and Poisson brackets, Hamilton's equations in Poisson bracket form, Hamilton-Jacobi equation, Harmonic oscillator by Hamilton-Jacobi method.

Reference Books:

1. Classical Mechanics by H. Goldstein, Poole & Safko (Pearson 2002)
2. Classical Mechanics by J.C. Upadhyaya (Himalaya Publishing House)
3. Introduction to Classical Mechanics by Takwale & Puranik (TMH)
4. Classical Mechanics by Rana & Joag (TMH)
5. Classical Mechanics of particles and Rigid Bodies by Kiran C Gupta (New Age International Publishers)
6. Lagrangian and Hamiltonian Mechanics by Calkin (Allied Publishers 2000)
7. Lagrangian Dynamics by D.A. Wells (Schaum's series 1967)



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-I Syllabus

(For the batch admitted from 2023-2024 onwards)

Core Paper – III (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-103T	QUANTUMMECHNAICS-I	3	0	0	3

CourseObjectives: This course enables the students:

COB1	To study the fundamentals of Quantum Mechanics
COB2	To study the commuting and non-commuting operators
COB3	To understand the basic concept of quantum pictures
COB4	To understand the concept of exactly soluble and symmetric problems
COB5	To study the importance of angular momentum

CourseOutcomes: After the completion of this course the student will be:

COC1	Able to understand the importance of Hermitian operator and its properties
COC2	Able to understand the concept of space and time displacements.
COC3	Able to understand the Hydrogen atom and radial part of the Schrodinger equation
COC4	Able to understand the commutation relations of J and its components
COC5	Able to understand C.G. Coefficients and Pauli's matrices.

UNIT-I

Fundamentals of Quantum Mechanics (15hrs):

Linear Vector space, Dirac's Ket and Bra notation. Eigenvalue equation, Eigenkets and Eigenvalues – Degenerate and non-degenerate states Operators, Hermitian operators and their properties - Commuting and non-commuting operators. Matrix representations of vectors and operators – Observable and expectation value of an observable – Parity operator, Projection operator, the number operator and significance

UNIT-II

Exactly Solvable and Symmetry Problems (15hrs):

The Schrodinger, Heisenberg picture and interaction pictures. Linear harmonic oscillator - Solution by operator method, Hydrogen atom, solution of the radial part of the Schrodinger equation
Space and time displacements – unitary operators of space and time displacements and equations of motion. Space inversion and unitary inversion operator - intrinsic parity. Time reversal operator – anti-linear operator

UNIT-III

Angular Momentum (15hrs):

Orbital Angular Momentum, Commutation Relations involving : \mathbf{L}^2 , L_x , L_y , L_z – Eigenvalues and Eigenfunctions of \mathbf{L}^2 – Generalized angular momentum, \mathbf{J} – commutation relations between \mathbf{J}^2 and components of \mathbf{J} . J_+ and J_- – Eigen values of J_x and J_z . Matrix representation for J^2 and J_z . Spin angular momentum - Pauli spin matrices and their properties. Addition of angular momenta - Clebsch-Gordon coefficients - Recursion relations - C-G coefficients for $J_1 = \frac{1}{2}, J_2 = \frac{1}{2}$, and $J_1 = \frac{1}{2}, J_2 = 1$, as examples.

Reference Books:

1. Quantum Mechanics by L.I. Schiff
2. A Text book Quantum Mechanics: P.M. Mathews and K. Venkateshan (TMH)
3. Quantum Mechanics by Ghatak and Loka Nath (Macmillan)
4. Quantum Mechanics by E. Merzbacher (John Wiley)
5. Quantum Mechanics by Aruldas (New Age International)
6. Modern Quantum Mechanics by Sakurai (Addison Wesley)



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-I Syllabus

(For the batch admitted from 2023-2024 onwards)
Core Paper – IV (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-104T	ELECTRONICS	3	0	0	3

CourseObjectives: This course enables the students:

COB1	To study the basic principles of regulated power supply
COB2	To study the conditions of feedback amplifiers
COB3	To understand the characteristics of operational amplifiers
COB4	To understand the concept of logic circuits
COB5	To study the architecture of 8085 microprocessor

CourseOutcomes: After the completion of this course the student will be:

COC1	Able to understand the importance of IC regulators
COC2	Able to understand the importance of positive and negative feedback conditions in amplifiers
COC3	Able to understand different types of oscillators and its circuitry diagrams
COC4	Able to understand the different applications of op-ampifiers and timer IC555 circuit
COC5	Able to understand SOP and POSK-maps. Assemble language programming of microprocessor

UNIT– I:(15 Hrs)

Regulated

PowerSupply: Basic Principle of regulated power supply, fixed IC voltage regulators using IC78XX and 79XX, variable IC regulators with LM723

FeedbackinAmplifiers: The concept of feedback, Positive and Negative feedback – feedback gain-Advantages of Negative feedback in amplifiers,

Oscillators: Barkhausen Criterion, RC oscillators: Phase shift Oscillator, Wein Bridge Oscillator, LC Oscillators: Hartley and Collpits Oscillators.

UNIT– II:(15Hrs)

Operational Amplifiers: Characteristics of Ideal operational Amplifier, Block diagram of an IC operational Amplifier, Analysis of inverting amplifier, Non-inverting amplifier, Integrator, Differentiator, summing amplifier, Difference amplifier, Comparator, Logarithmic amplifier and exponential amplifier, Squarewave, Rectangular wave and Triangular wave generators.
TimerIC555: Working of IC555, Astable Multi-vibrator with IC555.

UNIT-III: (15Hrs)

Logic Circuits: Min terms and Max terms, simplification of Boolean equations- sum of products and product of sums-Karnaugh Maps(upto 4 variables), Multiplexer (16:1) and De-multiplexer(1:4)

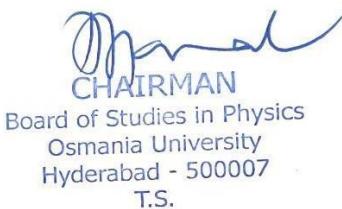
Flip-Flops: RS,D,JK and M/S JK flip flops with their truth tables, timing diagrams.

Counters: Asynchronous and Synchronous Counters, Modulus N Counter, Decade Counter using IC 7490.

Microprocessor: Introduction to Microprocessors – Architecture of 8085 microprocessor, Instruction set: Data transfer instructions, Arithmetic Logic and Branch operations, Interrupts, Simple Assembly language programming: 8-bit addition, 8-bit subtraction, 8-bit multiplication.

Reference Books:

1. Integrated Electronics – Millman and Halkias.
2. Microelectronics – Millman & Grabel.
3. Digital Principles and Applications – Malvino and Leech
4. Operational amplifier – Gayakwad
5. Principles of Digital Electronics – Gothman
6. Digital Principles and Applications Computer Electronics – Malvino.
7. Microprocessors Architecture, Programming and Application with the 8085 / 8080 – Gaonkar
8. Pulse Digital & Switching Waveforms by Millman and Taub, TMH 2001.
9. Fundamentals of Electronics by JDRyder, Wiley.



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-II Syllabus**

(For the batch admitted from 2023-2024 onwards)

Core Paper – I (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-201T	ELECTROMAGNETIC THEORY	3	0	0	3

CourseObjectives: This course enables the students:

COB1	To study the basic concepts of electrostatic potentials and Maxwell's field equations
COB2	To study the boundary conditions of E, D, B and H
COB3	To understand the theory of propagation of plane electromagnetic waves
COB4	To understand the concept of reflection and refraction of EM waves
COB5	To study the electromagnetic radiation

CourseOutcomes: After the completion of this course the student will be:

COC1	Able to get the solutions of Laplace equation and Poynting theorem
COC2	Able to understand the Lorentz and Coulomb Gauge transformations
COC3	Able to understand Propagation of EM waves in dielectric and conducting medium
COC4	Able to understand the normal and anomalous dispersion.
COC5	Able to understand dipole radiation and radiation from center-fed linear antenna,

UNIT– I:(15 Hrs)**Electro-Static Potentials and Maxwell's Field Equations:**

Special techniques for calculating electrostatic potential : Poisson's and Laplace's equations- Solutions of Laplace's equations for electrostatic potential in Cartesian, spherical and cylindrical coordinates-Multipole expansion of the energy of a system of charges in an electrostatic field-The scalar and vector magnetic potentials. Derivation of Maxwell's equations-General wave equation-Gauge transformations-Lorentz and Coulomb gauges-Momentum, angular momentum and free energies of electromagnetic field-Poynting Theorem (work-energy theorem in electrodynamics).

UNIT– II:(15Hrs)**Propagation of Plane Electromagnetic Waves:**

Electromagnetic (EM) waves in unbounded media-EM wave equation for a homogeneous isotropic dielectric medium-Propagation of plane EM waves in free space-

Propagation of EM waves in homogeneous isotropic dielectric medium- Energy transmitted by a plane EM wave-Propagation of EM wave in conducting medium-Attenuation and Skin effect-Energy transmitted-Polarization of EM wave. Propagation of EM waves in bounded media-Boundary conditions for **E,D,B** and **H** – Reflection and Refraction of plane EM waves at plane interface between two dielectrics

UNIT-III:(15Hrs)

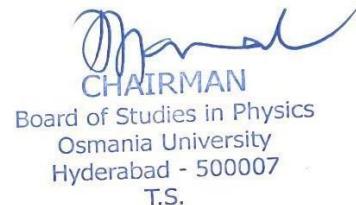
InteractionofElectromagneticWaveswithMatter:

Laws of reflection and refraction-Fresnel's relations- Reflection (R) and Transmission(T) coefficients - Brewster's angle-Total internal reflection-Reflection and Refraction of plane EM waves at plane interface between non-conducting and conducting medium-Metallic reflection and its applications -Dispersion in non-conductors-Normal and anomalous dispersion.

Electromagnetic radiation: Inhomogeneous wave equation for potentials-Retarded potentials, Oscillating electric dipole radiation-Oscillating magnetic dipole radiation-Radiation from center-fed linear antenna,Lienard-Wiechert potentials.

Reference Books:

1. Classical Electrodynamics by S.P. Purushottam, Tata McGraw-Hill Publishing Co., Ltd (2000).
2. Introduction to Electrodynamics by D.J. Griffiths, Prentice-Hall of India (1998).
3. Electricity and Magnetism by M.H. Nayfeh and M.K. Brussel, John Wiley and Sons (1985).
4. Classical Electrodynamics by J.D. Jackson, John Wiley and Sons (1999).
5. Foundations of Electromagnetic Theory by J.R. Rietz, F.J. Milford and Christy, Narosa Publishing house (1986).
6. Engineering Electromagnetics by W.H. Hayt and J.A. Buck, Tata McGraw-Hill (2001).
7. Electromagnetic waves and Radiating systems by E.C. Jordan and K.G. Balmain, Prentice Hall (1968).



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-II Syllabus**

(For the batch admitted from 2023-2024 onwards)

Core Paper – II (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-202T	STATISTICAL MECHANICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To study the basic concepts of statistical mechanics, phase space and ensembles
COB2	To study the postulates and partition functions of different ensembles
COB3	To understand Bose-Einstein condensation phenomenon
COB4	To understand the concept of fluctuations and its related terms
COB5	To study the Ising model and order-disorder transitions

Course Outcomes: After the completion of this course the student will be:

COC1	Able to understand the different ensembles and partition functions
COC2	Able to understand the peculiarities of liquid Helium and superfluidity property
COC3	Able to understand Fermi-Dirac gas and white dwarfs
COC4	Able to understand classification of phase transitions of first and second kind
COC5	Able to understand the Ising model and its application to ferromagnetic materials and importance of B.W. approximation

UNIT– I:(15Hrs)

Relation between thermodynamics and statistical mechanics- Micro states and macro states of a system – Phase space- Ensembles – Mean values and ensemble average – Density distribution in phase space- Liouville's theorem. Apriori probability postulate- Micro canonical, canonical and grand canonical ensembles – Quantization of phase space. Entropy and Probability. Entropy of a perfect gas using microcanonical ensemble-Gibbs paradox-Sackur-Tetrode equation. Equipartition theorem.

UNIT– II:(15Hrs)

Canonical ensemble- Partition function-Ideal gas, Grand canonical ensemble-Partition function-Ideal gas. Partition function and thermodynamic quantities-

Translational, rotational and vibrational partition functions.

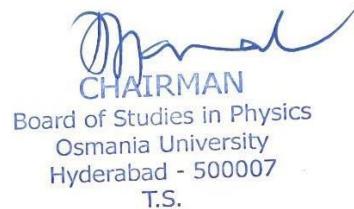
Ideal Bose-Einstein gas-Energy and pressure of the gas. Bose-Einstein condensation-Liquid Helium, Two Fluid model-Phonons, superfluidity. Ideal Fermi-Dirac gas-Energy and pressure of the gas. White dwarfs.

UNIT– III:(15Hrs)

Fluctuation-mean square deviation-Fluctuations in energy, volume and concentration. Brownian motion- Classification of phase transition-Phase transitions of first and second kind: Ising model, Bragg-Williams approximation-One dimensional Ising model an application to Ferro magnetic systems-Order-Disorder transition.

ReferenceBooks:

1. Statistical Mechanics by Satya Prakash and JP Agarwal (Pragati Prakashan-2002)
2. Statistical Mechanics by Gupta and Kumar (Pragathi Prakashan-2002)
3. Statistical Mechanics by BK Agarwal and MEisner (New Age International)
4. Statistical Mechanics by RK Srivastava and J Ashok (Prentice Hall, India)
5. Introduction to phase transitions and critical Phenomena H E Stanley (Clarendon Press, Oxford).
6. Heat and Thermodynamics by Zemansky (TMH).



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-II Syllabus

(For the batch admitted from 2023-2024 onwards)

Core Paper – III (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-203T	QUANTUMMECHANICS-II	3	0	0	3

CourseObjectives: This course enables the students:

COB1	To understand the concepts of scattering theory
COB2	To study the relationship between phase shift and Potential
COB3	To study the different approximation methods
COB4	To understand the concept time dependent perturbation theory
COB5	To study the relativistic quantum mechanics

CourseOutcomes: After the completion of this course the student will be:

COC1	Able to evaluate scattering amplitude by means of Green's and Born's approximation methods
COC2	Able to establish the connection formula
COC3	Able to understand Fermi's golden rule
COC4	Able to understand Klein-Gordon Equation and Dirac's matrices
COC5	Able to understand relativistic particle in central potential

UNIT– I (15hrs):

Scattering Theory: Kinematics of Scattering Process: differential and total cross-section - Asymptotic form of scattering wave function. Scattering amplitude by Green's method. Born approximation method and screened Coulomb potential and square well potential as examples - Partial wave analysis and phaseshift-Optical Theorem-Relationship between phaseshift and Potential. Scattering by Hard sphere.

UNIT–II(15hrs):

ApproximationMethods: Time Independent Perturbation Theory, Examples of harmonic and anharmonic Oscillators. Degenerate case- Stark effect for H-atom for n=2 level. Variation Method - Helium atom ground state. WK B approximation method-connection formulae.

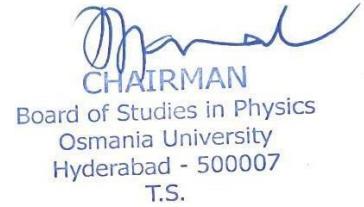
Time Dependent Perturbation Theory: Transition probability- Selection rules for transition. Constant perturbation. Transition probability to closely spaced levels- Fermi's golden rule. Harmonic perturbation-Transition probability rate.

UNIT–III(15hrs):

Relativistic Quantum Mechanics : Klein –Gordon Equation, Plane wave solution and Equation of continuity, Probability density-Dirac Equation, alpha, beta-matrices, Planewave solution, significance of negative energy states. Spin of Dirac particle Relativistic particle in central potential –Total Angular Momentum, Particle in a magnetic field – Spin Magnetic moment, properties of gamma matrices- Dirac's equation in covariant form.

