Department Of Physics
Osmania University

Scheme of Instruction and Syllabus

M.Sc (Physics)

I, II, III and IV Semesters
under CBCS scheme

(W.e.f academic year 2018-2019)

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY, HYDERABAD

M. Sc. (Physics) and M.Sc. (Appl. Electronics) Courses under CBCS
(With effect from the academic year 2018 –2019)

Semester – I

S.no.	Sub. Code	Paper No.	Subject	Instructions. Hrs/week	Credits	Max. Marks
THEORY						
01	PAE 101T	I	Mathematical Physics	4	4	100*
02	PAE 102T	II	Classical Mechanics	4	4	100*
03	PAE 103T	III	Quantum Mechanics - I	4	4	100*
04	PAE 104T	IV	General Solid State Physics	4	4	100*
PRACTICALS						
05	PAE 151P+ 152P	V & VI	C – Programming lab – I & Electronics lab - I	8	4	100
06	PAE 153P +154P	VII & VIII	Heat & Acoustics lab – I & Optics lab - I	8	4	100
			Total:		24	600

*** Out of 100 Marks for each theory paper 20 Marks are allotted for internals and 80 for University exam. Common Syllabus to University, Constituent Colleges and Affiliated Colleges. There shall be no internal assessment examinations for practicals.**
Practical Examinations will be conducted at the end of each semester.

Pattern of Question Paper: The question paper consists of two parts, each covering all the **four units**. Part –A consists of EIGHT short answer questions, carrying 4 marks each. The student has to answer all the questions. Part –B consists of FOUR essay type questions with an internal choice. Each question carries 12 marks.

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 101 T **Paper –I :: Mathematical Physics**

UNIT –I: (13 Hrs**)**
Linear Differential equations with variable coeffcients:
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. Beta and Gamma functions – Properties and their relations .

UNIT –II: (13 Hrs**)**
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 equtions

UNIT –III : (13 Hrs**)**
Fourier Transform : Infinite Fourier Sine and Cosine transforms–Properties of Fourier transforms-Derivative of Fourier transform –Fourier transform of a derivative-Fourier Sine and Cosine transform of derivatives-Finite Fourier transforms – Applications of Fourier Transforms.
Laplace Transform: Properties of Laplace transforms **–**Derivative of Laplace transform– Laplace transform of a derivative –Laplace transform of periodic functions-Inverse Laplace transform and its properties –Inverse Laplace theorem –Convolution theorem.
Unit –IV : (13 Hrs**)**
Matrices– eigen values- eigen vectors -Characteristic equation of a matrix- Cayley Hamilton theorem- Types of matrices- symmetric and skew symmetric and Hermitian matrices- Unitary and symmetry transformations
Tensors –Order and rank of the tensors –transformation laws of covariant, contra-variant 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, IC Goyal and SL Chua-Macmillan India Ltd.
3. Vector and Tensor Analysis –Schaum Series.
4. Mathematical Physics –SatyaPrakash

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 102 T Paper –II : CLASSICAL MECHANICS

UNIT –I : (13 Hrs**)**
Newtonian formalism : Inertial frames and Galilean transforms-Non-inertial frames-pseudo forces, rotational frames, rotational transforms and conservation theorems. Description of rotations in terms of Euler angles-Euler's equations of motion for a rigid body. Minkowski space, space-time diagrams, world point and world line-relativistic motion and Lorentz transforms as rotations in four-space, four velocity, energy-momentum vectors with few examples.

UNIT –II : (13 Hrs**)**
Lagrangian formalism : Constraints, generalized coordinates, Principle of virtual work, Lagrange's equations and applications, D'Alembert's principle, Lagrangian equations of motion for plane and spherical pendulums, L-C circuit; velocity dependent potentials-Lagrangian for a charged particle in electromagnetic field, Euler's equations from Lagrange equations. Hamilton's principle, Lagranges equations from Hamilton's principle.

UNIT –III : (13 Hrs**)**
Hamiltonian formalism : The Principle of Least Action–Applications of Hamiltons equations - motion of a particle in a central force field, projectile motion of a body. Cyclic coordinates and conservation theorems, Canonical coordinates and canonical transformations, Conditions for a transformation to be canonical, generating functions, Lagrange and Poisson brackets. Hamilton s quations in Poisson bracket from, Hamilton-Jacobi theory.

UNIT –IV : (13 Hrs**)**
Mechanics of continuous systems : Analysis of the free vibrations of a linear triatomic molecule, Eigen value equation- Principal axis transformation-Frequencies and normal coordinates Lagrangian formulation for continuous systems, Hamiltonian formulation.

Reference Books :

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

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 103 T Paper –III :: Quantum Mechanics- I

UNIT –I (13 hrs) :

Basics of Quantum Mechanics : Linear Vector space, Dirac's Ket and Bra notation. Eigenvalue equation, Eigenkets and Eigenvalues – Degenerate and non-degenerate states - completeness relation, Wave functions in position and momentum space. Normalization and Orthogonality of wave functions, change of basis. Observables - Operators, Hermitian operators and their properties-Commuting and non-commuting operators, Physical significance. Matrix representations of vectors and operators – Observable and expectation value of an observable - Parity operator, Projection operator and significance. Basic commutation relations. Uncertainty principle between any two non-commuting Operators.

UNIT –II (13 hrs) :

Exactly Solvable problems : The Schrodinger, Heisenberg picture and interaction pictures. Linear harmonic oscillator-Solution to Schrodinger equation, Eigen values and Eigen functions, properties of stationary states. Linear harmonic oscillator- Solution by operator method. Raising and Lowering operators, the number operator. Hydrogen atom, solution of the radial part of the Schrodinger equation.

UNIT –III (13 hrs) :

Symmetries in Quantum Mechanics : Discrete and continuous symmetries Noether's theorem - Space and time displacements –unitary operators of space and time displacements and equations of motion. Generators of infinitesimal rotations. Space inversion and unitary inversion operator - intrinsic parity. Time reversal operator –anti-linear operator- time reversal operator for spin zero and non- zero spin particles. SO(3) and SU(2) symmetries.

UNIT –IV (13 hrs) :

Angular Momentum : Orbital Angular Momentum, Commutation Relations involving : $\mathbf{L}^2$, L_X, L_Y, L_Z –Eigenvalues and Eigen functions of $\mathbf{L}^2$ –Generalized angular momentum, **J** – commutation relations between J^2 and components of **J**. J_+ and J_- Eigen values of $\mathbf{J}^2$ 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 $J_1 = ½$, $J_2 = ½$, and $J_1 = ½$, $J_2 = 1$, as examples.

Reference Books :

1. Quantum Mechanics by L.I. Schiff
2. A Text book Quantum Mechanics : PM 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 Aruldhas (New Age International)
6. Modern Quantum Mechanics by Sakurai (Addison Wesley)

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 104 T Paper – IV :: General Solid State Physics

UNIT – I : (13 Hrs**)**
Crystalline State & Structural Studies : Crystal translational vectors, unit cell, Bravais lattices, Crystal system, Miller indices, Symmetry operations, Point groups, Space groups and their notation. Crystal structures of fcc, bcc, hcp, CsCl, NaCl, ZnS and Diamond. Bragg's law, Atomic structure factor, Geometrical structure factor and Debye Wallar factor, Concept of reciprocal lattice, Concept of Brillouin zones, Experimental methods of X-ray diffraction of crystals – Laue and Powder methods, Determination of unit cell parameters of a cubic crystal, Elements of neutron and electron diffraction.

UNIT – II : (13 Hrs**)**
Lattice Vibrations and Thermal Properties : Elastic waves in one dimensional array of identical atoms, Vibrational modes of a 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 Grunceisen relation.

UNIT – III : (13 Hrs**)**
Band Theory and Semiconductor Physics : Failure of Free electron theory of metals, Bloch theorem, Behavior of electron in periodic potentials, Kronig- Penny model, E vs K relation, Density of states in a band, Effective mass of electron, Negative effective mass and concept of hole. Distinction between metals, Semiconductors and Insulators, Intrinsic semiconductors, Fermi level, Expressions for electron and hole concentrations in intrinsic and extrinsic semiconductors, Hall effect in semiconductors.

UNIT – IV : (13 Hrs**)**
Crystal Growth and Imperfections : Crystal growth from solution and melt, growth from vapour phase, Experimental techniques of growth from melt. Classification of imperfections, Schottky and Frenkel defects, expression for their equilibrium concentrations in metals and ionic crystals, Colour centers and their models, Diffusion mechanisms, Fick's laws of diffusion, Kirkendal effect, Ionic conductivity, Dislocations- Edge and Screw dislocations, Dislocation multiplication, Grain boundaries.

Reference Books. :

1. Crystallography and Solid State Physics – A.R. Verma and O.N. Srivastava
2. Solid State Physics – A.J. Decker, Macmillian Indian Ltd, 2003.
3. Introduction to Solid State Physics – C. Kittel, John Wiley Sons Inc, New York
4. Solid State Physics- RL Singhal, KedarNath&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 UNIVERSITY, HYDERABAD

M. Sc. (Physics) Courses under CBCS

(With effect from the academic year 2018 –2019)

M.Sc. :: Computer Programming Laboratory

PAE 151 P + 251 P

LIST OF EXPERIMENTS :

1. Write a 'C' Programme to generate Exponent Series
2. Write a 'C' Programme to generate Sine Series
3. Write a 'C' Programme to generate Cosine Series
4. Write a 'C' Programme to implement Bisection Method
5. Write a 'C' Programme to implement Newton Raphson Method
6. Write a 'C' Programme to perform Transpose of given mxn Matrix
7. Write a 'C' Programme to perform Matrix Multiplication
8. Write a 'C' Programme to perform Least Square Fitting
9. Write a 'C' Programme to generate Finite Difference Table
10. Write a 'C' Programme to implement Euler's Method
11. Write a 'C' Programme to implement Runge-kutta 2^{nd} Order Method
12. Write a 'C' Programme to implement Runge- kutta 4^{th} Order Method
13. Write a 'C' Programme to implement Trapezoidal Rule
14. Write a 'C' Programme to implement Simpson's $1/3^{rd}$ Rule
15. Write a 'C' Programme to implement Simpson's $3/8^{th}$ Rule

Note :: Each student has to perform minimum six experiments in I semester and also in II Semester and experiment should not be repeated.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY, HYDERABAD
M. Sc. (Physics) Courses under CBCS
(With effect from the academic year 2018 –2019)

M.Sc. :: Electronics Laboratory

PAE 152 P + 252 P

LIST OF EXPERIMENTS :

ANALOG :

1. RC-COUPLED AMPLIFIER (SINGLE - STAGE)
2. SQUARE WAVE GENERATOR (IC - 741)
3. WEIN-BRIDGE OSCILLATOR (IC - 741)
4. ASTABLE MULTIVIBRATOR (IC - 555)
5. REGULATED POWER SUPPLY (IC – 78 XX)
6. VOLTAGE CONTROLLED OSCILLATOR (IC - 555)
7. INTEGRATOR (IC - 741)
8. SCHMITT TRIGGER/ZERO CROSS DETECTOR
9. RC PHASE SHIFT OSCILLATOR (IC - 741)
10. UJT (RELAXATION OCILLATOR)

DIGITAL :

11. CONSTRUCTION AND VERIFICATION OF
    a.) LOGIC GATES/CIRCUITS (USING NAND GATES 7400)
    b.) AND, OR, NOT, NOR, NAND, EX-OR
12. HALF – ADDER & FULL ADDER
13. FLIP – FLOPS : D- TYPE, T-TYPE, J K- FLIP FLOP (IC - 7496)
14. PEAKING AMPLIFIER
15. LOGARITHMIC AMPLIFIER
16. COLPITT OSCILLATOR

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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY, HYDERABAD

M. Sc. (Physics) Courses under CBCS

(With effect from the academic year 2018 –2019)

M.Sc. :: Heat and Acoustics Laboratory

PAE 153 P + 253 P

LIST OF EXPERIMENTS :

1. Stefan's constant
2. Characteristics of a Thermistor
3. Specific Heat of Graphite
4. Linear Expansion of the give Material
5. Estimation of Errors
6. Ultrasonic Velocity of a liquid by Interferometer
7. Ultrasonic Velocity of water by Debye-Sear's Method
8. Ultrasonic Velocity of kerosene by Debye-Sear's Method
9. Viscosity of Water by oscillating disc method
10. Viscosity of castor oil by oscillating disc method
11. Young's Modulus Y of the material of the spiral spring
12. Rigidity Modulus of the material of the spiral spring
13. Determination of adiabatic compressibility of organic liquids using Ultrasonic interferometer
14. Thermal diffusivity of the given material

Note :: Each student has to perform minimum six experiments in I semester and also in II semester and experiment should not be repeated.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY, HYDERABAD

M. Sc. (Physics) Courses under CBCS

(With effect from the academic year 2018 –2019)

M.Sc. :: Optics Laboratory

PAE 154 P + 254 P

LIST OF EXPERIMENTS :

1. Determination of Cauchy's Constants
2. Determination of wavelength of Na light using a diffraction grating
3. Double refraction
4. Banded spectrum
5. Newton's rings – determination of Poisson's ratio
6. Fresnel Biprism – determination of wavelength of Na light
7. Malus law
8. Michelson's interferometer
9. Single slit diffraction
10. Double slit diffraction
11. Determination of wavelength of laser
12. Thickness of thin film using Fresnel biprism or Michelson interferometer
13. Fibre Optics : Characteristics of LED and Phototransistor
14. Fibre optics: determination of numerical aperture