Reference Books:

1. Quantum Mechanics by L.I.Schiff
2. A Text book Quantum Mechanics by P.M.Mathews and K.Venkateshan (TMH)
3. Quantum Mechanics by Ghatak and Lokanathan (Macmillan)
4. Quantum Mechanics by E Merzbacher (John Wiley)
5. Quantum Mechanics by Aruldas (New Age International)
6. Modern Quantum Mechanics by Sakurai (Addison Wesley)



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-II Syllabus

(For the batch admitted from 2023-2024 onwards)

Core Paper – IV (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-204T	GENERAL SOLID STATE PHYSICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the basic theory of crystal structure
COB2	To understand the different crystal growth methods
COB3	To understand crystal Imperfections
COB4	To study the thermal properties of solids
COB5	To study the band theory and semiconductors

Course Outcomes: After the completion of this course the student will be:

COC1	Able to understand the concept of reciprocal lattice and Brillouin zones
COC2	Able to understand defects and color centers. Establish the connection formula
COC3	Able to understand Fermi's golden rule
COC4	Able to understand Einstein and Debye's theories
COC5	Able to understand electron, hole concentration and band gap expressions

UNIT – I : (15 Hrs)

Crystal Structure and Growth: Introduction to crystal structures (Crystal translational vectors, unit cell, Bravais lattices, Crystal systems, Miller indices, Symmetry operations), Point groups, Space groups and their notation. Bragg's law, Atomic structure factor, Geometrical structure factor and Debye-Waller factor, Concept of reciprocal lattice, Concept and construction of Brillouin zones, Experimental methods of X-ray diffraction— Laue and Powder methods, Determination of unit cell parameters of a cubic crystal, Elements of electron and neutron diffraction.

Crystal growth from solution and melt, growth from vapour phase, Experimental techniques of growth from melt.

UNIT – II: (15 Hrs)

Crystal Imperfections: Classification of imperfections, Schottky and Frenkel defects, expression for their equilibrium concentrations in metals and Ionic crystals, Colour centers and their models, Dislocations- Edge and Screw dislocations, Dislocation multiplication, Grain boundaries.

Thermal Properties: Elastic waves in one dimensional array of identical atoms, Vibrational modes of diatomic linear lattice and dispersion relations, Acoustic and Optical modes, Infrared absorption in ionic crystals, Phonons and verification of dispersion relation in crystal lattices. Lattice heat capacity-Einstein and Debye theories, Lattice thermal conductivity – Phonon mean free path, Origin of thermal expansion and Gruneisen relation.

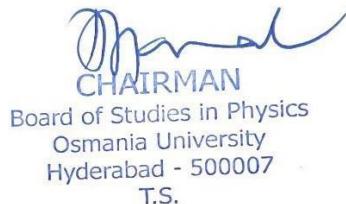
UNIT-III:(15Hrs)

Band theory: Introduction to band theory, Bloch theorem, Behavior of electron in periodic potentials, Kronig-Penny model, E vs. K relation, Density of states in a band, Effective mass of an electron, Negative effective mass and concept of hole, Distinction between metals, semiconductors and insulators.

Semiconductors: Intrinsic and extrinsic semiconductors, Fermi level, Expressions for electron and hole concentrations in intrinsic and extrinsic semiconductors. Measurements of band gap by infrared absorption in semiconductors, Hall-effect.

Reference Books:

1. Crystallography and Solid State Physics – A.R. Verma and O.N. Srivastava
2. Solid State Physics – A.J. Decker, Macmillan Indian Ltd, 2003.
3. Introduction to Solid State Physics – C. Kittel, John Wiley Sons Inc, New York
4. Solid State Physics – R.L. Singhal, Kedar Nath & Ramnath & Co, 2006
5. Elements of Solid State Physics – J.P. Srivastava, Prentice Hall India, 2006.
6. Elements of Solid State Physics – Ali Omar, Pearson Education Inc, 2002.



**DEPARTMENT OF PHYSICS, OSMANIA
UNIVERSITYREVISED SYLLABUS FOR
M.Sc.(PHYSICS) III SEMESTER
With effect from the academic year 2023–2024 onwards**

S.No	Papercode	Paper	Papertitle	Instructions Hrs/Week	Credits	Max Marks
1.	P301T	Core Paper-I	ModernOptics	3	3	100*
2	P302T	Core Paper-II	Advancedsolidstatephysics	3	3	100*
SolidStatePhysics(SSP)						
3	P303T/SSP	ElectivePaper-I	BandTheory&electrical Properties	3	3	100*
4	P304T/SSP	ElectivePaper-II	Crystal PhysicsandPhysicsof Phonons	3	3	100*
MaterialsScience(MS)						
5	P303T/MS	ElectivePaper-I	MechanicalPropertiesof materials	3	3	100*
6	P304T/MS	ElectivePaper-II	Thinfilmsandtheirproperties	3	3	100*
Electronics&Instrumentation(E&I)						
7	P303T/EI	ElectivePaper-I	ElectronicInstrumentation	3	3	100*
8	P304T/EI	ElectivePaper-II	EmbeddedSystemsandits applications	3	3	100*
NanoScience(NS)						
9	P303T/NS	ElectivePaper-I	SynthesisandCharacterization ofNanomaterials	3	3	100*
10	P304T/NS	ElectivePaper-II	PropertiesofNanomaterials	3	3	100*
ElectronicsCommunications(EC)						
11	P303T/EC	ElectivePaper-I	8051Microcontroller &its applications	3	3	100*
12	P304T/EC	ElectivePaper-II	DataandComputer communications	3	3	100*
BioPhysics(BP)						
13	P303T/BP	ElectivePaper-I	MolecularandEnvironmental Biophysics	3	3	100*
14	P304T/BP	ElectivePaper-II	Physico-chemicaltechniquesin Biophysics	3	3	100*
CondensedMatterPhysics(CMP)						
15	P303T/CM P	ElectivePaper-I	LatticeDynamicsinCrystals	3	3	100*
16	P304T/CM P	ElectivePaper-II	OpticalPhenomenainSolids	3	3	100*

OptoElectronics(OE)						
17	P303T/OE	ElectivePaper-I	Introductiontooptoelectronics	3	3	100*
18	P304T/OE	ElectivePaper-II	SemiconductorOptoelectronics	3	3	100*

PRACTICALS

19	P 305P	V	General Physicslab	4	2	50
20	P 306P	VI	Speciallab	8	4	100
			Seminar		2	50

Total **20** **600**

AppliedElectronics(AE)				Credits	Marks
21	P301T/AE	Core Paper-I	DigitalSystemDesign	3	3
22	P302T/AE	Core Paper-II	Digitalsignalprocessingand digitalsignalprocessors	3	3
23	P303T/AE	ElectivePaper-I	Datacommunicationand networking	3	3
24	P304T/AE	ElectivePaper-II	Microcontrollerandapplications	3	3

PRACTICALS

25	P 305P	V	Analog/Digital/Microcontroller Lab	8	4	100
26	P 306P	VI	DSPLab	4	2	50
			Seminar		2	50

20 **600**

Detailsofcreditsandmarks	
Number instructionhours per eachtheorypaperperweek	3
Maximummarks for eachtheorypaper	100(70semester exam+ 30 internal evaluation)
Numberof creditsforeachtheorypaper	3
Numberinstructionhoursforeachpracticalpaperperweek	8/4
MaximumMarks pereachpracticalpaper	100/50
Number creditsforeachpractical paper	4/2
TotalCreditspersemester	20



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc.(Physics)-Semester-III Syllabus**

(For the batch admitted from 2023-2024 onwards)

Core Paper-I (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-301T	MODERNOPTICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To identify conditions for laser phenomenon and properties of the laser.
COB2	To classify different types of lasers with respect to design and working principles.
COB3	To understand the basics of holograms and able to differentiate between holography and Photography.
COB4	To understand the concept of Fourier transforming properties of lenses.
COB5	To understand the concept of non-linear optical process in which photons of intense incoming laser radiation interact with a non-linear material and how radiation with corresponding harmonic frequencies are regenerated.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to evaluate conditions for laser phenomenon and properties of the laser.
COC2	Able to appraise different types of lasers with respect to design and working principles.
COC3	Able to identify the parameters which differentiate holograms from photographs
COC4	Able to distinguish between various types of holograms and to analyze the different parameters of holographic recording materials.
COC5	Able to evaluate intensity dependent material properties like refractive indices, optical mixing and self-focusing of light.

Unit I: Lasers: Emission and absorption of Radiation, Einstein Relations, pumping Mechanisms, Optical feedback, Laser Rate equations for two, three and four level lasers, pumping threshold conditions, Laser modes of rectangular cavity, Properties of Laser beams. He-Ne, CO₂ Gas lasers, Excimer laser, Ruby, Nd-YAG laser and their applications.

Unit II: Holography: Basic Principles of Holography- Recording of amplitude and phase, the recording medium, reconstruction of original wave front, image formation by wave front reconstruction, Gabor Hologram, limitations of Gabor Hologram, Off axis Hologram, Fourier transform Holograms, Volume Holograms, Applications of Holograms-Spatial frequency filtering.

Unit III: Fourier and Non-Linear Optics: Fourier optics- Thin lens as phase transformation, Thickness function, Fourier transforming properties of lenses, Object placed in front of the lens, Object placed behind the lens.

Non-Linear Optics, Harmonic generation, Second harmonic generation, Phase matching condition, Optical mixing, Parametric generation of light, Self focusing of light.

Recommended Books:

1. OptoElectronics-An Introduction-Wilson & JFB Hawkes 2nd Edition.
2. Introduction to Fourier optics -J.W. Goodman
3. Lasers and Non-Linear optics -B.B. Laud
4. Optical Electronics -Ghatak and Thyagarajan.
5. Principles of Lasers-O. Svelto
6. Laser Fundamentals-Silfvast Cambridge



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M.Sc.(Physics)-Semester-III Syllabus

(For the batch admitted from 2023-2024 onwards)

Core Paper-II (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-302T	ADVANCED SOLID STATE PHYSICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the electronic properties of metals by studying the Brillouin zones and Fermi surfaces.
COB2	To study the effect of electric and magnetic fields on Fermi surfaces in metals.
COB3	To understand the basic concept of Dielectrics and Magnetic properties of solids and different types of polarizabilities, ferroelectrics and their properties.
COB4	To understand the classification of magnetic materials and the theories to explain Ferromagnetism, Anti-ferromagnetism and Ferri-magnetism and their applications.
COB5	To study the superconductivity and their properties and to understand the theories to explain the superconductivity and their applications.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to understand and gain the knowledge of electrical, dielectric and magnetic properties of solids and superconductivity and its applications.
COC2	Able to construct the Brillouin zones and Fermi surfaces and to identify the energy bands in solids.
COC3	Able to distinguish different types of polarizabilities and their behavior in AC fields and to classify the ferroelectric materials and their properties
COC4	Able to identify different types of magnetic materials and their applications.
COC5	Able to understand superconductivity its properties and applications.

Unit I: Electronic Properties: Introduction to band theory of solids. Fermi surface and Brillouin zones. Construction of Fermi surfaces. Extended, periodic and reduced zone schemes. Fermi surfaces in simple cubic, bcc and fcc lattices. Effect of electric and magnetic fields on Fermi surfaces. Anomalous and skin effects. Cyclotron frequency, energy levels and density of states in magnetic field, De Haas-van Alphen effect.

Unit II: Dielectrics and Magnetic properties of solids: Introduction to Dielectrics, Concept of local field. The electronic, ionic and orientational polarizabilities. Clausius-Mosotti relation. Behavior of dielectrics in an alternating field, Classification of ferroelectrics- BaTiO₃ and KDP. Theory of ferroelectrics, ferroelectric hysteresis.

Origin of permanent magnetic moment, Spontaneous magnetization, Weiss theory of spontaneous magnetization. Nature and origin of Weiss molecular field, Heisenberg exchange interaction. Spin waves, Ferromagnetic domains and hysteresis. The Bloch wall, Neel's theory of anti-ferromagnetism. Ferrimagnetism, ferrites and their applications.

Unit III: Superconductivity: Introduction to type-I and type-II superconductors, Isotope effect, entropy, heat capacity and thermal conductivity. Energy gap, London equations, penetration depth, Coherence

length, Cooper pairs and elements of BCS theory, BCS ground state, Giaever tunneling, DC and AC Josephson effects, SQUID, Elements of high temperature superconductors and applications.

Recommended Books:

- | | |
|--|-------------------|
| 1. Solid State Physics | --A.J. Deckker |
| 2. Introduction to Solid State Physics | --Kittel |
| 3. Solid State Physics | --R.L. Singhal |
| 4. Elements of Solid State Physics | --J.P. Srivastava |
| 5. Solid State Physics | --M.A. Wahab |



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc.(Physics)-Semester-

III Syllabus (For the batch admitted from 2023-2024 onwards)

Elective Paper-I

CourseCode	CourseTitle	L	T	P	C
P-303T/SSP	BAND THEORY AND ELECTRICAL PROPERTIES	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the structure of crystals structures with examples, and the study of Energy versus wave vector relations.
COB2	To define Brillouin zones in one, two and three dimensions and how the density of states are distributed and to understand the energy versus wave vector representations in one, two and three dimensions.
COB3	To understand the behavior of an electron in a cellular method, APW method, Pseudopotential method, OPW method and the studying the variation of energy with momentum vector in the above mentioned methods.
COB4	To understand the transport properties of semiconductors and metals limited by electric current density J in the presence of electric field.
COB5	To understand the electrical conduction from the hopping of electrons from one site to another site in the crystal.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the structure of crystals in 1, 2 and 3 dimensions. It also helps to understand the variation of energy (E) of an electron with its momentum vector (K). E vs K variation is not linear but is discontinuous at the boundaries of the Brillouin zones defined as first, second, third etc. separated by certain values of K ..
COC2	Able to determine the quantities such as electrical conductivity, current density for an electron in the presence of electric field.
COC3	Able to determine the electrical conduction is from the hopping of electrons from one site to another site in hoppers or electron transfer materials.
COC4	Able to identify the phenomena of conductivity in ionic crystals are due to the movement of ions from one site to another site.
COC5	Able to understand the structures of α -AgI and β -alumina unit cell and the defects present in their structures and the properties of superionic conductors.

Unit I : Band Theory Of Solids : Brillouin zones.- Brillouin zones in one, two and three dimensions., Density of states, Extended, reduced and periodic zone schemes; Nearly free electron model, Tight binding approximation and its application to simple cubic lattice, Calculation of energy bands- Cellular method, APW method, Pseudo potential method, OPW method.

Unit II : Transport Phenomenon In Metals: The Boltzmann transport equation, Electrical conductivity, Definition and experimental features – The Drude Lorentz theory, The Sommerfeld theory- Calculation of the relaxation time, The electrical conductivity at low temperatures, Macheissen's rule, Thermal conductivity, Wiedemann-Franz law, Hall-effect-Hall coefficient and Hall angle.

Unit III : Electrical Transport Properties of Insulators :Hopping conduction; Temperature variation of electrical conductivity; Seebeck coefficient; Polarons- small polaron band conduction; large polaron band conduction; small polaron hopping conduction; Mott transitions; Ionic Conductivity-conductivity,mobility,Nernst-Einstein relation; Superionic Conductivity- structure, structures of α -AgI and β -alumina unit cell; Defects-defect equilibria and conductivity; Properties of super ionic conductors

Recommended books

1. Principles of the theory of Solids – Ziman
2. Solid state Physics - Singhal
3. Solid state Physics – H.C. Gupta
4. Elementary Solid State Physics – M. Ali Omar
5. Solid State Physics – M.A. Waheb
6. Solid State Physics – Kachava,



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-III Semester Syllabus
(For the batch admitted from 2023-2024 onwards)

Elective Paper-II

CourseCode	CourseTitle	L	T	P	C
P-304T/SSP	CRYSTAL PHYSICS AND PHYSICS OF PHONONS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To study the basic crystallographic point groups and space groups of crystal structures.
COB2	To learn Mullikansymbolism and rules of crystal symmetry .
COB3	To understand the concept of phonons.
COB4	To learn phenomenological description of diffusion.
COB5	To study the theoretical concepts of ionic conductivity in detail.

Course Outcomes: After the completion of this course the student will be:

COC1	I am able to enable the students to understand the complete concepts of crystal structure and symmetry operations.
COC2	Able to draw characteristic tables, which describes the complete set of irreducible representations of a symmetry group.
COC3	Able to determine the role of phonons in the conductivity and interaction processes.
COC4	Able to identify different types of diffusion process with the help of phenomenological theories like Nernst-Einstein relations.
COC5	Able to understand the effect of divalent impurities on ionic conductivity.

Unit I : Elements of group theory: Introduction to crystallographic point groups, the five platonic solids, procedure for symmetry classification of molecules, class, matrix notation for geometrical transformations, matrix representation of point groups, reducible and irreducible representations, great orthogonality theorem and its consequences, Character tables for C_{2v} and C_{3v} point groups, Mullikansymbolism, Symmetry species.

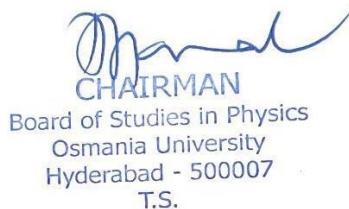
Development of theoretical formalism, tensors, Physical property and its tensorial representation. Quotient theorem, Symmetry in crystals -point groups and space groups.