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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY, HYDERABAD

M. Sc. (Physics) Courses under CBCS
(With effect from the academic year 2018 –2019)

Semester – II

S.no.	Sub. Code	Paper No.	Subject	Instructions. Hrs/week	Credits	Max. Marks
THEORY						
01	PAE 201T	I	Electromagnetic Theory	4	4	100*
02	PAE 202T	II	Statistical Mechanics	4	4	100*
03	PAE 203T	III	Quantum Mechanics - II	4	4	100*
04	PAE 204T	IV	Electronics	4	4	100*
PRACTICALS						
05	PAE 151P+ 152P	V & VI	C – Programming lab – I & Electronics lab - I	8	4	100
06	PAE 153P +154P	VII & VIII	Heat & Acoustics lab – I & Optics lab - I	8	4	100
			Total:		24	600

*** Out of 100 Marks for each theory paper 20 Marks are allotted for internals and 80 for University exam. Common Syllabus to University, Constituent Colleges and Affiliated Colleges. There shall be no internal assessment examinations for practicals. Practical Examinations will be conducted at the end of each semester.**

Pattern of Question Paper: The question paper consists of two parts, each covering all the **four units**. Part –A consists of EIGHT short answer questions, carrying 4 marks each. The student has to answer all the questions. Part –B consists of FOUR essay type questions with an internal choice. Each question carries 12 marks.

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 201 T Paper – I :: Electromagnetic Theory

UNIT – I : (13 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-Multi-pole 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: (13 Hrs**)**
Propagation of Plane Electromagnetic Waves: Electromagnetic (EM) waves in unbounded media-EM wave equation for a homogeneous isotropic dielectric medium-Propagation of plan 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.

UNIT – III: (13 Hrs**)**
Interaction of Electromagnetic Waves with Matter : 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- 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.

UNIT – IV: (13 Hrs**)**
Electromagnetic Fields and Radiating Systems: Electromagnetic radiation: Inhomogeneous wave equation for potentials-Retarded potentials-Multipole expansion of EM radiation for harmonically oscillating source-Long wavelength approximation-Oscillating electric dipole radiation-Oscillating magnetic dipole radiation-Radiation from center-fed linear antenna. Radiation from accelerated charges : Lienard-Wiechert potentials-Electromagnetic field of a charge in arbitrary motion.

Reference Books:

1. Classical Electrodynamics by SP Puri, Tata McGraw-Hill Publishing Co., Ltd (2000).
2. Introduction to Electrodynamics by DJ Griffiths, Prentice- Hall of India (1998).
3. Electricity and Magnetism by MH Nayfeh and MK Brussel, John Wiley and Sons (1985).
4. Classical Electrodynamics by JD Jackson, John Wiley and Sons (1999).
5. Foundations of Electromagnetic Theory by JR Rietz, FJ Milford and Christy, Narosa Publishing house (1986)
6. Engineering Electromagnetics by WH Hayt and JA Buck Tata Mc-Graw Hill (2001)
7. Electromagnetic waves and Radiating systems by EC Jordan and KG Balmain, Prentice Hall (1968)

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 202 T Paper – II :: Statistical Mechanics

UNIT – I : (13 Hrs**)**

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 –Equilibrium conditions: Thermal, mechanical and quasi static equilibrium. Entropy of a perfect gas using micro canonical ensemble-Gibbs paradox-Sackur.-Tetrode equation.

UNIT – II : (13 Hrs**)**

Maxwell –Boltzmann statistics-Distribution law- Maxwell velocity distribution-Equipartition theorem. Canonical ensemble- Partition function-Ideal gas, Grand canonical ensemble-Partition function-Ideal gas .Quantum Statistical Mechanics-Postulates-Indistinguishability-Bose-Einstein and Fermi-Dirac statistics and distribution laws.

Partition function and thermodynamic quantities-Translational, rotational and vibrational partition functions - Specific heat of diatomic molecules.

UNIT – III : (13 Hrs**)**

Ideal Bose-Einstein gas-Energy and pressure of the gas. Bose-Einstein condensation-Liquid Helium-Two Fluid model-Phonons, protons, super fluidity. Ideal Fermi-Dirac gas Energy and pressure of the gas –Electronic specific heat, thermionic emission, white dwarfs.

UNIT – IV : (13 Hrs**)**

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.

Reference Books. :

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

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 203 T Paper – III :: Quantum Mechanics – II

UNIT – I (13 hrs) :

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 phase shift-Optical Theorem- Relationship between phase shift and Potential. Scattering by Hard sphere.

UNIT – II (13 hrs) :

Time Independent Perturbation Theory : Approximation Methods. Non-degenerate case, First-and Second- order cases - Examples of harmonic and an-harmonic Oscillators. Degenerate case- Stark effect for H-atom for n=2 level. Variation Method - Helium atom ground state. WKB approximation method - connection formulae - application to Alpha Decay.

UNIT – III (13 hrs) :

Time Dependent Perturbation Theory : Time development of state, variation of constants (coefficients), Transition probability- Selection rules for transition. Constant perturbation. Transition probability to closely spaced leaves- Fermi's golden rule. Harmonic perturbation- Transition probability rate. Interaction of an atom with electromagnetic radiation. Electric dipole approximation. The Einstein Coefficients.

UNIT – IV (13 hrs) :

Relativistic Quantum Mechanics : Klein –Gordon Equation, Plane wave solution and Equation of continuity, Probability density- Dirac Equation, alpha, beta- matrices, Plane wave 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 LI Schiff
2. A Text book Quantum Mechanics by PM 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 Aruldhas (New Age International)
6. Modern Quantum Mechanics by Sakurai (Addison Wesley)

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

(w. e. f 2018 -2019 Under **CBCS)**

PAE 204 T **Paper – IV :: Electronics**

UNIT – I : (13 Hrs**)**

Regulated Power Supply : basic Principle of regulated power supply: Zener regulator and its working, Transistorized Series regulator, fixed IC voltage regulators using IC 78XX and 79XX, variable IC regulators with LM317 and LM338.

Feed back in Amplifiers: The concept of feedback, Positive and Negative feedback – feedback gain- Advantages of Negative feedback in amplifiers, Emitter follower - Darlington pair.

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

UNIT – II : (13 Hrs**)**

Operational Amplifiers : Characteristics of Ideal operational Amplifier, Block diagram of an IC operational Amplifier, Emitter coupled differential amplifier and its transfer characteristics. Analysis of inverting amplifier, Non-inverting amplifier, Integrator, Differentiator, summing amplifier, Difference amplifier, Comparator, Logarithmic amplifier and exponential amplifier, Square wave, Rectangular wave and Triangular wave generators.

Timer IC 555: Working of IC 555, Astable and Mono-stable Multi-vibrator with IC 555.

UNIT – III : (13 Hrs**)**

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

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

Registers: Types of Registers, Serial in Serial out, Serial in Parallel out, Parallel in Serial out and Parallel in Parallel out Registers.

Counters: Asynchronous and Synchronous Counters, Modulus N Counter, Ripple Counter, Decade Counter using Flip-Flops and IC's 7490, 7493.

UNIT – IV: (13 Hrs**)**

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, Ascending and descending arrangement of given numbers.

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, Programing and Application with the 8085 / 8080 – Gaonkar
8. Pulse Digital & Switching Waveforms by Millman and Taub, TMH 2001.
9. Fundamentals of electronics by JD Ryder, Wiley.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

REVISED SYLLABUS FOR M.Sc (PHYSICS)

III SEMESTER

With effect from the academic year 2018 -2019 onwards

S.No	Paper code	Paper	Paper title
1.	P301T	Paper I	Modern Optics
2	P302T	Paper II	Advanced solid state physics
Solid state physics (SSP)			
3	P303T/SSP	Paper III	Band Theory & electrical Properties
4	P304A/T/SSP	Paper IVA	Physics of phonons and structural phase transitions
5	P304B/T/SSP	Paper IVB	Crystal Physics and physical properties
Materials Science (MS)			
6	P303T/MS	Paper III	Mechanical Properties of materials
7	P304A/T/MS	Paper IVA	Thin films and their properties
8	P304B/T/MS	Paper IVB	Metal and Alloys
Electronic Instrumentation (EI)			
9	P303T/EI	Paper III	Electronic Instrumentation
10	P304A/T/EI	Paper IVA	Digital logic circuits
11	P304B/T/EI	Paper IVB	Microprocessors, DSP & interfacing
Nano Science(NS)			
12	P303T/NS	Paper III	Carbon nano tubes and applications
13	P304A/T/NS	Paper IVA	Synthesis and characterization of nano materials
14	P304B/T/NS	Paper IVB	Properties of nano materials
Electronic communication (EC)			
15	P303T/EC	Paper III	8051 Microcontroller and applications
16	P304A/T/EC	Paper IVA	Data Computer communications- I
17	P304B/T/EC	Paper IVB	Digital transmission techniques and information theory
Biophysics (BP)			
18	P303T/BP	Paper III	Molecular Biophysics
19	P304A/T/BP	Paper IVA	Physico-chemical techniques in Biophysics
20	P304B/T/BP	Paper IVB	Medical Biophysics
Microwaves (MW)			
21	P303T/MW	Paper III	Transmission lines – microwave passive devices
22	P304A/T/MW	Paper IVA	Microwave (active) devices and circuits
23	P304B/T/MW	Paper IVB	Information theory and computer communications
Condensed Matter Physics (CMP)			
24	P303T/CMP	Paper III	Electrical transport phenomena in solids
25	P304A/T/CMP	Paper IVA	Physics of Phonons and structural phase transitions
26	P304B/T/CMP	Paper IVB	Crystal Physics and physical properties
Opto-Electronics (OE)			
27	P303T/OE	Paper III	Introduction to optoelectronics
28	P304A/T/OE	Paper IVA	Optoelectronic devices
29	P304B/T/OE	Paper IVB	Laser Physics and applications
Applied Electronics (AE)			
30	P301T/AE	Paper I	Digital system design
31	P302T/AE	Paper II	Digital signal processing and digital signal processors
32	P303T/AE	Paper III	Data communication and networking
33	P304A/T/AE	Paper IVA	Optical fiber and mobile communications
34	P304B/T/AE	Paper IVB	Electronic instrumentation

Practical

35	P305P	Paper V	General Physics lab-I (Common to all specializations)
36	P306P	Paper VI	General Physics lab-II (Common to all specializations)
37	P307P	Paper VII	Special Lab - I
38	P308P	Paper VIII	Special Lab - II

Practical (Applied Electronics)

35	P305P/AE	Paper V	Lab-I
36	P306P/AE	Paper VI	Lab-II
37	P307P/AE	Paper VII	Lab-III
38	P308P/AE	Paper VIII	Lab-IV

Details of credits and marks	
Number instruction hours per each theory paper per week	4
Maximum marks for each theory paper	100(80 semester exam + 20 internal evaluation)
Number of credits for each theory paper	4
Number instruction hours per each practical paper per week	16 (3 x 5 + 1 Tutorial)
Maximum Marks per each practical paper	50
Number credits per each practical paper	2
Total Credits per semester	24

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019 onwards)

P–301T

Paper – I: Core (Common for all Specializations)

MODERN OPTICS

Unit I: Principles of 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.

Unit II: Laser Systems: Classification of laser systems –Gas, Liquid and Solid Lasers-Gas lasers and Energy level schemes: He- Ne, Argon, CO_2 Gas lasers, EXCIMER lasers- Applications. Solid State lasers: Ruby, Neodymium, Nd-YAG lasers –Dye lasers- Applications
Semiconductor lasers: Ga-As lasers and applications.

Unit III: 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 IV: Fourier and Non-Linear Optics: Fourier optics- Thin lens as phase transformation – Thickness function- Various types of lenses- 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. Opto Electronics- 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 Thayagarajan.
5. Principles of Lasers –O. Svelto
6. Laser fundamentals Silfvast Cambridge

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 302T

Paper –II: Core (Common for all Specializations)

ADVANCED SOLID STATE PHYSICS

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. De Haas-van Alphen effect.

Unit II: Dielectrics and Ferroelectrics: Macroscopic description of the static dielectric constant. Concept of local field. The electronic, ionic and orientational polarizabilities. Measurement of dielectric constant of a solid. Clausius-Mosotti relation. Behavior of dielectrics in an alternating field, elementary ideas on dipole relaxation. Classification of ferroelectrics- Ba TiO_3 and KDP. Theory of ferroelectrics, Spontaneous polarization and ferroelectric hysteresis.

Unit III: Magnetic Properties: Diamagnetism - Langevin's theory and quantum theory. Origin of permanent magnetic moment, Theories of paramagnetism, Paramagnetic cooling. Spontaneous magnetization Weiss theory of spontaneous magnetization. Nature and origin of Weiss molecular field, Heisenberg exchange interaction. Ferromagnetic domains and hysteresis. The Bloch wall, Neel's theory of anti-ferromagnetism. Ferrimagnetism, ferrites and their applications (basic concepts only)

Unit IV: Superconductivity: Occurrence of superconductivity. Experimental observations – persistent currents, effect of magnetic field, Meissner effect, Type I and type II superconductors. Isotope effect, entropy, heat capacity and thermal conductivity. Energy gap. Microwave and infrared absorption.

Theoretical explanations:-penetration depth, Coherence length London equations, Cooper pairs and elements of BCS theory. Giaver tunneling, Josephson effects (Basic ideas only). Elements of high temperature superconductors (basic concepts). Applications of superconductors.