Unit II: Phonon Physics : Theoretical background of lattice vibrations – Phonons and their properties – Crystal momentum – Conservation – Neutron diffraction from phonons – Experimental verification of dispersion relations – Thermal conductivity – Role of phonons – Thermal conductivity – Normal and Umklapp processes – Photon –Phonon interaction – TO and LO phonons– Lyddane– Sach-Teller's(LST) relation–Applications–Infrared measurements, Raman effect–Theory of polaritons– Experimental measurement.

Unit III: Diffusion in solids : Solid state diffusion, Diffusion mechanisms, Self-diffusion, Impurity diffusion coefficient, Fick's second law, Diffusion coefficient, Experimental determination of diffusion coefficient, Various methods, Random walk diffusion, Diffusion in a simple cubic structure, Diffusion under external field, Nernst-Einstein relation, Kirkendall shift. Ionic conductivity, Ionic conductivity of alkali halides and effect of divalent impurities on ionic conductivity.

Recommended Books

1. Solid State Physics - G. Burns;
2. Intermediate Quantum Theory of Crystalline Solids - Alexander O. E. Animalu
3. Solid State Physics - H. Ibach and H. Luth
4. Fundamentals of Solid State Physics - J. R. Christman,
5. Solid State Physics, Solid State Device and Electronics, Kachhava, C.M..
6. Solid State Physics - A. J. Dekker
7. Solid State Physics - M. A. Wahab.
8. Chemical Applications of Group Theory F. A. Cotton
9. Physical Properties of Crystals J. F. Nye;
10. Physics of Crystals S. Bhagavantam and S. Radhakrishna,



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-III Semester Syllabus
(For the batch admitted from 2023-2024 onwards)

Elective Paper-I

CourseCode	CourseTitle	L	T	P	C
P-303T/MS	MECHANICAL PROPERTIES OF MATERIALS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To study the basic dislocations and their interactions.
COB2	To study mechanical behavior of materials .
COB3	To understand the concept of elastic behavior of materials.
COB4	To learn about creep resistant materials.
COB5	To study the deformation of polycrystalline materials.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the complete concept of dislocations in materials.
COC2	Able to understand the stress-strain curves.
COC3	Able to determine the activation energy.
COC4	Able to measure mechanical parameters of materials.
COC5	Able to understand the re-crystallization, grain growth and grain size on dislocation motion..

Unit I: Dislocations: Dislocations - Edge and screw dislocations, Mixed dislocation, Burgers vector and Burgers circuit, Stress field of dislocation, Force on a dislocation, Line tension, Forces between dislocations, Interaction of dislocations, Elastic energy of dislocations, Movement of dislocations, Glide motion, Slip vector and slip plane, Climb of an edge dislocation, creation of jogs, - Jogs and kinks, Grain Boundaries, Small angle boundaries – Tilt and twist boundaries, energies.

Unit II: Elastic Behavior of Materials: Mechanical behavior of crystalline materials: Elastic deformation - Thermo elastic effect, An-elasticity, Relaxation, Plastic deformation. Tensile Test, Mechanical parameters, Hardness (Brinell, Vickers and Rockwell) tests, Pierls' force, Stress – strain curves of crystals, Different stages, Dislocation mechanisms in easy glide stage, Multiplication of dislocations – Frank-Read source, Creep, creep curve, Mechanism of creep, activation energy, Dislocation mechanisms, Creep resistant materials.

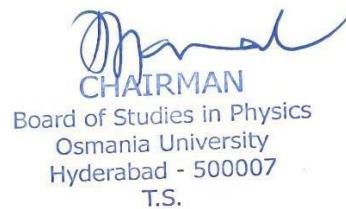
Unit III: Strengthening Mechanisms: Strengthening Mechanisms: Work hardening or Strain hardening – Degree of cold working, Dislocation mechanisms - creation of Partial dislocations in f.c.c crystals, sessile dislocations, dislocation locks, dislocation pileups; Deformation of polycrystalline materials; Annealing – Re-crystallization, grain growth, recovery, effect of grain size on dislocation motion.

Recommended Books:

- Materials Science and Engineering – W.D. Callister John Wiley & Sons

- 2. Physical Metallurgy principles
- 3. Elements of Physical Metallurgy
- 4. Physical Metallurgy
- 5. Material Science

– Reed Hill, Robert Mc-Graw Hill
– A.G. Guy Addison-Wesley
– R.W. Cahn and Peter Haasen, North Holland
Kakani S.L, Amit Kakani Newage



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-III Semester Syllabus
(For the batch admitted from 2023-2024 onwards)

Elective Paper-II

CourseCode	CourseTitle	L	T	P	C
P-304T/MS	THIN FILMS AND THEIR PROPERTIES	3	0	0	3

Course Objectives: This course enables the students:

COB1	To study the basic techniques of thin film deposition and preparation.
COB2	To learn about various types of gauges.
COB3	To study the thin film thickness measurement.
COB4	To learn about ellipsometry.
COB5	To study the properties of thin films.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the complete concept of thin film preparation
COC2	Able to measure thickness of thin films.
COC3	Able to determine dielectric constant of thin films.
COC4	Able to identify different types of reflection, transmission and absorption by thin films
COC5	Able to understand dielectric thin films and their properties.

Unit I

Vacuum Techniques & Thin Film Deposition Methods

Production of vacuum, vacuum pumps, Oil seal rotary and roots pumps, diffusion pumps, turbomolecular pump, cryogenic, cryosorption and getter pumps, measurement of vacuum - various types of gauges, Bourdon gauge, Pirani gauge, Penning gauge.

Method of thin film preparation, thermal evaporation, electron beam evaporation, pulsed laser deposition, magnetron sputtering, MBE, Chemical vapor deposition methods, Sol gel spin coating, spray pyrolysis.

Unit II

Thin Film Formation and Thickness Measurement

Nucleation, film growth and structure - various stages in thin film formation, thermodynamics of nucleation, nucleation theories, Capillary model and Atomistic model and their comparison. Structure of thin film, role of substrate, role of film thickness, film thickness measurement - interferometry, ellipsometry, microbalance, quartz crystal oscillator techniques.

Unit III

Properties of Thin Films

Electrical conduction in metallic films - Continuous and discontinuous films, conduction in continuous metal films, conduction in discontinuous metal films, Dielectric thin films

- experimental techniques capacitor preparation and setup, measurement of dielectric constant, effect of frequency and temperature. Optical properties of thin films - reflection, transmission and absorption by thin films - reflection and transmission by a single film; Applications of thin films.

Bookssuggested:

1. Materialsscienceofthinfilms,M.Ohring,Elsevier,2006.
2. Thinfilmfundamentals—A.Goswami,NewAgeInternationalpublishers,2006.
3. Thinfilmphenomena-K.L.Chopra,McGraw–HillBookCompany1969.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus(For the batch admitted from 2023-2024 onwards)****P 303T/EI****Elective Paper - I**

CourseCode	CourseTitle	L	T	P	C
P-303T/EI	ELECTRONIC INSTRUMENTATION	3	0	0	3

Course Objectives: This course enables the students:

COB1	To study the basic measurements of errors.
COB2	To study characteristics of instrumentation system .
COB3	To understand the concept of instrumentation amplifier and attenuators.
COB4	To learn about signal generation and analysis.
COB5	To study the electronic measuring instruments.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the accuracy and precision in measurement.
COC2	Able to understand the response of the system.
COC3	Able to measure power and voltage measurement.
COC4	Able to read oscilloscope measurements.
COC5	Able to understand LED and seven segment display systems..

Unit I: Measurement and Error:

Accuracy and Precision – significant figures – Types of error – Statistical analysis – Probability of errors – Limiting errors.

Performance characteristics of an instrumentation system: Zero, First and Second Order systems – Response of first and second order systems to STEP, RAMP and IMPULSE inputs – Frequency response of first and second order systems.

Unit II: Amplifiers and Signal Conditioning:

Instrumentation amplifiers – Isolation amplifiers – Logarithmic amplifiers – Attenuators – Second order active filters – Lowpass, Highpass, Bandpass, and Bandstop filters – Allpass filters – Phase sensitive detector (PSD).

Signal Generation:

Frequency synthesized signal generator – Frequency divider generator – Function generator – Noise generator. **Signal Analysis:** Wave Analyzer – Heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer – Spectra of CW, AM, FM and PM waves.

Unit III**Electronic Measuring Instruments:**

Digital frequency meter – Digital voltmeter – Phasemeter – RF power and voltage measurement.

Display and Recording: Magnetic tape recorders – Laser printers – Storage oscilloscope.

Characteristics of digital displays: LED and seven segment display systems.

Recommended Books

1. Modern Electronic Instrumentation and Measurement Techniques – A.O. Hefrick and W.D. Cooper, Prentice Hall India Publications.
2. Instrumentation Devices and Systems – C.S Rangan, G.R. Sharma and V.S V Mani, Tata McGraw Hill Publications.
3. Introduction to Instrumentation and Control – A.K. Ghosh – PHI Publications.
4. Electrical and Electronics Measurement and Instrumentation – A.K. Sawhney.
5. Transducers and Instrumentation – D.V.S. Murty PHI Publications.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - III Semester
Syllabus (For the batch admitted from 2023-2024 onwards)

Elective Paper-II

CourseCode	CourseTitle	L	T	P	C
P-304T/EI	EMBEDDED SYSTEMS AND ITS APPLICATIONS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To study the functional block diagram of microcontroller 8051.
COB2	To study memory and programming aspects of microcontroller 8051 .
COB3	To understand the concept of PIC microcontrollers.
COB4	To learn about interfacing with microcontroller 8051.
COB5	To study the PID and Stepper motors.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the working of microcontroller 8051.
COC2	Able to program microcontroller 8051.
COC3	Able to interface microcontroller 8051 with keyboard, LED, 7-Segment displays.
COC4	Able to measure Strain gauge.
COC5	Able to understand working of LVDT; PID and Relays systems.

Unit I

The 8051 Microcontroller

Block diagram of the 8051; Program Counter and ROM space, Data Types and Directives, PSW Register, Register Banks and Stack; **Pin Description**, I/O Programming, Addressing Modes of 8051. Arithmetic instructions and programming: Add, Subtract, Multiplication and Division of Signed and Unsigned numbers; Logical Instruction and Programs- Logic, Compare, Rotate, Swap, BCD and ASCII Application Programs; Single Bit Instructions with CY; Jump, Loop and CALL Instructions, Time Delay Generation and Calculation; Timer/Counter Programming, Serial Communication and Interrupts Programming.

Unit II

PIC Microcontrollers

PIC 16C6X/7X Architecture (PIC 16C61/C71), Registers, Pin diagram, Reset action Memory Organization, **Instructions**, Addressing Modes, I/O Ports, Interrupts, Timers, Analog-to-Digital Converter (ADC).

Pin Diagram of **PIC 16F8XX Flash Microcontrollers**, Registers, Memory organization, Interrupts, I/O Ports and Timers.

Unit -III

Applications of Microcontrollers

Interfacing of - Light Emitting Diodes (LEDs), Push Buttons, Relays and Latches.
Interfacing of - Keyboard, 7-Segment Displays, LCD Interfacing, ADC and DAC with 89C51 Microcontrollers.
Measurement Applications of - Robot Arm, LVDT and Strain Gauges
Automation and Control Applications of - PID Controllers, DC Motors and Stepper Motors.

Recommended Books:

1. Microcontrollers – Theory and Applications – By Ajay V Deshmukh, TMH, 2005
2. The 8051 Microcontrollers and Embedded Systems – By Muhammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, 4th Reprint, 2002
3. The 8051 Microcontroller – architecture, programming & applications – By Kenneth J. Ayala, Penram International Publishing, 1995.
4. Microcontroller 8051 by D. Karuna Sagar, Narosa Publishing House, New Delhi, 2011.
5. Design with PIC Microcontrollers – By J.B. Peatman, MH, Pearson Education Asia, 2003.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-Semester-IIISyllabus

(For the batch admitted from 2023-2024 onwards)
Elective Paper-I

CourseCode	CourseTitle	L	T	P	C
P-303T/NS	SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Study the classification of nanomaterials.
COB2	Study the various synthesis methods of nanomaterials.
COB3	Understand optical and thermal properties of nanomaterials.
COB4	Understand lithographic technique used in nanomaterials.
COB5	Study various characterization techniques for nanomaterials.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to demonstrate the concept of nanostructured materials, their size dependent properties, various examples in zero, one, two and three dimensions
COC2	Able to synthesize various routes which could be bottom-up and top-down approaches.
COC3	Able to develop skills in the preparation of nanomaterials by Physical and Chemical methods
COC4	Able to compare the lithographic techniques for the nanomaterial fabrication with the other techniques.
COC5	Able to use the knowledge of characterization techniques which include X-ray diffractometry and spectroscopy for studying more novel materials.

Unit -I

Properties of nanomaterials:

Classification of Nanostructured materials, density of states for 0D, 1D, 2D and 3D, nanoparticles, nano-wires, nano-clusters, quantum wells - Size dependent properties of nanomaterials – optical and thermal properties **Synthesis of nanomaterials-I**

Synthesis routes: Bottom-Up Approaches, Top-Down Approaches, consolidation of Nanopowders

Physical methods: Inert gas condensation, Arc discharge, RF Plasma, plasma organic spraying sputtering and thermal evaporation, laser pyrolysis, ball milling, molecular beam epitaxy, chemical vapour deposition method, electrodeposition.

Unit-II

Synthesis of nanomaterials-II

Chemical methods: chemical nucleation theory for cluster formation, metal nanocrystal synthesis by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, sonochemical routes, liquid-liquid interface, hybrid methods, solvated metal atom dispersion, sol-gel, micelles and micro-emulsion technology.

Lithographic techniques: AFM based nanolithography, e-beam lithography and SEM based nanolithography, ion beam lithography, deep UV lithography, X-ray based lithography.

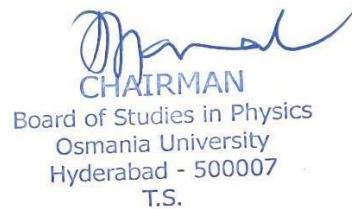
Unit-III

Characterization methods :Electron Microscopy : Introduction , Working of SEM,TEM,AFM, applications.
X-rayCrystallography:Introduction,Structureofnanomaterials,X-raydiffraction(XRD),Thepowdermethod-Determinationofgrainsize/crystalliteusingScherrer'sformula,DeterminationofCrystallitesizedistribution,Smallangle X-rayscattering(SAXS).

SpectroscopyTechniques:Introduction,Fouriertransforminfraredspectroscopy(FTIR),Ramspectroscopy,DSC,UV visible spectroscopy.

RecommendedBooks:

1. Textbook of Nanoscience and Nanotechnology-B.S.Murty, P.Shankar, BaldevRaj,
BBRathandJamesMurdayUniversitiespress,IIM,MetallurgyandMaterials Science
2. PrinciplesofNanoscience&NanotechnologyM.A.Shah,Tokeer Ahmad,NarosaPublishingHouse.
3. Nanocrystals:Synthesis,PropertiesandApplicationsC.N.Rao,P.J.Thomas,G.U.Kulkarni.
4. Springer HandbookofNanotechnology–Bharat Bhushan.
5. NanomaterialsHandbook– YuryGogotsi.



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

**M.Sc.(Physics)-Semester-
III Syllabus (For the batch admitted from 2023-
2024 onwards)**

Elective Paper -II

CourseCode	CourseTitle	L	T	P	C
P-304T/NS	PROPERTIES OF NANOMATERIALS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the electronic properties of nanomaterials.
COB2	Study the dielectric properties of nanomaterials.
COB3	Understand optical and thermal and mechanical properties of nanomaterials.
COB4	Understand concept of phonons in nanomaterials.
COB5	Study about magnetic nanofluids.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to identify the nano composites, nanofillers, their classification, properties and applications.
COC2	Able to develop skills in the preparation of nanocomposites such as polymer nanocomposites by Physical and Chemical methods..
COC3	Able to use the knowledge of synthesis techniques for studying more novel materials and apply in daily life or further research.
COC4	Able to analyze the mechanical properties of nanocomposites in general and also while they are used in devices.
COC5	Able to use the knowledge of characterization techniques which include X-ray diffractometry and spectroscopy for studying more novel materials.

Unit-I

Electronic properties: Classification of materials- metal, semiconductor, insulator-band structures, Brillouin zones, mobility, resistivity, relaxation time, recombination centers, Hall effects, Confinement and transport in nanostructures: current , reservoirs and electron channels, conductance, local density of states, ballistic transport, Hopping transport, coulomb blockade, diffusive transport and Fock space.

Unit-II

Dielectric and magnetic properties: Dielectric properties: Polarization, Clausius-Mossotti relation, Debye's equations, ferroelectric behavior, Curie-Weiss law, Polarons, Dielectric nanofluids and applications.