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

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - III Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P – 303/T /SSP

Paper –III

BAND THEORY AND ELECTRICAL PROPERTIES

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 : Fermi Surface : Introduction, Characteristics of Fermi Surface, Construction of Fermi surface, Fermi surface and Brillouin zones, Dynamics of an electron in electric field; Dynamics of an electron in magnetic field –Cyclotron frequency, Cyclotron mass, Onsager-Lifshitz quantization condition, Cyclotron resonance, Energy levels and density of states in magnetic field, de-Haas van Alphen effect.

Unit III : 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, Matheissen's rule, Thermal conductivity, Wiedemann-Franz law, Hall-effect.

Unit IV : 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; Superionic Conductivity- structure, defects and conductivity.

Recommended books

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

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - III Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P – 304A/T/SSP

Paper – IV A

PHYSICS OF PHONONS AND STRUCTURAL PHASE TRANSITIONS

Unit I : 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 – Liddane – Sach – Teller's (LST) relation – Applications – Infrared measurements, Raman effect – Theory of polaritons – Experimental measurement.

Unit II : 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.

Unit III : Ferroelectricity and structural phase transitions : Introduction to ferroelectricity and phase transitions, The free energy expression to summarize characteristics of ferroelectrics, Soft modes in ferroelectrics, Structural phase transitions, Comparison with experiments, Symmetry of low temperature phases, Microscopic model of soft modes, Optical properties of ferroelectrics, other related properties including pyroelectricity, Piezoelectricity, Ferroelasticity and Antiferroelectricity.

Unit IV : Superconductivity : Instability of Fermi Sea and Cooper pairs, BCS ground state, manifestation of energy gap; consequence of BCS theory and comparison with experimental results, Quantization of magnetic flux, Giaever tunneling, Josephson effect – Phase coherence, D.C. and A.C. Josephson effects, Superconducting quantum interference devices (SQUIDS). Discovery of the phenomenon of High Temperature Superconductivity; Discovery of various types of HTSC materials, viz; - Y-, Bi-, Tl and Hg based materials. Preparation of HTSC materials by the solid state reaction method and their fundamental physical properties (Elementary treatment only)

Recommended Books

1. Solid state physics G.Burns;
2. Intermediate theory of crystalline solids – Animalu
3. Solid state physics – H.Ibach and H.Luth,
4. Solid state physics – Christ,
5. Solid state physics – Kachava
6. Solid State Physics - Dekker
7. Solid State Physics --Wahab.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - III Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P – 304B/T/SSP

Paper – IV B

CRYSTAL PHYSICS AND PHYSICAL PROPERTIES

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, Mullikan symbolism, Symmetry species.

Unit II : Elements of Ligand field theory and Electronic spectra: Concept of ligand field and crystal field. Free ion configurations- terms and states. Derivation of free ion terms for d_1 and d_2 configuration. Energy ordering of terms- Hund's rules. Strength of crystal fields, Crystal field potentials for O_h and T_d fields. Meaning of Dq. Construction of ligand field energy level diagrams- effect of weak crystal fields on terms. Splitting due to lower symmetries Electronic spectra of d_1 and d_9 systems.

Unit III : Crystal symmetry and physical properties : Development of theoretical formalism, tensors, Physical property and its tensorial representation . Quotient theorem, Symmetry in crystals - point groups and space groups, Crystal classes. Neumann's Principle. Fumi's method determining symmetry of physical properties, Pyroelectricity and crystal Symmetry, Dielectric constant and Crystal symmetry –triclinic, monoclinic, orthorhombic and cubic systems; Piezoelectricity and crystal symmetry- triclinic, monoclinic and cubic systems, Piezoelectricity in quartz. Elasticity and crystal symmetry – triclinic, monoclinic, orthorhombic and cubic systems .

Unit IV : Surface science : Introduction, Crystal shape and bond densities, Preparation clean surfaces, Low energy electron diffraction (LEED), Structure of surfaces, Examples of surface reconstruction, Interaction of gases with surfaces, Chemisorptions and co-adsorption, Photoelectron spectroscopy(PES), UPS, XPS, ESCA, Synchrotron radiation, Auger electron spectroscopy(AES), Electron Energy Loss spectroscopy (EELS), Extended X-ray absorption fine structure (EXAFS)

Recommended books

1. Chemical applications of group theory F.A. Cotton
2. Spectroscopy of molecules Veera Reddy
3. Ligand field theory B.N. Figgs
4. Physical properties of crystals J.F.Nye;
5. Physics of crystals S.Bhagavantam and S.Radhakrishna,
6. Solid State Physics G. Burns

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

Paper III

P 303/T/MS

MECHANICAL PROPERTIES OF MATERIALS

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 (Rockwell Brinell and Vickers) tests, Critically resolved stress, Pierl's force, width of a dislocation, 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 pile ups; Deformation of poly crystalline materials; Annealing – Re-crystallisation, grain growth, recovery, effect of grain size on dislocation motion. Grain boundary sliding in polycrystalline materials during stage Iii or recovery of deformation; The effect of solute atoms on dislocation motion, Precipitation hardening – mechanisms.

Unit IV: Failure and Corrosion of Materials: Failure and Degradation of materials: Fracture – Brittle fracture and ductile fracture – Brittle fracture: Griffith's model. Fracture toughness or resistance, Propagation of crack; Ductile fracture-Cup and Cone, mechanism involved in fracture, Ductile – Brittle transition ,Protection against fracture; Fatigue fracture, S-N curves, fatigue life; Corrosion – principle of corrosion, the galvanic cell, stress corrosion ,intergranular corrosion , Prevention of corrosion – cathode and anodic protection, Passivation.

Recommended Books:

1. Materials Science and Engineering –W.D.Callister John Wiley & Sons
2. Physical Metallurgy principles –Reed Hill, Robert Mc-Graw Hill
3. Elements of Physical Metallurgy –A.G.Guy Addison-Wesley
4. Physical Metallurgy –R.W.Cahn.and Peter Haasen, North Holland
5. Material Science Kakani. S.L, Amit Kakani New age

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 304A/ T/ MS **Paper IVA**

THIN FILMS AND THEIR PROPERTIES

Unit I

Vacuum Techniques

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

Unit II

Thin Film Deposition Methods

Methods of thin film preparation, thermal evaporation, electron beam evaporation, pulsed laser deposition, cathodic sputtering, r.f. magnetron sputtering, MBE, Chemical vapour deposition methods, Sol gel spin coating, spray pyrolysis, Chemical bath deposition.

Unit III

Thin Film Formation and Thickness Measurement

Nucleation, film growth and structure - various stages in thin film formation, thermodynamics of nucleation, nucleation theories, Capillarity model and Atomistic model and their comparison. Structure of Thin film, roll of substrate , roll of film thickness, film thickness measurement-interferometry, ellipsometry, micro balance, quartz crystal oscillator techniques.