Magnetic properties: different kinds of magnetism in nature: dia, para, ferro, anti-ferro, ferri, superpara, and important properties in relation to nanomagnetism, magnetic nanofluids-characteristics and applications.

Unit-III

Optical, thermal and Mechanical properties:

Optical properties: photoconductivity, optical absorption & transmission, energy gap determination, photoluminescence, phosphorescence, electroluminescence.

Thermal properties: concept of phonons, thermal conductivity, specific heat, exothermic & endothermic processes.

Mechanical properties: tensile testing and tensile strength, breaking strength, plastic deformation, statistical analysis of failure data, true stress and strain, bend testing flexural strength and modulus, Brinell's, Vicker's hardness testing, impact testing – toughness, resilience and scratch test.

Recommended Books:

1. Textbook of Nanoscience and Nanotechnology-B.S.Murty, P.Shankar, BaldevRaj,BBRath and James Murday Universities press, IIM, Metallurgy and Materials Science
2. Principles of Nanoscience & Nanotechnology M.A.Shah, Tokeer Ahmad, Narosa Publishing House
3. Nanocrystals: Synthesis, Properties and Applications C.N.Rao, P.J.Thomas, G.U.Kulkarni
4. Springer Handbook of Nanotechnology – Bharat Bhushan
5. Nanomaterials Handbook – Yury Gogotsi
6. Introduction to Nanoscience and Nanotechnology – K K Chatopadhyay & Banerjee, PHI
7. Introduction of Nanotechnology – Charles P. Poole Jr and Franks J. Qwens
8. Physics of Magnetism – S. Chikazumi and S.H. Charap
9. Encyclopedia of Nanotechnology – Hari Singh Nalwa



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - Semester-III

Syllabus (For the batch admitted from 2023-2024 onwards)

P303T/EC

Elective Paper-I

CourseCode	CourseTitle	L	T	P	C
P-303T/EC	8051 MICRO-CONTROLLER & ITS APPLICATIONS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the architecture of 8051 microcontroller.
COB2	Study the addressing modes of 8051 microcontroller.
COB3	Understand timer and counter in 8051 microcontroller.
COB4	Understand concept of interfacing of 8051 microcontroller.
COB5	Understand programming of serial communication in 8051 microcontroller

Course Outcomes: After the completion of this course the student will be:

COC1	Able to program using 8051 microcontroller.
COC2	Able to program timers and counters in different modes in 8051 microcontroller.
COC3	Able to program serial communication RS-232 with 8051 microcontroller.
COC4	Able to program interrupts in 8051 microcontroller.
COC5	Able to interface LED/LCD; ADC and DAC with 8051 microcontroller.

Unit-I: Architecture of Microcontroller 8051:

Input/output pins, ports and circuits, external memory, counter and timer, serial data input and output, interrupts.

Addressing modes of 8051: immediate and register addressing modes, accessing memory using various addressing modes; unsigned addition and subtraction, unsigned multiplication and division, signed numbers concepts and arithmetic operations. Logic and compare instructions rotate and swap instructions. Jump, Loop and Call instructions, time delay generation and calculation; single bit operation with carry; reading input pins versus port latch and I/O programming.

Unit-II: 8051 Timer/ Counter, Serial Communication and Interrupts Programming:

Timer / Counter programming: programming 8051 timers, counter programming, pulse frequency and pulse width measurements. Basics of serial communication, 8051 connection to RS232, 8051 serial communication programming. Interrupts of 8051; programming timer interrupts, programming external hardware interrupts, and programming serial communication interrupts.

Unit-III: Interfacing of 8051 Microcontroller: Programmable peripheral interface (PPI)-

8255, programming 8255, 8255 interfacing with 8051. Interfacing Key board. Interfacing LED / LCD, Interfacing A/D & D/A converters, Interfacing stepper motor and temperature sensor.

Recommended Books:

1. 8051 Micro controller and Embedded systems by Mazidi andMazidi, Pearson EducationAsia(2002).
2. The 8051 Microcontroller Architecture.Programming and Applications byKennethAyala:PenramInternationalPub(1996).
3. Microcontroller8051byD.Karuna Sagar,Narosa PublishingHouse(2011).
4. The concepts and features of micro controllers (68HC11, 8051, 8096) by Rajkamal:Wheeler Pub(2000).



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-Semester-III Syllabus
(For the batch admitted from 2023-2024
onwards) Elective Paper-II

CourseCode	CourseTitle	L	T	P	C
P-304T/EC	DATA AND COMPUTER COMMUNICATIONS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the data communication networks.
COB2	Study the physical layer in communication.
COB3	Understand data link layer and different topologies.
COB4	Understand concept of network layer.
COB5	Understand transportation and application layer.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to communicate through LAN network.
COC2	Able to understand the TCP/IP layers and their functions.
COC3	Able to understand the flow control and error control in data link layer.
COC4	Able to understand packet switching principles.
COC5	Able to understand the HTTP and SNMP protocol.

Unit I:

Data Communication Networks:

LANs: PANs, MANs, Wireless LANs. Internetworks: WANs, Third-Generation Mobile Phone Networks, RFID and Sensor Networks. Protocol Hierarchies, Connection-Oriented Versus Connectionless Service, Service Primitives, Relationship of Services to Protocols. OSI Model: Functions of OSI layers. TCP/IP Model: TCP/IP layers and their functions.

The Physical Layer: Analog and Digital transmission, Transmission Impairments, Channel Capacity. Transmission Media: Guided transmission media, Wireless transmission, Wireless Propagation, Line of sight transmission. Signal Encoding Techniques: Digital Data, Digital Signals; Digital Signal Encoding Formats. Digital Data, Analog Signals; ASK, PSK, FSK. Analog Data, Digital Signals; PCM & DM. Error Detection & Error Correction: Types of Errors, Error Detection, Parity Check, Checksum, CRC.

Unit II:

The Data Link Layer: Flow Control, Error control, HDLC. Multiplexing: FDM, STDM. Asymmetric Digital Subscriber Line, xDSL. LANs: Topologies, LAN Protocol Architecture, Layer 2 & Layer 3 switches, Virtual LANs. High Speed LANs: Traditional Ethernet, High-Speed Ethernet, IEEE 802.1Q VLAN Standard. Wireless LANs: IEEE 802.11 Architecture and Services, IEEE 802.11 Medium Access Control, IEEE 802.11 Physical layer, IEEE 802.11 Security Considerations. WANS: Circuit Switching Networks, Circuit Switching Concepts, Soft Switch Architecture, Packet Switching Principles. Asynchronous Transfer Mode (ATM): ATM architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service categories, ATM Adaptation Layer.

Unit III:

The Network Layer: Principles of Internetworking: Connectionless Internetworking. Internet protocol: IP services, IP datagram format, IP addresses, Network Classes, Subnets and Subnet Masks, Internet Control Message Protocol (ICMP). IPv6: Motivation for new version, enhancements in IPv6 over IPv4,

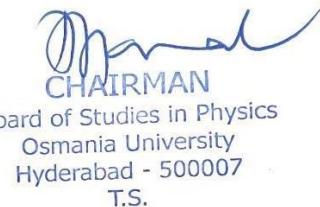
IPV6 structure, IPV6 header, IPV6 addresses, hop by hop option header, fragment header, routing header and destination option header. Multicasting: Practical applications, multicasting in an internet environment, requirements for multicasting. Routing protocols: Autonomous systems, Approaches to Routing, Open Short Path First (OSPF) Protocol and Border Gateway Protocol (BGP).

Transport Layer: Connection Oriented Transport Protocol Mechanisms: TCP and UDP.

Application Layer: Electronic Mail, SMTP and MIME. Internet Directory Service: Domain Name System (DNS). Hypertext Transfer Protocol (HTTP). Simple Network Management Protocol (SNMP).

Recommended Books

1. Data and Computer Communications, William Stallings [Tenth Edition]
2. Computer Networks, A.S. Tanenbaum [Fifth Edition]
3. Data Communications and Networking, Behrouz A. Forouzan [Fourth Edition]



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-Semester-III Syllabus

(For the batch admitted from 2023-2024 onwards)
Elective Paper – I

CourseCode	CourseTitle	L	T	P	C
P-303T/BP	Molecular and Environmental Biophysics	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the structure and function, stability of biological macromolecules (enzyme, protein, lipids, nucleic acids and biocatalysts). .
COB2	Study the different biological systems and biological processes through statistical thermodynamic principles.
COB3	Understand the importance of environment and life.
COB4	Understand electromagnetic radiation and environment; conductance of heat and temperature, mass transfer etc.
COB5	Understand optical activity in detail.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to learn about basic functions of macromolecules.
COC2	Able to understand enzymes classification of different models.
COC3	Able to understand the statistical thermodynamics, entropy, application to biological system.
COC4	Able to understand Optical activity: CD and ORD, Proteins.
COC5	Able to student will able to familiar with environment and its importance to human being.

Unit I: Structure and functions of macromolecules and Biocatalysis:

Structure and function of disaccharides and polysaccharide. Classification of proteins. Primary and secondary structures of proteins. Chemistry of nucleic acids. DNA duplication. Protein synthesis. Structure and functions of lipids. Classification of enzymes. Michaelis-Menten model for enzyme catalysed reactions. Lineweaver-Burke plots. Inhibitors- specific and non-specific. Modified Michaelis-Menten model for fully competitive and non-competitive inhibited enzyme catalysed reactions. Enzyme specificity. Enzyme structure and function relation.

Unit II: Statistical thermodynamics: CD & ORD

Statistical thermodynamics: Intramolecular and intermolecular forces, Types of bonds, Debye-Hückel theory. Statistical thermodynamics and biology. Entropy transfer of living organisms. Information theory – relation between information and entropy. Information content of some biological systems.

CD & ORD: Polarisation (basics), nature and origin of optical activity, chiral molecules. Optical rotation and circular dichorism, relation between CD & ORD. Drude's equation. Moffit's equation. Cotton effect. Optical activity in native proteins and conformation. Determination of helical content.

Unit III: Environmental Biophysics

Introduction: Microenvironments, Energy exchange, Mass and momentum transport, conservation of energy and mass, continuity in the biosphere, models, heterogeneity and scale.

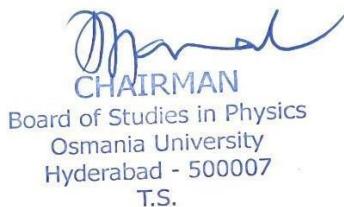
Temperature: Typical behavior of atmosphere and soil temperature, Random temperature variation, Modeling vertical variation in Air temperature, Modeling Temporal variation in Air temperature, soil temperature changes with depth and time, Temperature and Biological Development, Thermal time and calculation from weather data, Temperature extremes and the computation of thermal time, Normalization of thermal time, Thermal time in relation to other environmental variables.

Heat and Mass Transport: Molar Fluxes, Integration of the transport equations, Resistances and Conductances, Resistors and Conductors in series, Resistors in Parallel, Calculation of Fluxes. Conductance for molecular diffusion, Molecular Diffusivities, Diffusive conductance of the integuments, Turbulent transport, Fetch and Bouyancy, Conductance of the atmospheric surface layer, conductance for heat and mass transfer in laminar forced convection, cylinders, spheres and animal shapes.

Humans and their environment: Area, Metabolic rate and evaporation, survival in cold environments, wind chill and standard operative temperature, survival in hot environments, the humid operative temperature, Comfort, Dosimetry and variable linear energy transfer.

Recommended Books:

1. Essentials of biological chemistry - by Fairley & Kilgour
2. Molecular Biophysics - by Setlow & Pollard
3. Life chemistry - An introduction to Biochemistry - by Steiner
4. Intermediate Physics for medicine and biology - by Russell K. Hobby
5. Biophysical Chemistry - by AG Marshall
6. An Introduction to Environmental Biophysics - Gaylon S. Campbell and John M. Norman.
7. Experimental methods in Biophysical Chemistry - by CNicolau
8. An introduction to spectroscopy for biochemists - by Brown



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-Semester-III Syllabus

(For the batch admitted from 2023-2024 onwards)
Elective Paper -II

CourseCode	CourseTitle	L	T	P	C
P-304T/BP	Physico-Chemical Techniques in Biophysics	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand physicochemical techniques such as viscosity..
COB2	Study the different biological systems and biological processes through statistical thermodynamic principles.
COB3	Understand the students familiar with some separation techniques such as electrophoresis and various chromatographic techniques.
COB4	Understand various Imaging techniques such as Fluorescence microscope; Ultraviolet microscope; Interference microscope; Polarizing microscope.
COB5	Understand phase contrast microscope; electron microscope; scanning probe microscopy – atomic force microscope (AFM), scanning tunneling microscope ((STM). scanning nearfield optical microscope (SNOM).

Course Outcomes: After the completion of this course the student will be:

COC1	Able to learn about different techniques in order to get information about polymers and biomolecules.
COC2	Able to understand methods and techniques like: molecular weight determination, sedimentation and scattering.
COC3	Able to gain the knowledge of different separation techniques, will understand basic principles, instrumentation, working and applications in biology and medicine.
COC4	Able to gain the knowledge of different Imaging techniques, instrumentation, working and applications in biology and medicine.
COC5	Able to understand techniques used in biological applications of bio-molecules.

Unit I: Molecular weight determination

Viscosity: Specific and intrinsic viscosities and their determination by Ostwald's method. Determination of molecular weight from intrinsic viscosity.

Sedimentation: Theory of sedimentation. Determination of sedimentation coefficient by sedimentation equilibrium method and sedimentation velocity method. Calculation of molecular weight from sedimentation equilibrium and velocity methods.

Rayleigh's Scattering: Rayleigh's equation for scattering for dilute gas. Theory for particles small compared with wavelength of light. Theory of large particles with dimensions approaching the wavelength of light. Expression for the particle scattering factor $P(\phi)$ and its relation to radius of gyration

Unit-II:Separation Techniques

Electrophoresis: Introduction to Electrophoresis. Principle of electrophoresis. Electrophoretic Mobility(EPM) estimation, factors effecting EPM, Supporting media. Types of electrophoresis - Discelectrophoresis: Isoelectric focusing, Isotachophoresis, Paper electrophoresis, Gel electrophoresis;Capillaryelectrophoresis. Applications of electrophoresis in biology and medicine.

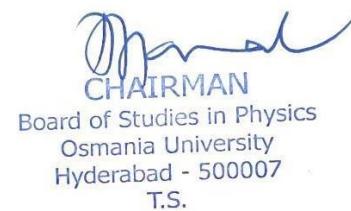
Chromatography: Introduction to chromatography. Principle, Instrumentation, working and biological applications of Column chromatography, liquid chromatography, Thin layer chromatography (TLC), Paper chromatography, Ion exchange chromatography, Gel chromatography, Affinity chromatography, Gas chromatography.

Unit-III:Microscopy

Principle, description, working and biological applications of Fluorescence microscope; Ultraviolet microscope; Interference microscope; Polarizing microscope; Phase contrast microscope; Electron microscope; Scanning probe microscopy – Atomic Force microscope (AFM); Scanning tunneling microscope ((STM)). Scanning near field optical microscope (SNOM).

Recommended Books:

1. Experimental methods in biophysical chemistry – Nicolau
2. Intermediate Physics for Medicine and biology – Russel K, Hobby
3. Basic Biophysics for biologist – M. Daniel.
4. Molecular Biophysics – Richard B. Setlow and Ernest C. Pollard.
5. Electrophoresis in Practice – Reiner Westermeier.



**DEPARTMENT OF
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M.Sc. (Physics) - Semester-III
Syllabus(For the batch admitted from 2023-2024 onwards)

Elective Paper -I

CourseCode	CourseTitle	L	T	P	C
P-303T/CMP	LATTICEDYNAMICSINCRYSTALS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the lattice vibrations of crystals..
COB2	Study the effect of lattice vibrations on the intensity of the scattered radiation
COB3	Understand the methods of X-ray diffraction.
COB4	Understand theory of small vibrations.
COB5	The absorption and Emission in optical crystals and phonons.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to learn about density of phonon modes, Normal modes of vibration.
COC2	Able to understand Hamiltonian for lattice vibrations in the Harmonic approximation
COC3	Able to gain the knowledge of Laue method, Bragg method and Debye-Scherrer method.
COC4	Able to gain the knowledge of deformation potential scattering, piezoelectric scattering and Frolich scattering.
COC5	Able to understand Hartree-Fock theory of free electrons-Ground state energy, exchange energy, correlation energy.

Unit-I

Lattice Vibrations of Crystals: The infinite and finite linear crystal, Vibrational modes for linear chain with basis and in higher dimensions,. - Lattice vibrations in Three dimensions: The equation of motion, Allowed values of k : Density of phonon modes, Normal modes of vibration, Energy levels.

Group Theory and Lattice Vibrations: Properties of Normal coordinates, the frequency of Eigenvalues and the polarization vectors, Time-Reversal Degeneracy. Group theoretical analysis of the lattice vibrations of a linear crystal- case of one atom per unit cell, case of two atoms per unit cell; Ex: Lattice vibrations of a two dimensional crystal with symmetry C^1 ^{4v..}.

Born-Oppenheimer Approximation, Hamiltonian for Lattice Vibrations in the Harmonic Approximation, Normal Modes of the System and Quantization of Lattice Vibrations-Phonons.

Unit-II

Effect of lattice vibrations on the intensity of the scattered radiation: The intensity of scattered radiation, effect of lattice vibrations-Einstein model, Normal mode treatment.

Scattering of X-rays: from a single electron, single atom and crystal; Interpretation of Laue equations in Reciprocal space. **Method of X-ray Diffraction:** Laue method, Bragg method and Debye-

Scherrer method. Theory of Neutron scattering, Elastic Neutron scattering, Inelastic Neutron scattering, Applications of Neutron scattering to the study of lattice Vibrations.

Unit-III

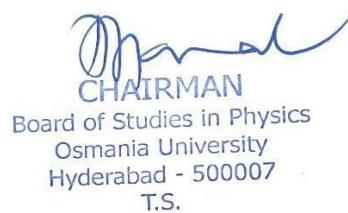
Theory of small vibrations (Classical & quantum mechanical), Harmonic and Anharmonic relaxation in solids, the effect of impurities on lattice vibrations, The Franck-Condon principle.

The absorption and Emission in optical crystals, Phonons: Properties of phonons and momentum of phonons; Zero-Phonon (electronic) transitions, Characteristics of Zero-Phonon lines, Phonon-assisted transitions- Electron-phonon interactions:- The rigid-ion model. Electron-phonon matrix elements

for metals, insulators and semiconductors. Deformation Potential Scattering, Piezoelectric Scattering, Frohlich Scattering. Polaron.- Deviations from the Franck-Condon Approximation, Deviations from the Adiabatic Approximation-Radiationless Transitions- The Hartree equations, Exchange: The Hartree-Fock approximation, Hartree-Fock theory of free electrons- Ground state energy, exchange energy, correlation energy (only concept).

Recommended books

1. Principles of the Theory of Solids: J. M. Ziman
2. Elementary Solid State Physics: M. A. Omar
3. Introduction to Solid State Physics: C. Kittel
4. Advanced Solid State Physics: Philip Phillips
5. The Wave Mechanics of Electrons in Metals: Stanley Raimes
6. Solid State Physics: Neil W. Ashcroft and N. David Mermin
7. Introduction to Modern Solid State Physics: Yuri M. Galperin
8. Solid State Physics: An Introduction to Principles of Materials Science (4th Ed.): H. Ibach and H. Luth
9. Principles of Condensed Matter Physics: Chaikin and Lubensky
10. Solid State Physics, Essential Concepts: David W. Srolovitz
11. Condensed Matter Physics, M. P. Marder, John Wiley & Sons, Inc. 2000.
12. Group Theory and its Application to the Quantum Mechanics of Atomic Spectra : E.P. Wigner, (1959), Academic Press
13. Quantum Chemistry: I.N. Levine, (1994), Prentice-Hall of India, Pvt. Ltd.
14. Initio Molecular Orbital Theory: W.J. Hehre, L. Radom, P.V.R. Schleyer, J.A. Pople, John Wiley, (1986).
15. Modern Quantum Chemistry: A. Szabo and N.S. Ostlund, (1996), Mc-Graw Hill.



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus (For the batch admitted from 2023-2024 onwards)****Elective Paper -II**

CourseCode	CourseTitle	L	T	P	C
P-304T/CMP	OPTICAL PHENOMENA AND MOSSBAUER EFFECTS IN SOLIDS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the interaction of radiation and matter with the help of quantum theory.
COB2	Study the dielectric and optical properties of materials.
COB3	Understand the Kramers-Kronig relations and Photon-Phonon transitions.
COB4	Understand the Mossbauer Effect.
COB5	Understand different kinds of luminescence.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to the processes of absorption and emission of radiative fields.
COC2	Able to understand principles of magneto-optic effect and optical transitions
COC3	Able to differentiate the direct and indirect bandgap semiconductors.
COC4	Able to analyze the Mossbauer spectroscopy, Isomeric shift and Magnetic hyperfine interactions.
COC5	Able to explain energy level diagrams of radiative and non-radiative processes.

UNIT-I**Interaction of Radiation with matter**

Classical and Quantum theory of radiative field. The Hamiltonian of a charged particle in an electromagnetic field, T he interaction between a charged particle and a radiative field. First order process:- Absorption and Emission of Radiative field; Second order process:- Matrix elements due to H₁ and H₂, Effective matrix element, Transition rates of Scattering processes.

Relation between dielectric and optical properties (macroscopic theory), Kramers-Kronig relations, Absorption of electromagnetic radiation, Photon-Phonon transitions, Interband transitions, Direct and indirect band gap semiconductors - Absorption coefficients. Frenkel and Wannier excitons and their absorption, Imperfections - exciton absorption below the band gap, Intra band transitions- Absorption and reflection in metals. Hagen-Rubens relation, Magneto-optic effects: Faraday effect.

UNIT-II**Mossbauer Effect**

Resonance fluorescence/Natural and Doppler broadening of lines, Qualitative theory of recoil less gamma ray emission, Mossbauer effect, Temperature dependence of recoilless process, Debye-Waller factor, Experimental study, Mossbauer spectroscopy, Quantum mechanical theory of Mossbauer effect, Isomeric shift, Magnetic hyperfine interactions, Electric quadrupole interactions, Applications of Mossbauer effect

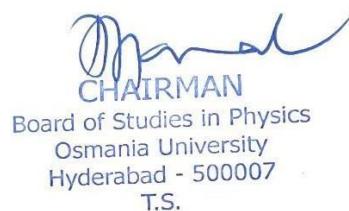
UNIT-III

LuminescenceandColorcenters

General considerations of luminescence, exciton, absorption and emission processes of luminescence. Configuration coordinate diagram, Energy level diagram, radiative and non-radiative processes, Decay mechanisms. Effect of doping and efficiency, Energy transfer and charge transfer, Different kinds of luminescence-Electro luminescence, Photoluminescence and Thermo luminescence. Defects and colorcenters, Different kinds of colorcenters in the context of luminescence in alkali halides, Thallium activated alkali halides, Zinc sulphide phosphors.

Recommended books

1. Principles of Theory of Solids: Ziman, Vikas Publishing House, New Delhi.
2. Solid State Physics: G. Burns
3. Luminescence and Luminescent Materials: Blasse
4. Solid State Physics: Dekker.
5. Elementary Solid State Physics: M. Ali Omar
6. Crystal Symmetry, Lattice Vibrations, and Optical Spectroscopy of Solids: A Group Theoretical Approach: Baldassare Di Bartolo and Richard C Powell
7. Laser Spectroscopy, Basic Concept and Instrumentation: W. Demtroder, (2004), Springer.
8. Infrared and Raman Spectroscopy: B. Schrader, (1993), John Wiley & Sons
9. Group Theory and its Application to the Quantum Mechanics of Atomic Spectra : E.P. Wigner, (1959), Academic Press



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus (For the batch admitted from 2023-2024 onwards)****Elective Paper-I**

CourseCode	CourseTitle	L	T	P	C
P-303T/OE	INTRODUCTION TO OPTOELECTRONICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the fundamental of optical theories.
COB2	Compare the light wave propagation through different media.
COB3	Understand and identify the importance of optical anisotropy.
COB4	Understand describe the effect of external fields on light.
COB5	Understand the elementary concept of quantum theory of optics.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to describe the light given by different optical theories.
COC2	Able to differentiate the behavior of light propagating through different media.
COC3	Able to understand the concept of optical anisotropy.
COC4	Able to compare the effect of external fields on light.
COC5	Able to explain the elementary concept of quantum optics.

Unit I: Introduction: Ray optics: postulates, differential equation of a light ray; wave optics: postulates, monochromatic waves, elementary waves, eikonal equation; electromagnetic optics: plane waves in a dielectric, polarization of light, uniaxial and biaxial crystals, dielectric tensor, birefringence, plane waves in anisotropic media, the phase velocity and ray velocity, wave refractive index, index ellipsoid.

Unit II: Modulation of light: Index ellipsoid in the presence of an external electric field, electro-optic effect-Kerr effect, Pockels effect, electro-optic retardation, electro-optic phase and amplitude modulation, modulator design considerations, Photoelastic effect, Acousto-optic effect - Acousto-optic modulation, Raman-Nath and Bragg regimes and their modulators. Magneto-optic effect - Faraday effect, optical activity.

Unit III: Quantum Optics: Quantization of free electromagnetic field - mode expansion, quantization infinite one-dimensional cavity, quantization in unbounded free space, creation and annihilation operators, number states, vacuum fluctuations and the zero-point energy, coherent states - generation and properties, squeezed states: uncertainty relation, squeeze operator, generation of squeezed states, entangled states and their properties.

Reference Books:

1. Fundamentals of Photonics – B.E. A.Saleh and M. C.Teich, wiley, 2nd edition.
2. Principles of Optics – M.Born and E.Wolf, Cambridge university press, 7th edition.
3. Optical Electronics – A.Ghatak and K.Thyagarajan, Cambridge University Press.
4. Lasers and Electro-optics: Fundamentals and Engineering - Christopher C. Davis, Cambridge University Press, 2nd Edition.
5. Quantum Optics – Marlan O. Scully and M. Suhail Zubairy, Cambridge university press
6. Introductory quantum optics - Christopher C. Gerry and Peter L. Knight, Cambridge University Press.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus (For the batch admitted from 2023-2024 onwards)****Elective Paper-II**

CourseCode	CourseTitle	L	T	P	C
P-304T/OE	SEMICONDUCTOR OPTOELECTRONICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of optical transitions in semiconductor materials.
COB2	Describe the structures and working of different optical sources & detectors.
COB3	Understand to compare different optoelectronic devices.
COB4	To identify the applications of optoelectronic devices.
COB5	Analyze the need of optoelectronic integrated devices.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to explain the optical transition processes in semiconductor materials.
COC2	Able to differentiate the different type of optical sources & detectors.
COC3	Able to identify different optoelectronic devices.
COC4	Able to evaluate varied applications of optoelectronic devices.
COC5	Able to appreciate the applications of optoelectronic integrated devices.

Unit I: Optical Processes in Semiconductors: Alloy semiconductors, Electron-hole pair formation and recombination, radiative and nonradiative recombination, band-to-band recombination.

Absorption in semiconductors - indirect intrinsic transitions, exciton absorption, donor-acceptor and impurity-band absorption, effect of electric field on absorption, absorption in quantum wells, the Kramers-Kronig relations.

Radiation in Semiconductors - Relation between absorption and emission spectra, near band gap radiative transitions, Auger recombination, luminescence from quantum wells.

Unit II: Sources and Detectors:**Light Emitting Diodes:** Electroluminescent process, choice of LED materials, device configuration and efficiency, LED structures: heterojunction LED, surface emitting LED, edge-emitting LED, device performance characteristics.**Junction lasers:** Operating principle, threshold current, heterojunction lasers, modulation of lasers - rate equations, steady state solution, mode-locking of semiconducting lasers.**Photodetectors:** Photoconductor, junction photodiodes - PIN photodiodes, phototransistor, Schottky-barrier photodiode.

Unit III: Optoelectronic Integrated Devices: Optical amplifiers - Erbium-doped, Raman and Brillouin amplifiers, Beam splitters, Direction couplers and switches, bistable optical devices, fiber splicers, fiberconnectors,fibercouplers,fiberoptic sensors,fiberBragggratings.

Optoelectronic Integrated Circuits: Need for integration, materials for optoelectronic integrated circuits(OEICs),frontend photoreceivers,opticalcontrolofmicrowaveoscillators.

Reference Books:

1. Semiconductor optoelectronic devices-Pallab Bhattacharya, Pearson Education, 2nd edition.
2. Semiconductor optoelectronics: Physics and Technology-J. Singh, McGraw-Hill.
3. Semiconductor physics and devices-Donald A. Neamen, McGraw-Hill, 3rd edition.
4. Integrated optics: theory and technology-Robert G. Hunsperger, Springer, 6th edition.
5. Optical Fiber communications: principles and practice – John M. Senior, Pearson Education, 3rd edition.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus(For the batch admitted from 2023-****2024 onwards)****P301T/AE****Core Paper -I**

CourseCode	CourseTitle	L	T	P	C
P-301T/AE	DIGITAL SYSTEM DESIGN	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of Boolean functions and Boolean algebra.
COB2	Describe the logic design and the digital circuits.
COB3	Understand the working of CPLD and FPGA .
COB4	To understand the sequential logics and counters.
COB5	Analyze the TTL, ECL, MOS and CMOS circuits.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to explain the Boolean algebra.
COC2	Able to apply logic design using adders, subtractors and code converters.
COC3	Able to identify different logic families.
COC4	Able to evaluate varied applications of combinational logic.
COC5	Able to appreciate the applications of sequential logic circuits and counters.

Unit I: Boolean Functions: Binary, Octal, Hexadecimal Numbers, Binary Codes and Logics; Boolean Algebra, Basic Theorems and Functions, Canonical, Digital and Integrated Circuits; Simplifications of Boolean Functions, Two to Six Variable Map Simplification, NAND and NOR Implementation, Tabulation method, Determination and Selection of Prime Implicants.

Unit II: Logic Design: Combinational Logic – Adders, Subtractors, Code Conversion, Multilevel NAND, NOR and Ex-OR functions; MSI and PLD Components – Decimal, Binary Adder and Subtractor, Comparators, Decoders, Encoders, Mux and Demux, ROM, PLA and PAL; **GAL, CPLD and FPGA.** Over view of Digital Integrated Circuits with all Logic Families – TTL, ECL, MOS, CMOS.

Unit III: Sequential Logics and Counters: Synchronous Sequential Logics – FFs, Analysis, State Reduction and Assignment, FF Excitation Tables, Design Procedure and Design of Counters; Asynchronous Sequential Logics – Analysis, Circuits with Latches, Registers, Shift Registers, Ripple and Synchronous Counter. -

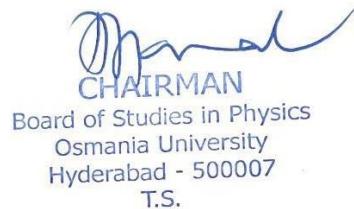
Text Books:

1. Digital Design – M. Morris Mano
2. Switching theory & Logic Design – R.P. Jain TMH 2003

3. Digital System Principles & Applications - Ronald J. Tocci

Reference Books:

1. Computer Architecture and Logic Design - Thomas C. Bartee
2. Digital Principles & Applications - Albert Paul Malvino and Donald P. Leach
3. Digital Computer Design - V. Rajaraman and T. Radhaknan
4. Digital Electronics - An Introduction to Theory and Practice - William H. Gothman
5. Digital Computer Electronics - A.P. Malvino and J.A. Brown
6. Digital Integrated Circuits - A Design Perspective - Jan M.Rabaey
7. ICs & Microprocessors - Data Handbook, BPB Publications, India
8. Digital Logic and Microprocessors - F.J. Hill and G.R. Peterson
9. Digital Circuits and Microprocessors - Herbert Taub
10. Switching and Finite Automata Theory - Zvi Kohavi and Niraj K. Jha
11. Digital Design - John F. Wakerly



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus(For the batch admitted from 2023-2024 onwards)****Core Paper -II**

CourseCode	CourseTitle	L	T	P	C
P-302T/AE	DIGITAL SIGNAL PROCESSING AND DIGITAL SIGNAL PROCESSORS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of Discrete Time Signal and Linear Systems.
COB2	Describe the Discrete Fourier Transform.
COB3	Understand the concept of Fast-Fourier Transform.
COB4	To understand the Design of Digital Filters.
COB5	Understand the architecture of TMS320C5X.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to appreciate the use of FFT in digital signal processing.
COC2	Able to apply frequency analysis of discrete time signals.
COC3	Able to design FIR filter using windows.
COC4	Able to program TMS320C5X in terms of central architecture logic unit (CALU)-auxiliary register (AR) and index register.
COC5	Able to apply pipelining in TMS320C5X and its operation.

Unit I: Discrete Time Signal And Linear Systems – Introduction-Advantages of DSP-Classification of Signals-Signal representation-Standard signals discrete –time signals- Operation on signals Discrete time system-Classification of Discrete time system- Convolution- Correlation of Two sequences-Inverse systems and Deconvolution, frequency analysis of Discrete time signals.