Unit IV

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, reflection from multilayer film, Applications of thin films:

Books suggested:

1. Materials science of thin films, M.Ohring, Elsevier, 2006
2. Thin film fundamentals –A. Goswami, New Age International publishers, 2006.
3. Thin film phenomena - K.L. Chopra, Mc Graw – Hill Book Company 1969

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 304B/ T/MS

Paper IVB
METALS AND ALLOYS

Unit I: Solid Solutions: Solid solutions, Hume-Rothery's rules, substitutional property changes in solid solutions, intermediate phases, interstitial phases, Free energy of solid solutions, phase mixtures, stable state of an alloy, equations of phase equilibrium, Phase rule, The free energy of intermediate phases, Variation of solubility with temperature, long range and short range order in solid solutions.

Unit II: The Phase Diagrams: Introduction, solubility limit, complete and partial miscibility in the solid state phases, phase equilibria, equilibrium phase diagrams, binary isomorphous systems, interpretation of phase, binary eutectic systems, equilibrium diagrams having intermediate phases or compounds, eutectoid and peritectic reactions, congruent phase transformations, ternary phase diagrams, construction of a simple equilibrium diagram, interpretation of phase diagrams, systems containing intermediate phases, eutectic, eutectoid, peritectic, peritectoid systems. Gibbs phase rule, Lever Rule, Phase diagram of Fe-C system development of microstructures in iron-carbon alloys.

Unit III: Phase Transformations: Phase transformations in metals, Basic concepts, The Kinetics of Solid-State Reactions, Multiphase Transformations, microstructural and property changes in iron-carbon alloys, Isothermal Transformation, Tempered Maternsite, Review of Phase Transformations for Iron-Carbon Alloys, Precipitation hardening, Heat Treatments, Mechanism of Hardening.

Unit IV: Alloys: Ferrous alloys: steels- Heat treatment of alloys, Formation of pearlite, Formation of bainite, Formation of martensite, Tempering of quenched steel.

Non-ferrous allots: Heat treatment of alloys- Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Nickel and its alloys.

Recommended Books:

1. Foundation of Materials Science and Engineering –Kakani and Kakani
2. Materials Science and Engineering –W.D. Callister
3. Physical Metallurgy- R.E. Reed Hill
4. Foundations of Materials Science and Engineering - William F.Smith

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 303 T/EI

Paper - III
ELECTRONIC INSTRUMENTATION

Unit I : Measurement and Error

Definitions- 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. Specification and testing of dynamic response.

Unit II : Amplifiers and Signal Conditioning

Instrumentation amplifiers- Isolation amplifiers- Chopper amplifiers- Voltage to frequency and frequency to voltage converters-Frequency multipliers - Logarithmic amplifiers,- S/H Circuits-

Attenuators. Second order active filters –Low pass , High pass, Band pass, and Band stop filters- Butterworth and Chebychev filters- Frequency transformation- All pass filters. Phase sensitive detectors (PSD) - Phase lock loop (PLL) –Lock-in-amplifier.

Unit III : Signal Generation

Frequency synthesized signal generator- Frequency divider generator- RF signal generator- Signal generator modulation- Sweep frequency generator- Function generator –Noise generator. **Signal Analysis:** Wave Analyzer- Audio frequency Wave analyzer- Heterodyne wave analyzer-Harmonic distortion analyzer- Resonant harmonic distortion analyzer- Heterodyne harmonic distortion analyzer- Fundamental suppression harmonic distortion analyzer- Spectrum analyzer-Spectra of CW, AM, FM and PM waves.

Unit IV

Electronic Measuring Instruments

Q- meter- Vector impedance meter- Digital frequency meter –Digital voltmeter –Phase meter – RF power and voltage measurement –Power factor meter –Vector volt meter.

Display and Recording: X-t, X-Y Recorders –Magnetic tape Recorders- Laser printers –Ink jet printers. - Storage oscilloscope.

Characteristics of digital displays: LED- LCD –Dot matrix and seven segment display systems.

Recommended Books

1. Modern Electronic Instrumentation and Measurement Techniques –A.O. Helfrick and W.D.Cooper, Prentice Hall India Publications.
2. Instrumentation Devices and Systems –C.S Rangan, G.R. Sharma and VSV Mani, Tata Mc Graw Hill 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- D.V.S Murty PHI Publications.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 304A/T/EI

Paper IVA DIGITAL LOGIC CIRCUITS

Unit I : Combinational Logic Circuits

Simplifying Logic Circuits, Sum of products form - Algebraic simplification, designing combinational logic circuits, Karnaugh Map Method, looping - pairs, quads, octets, complete simplification process, Don't care condition

Digital Arithmetic Operations and Circuits Binary addition, representing signed numbers, binary subtraction, BCD addition, Hex arithmetic, ALU, parallel binary adder, design of full adder, carry propagation's, IC parallel adder, 2's compliments system, IEEE/ANSI symbols.

Unit II : Flip-Flops

NAND and NOR gate latches, clock signals and clocked flip-flops, clocked R-S, J-K, and D-FFs, D latches, Asynchronous inputs, IEEE/ANSI symbols, Timing consideration, one shot.

Counters and Registers : Ripple counters, Counter with MOD numbers $< 2^n$. IC asynchronous counters, asynchronous down counters, propagation delay in ripple counter, Up/Down counters. Presettable counters, 74193 counter, Decoding a counter, Decoding glitches, synchronous counter design, Left & Right shift registers, shift register counters, IEEE/ANSI symbols.

Unit III : IC Logic Families

Digital IC terminology, TTL logic family, TTL series characteristics, improved TTL series, TTL loading and fan-out other TTL characteristics, connecting TTL outputs together, tristate TTL, ECL Family, MOS digital IC's and characteristics, CMOS logic and characteristics, bilateral switch, TTL driving CMOS and vice versa. Low voltage technology

MSI Logic Circuits: Decoders, BCD to 7 segment decoder/driver, liquid crystal display, Encoders, multiplexers and their applications, demultiplexers, magnitude comparators, code converters, data busing, data bus operations, IEEE./ANSI symbols,

Unit IV : Memory Devices

General Memory Operation, CPU-Memory connection, Read only memories, ROM architecture, ROM timing, and types of ROMs, Flash memory, and ROM applications. Semiconductor RAMs, RAM architectures, static RAM, Dynamic RAM (DRAM), DRAMS structure and its operation, DRAM Read/Write cycles, DRAM refreshing, Expansion of word sizes and capacity

Programmable Logic Devices and Introduction to VHDL

Basic ideas, PLD architectures (PROM), PAL, PLAS, Application of programmable logic devices - GAL 16 V, 8A, programming a PLD, Introduction to VHDL- Description Languages verses Programming Languages, HDL Format and Syntax , Intermediate signals, representing data in VHDL, Truth tables using VHDL.