Z-Transform-Introduction-ROC-Properties of ROC-Inverse Z-Transform-Discrete Fourier Transform-Discrete Fourier Series-Properties-DFT-Properties-Comparison between linear and circular convolution-filtering long duration sequence.

Unit II: Fast-Fourier Transform- direct evaluation of DFT-Decimation-in-Time and Frequency-Differences and similarities between DIT and DIF-IIR filters- Introduction-Design of Digital Filters from analog filters-Analog low pass filter design-Butterworth-Chebyshev- filters-Design of IIR filters from analog filters-Frequency transformation on digital domain-realization of Digital Filters.

FIR Filter- Introduction-Linear Phase FIR filters-their frequency response-Location of the zeros of LPF FIR filters-Fourier series method of designing FIR filter-Design of FIR filter using windows-Frequency sampling method of designing FIR filters-Realization of FIR filters-Finite word length effects in digital filters-Introduction-Rounding and truncation errors-Quantization in A/D signals-Quantization effects in the computation of DFT.

Unit III: Digital Signal Processor- Architecture of TMS320C5X-Bus structure-Central Architecture

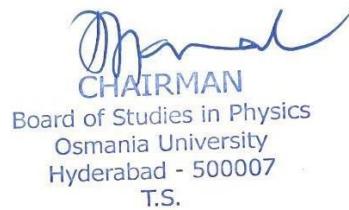
logicunit(CALU)-AuxiliaryRegister(AR)-Indexregister(INDX)-ARCR-BlockmoveaddressRegister-BlockRepeatRegister-Parallellogicunit-memorymappedregisters-programcontroller-someflagsinstatusregister-On-chip memory-On-chipperipherals.

TMS320C5XLanguage-Assemblylanguagesyntax-Addressingmodes-Instructions-Load/Store-Addition/Subtraction-Move-MultiplicationNORM-Programcontrol-Peripheral control.

Instruction Pipelining in C5X-Pipeline structure-Operation-Application programs in C5X-C50 basedDSP starter Kit (DSK)-Programs for familiarization of arithmetic instructions-Programs in C5X forprocessingRealTime signals.

RecommendedTextBooks:

1. DigitalSignalProcessingbyProkaiies(PHI)
2. DigitalSignal ProcessingbySanjitKMitra
3. Digital SignalProcessingbyRameshBabu-Sci-TechPub
4. DigitalSignalProcessersbyB.VenkataRamanietal(TMH)
5. DigitalSignal ProcessersbySenMKuoetal-PearsonEducation



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus (For the batch admitted from 2023-2024 onwards)****Elective Paper - I**

CourseCode	CourseTitle	L	T	P	C
P-303T/AE	Data Communications & Networking	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of TCP/IP Protocol Architecture.
COB2	Describe the guided transmission media and wireless transmission.
COB3	Understand the concept of Digital Data Communication Techniques.
COB4	To understand the Data Link Control Protocols.
COB5	Understand the Circuit Switching and Packet Switching.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to use OSI model for digital data transmission.
COC2	Able to apply signal encoding techniques.
COC3	Able to design data flow control, error control and HDLC.
COC4	Able to frequency-division multiplexing, synchronous time-division multiplexing of digital data.
COC5	Able to apply effects of congestion, congestion control and traffic management.

UNIT-I**TCP/IP Protocol Architecture, OSI Model, Standardization within a Protocol Architecture, Traditional Internet-Based Applications, Multimedia.****Data Transmission:** Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity.**Transmission Media:** Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission.**Signal Encoding Techniques:** Digital Data, Digital Signals, Digital Data, Analog Signals, Analog Data, Digital Signals, Analog Data, Analog Signals.**Digital Data Communication Techniques:** Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations.**Unit-II****Data Link Control Protocols:** Flow Control, Error Control, High-Level Data Link Control**(HDLC).** **Multiplexing:** Frequency-Division Multiplexing, Synchronous Time-

Division Multiplexing, Statistical Time-Division Multiplexing, Asymmetric Digital Subscriber Line, xDSL

Circuit Switching and Packet Switching: Switched Communications Networks, Circuit Switching Networks, Circuit Switching Concepts, Softswitch Architecture, Packet-Switching Principles, X.25, Frame Relay.**Asynchronous Transfer Mode:** Protocol Architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service Categories.

Unit-III

Routing in Switched Networks: Routing in Packet-Switching Networks, Least-Cost Algorithms. **Congestion Control in Data Networks:** Effects of Congestion, Congestion Control, Traffic Management, Congestion Control in Packet-Switching Networks, Frame Relay Congestion Control, ATM Traffic Management, ATM-GFR Traffic Management.

Recommended Books:

1. William Stallings, Data & computer communications 8/e Pearson education.
2. Behrouz A. Forouzan, Data communications & networking 3/e TMH.
3. Fred Hasal, Data communications computer network and open systems 4/e Pearson education 2005.
4. R.P. Singh, S.D. Sapre Communication Systems, Analog and Digital 3/e, McGraw Hill, 2017.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-III****Syllabus(For the batch admitted from 2023-2024 onwards)****Elective Paper -II**

CourseCode	CourseTitle	L	T	P	C
P-304T/AE	MICROCONTROLLER AND APPLICATIONS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the architecture of 8051 microcontroller.
COB2	Study the addressing modes of 8051 microcontroller.
COB3	Understand timer and counter programming of 8051 microcontroller.
COB4	Understand concept of interfacing of 8051 microcontroller.
COB5	Understand interfacing using Arduino.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to program using 8051 microcontroller.
COC2	Able to program timers and counters in different modes in 8051 microcontroller.
COC3	Able to interface LCD; ADC; DAC and stepper motor with 8051 microcontroller.
COC4	Able to program interrupts in 8051 microcontroller.
COC5	Able to interface using Arduino.

Unit I: The 8051 Microcontroller

Microcontrollers and Embedded processors, overview and Block diagram of the 8051; Inside the 8051, Assembling and Running an 8051 Program, The Program Counter and ROM space, Data Types and Directives, Flag Bits and PSW Register, Register Banks and Stack; Pin Description, I/O Programming, Bit Manipulation; Addressing Modes- Immediate and Register Addressing Modes, Accessing Memory using Various Addressing Modes

Unit II: Programming and Interfacing 8051

Instruction Set- Arithmetic instruction Programs- Add, Subtract, Multiplication and Division of Signed and Unsigned Numbers; Logical Instruction and Programs- Logic, Compare, Rotate, Swap, BCD and ASCII Application Programs; Single Bit Instructions and Programming- Single Bit Instructions with CY; Jump, Loop and call Instructions, Time Delay Generation and Calculation; Timer/Counter Programming, Serial Communication and Interrupts Programming.

Interfacing an LCD, ADC and Sensors with the 8051; Interfacing a Stepper Motor, Keyboard and DAC to generate waveforms on CRO with 8051.

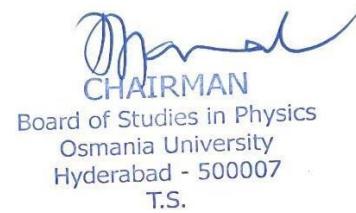
Unit III: Interfacing using Arduino

Types of Arduino boards, Arduino Uno Architecture, Sensors and Actuators, Interfacing of Sensors with Arduino-

Temperature, Humidity, Motion, Ultrasonic Sensor, PIR Motion Sensor, Light, Moisture Sensor and Gas Sensor. Interfacing of Actuators- Relay Switch and Servo Motor, Introduction to NodeMCU.

Recommended Books:

1. The 8051 Microcontrollers and Embedded Systems -
By Muhammad Ali Mazidi and Janice Gillispie Mazidi, Person Education, Asia, 4th Reprint, 2002.
2. The 8051 Microcontroller - Architecture, Programming & Applications -
By Kenneth J. Ayala, Penram International Publishing, 1995.
3. Microcontroller 8051 - By D. Karuna Sagar, Narosa Publishing House, 2011.
4. C Programming for Arduino, Jelien Bayle, Packt Publishing, Birmingham, UK.
5. Arduino Made Simple by Ashwin Pajankar, BPB Publications.



**DEPARTMENT OF PHYSICS, OSMANIA
UNIVERSITY REVISED SYLLABUS FOR
M.Sc.(PHYSICS)**

IV SEMESTER

With effect from the academic year 2023-2024 onwards

S.No	Papercode	Paper	Papertitle	Instructions Hrs /Week	Credits	Max Marks
1.	P401T	CorePaper-I	NuclearPhysics	3	3	100*
2	P402T	CorePaper-II	Spectroscopy	3	3	100*
Solid State Physics (SSP)						
3	P403T/SSP	Elective-III	Optical Phenomena in solids	3	3	100*
Materials Science (MS)						
4	P403T/MS	Elective-III	Material Science	3	3	100*
Electronics & Instrumentation (E&I)						
5	P403T/EI	Elective-III	Instrumentation for measurement and data transmission	3	3	100*
Nano Science (NS)						
6	P403T/NS	Elective-III	Nanocomposites	3	3	100*
Electronics Communications (EC)						
7	P403T/EC	Elective-III	Mobile cellular communications	3	3	100*
Bio Physics (BP)						
8	P403T/BP	Elective-III	Cell and membrane biophysics	3	3	100*
Condensed Matter Physics (CMP)						
9	P403T/CMP	Elective-III	Transport Phenomena in solids	3	3	100*
Opto Electronics (OE)						
10	P403T/OE	Elective-III	Fiber Optic Technology	3	3	100*
PRACTICALS						
11	P 405P	V	General Physics lab	8	4	100
12	P 406P	VI	Special lab	4	2	50
13			Project		5	150
					20	600

Applied Electronics (AE)				Marks	Credits	
14	P401T/AE	Core Paper I	Digital system design using VHDL	3	3	100*
15	P402T/AE	Core Paper II	Feedback Control Systems	3	3	100*
16	P403T/AE	Elective Paper III	Guided and Unguided media communication	3	3	100*

	P404/AE	Project			5	150
<u>PRACTICALS</u>						
17	P 405P/AE	V	FiberOpticsCommunication& Microwaves Lab	4	2	50
18	P 406P/AE	VI	VHDLLab	8	4	100

Detailsofcreditsandmarks	
Number instructionhours per eachtheorypaperperweek	3
Maximummarks for eachtheorypaper	100(70semester exam+ 30 internal evaluation)
Numberof creditsforeachtheorypaper	3
Numberinstructionhoursper eachpracticalpaperperweek	8/4
MaximumMarks pereachpracticalpaper	100/50
Number creditsperpractical paper	4/2
TotalCreditspersemester	20


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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV
Syllabus (For the batch admitted from 2023-2024 onwards)

P 401T

Core Paper- I (Common for all Specializations)

CourseCode	CourseTitle	L	T	P	C
P-401T	NUCLEAR PHYSICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of nuclear forces.
COB2	Study the nuclear models and its magnetic moments.
COB3	Understand nuclear decay and nuclear detection.
COB4	Understand concept of interaction of charged particles with matter.
COB5	Understand applications of nuclear physics.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Demonstrate the concepts of nuclear force, nuclear decay processes, detection mechanism and reactions.
COC2	Analyze the Deuteron problem, exchange force theories, α -decay, β -decay, Bethe's formula Photoelectric effect, Compton effect and pair production.
COC3	Understand the neutrino hypothesis, Bohr's theory, working of gamma ray detectors, kinematics of nuclear reactions, nuclear reactors.
COC4	Evaluate the importance of knowledge of handling radioactive materials for various applications in day-to-day life like food irradiation, radiation therapy and diagnosis.
COC5	Develop skills in critical thinking and problem-solving and apply them effectively in both academic and professional contexts.

Unit I:

Nuclear Forces: Systematics of nuclear force - strength, range, charge independence; Deuteron problem and its contribution to the definition of the Nuclear force. Exchange force theories - Majorana, Bartlett, Heisenberg and Yukawa.

Nuclear Models: The liquid drop model, the semi empirical mass formula and its applications; The Shell model, states based on square well potential and harmonic oscillator potential, Predictions - spins and parities of nuclear ground states, magnetic moments, electric quadrupole moments.

Unit II:

Nuclear Decay: α -decay, Gamow's theory, fine structure of α -spectrum, alpha decay, systematics, neutrino hypothesis, Fermi's theory of β -decay, Fermi-Curie plot, angular momentum, selection rules for β -decay,

Nuclear Detection: Interaction of charged particles with matter, Bohr's theory, Bethe's formula. Range-energy relation, Stopping power, Measurements of range and stopping power. Interaction of gamma rays

with matter-Photoelectric effect, Compton Effect and pair production; Gamma ray detection using gas, scintillation and solid state detectors.

Unit III:

Nuclear Reactions: Classification of nuclear reactions, Kinematics and Q-value of reactions; Basic theory of direct nuclear reactions - Born approximation, stripping and pick-up reactions, Compound nucleus formation;

Theory of Fission and fusion reactions. Nuclear Reactors: Fission reactors - fusion reactors -

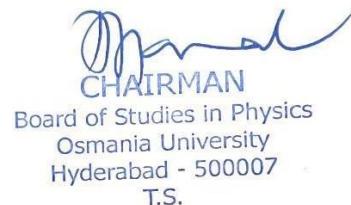
Particle Physics: Elementary Particles, Classification and their Quantum Numbers (Charge, Spin, iso-spin etc.).

Fundamental forces, Conservation of Parity, Strangeness and Lepton and Baryon

numbers, **Applications of Nuclear Physics:** Food irradiation, Medical physics - radiation therapy - radiation dosimetry, radioactive tracers, Tomography (PET)

Recommended Books:

1. Concepts of Nuclear Physics; B.L. Cohen (TMH)
2. Introductory Nuclear Physics: Kenneth S. Krane (Wiley)
3. Nuclear and Particle Physics: Blin-Stoyle (Chapman and Hall)
4. Nuclear Physics; I. Kaplan (Narosa 2002)
5. Introductory Nuclear Physics: W. Wong
6. Introductory Nuclear Physics: S.B. Patel
7. Nuclear Physics: Tayal DC
8. John Lilley, Nuclear Physics: Principles and Applications, Wiley (2001)



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-IV****Syllabus (For the batch admitted from 2023-2024 onwards)****Core Paper-II (Common for all Specializations)**

CourseCode	CourseTitle	L	T	P	C
P-402T	SPECTROSCOPY	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of atomic and molecular spectra.
COB2	Study the spin-orbit interaction.
COB3	Understand Raman and IR spectra.
COB4	Understand concept of nuclear spin and magnetic moment.
COB5	Understand ESR instrumentation and applications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Determine the spectroscopic terms for equivalent and non-equivalent electron atom.
COC2	Analyze the hyperfine splitting of spectral lines.
COC3	Understand the nuclear spin and magnetic moment, origin of nuclear magnetic resonance.
COC4	Evaluate the vibrational and rotational Raman spectra.
COC5	Develop skills in estimating the hyperfine structure of ESR absorptions.

Unit I

Atomic Spectra: Different series in alkali spectra (main features), Ritz combination principle, L-S and j-j coupling; Spectroscopic terms for equivalent and non-equivalent electron atom- Energy level diagrams- Spin-Orbit interaction, doublet structure in alkali spectra, selection rules, intensity rules, alkali-like spectra, Lamb shift, isotope shift; hyperfine splitting of spectral lines, Lande interval rule.

Unit II

Molecular Spectra: Types of Molecular spectra, Salient features of rotational spectra, rotational spectra of diatomic molecule as a rigid rotator and a non-rigid rotator, effect of isotopic substitution on rotational spectra, salient features of Vibrational-Rotational spectra, vibrating diatomic molecule as a harmonic oscillator and a anharmonic oscillator.

Raman and Infrared (IR) Spectra: Raman effect, classical and quantum theory of Raman effect, normal vibrations of CO₂ and H₂O molecules, vibrational and rotational Raman spectra. Basic concept of IR spectroscopy-IR spectrophotometer- Principle and Instrumentation, FTIR principle and working.

Unit III:

Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR) Spectroscopy: Nuclear spin and magnetic moment, origin of nuclear magnetic resonance (NMR) spectra, Theory of NMR spectra, relaxation process-Bloch equations-chemical shift, experimental study of NMR spectroscopy, Experimental technique, ESR spectroscopy, origin and resonance condition, hyperfine structure of ESR absorptions, fine structure in ESR spectra, ESR instrumentation, Applications of

ESR.