Books Recommended

1. Digital systems Principles& Applications Ronald J.Tocci PHI,
2. Modern digital electronics R.P.Jain, Tata McGraw Hill 6E
3. Digital Systems - Principles and Applications - Ronald J.Tocci
4. Digital Design, Morris Mano
5. Digital Principles and Design -Donald D. Givone.
6. Digital Integrated Electronics - Herbert Taub and Donal Schilling, McGraw Hill,
7. Digital Electronics - An introduction to Theory and Practice -- William H.Gothmann

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 304B/T/EI

Paper IVB
MICROPROCESSORS, DSPs & INTERFACING

Unit I

The 8086 Microprocessor - General Organization of a Microcomputer, Detailed Architecture of 8086, Addressing Modes, Instructions Set, Assembly Language Programming, Programming Examples. The 8086-Based **System Design** - Pins and Signals, System Components, Interfacing Memory, I/O Devices.

Unit II

Peripheral Interfaces and Interfacing with 8086 : Parallel I/O Methods, Programmable Peripheral Interface (8255 A), Key board /Display interface (8279),Programmable Priority Interrupt Controller (8259 A), DMA Controller (8237/8257), Programmable Interval Timer (8254), Programmable Communication interface (8251), UART.

Advanced Microprocessors- Protected Mode Operation, The 80286, 80386, 80486, Pentium, Pentium-Pro and Pentium I-IV Microprocessors.

Unit III

Digital Signal Processors (DSP) Architecture of TMS320C5X- Introduction-Bus structure-Central architecture logic unit (CALU)-Auxilary Register (AR)-Index register (INDX)-ARCR-Block move address register Block Repeat Register, Parallel Logic Unit (PLU), memory mapped registers-Program controller-Some flags in status registers. On chip memory –on chip peripherals.

Unit IV

Digital Signal Processors (DSP) TMS320C5X Assembly Language Instruction –Assembly Language Syntax, Addressing Modes, Load and Store Instructions, Addition/ Subtraction Instructions, Move Instructions, Multiplication Instructions, The NORM Instruction, Programme Control Instruction, Peripheral Control.

Books:

1. Microprocessors, PC Hardware and Interfacing - By N. Mathivanan, PHI, 2003
2. The Intel Microprocessors 8086/8088, 80186/80188, 80286,80386,80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming, and
   Interfacing - By Barry B. Brey, 6th Ed., PHI / PEA, 17th Reprint, 2003
3. Digital Signal Processors- B.Venkata Ramani and M.Bhaskar (TMH).
4. The 8086 Microprocessor : Programming & Interfacing the PC - By Kenneth J. Ayala Penram International Publishing, 1995
5. Advanced Microprocessors and Peripherals - Architecture, Programming and Interfacing - By A K Ray and K M Bhurchandi, TMH, 2000
6. Advanced Microprocessors and Interfacing - By Badri Ram, TMH, 2nd Reprint 2002
7. Microprocessors and Interfacing, Programming and Hardware - By Douglas V. Hall, TMH, 2nd Ed., 18th Reprint, 2003
8. The 8088 and 8086 Microprocessors - Programming, Interfacing, Software, Hardware and Applications - By Walter A Triebel and Avtar Singh, PHI, 4th Ed., 2002
9. Microcomputer Systems : The 8086/8088 Family, Architecture , Programming, and Design By Yu-cheng Liu and Glenn A. Gibson, PHI, 2nd Ed., 1986.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019 onwards)

P303/T/NS

PAPER –III

CARBON NANOTUBES AND APPLICATIONS

Unit-I: Structure of CNTs preparation of carbon nanotubes: CVD ,PLD,ARC discharge method, electronic properties of CNTs: grapheme electronic structure , CNT electronic structure ,carrier concentration in intrinsic and doped CNTs, types of CNTs.

Unit-II: Metallic carbon nanotubes, CNTs for current conduction –Low bias transport –ballastic conductors, high bias transport ,classical capacitance ,intrinsic capacitance, classical inductance and intrinsic inductance.

Unit-III : Electronic devices: CNTSs in junctions , metal semiconductor junctions, Field effect transistor, ohmic contacts, schottky contacts, logic circuits- NOR,OR,NAND. AND ,Channel effects, cross talk ,noise .

Unit-IV: Electromechanical and optical devices: Bending ,uniaxial and torsional strain, radial deformation, electro mechanical oscillations, torsional actuators , nanotube memory, optical properties –excitons, excitons in electric fields, photoconductivity , bolometers, electroluminescence, thermal light emission.

Recommended Books:

1.Physical properties of carbon Nanotubes-R.Satio

2.Carbon Nanotubes: Properties and application : MICHEAL lo Connell

3. Nanotubes and Nano wires : CNR Rao and A.Govindraj

4.The physics of CNT devices – Francois Leonard

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019s onwards)

P304A/T/NS

PAPER –IVA

SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS

Unit –I: Introduction to Nanomaterials ,role of size in nano materials, Classification of Nano structured materials -0D,1D,2D,3D ,nanoparticles, nano-wires, nano-clusters, quantum wells.

Synthesis routes- Bottom –Up Approaches, Top –Down Approaches, consolidation of Nano powders

Synthesis of nanomaterials-I

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, electro deposition.

Unit –II: Synthesis of nanomaterials-II

Chemical methods: chemical nucleation theory for cluster formation, metal nanoc rystal 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.

Unit-III: Characterization methods : Electron Microscopy ; Introduction , Working of SEM,TEM,AFM

X-ray Crystallography: Introduction, Structure of nano materials, X-ray diffraction (XRD) ,The powder method- Determination of grain size/crystallite using X-ray broadening studies (Scherer's formula), Determination of Crystallite size distribution, Small angle X-ray scattering (SAXS).

Unit –IV: Introduction to Lithographic techniques: AFM based nanolithography, e-beam lithography and SEM based nanolithography, ion beam lithography,deep UV lithography, X-ray based lithography.

Spectroscopy Techniques: Introduction, Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, DSC, UV vis spectroscopy.

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. Nano materials Handbook – Yury Gogotsi

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019 onwards)

P304B/T/NS

PAPER –IVB

PROPERTIES OF NANOMATERIALS

Unit-I : Electronic properties:: Introduction , properties of materials& nanomaterials, role of size in nanomaterials, classification of materials,metal,semiconductor,insulator,bandstructures,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, coulomb blockade, diffusive transport , Fock space.

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

Magnetic properties: fundamentals of magnetism, different kinds of magnetism in nature: dia, para, ferro, antiferro, ferri, superpara, and important properties in relation to nanomagnetism.

Unit- III: Optical and thermal properties: Optical 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.