Books Recommended

1. Elements of Spectroscopy
2. Atomic Spectra & Atomic Structure
3. Introduction to Molecular Spectroscopy
4. Molecular Spectroscopy
5. Atomic and Molecular Spectroscopy
6. Molecular Structure & Spectroscopy
7. Introduction to Atomic Spectra
8. Fundamentals of Molecular Spectroscopy
9. Spectra of Diatomic Molecules
10. Spectroscopy Vol. I, II, III
11. Principles of Magnetic Resonance
12. Electron Spin Resonance: Their Applications

- Gupta, Kumar, Sharma
- Gerhard Herzberg
 - G.M. Barrow
 - J.D. Graybeal
- Raj Kumar
- G. Aruldas
 - H.E. white
- C.N. Banwell and EMM McCash
 - Herzberg
- Walker and Straughen
- C.P. Slusher
 - Wertz and Bolton



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV

**Syllabus(For the batch admitted from 2023-
2024 onwards)**

Elective Paper-III

CourseCode	CourseTitle	L	T	P	C
P-403T/SSP	OPTICAL PHENOMENA IN SOLIDS	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of optical properties of solids.
COB2	Study the direct and indirect bandgap semiconductors.
COB3	Understand absorption and emission processes of luminescence.
COB4	Understand concept of quantum efficiency & frequency response of photodiodes.
COB5	Understand semiconductor materials for fabrication of homo junction solar cells.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Determine the photon-phonon transitions and inter band transitions.
COC2	Analyze the radiative and non radiative processes and decay mechanisms.
COC3	Understand the different kinds of color centers in the context of luminescence in alkali halides.
COC4	Evaluate different kinds of luminescence.
COC5	Develop skills in estimating the Fill factor, conversion efficiency, quantum efficiency of solar cells.

Unit I: Optical Properties of Solids:

Relation between dielectric and optical properties (macroscopic theory), Kramer-Kronig relations, Absorption of electromagnetic radiation, Photon-Phonon transitions, Inter band transitions, Direct and indirect band gap semiconductors - Si and Ge; Absorption coefficients - Infrared absorptions in semi-conductors. Frenkel and Wannier excitons and their absorption, Imperfections - exciton absorption below the band gap, Intra-band transitions - Absorption and reflection in metals, Hagen-Rubens relation, Raman, Brillouin and Rayleigh scattering, Magneto-optic effects: Faraday effect.

Unit II: Luminescence:

General considerations of luminescence, exciton, absorption and emission processes of luminescence, Configuration coordinate diagram, Energy level diagram, radiative and non radiative processes, Decay mechanisms, Effect of doping and efficiency, Energy transfer and charge transfer, Different kinds of luminescence, Electroluminescence-The Gudden-Pohl effect, Destraube effect, Carrier injection luminescence, Photoluminescence and Thermo-luminescence, Defects and color centers, Different kinds of color centers in the context of luminescence in alkali halides, Thallium activated alkali halides, Zinc sulphide phosphors.

Unit III: Photo-detectors and Photo-voltaics:

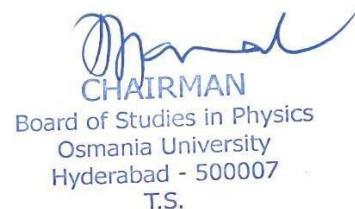
Photoconductors - dc and ac photo conductors, gain & band width, noise in photo conductors, junction photodiodes, PIN diodes, quantum efficiency & frequency response - heterojunction photodiodes,

avalanche photo diodes, noise performance of avalanche photo diodes– comparison of avalanche and PIN diodes.

Photovoltaic effect, Types of interfaces, homo junction, hetero junction and Schottky barrier- Choice of semiconductor materials for fabrication of homo junction solar cells, equivalent circuit of a solar cell, Solar cell output parameters – Fill factor, conversion efficiency, quantum efficiency, effect of series and shunt resistance on the efficiency of solar cells.

References:

1. Solar cells – Charles E. Backus, IEEE Press.
2. Fundamentals of Solar cells, Farenbruch and Bube.
3. Principles of theory of solids – Ziman, Vikas Publishing House, New Delhi.
4. Solid State Physics – G. Burns
5. Luminescence and Luminescent Materials – Blasse
6. Solid State Physics – Dekker.
7. Optoelectronic devices – P. Bhattacharya
8. Physics of semiconductor devices – S.M. Sze.
9. Elementary solid state physics – M. Ali Omar



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-IV****Syllabus (For the batch admitted from 2023-2024 onwards)****P403T/MS****Elective Paper-III**

CourseCode	CourseTitle	L	T	P	C
P-403T/MS	MATERIALS SCIENCE	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of ferroic materials.
COB2	Study the classification of polymers.
COB3	Understand molecular structure of polymers.
COB4	Understand concept of composite materials.
COB5	Understand applications of hybrid composites.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the structural classification of ferroelectrics.
COC2	Compare the domain structures in ferroelectric materials.
COC3	Evaluate the mechanical behavior of polymers.
COC4	Explain crystallization, melting and glass transition phenomenon in polymers
COC5	Appreciate the applications of Ceramic structures and glass ceramics.

Unit I**Ferroic Materials**

Introduction to ferroics, Structural classification of ferroelectrics, hydrogen-bonded and non-hydrogen bonded ferroelectrics, Thermodynamics of ferroelectric phase transitions - proper, improper and pseudo-proper ferroelectric phase transitions, Ferroelectric diffuse transitions, Relaxor ferroelectrics, Domain structures in ferroelectric materials, Orientation of walls between domain pairs, Domain wall thickness, Domain switching, Hysteresis loop, Polycrystalline ferroelectrics, size effects in ferroelectric powders, Applications of ferroic materials.

Unit II**Polymers & Composites**

Polymers: Classification of polymers, polymer molecules, chemistry of polymer molecules, molecular weight, molecular structure of polymers, thermoplastic and thermosetting polymers, polymer crystallinity, mechanical behavior of polymers - stress-strain behavior, viscoelastic deformation, strengthening of polymers, crystallization, melting and glass transition phenomenon in polymers, polymerization, manufacturing of polymers, applications of polymers.

Composites:

Basic Concepts, Definition of Composite materials, reinforcements, Classification of composites - Particle reinforced, Fiber reinforced and structural composites, Particulate reinforced composites - large particle composites, dispersion strengthened composites, Carbon-Carbon Composites, Hybrid Composites, Applications of composites.

UnitIII

Ceramics&Glasses

Ceramics: Introduction to ceramics, classification of ceramics, Ceramic structures-oxide structures, silicate structures, Ceramic Phase diagrams- examples of two oxide systems, Different kinds of Ceramics- glass ceramics, refractories, Properties of Ceramics-Stress-Strain behavior, applications of ceramics

Glasses – types of glasses, glass ceramics, structure of glasses, properties of glasses, synthesis of glasses and applications of glasses.

Books Recommended:

1. Solid State Physics–A.J. Dekker, Macmillan India Ltd., 2003.
2. Introduction to Ferrioc Materials–V.K. Wadhawan,
3. Materials Science and Engineering an Introduction–W.D. Callister Jr, John Wiley and Sons.
4. Introduction to Ceramics–W.D. Kingery, H.K. Bowen and D.R. Uhlmann, John Wiley and Sons.
5. Luminescent materials–G. Blasse and C. Grabmaier, Springer-Verlog, 1994.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - IV Semester
Syllabus (For the batch admitted from 2023-2024 onwards)

Elective Paper-III

CourseCode	CourseTitle	L	T	P	C
P-403T/EI	INTRUMENTATION FOR MEASUREMENT AND DATA TRANSMISSION	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the classification of transducers.
COB2	Study the displacement, strain and pressure measurement.
COB3	Understand temperature sensors.
COB4	Understand concept of flow measurement.
COB5	Understand the methods of data transmission.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the functionality of various transducers.
COC2	Compare the various temperature measuring devices.
COC3	Evaluate the ultrasonic flowmeter.
COC4	Explain interfacing transducers to electronic control and measuring systems
COC5	Appreciate the multiplexing in telemetry system.

Unit I

Transducers: Classification of transducers – Active and Passive transducers- Electrical transducers- Displacement transducers -Digital transducers -Basic requirement of a transducer, **Displacement Measurement:** Variable resistance devices– Variable inductance devices - Variable capacitance devices.

Strain Measurement: Theory of operation of strain gauge –Types of strain gauges –Strain gauge circuits -Full bridge.

Pressure Measurement: Bourdon Tube- Bellows - Potentiometer device- Strain gauge transducer – LVDT type transducer.

Unit II

Temperature Measurement: Classification of temperature measuring devices-Resistance type temperature sensors (platinum resistance thermometer, thermistors) –Resistance thermometer circuits-Thermocouples-Temperature Control-Liquid level control.

Flow Measurement: Classification of flowmeters–Head type flowmeters—Ultrasonic flowmeter-DC and AC Servomotors-Stepper motor.

Unit III

Data Transmission and Telemetry:

Analog and Digital Data Acquisition Systems: Interfacing transducers to electronic control and measuring systems– IEEE488 Bus.
 Methods of data transmission–General telemetry system-Functional blocks of telemetry system–

Types of telemetry systems—Land line telemetering system—Voltage telemetering systems—
Currenttelemetering system—Position telemetering system— Land line telemetry—Multiplexing in
telemeteringsystem.

RecommendedBooks:

1. Modern Electronic Instrumentation and Measurement Techniques—
A.O.Hefrick and W.D.Cooper, Prentice Hall India Publications.
2. Instrumentation Devices and Systems—
C.S.Rangan, G.R.Sharma and V.S.V.Mani, Tata Mc.GrawHill Publications.
3. Introduction to instrumentation and Control—A.K.Ghosh—Prentice Hall India Publications.
4. Electrical and Electronics Measurement and Instrumentation—A.K.Sawhney.
5. Transducers and Instrumentation —DVS Murthy, PHI Publications.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III

Syllabus (For the batch admitted from 2023-

2024 onwards)

Elective Paper – III

CourseCode	CourseTitle	L	T	P	C
P-403T/NS	NANOCOMPOSITES	3	0	0	3

Course Objectives: This course enables the students:

COB1	Understand the concept of nuclear forces.
COB2	Study the nuclear models and its magnetic moments.
COB3	Understand nuclear decay and nuclear detection.
COB4	Understand concept of interaction of charged particles with matter.
COB5	Understand applications of nuclear physics.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the functionality of various transducers.
COC2	Compare the various temperature measuring devices.
COC3	Evaluate the ultrasonic flowmeter.
COC4	Explain interfacing transducers to electronic control and measuring systems
COC5	Appreciate the multiplexing in telemetering system.

Unit-I: Introduction: Nanocomposites, nanofillers, classification of nanofillers, carbon and non-carbon based nanofillers-synthesis and properties of fillers, Nano composites containing functionalized nanoparticles : organic and polymer materials for light-emitting diodes,

Polymernanocomposites: Nanotube/polymer composites, layered filler polymer composite processing-polyamide matrices, polyimide matrices, polypropylene and polyethylene, matrices, liquid-crystal matrices, Epoxy and polyurethane matrices and rubber matrices, photo-oxidation of light emitting polymers, nanoparticles approach to enhance the lifetime of emitting polymers. (15)

Unit-II: Synthesis of Nanocomposites: Direct Mixing, Solution Mixing, In-Situ Polymerization, In-Situ Particle processing ceramic / polymer composites, In-Situ particle processing, metal / polymer nanocomposites, modification of interfaces, modification of nanotubes, modification of nanoparticles, wear resisting polymernanocomposites: preparation and properties, surface treatment, composites manufacturing, wear performance and mechanism. (15)

Unit-III: Mechanical Properties of Nanocomposites: modulus and the Load-Carrying capability of nanofillers, failure stress and strain, Toughness, glass Transition and Relaxation Behavior, abrasion and wear

resistance , permeability , dimensional stability constants, thermal stability and flammability, electrical and optical properties, resistivity, permittivity, and breakdown strength, refractive index, light emitting devices.(15)

Reference Books:

1. Encyclopedia of Nanotechnology – Hari Singh Nalwa
2. Springer Handbook of Nanotechnology – Bharat Bhushan
3. Handbook of Semiconductor Nanostructures and Nano devices, Vol 1-5 - A Balndin, K.L Wang.
4. Nanostructures and Nanomaterials - Synthesis, Properties and Applications – Cao, Guozhong



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV
Syllabus (For the batch admitted from 2023-2024 onwards)

Elective Paper-III

CourseCode	CourseTitle	L	T	P	C
P-403T/EC	MOBILE CELLULAR COMMUNICATIONS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the concept of mobile communication.
COB2	To describe the spread spectrum systems.
COB3	To examine medium access control.
COB4	To describe diversity branch and signal paths.
COB5	To understand the use of satellites in mobile communications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the fundamental radio propagation and system concepts.
COC2	Compare the various medium accessing methods.
COC3	Evaluate the transmission characteristics of GSM.
COC4	Differentiate GEO, LEO, MEO, routing and localization.
COC5	Appreciate the digital video broadcasting.

Unit I

Cellular Concepts: Mobile communications - evolution, Standards, Speech Coder.

Fundamental Radio Propagation and System concepts, Antenna Gain, Propagation characteristics, model for multipath-faded radio signals.

Spread Spectrum Systems and Diversity Techniques: Concept of Spread Spectrum System, pseudo-noise sequences, performance of Direct Sequence Spread Spectrum Systems, Code Division Multiple Access, Direct Sequence and Frequency Hopping systems and synchronization. Concept of Diversity Branch and Signal Paths, Combining and Switching Methods, Carrier-to-Noise and Carrier-to-Interference Ratio, Performance Improvements.

Unit II

Medium Access Control: Motivation for a specialized MAC, Hidden and exposed terminals, Near and far terminals, SDMA, FDMA, TDMA, Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA, packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access, CDMA, Spread Aloha multiple access, Comparison of S/T/F CDMA.

Telecommunication Systems: GSM, Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services.

Unit III

SatelliteSystems:History,Applications,Basics,GEO,LEO,MEO,Routing,Localization,Handover, Examples.

Satelliteapplications:Communicationssatellites,surveillancesatellite,navigationsatellites.Globalpositioningsystem(GPS)spacesegment, controlsegment, GPSreceivers, GPSapplications.

BroadcastSystems:Overview,cyclicrepetitionofdata,Digitalaudiobroadcasting,Multimediaobjecttransferprotocol, Digitalvideobroadcasting,

RecommendedBooks:

- 1.Wireless Digital Communications --Kamilo Feher
- 2.Mobile Communications Jochen Schiller
- 3.Composite satellite and cable television.R.RGulati(NewAge International Pub)
- 4.Mobile Cellular Telecommunications W.C.Y. Lee[Second Edition]



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc.(Physics)-IV Semester Syllabus
(For the batch admitted from 2023-2024 onwards)

Elective Paper-III

CourseCode	CourseTitle	L	T	P	C
P-403T/BP	CELL AND MEMBRANE BIOPHYSICS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the concept of mobile communication.
COB2	To describe the spread spectrum systems.
COB3	To examine medium access control.
COB4	To describe diversity branch and signal paths.
COB5	To understand the use of satellites in mobile communications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the fundamental radio propagation and system concepts.
COC2	Compare the various medium accessing methods.
COC3	Evaluate the transmission characteristics of GSM.
COC4	Differentiate GEO, LEO, MEO, routing and localization.
COC5	Appreciate the digital video broadcasting.

Unit I: Cellular Oscillations and Physics of charged membrane

Cellular Oscillations: Cell, structure of cell, cell division, Electrical oscillatory phenomenon associated with cellular reproductive cycle. Electrical oscillations related to the contact inhibition of reproduction in cells.

Origin of cellular spin resonance – Abipolar rotational conduction. Asymmetric cell to cell polarization. Cellular spin resonance (CSR). Evidences of oscillating electric fields from cells by

CSR. Charged Cell Membrane: Excitable tissues - nerve and muscle cells, action potential, Membrane models, membrane channels, membrane capacitance, relation among capacitance, resistance and diffusion between two conductors. Fick's first law and second law of diffusion. Movement of substance across membrane: Donnan equilibrium. Potential change at the equilibrium. Ion movement in solution: the Nernst – Planck equation. Zero total current in a constant field membrane – Goldmann equation.

Unit II: Biological cell Dielectrophoresis and Magnetophoresis

Dielectrophoresis Behaviour of charged and neutral matter in (a) uniform and (b) non-uniform electric fields. Types of polarization. Field geometries – spherical, cylindrical and isomotive. Dielectrophoretic force in radial field. Dielectrophoretic collection rate (DCR) of cells in radial field. Experimental technique for DCR of biological cells. Calculation of excess permittivity of cells. Single cell dielectrophoresis – Experimental technique for the determination retention voltage and calculation of excess permittivity of lone cells.

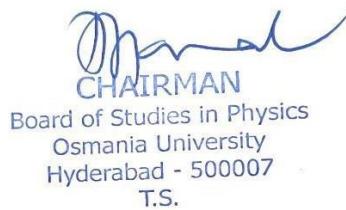
Magnetophoresis : Introduction to Magnetophoresis. Behaviour of charge and neutral matter in magnetic field. Theory and experimental technique of magnetophoresis. Biological applications of magnetophoresis.

UnitIII:Physicsofnaturalflyingmachine

Flight surface(wing); Flight muscles; Sensory organs; Laminar and Turbulent flow, equation of continuity, bernoulli's equation, reynold's number. Basics/Fundamentals of aerodynamics. Wind tunnel-types. Physics of wing beat- Mechanical oscillator theory; Theory based on Newton's laws; Theory based on Dimensional analysis; Mass flow theory. Types of flight – Hovering; forward horizontal flight; gliding flight; Soaring flight. Aerodynamic forces – lift, thrust and drag. Components of power, Power requirements of flight. Applications of natural flight to Micro Vehicles.

Recommended Books:

1. Dielectrophoresis–Pohl.
2. Electromechanics of particles–Thomas B. Jones.
3. Intermediate Physics for Medicine and Biology–Russel K. Hobby.
4. Bio-physics of Bird Flight–N. Chari.
5. BioAerodynamics of avian flight–N. Chari.
6. Fundamentals of Aerodynamics–John D. Anderson, Jr.



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-IV****Syllabus (For the batch admitted from 2023-2024 onwards)****P403T/CMP****Elective Paper - III**

CourseCode	CourseTitle	L	T	P	C
P-403T/CMP	TRANSPORT PHENOMENA IN SOLIDS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the concept of mobile communication.
COB2	To describe the spread spectrum systems.
COB3	To examine medium access control.
COB4	To describe diversity branch and signal paths.
COB5	To understand the use of satellites in mobile communications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the fundamental radio propagation and system concepts.
COC2	Compare the various medium accessing methods.
COC3	Evaluate the transmission characteristics of GSM.
COC4	Differentiate GEO, LEO, MEO, routing and localization.
COC5	Appreciate the digital video broadcasting.

UNIT-I

Diffusion in solids - Ficks first law and second law, Diffusion coefficient through plane surface, cylinder and sphere, Application based on second law of diffusion.

Diffusion in a simple cubic structure, Diffusion under external field, Nernst-Einstein relation, Kirkendall shift.

Ionic conductivity, Ionic conductivity of alkali halides and effect of divalent impurities on ionic conductivity.

Thermodynamics of Specific Heats: The Specific heat of a linear crystal, Debye theory applied to a linear crystal and three dimensional crystal.

Temperature dependence of the amplitude of vibrations in solids: The Lindemann Law of Melting, Thermoelectric effects, Thermopower, Seebeck effect, Peltier effect, The Wiedemann-Franz law.

UNIT-II

Electron Transport Phenomenon: Motion of electrons in bands and the effective mass tensor (semi-classical treatment), Currents in bands and holes.

Hopping conduction, Electrical conductivity of metals - Polarons - small polaron band conduction; large polaron band conduction; small polaron hopping conduction; Mott transitions; Ionic Conductivity; Superionic Conductivity - structure, defects and conductivity. The electrical conductivity at low temperatures, Matheissen's rule.

UNIT-III

Electronic structure of 1D systems: 1D sub-bands, Van Hove singularities; 1D metals-Coulomb interactions and lattice couplings.

Electrical transport in 1D: Conductance quantization and the Landau formula, two barriers in series resonant tunnelling. Incoherent addition and Ohm's law, Coherence-Localization.

Electronic structure of 0D systems (Quantum dots): Quantized energy levels, Semiconductor and metallic dots, Optical spectra, discrete charge states and charging energy. Electrical transport in 0D-Coulomb blockade phenomenon.

Magnetoresistance and the Hall effect. Magnetoresistance in two band model.

Recommended books

1. Principles of Theory of Solids: Ziman
2. Solid State Physics: Singhal
3. Solid State Physics: H.C. Gupta
4. Elementary Solid State Physics: M. Ali Omar
5. Solid State Physics: M.A. Waheb
6. Solid State Physics: Kachchava,
7. Principles of the Solid State Physics: H. V. Keer
8. Introduction to Solid State Physics (7th edition): C. Kittel
9. Solid State Physics: W. Ashcroft and N. David Mermin
10. Solid State Physics: A.K. Saxena



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV
Syllabus (For the batch admitted from 2023-2024 onwards)
Elective Paper-III

CourseCode	CourseTitle	L	T	P	C
P-403T/OE	FIBEROPTIC TECHNOLOGY	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the light propagation through an optical waveguide.
COB2	To describe the formation of modes in planar and cylindrical waveguides.
COB3	To examine the transmission characteristics of optical fibers.
COB4	To describe different nonlinear effects in optical fibers.
COB5	To identify the applications of optical fiber.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the propagation of light through an optical waveguide.
COC2	Compare the formation of modes in planar and cylindrical waveguides.
COC3	Evaluate the transmission characteristics of optical fibers.
COC4	Differentiate nonlinear effects in optical fibers.
COC5	Appreciate the applications of optical fiber.

Unit I: Optical fiber Guide: Ray theory transmission: total internal reflection, numerical aperture, planar wave guides, guided and radiation modes, TE and TM modes in a symmetric step-index planar waveguide, Nonplanar waveguides, types of fibers – multimode and single mode; step and graded index, skew rays, modes in optical fibers, modal analysis for a step-index and parabolic index fibers, cut-off wavelength.

Unit II: Transmission Characteristics of Optical Fibers: Attenuation - material absorption losses, linear and nonlinear scattering losses, Dispersion - intermodal dispersion in step and graded index multimode fibers, intramodal dispersion, dispersion modified singl e-mode fiber, fiber birefringence, polarization-mode dispersion.

Nonlinear effects of optical fibers: Nonlinear refraction, group velocity dispersion, cross phase modulation, self-phase modulation, Four wave mixing, stimulated Raman scattering, stimulated Brillouin scattering, fiber solitons.

Unit III: Optical Fiber communication Systems: Elements of fiber optic system, analog and digital signals, analog systems – signal-to-noise ratio, digital systems - power budgeting, bit error ratio, optical transmitter circuit-source limitations, drive circuits for LED and LASER; optical receiver circuit.

Multiplexing systems: Optical time division multiplexing, wavelength division multiplexing.

Optical Networks: Network topologies, local area networks – SONET/SDH, FDDI, WDM light wavenetworks – single-hop and multi-hop operations, ultrahigh capacity networks.

ReferenceBooks:

1. Optical Fiber communications: principles and practice - John M.Senior, Pearson Education,3rdedition.
2. OpticalFibercommunications-GerdKeiser,McGraw-Hill,4thedition.
3. FiberOpticscommunications -GovindP.Agarwal,AcademicPress,3rdedition.
4. IntroductiontoFiberOptics-A.GhatakandK.Thyagarajan,CambridgeUniversityPress
5. FiberOpticCommunications-JosephC.Palais,Pearson,5thEdition.
6. WDMoptical Networks-C. SivaRamMurthyandMohan Guruswamy,PrenticeHall,2002.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-IV****Syllabus(For the batch admitted from 2023-2024 onwards)****Core Paper - I**

CourseCode	CourseTitle	L	T	P	C
P-401T/AE	DIGITAL SYSTEM DESIGN USING VHDL	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the importance of VHDL .
COB2	To describe the various modeling techniques to design the digital circuits.
COB3	To examine the simulation and working of the designed circuits.
COB4	To describe hardware modeling using VHDL.
COB5	To identify the applications of VHDL.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the use of VHDL in designing any given digital circuit.
COC2	Compare the different styles of modeling using VHDL.
COC3	Evaluate the functionality and the versatility of VHDL.
COC4	Differentiate simulation and implementation of the design of digital circuits.
COC5	Appreciate the applications of VHDL.

Unit-I: Basic Language Elements: Identifiers, Data objects, Data types, Operators.

Behavioral Modeling : Entity declaration, Architecture body, Process statement, Variable assignment statement, Signal assignment statement, Wait statement, If statement, Case statement, Loop statement, Exit statement, Next statement, Assertion statement, Report statement.

Data Flow Modeling: Concurrent signal assignment statement, Concurrent versus sequential signal assignment, Delta delay revisited, Multiple drivers, Conditional signal assignment statement, selected signal assignment statement. The unaffected value, block statement, concurrent assertion statement, Value of a signal

Structural Modeling: An Example, Component declaration, Component instantiation and examples, Resolving signal values. Generics, Configuration specification, Configuration declaration, Default rules, Conversion functions, Direct instantiation, Incremental binding.

Unit-II: Subprograms and Overloading: Subprograms-

Subprogram overloading, Operator overloading, Signatures, Default values for parameters.

Packages and Libraries: Package declaration, Package body, Design file, Order of analysis, Implicit visibility, Explicit visibility.

Advanced Features: Entity statements, Generate statement, Aliases, Qualified expressions, Type conversions, Guarded signals, Attributes, Aggregate targets, more details on ports.

Unit-III: Model Simulation: Simulation-Writing a Test Bench-Converting real and integer to time-Dumping results into a text file-Reading vectors from a text file-A testbench example-Initializing a memory-Variable file names.

Hardware Modeling Examples: Modeling entity interfaces, modeling simple elements, Different

styles of modeling, modeling regular structures, modeling delays, modeling conditional operations, modeling synchronous logic. State machine modeling, Interacting state machines, modeling a MooreFSM, modeling a MeaslyFSM.

Recommended Books:

1. AVHDLPrimer-ByJ.Bhasker.,PearsonEducation Asia,11th IndianReprint,2004.
2. VHDLProgrammingbyExample-ByDouglasL. Perry,4thEd.,TMH., 2002.
3. IntroductoryVHDL:FromSimulationtoSynthesis-BySudhalarYalamanchili.,PearsonEducation Asia2001..
4. FundamentalsofDigitalLogicwithVHDLDesign-ByStephenBrown&ZvonkoVranesic.,THM2002.
5. DigitalSystemsDesignusingVHDLbyCharlesH.RothJr.PWSPub.,1998.
6. VHDL—Analysis&ModelingofDigitalSystems-
ByZainalabedinNavabi.,2nd Ed., MH., 1998.



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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY**M.Sc. (Physics) - Semester-IV****Syllabus(For the batch admitted from 2023-2024 onwards)****Core Paper-II**

CourseCode	CourseTitle	L	T	P	C
P-402T/AE	FEEDBACK CONTROL SYSTEMS	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the feedback on the response of control systems.
COB2	To describe the transfer function of the given systems.
COB3	To examine the time domain analysis of control systems.
COB4	To describe the concept of stability of the control system.
COB5	To identify the applications of feedback in control systems.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the use of signal flow graphs to describe the functionality of the given system.
COC2	To evaluate the time response of control systems – steady state error.
COC3	Evaluate the feedback compensation techniques.
COC4	To describe time domain interpretation and design of PI controller – design with PID controller and design with phase lead controller.
COC5	Appreciate the applications of feedback control mechanism in control systems.

Unit-I: General concepts and Mathematical techniques:

Introduction, Open loop control system, Closed loop control systems, Modern control system applications . Transfer function concept, transfer function of common networks (RC, RL & RLC), Transfer function of physical systems, Block Diagram Representation of Control System, Block Diagram reductions, Signal Flow Graph and Mason's Gain formula, Reduction of signal flow Graphs, Applications of signal flow Graph .

State equations and Transfer Function representation of Physical control system elements:

State Space Concepts, the State Variable Diagram, State Equations of Electrical Networks, Transfer Function And State Space Representation Of Typical Mechanical, Electrical, Hydraulic, Thermal Systems.

Unit – II:

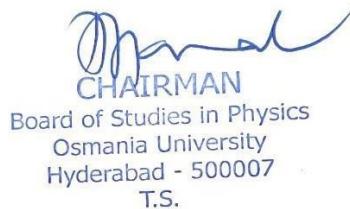
Time domain analysis of control systems: Typical Test Signals for the Time Response of Control Systems – Steady State Error – Unity Feedback Systems. Steady State Error For A Unity Feedback System With Step Input, Ramp Input And Parabolic Input – Unit Step Response And Time Domain Specifications – Transient Response of a Prototype Second Order System – Effect Of Adding Poles And Zeros To Transfer Functions. **The Concept of Stability** – Routh-Hurwitz Stability Criterion – The Stability of State Variable Systems – Root Locus method, Root Locus Concept – Properties and Construction of Root Loci – Frequency Plots – Polar and Bode plots – Frequency Domain Specifications

–resonantpeak,resonantangularfrequencyandbandwidthof2ndOrderSystem-NyquistStabilityCriterion– Applications.

Unit – III : Design of Control Systems – Introduction, Cascade Compensation Techniques, Minor loop feedback compensation techniques, and example of the design of a linear feedback control system– Design with PD controller – Time Domain interpretation of PD controller – Design with PI controller – Time domain interpretation and design of PI controller – Design with PID controller – Design with phase lead controller – Time domain interpretation and design of phase lead controller – Design with phase lag controller – Time domain interpretation and design of phase lag controller – Design with lead and lag controller – Pole zero cancellation compensation.

Recommended Books

1. Automatic Control systems – Benjamin C. Kuo, (PHI)
2. Modern Control systems – Richard C. Dorf and Robert H. Bishop, Addison Wesley Publications
3. Control systems principles and design by M. Gopal 2nd edition 2002 (MGH)
4. Control and Systems Engineering – IJ Nagarath and M. Gopal, (New Age Int Pub)
5. Modern control engineering – Katsuhiko Ogata – PHI.



DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV
Syllabus (For the batch admitted from 2023-2024 onwards)
Elective Paper-III

CourseCode	CourseTitle	L	T	P	C
P-403T/AE	GUIDED AND UNGUIDED MEDIA COMMUNICATION	3	0	0	3

Course Objectives: This course enables the students:

COB1	To understand the guided and unguided media communication mechanism.
COB2	To describe the optical fiber and microwave communication.
COB3	To examine the techniques involved in mobile cellular communications.
COB4	To describe the concept of analog and digital cellular communications.
COB5	To identify the applications of communications in day-to-day life.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the use of signal flow optical fiber systems.
COC2	Evaluate the transmission characteristics in optical fibers.
COC3	Evaluate the dispersion mechanisms in optical fibers and cellular communications.
COC4	Describe waveguides and components used in microwave communication.
COC5	Appreciate the applications of guided and unguided media in communications.

Unit I

Optical Fiber communication:

Electromagnetic Mode Theory for Optical Propagation- Electromagnetic Waves, Modes in a planar wave guide, Phase and Group velocity, Phase shift with total internal reflection and Evanescent fields. Cylindrical optical Fiber-Modes, Mode coupling, Step index fiber, Graded index fiber and WKB method.

Transmission characteristics- Attenuation, absorption, intrinsic and extrinsic absorption, intra-modal and inter-modal dispersion.

Unit II

Waveguides and components:

Rectangular Waveguides, Solutions of Wave equations in Rectangular coordinates , TE modes in Rectangular Waveguides, TM modes in Rectangular Waveguides, Circular Waveguides, Solutions of Wave equations in Cylindrical coordinates, TE modes in Cylindrical Waveguides, TM modes in Cylindrical Waveguides, TEM modes in Cylindrical Waveguides, Microwave cavities, Rectangular cavity resonator, Circular cavity resonator, Semicircular cavity resonator, Q Factor of a Cavity Resonator.

Unit III

Cellular Mobile communication:

A basic cellular system, Performance criteria, Operation of cellular systems, Hexagonal shaped cells, Planning a cellular system, Elements of cellular system design, Frequency reuse, Co-channel interference reduction factor, Hand-off mechanism, Cell splitting, Concept of Spread Spectrum, Frequency-Hopping Spread Spectrum, Direct Sequence Spread

Spectrum, Code Division Multiple Access.

Analog And Digital Cellular Systems: Definitions of terms and functions, Introduction to digital technology, ARQ techniques, Digital speech, Digital mobile telephony, Multiple access schemes, Global system for mobile (GSM).

TEXTBOOKS:

1. Optical fiber communication— John M. Senior.
2. Optical fiber communication— G Keiser
3. Semiconductor Optoelectronics— Pallab Bhattacharya.
4. Microwave Devices and Circuits— By S. Y. Liao
5. Fundamentals of Microwave Engineering— R. E. Collin— McGraw-Hill International
6. Mobile Cellular Telecommunications by William C. Y. Lee. [McGRAWHILL].

REFERENCE BOOKS:

1. Optical communications system— J. Gower
2. Fundamentals of fiber optical communication and sensor system— Bishnu P. Pal.
3. Integrated optics— Theory and technology— R. Ghunspurger.



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