Unit- IV: Mechanical properties: Young's modulus, Bulk modulus ,Modulus of rigidity, 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, Viker's hardness-testing, impact testing – toughness, resilience, 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. Nano materials Handbook – Yury Gogotsi
6. Introduction to Nano science and Nano technology – K K Chatopadhayya &Banerjee,PHI
7. Introduction of Nano technology-Cahrles P.Poole Jr and Franks J.Qwens
8. Physics of Magnetism-S.Chikazmi and S.H.Charap
9. Encyclopedia of Nanotechnology –Hari Singh Nalwa

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019 onwards)

P303/T/EC

Paper- III

8051 MICRO-CONTROLLER & ITS APPLICATIONS

Unit -I: Architecture Of Microcontroller 8051: Micro controllers & Embedded Processors: Micro controller versus General-purpose Microprocessors, Microcontrollers for embedded systems, embedded applications, choosing a Microcontroller.8051 Architecture: 8051 Microcontroller hardware, input/output pins, ports and circuits, external memory, counter and timer, serial data input and output, interrupts, other members of 8051.

Unit-II: 8051 Instructions and Assembly Language Programming: Addressing modes: immediate and register addressing modes, accessing memory using various addressing modes.
Arithmetic instructions and programs unsigned addition and subtraction, unsigned multiplication and division, signed members concepts and arithmetic operations.
Logic Instruction and programs: Logic and compare instructions rotate and swap instructions. Jump, Loop and call instructions; Loop and jump instructions, call instructions, time delay, generation and calculation.
Single bit instructions and programming: single bit instruction programming, single bit operation with carry reading input pins versus port latch. I/O port programming: I/O programming, bit manipulation.

Unit-III: 8051 Timer / Counter, Serial Communication And Interrupts Programming:
Timer / Counter programming: programming 8051 timers, counter programming, pulse frequency and pulse width measurements.
Serial data communication programming: Basics of serial communication, 8051 connection to RS232, 8051 serial communication programming.
Interrupts programming: Interrupts of 8051; programming timer interrupts, programming external hardware interrupts, and programming serial communication interrupts.

Unit-IV: Application Of 8051 Micro Controllers: 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.

Recommended Books:

1. The 8051 Microcontroller Architecture. Programming and Applications by Kenneth Ayala: Penram International Pub (1996)
2. 8051 Micro controller and Embedded systems by Mazidi and Mazidi, Pearson Education Asia (2002)
3. The concepts and features of micro controllers (68HC11, 8051, 8096) by Rajkamal: Wheeler Pub (2000)

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019 onwards)

P304A/T/EC

Paper-IVA: **DATA AND COMPUTER COMMUNICATIONS**

Unit I: Data Transmission**:** Transmission Terminology, Time Domain and Frequency Domain Concepts, Data rate, Band Width, Analog and Digital transmission, Transmission Impairments, Channel Capacity. Guided and Wireless Transmission Guided transmission media, Wireless transmission, Wireless propagation, Line of sight transmission.

Digital Data Communication Techniques**:** Digital Signal Encoding Formats, Asynchronous and synchronous transmission, Types of Errors, Error detection, Block Code Principles, Error correction, Line Configurations, Interfacing.

Unit II: Data Link Control: Flow Control, Error control, High level Data link control. Multiplexing Frequency division Multiplexing, Synchronous Time division Multiplexing, Statistical Time division Multiplexing, Asymmetric Digital Subscriber line, x DSL.Circuit Switching, Packet Switching: Switching Networks, Circuit Switching Networks, Circuit Switching Concepts, Control Signaling. Soft switch Architecture, Packet Switching principles, X.25.

Frame Relay: Frame Relay Protocol architecture, User Data Transfer.

Unit -III : Routing in Switching Networks Routing in Circuit switching Networks, Routing in Packet switching Networks, Least cost Algorithms.

Asynchronous Transfer Mode (ATM): ATM Protocol architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service categories, ATM Adaptation Layer.

Congestion Controlling Data Networks Effect of congestion, Congestion control, Traffic management, Congestion control in Packet switching networks, Frame relay congestion control, ATM Traffic Management.

Unit IV: Local Area Networks (LAN): Topologies & Transmission Media, LAN Protocol Architecture, Layer 2 & Layer 3 switches.High Speed LANs Ethernet, Token Ring, Fiber Channel.

Wireless LANs: Wireless LAN Technology, IEEE 802.11 Architecture and Services, IEEE 802.11 Medium Access Control, IEEE 802.11 Physical layer

Recommended Books

1. Data and Computer Communications , William Stallings [SEVENTH &EIGTH Edition]
2. Computer Networks A.S.Tanenbaum [Third Edition]

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

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

(For the batch admitted from 2018-2019 onwards)

P304B/T/EC

Paper-IVB

DIGITAL TRANSMISSION TECHNIQUES & INFORMATION THEORY

Unit I: Digital Transmission of Analog Signals

The Sampling Theorem, Pulse-Amplitude Modulation, Natural Sampling, Flat-top Sampling, Signal Recovery through Holding, Quantization of Signals, Quantization Error, Pulse-code Modulation(PCM), The PCM System, Companding, Multiplexing PCM Signals, Differential PCM, Delta Modulation.

Digital Modulation Techniques

Binary Modulation Techniques:: ASK, PSK, FSK, and their Generation & Detection QPSK, MSK.

Unit II Information Theory

Discrete messages, The concept of amount of Information, Average Information, Entropy, Information rate, Shannon's Theorem, Channel Capacity, Capacity of a Gaussian Channel, Bandwidth-S/N Trade-Off, Use of Orthogonal Signals to attain Shannon's limit, Efficiency of Orthogonal Signal Transmission.

Unit III : Coding

Need for Coding, Parity Check Bit Coding for Error detection, Coding for Error detection and Correction, Block Codes, Coding and Decoding for block codes, Algebraic codes, Burst Error Correction, Convolution Coding and Decoding, Error in Convolution codes, Automatic repeat request. An Application Information Theory, Optimum Modulation System, Trellis decoded Modulation.

Unit IV: Optimum Receivers Matched Filters

Formulation of optimum receiver problems. Maximization of output signal to noise ratio. Properties of matched filters; Approximations in matched filter design. Probabilistic approach; Probability of error in Binary PCM.

Recommended Books

1. Principles of Communication Systems- H.Taub and D.L.Schilling, Second Edition.
2. An Introduction to Analog and Digital Communications-Simon Haykin
3. Digital and Analog Communications Systems-K.Sam Shanmugam

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 303T/BP

Paper - III

Molecular Biophysics

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. Debye- Huckel 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: Nature and origin of optical activity.Optical rotation and circular dichorism.Drude's equation.Moffit's equation. Cotton effect. Optical activity in native proteins and conformation.Determination of helical content.

Unit III: Absorption spectroscopy

Basic principle and experimental technique of infrared spectroscopy.Application to biomolecules and tissues.Basic principle and experimental technique of ultraviolet spectroscopy.Beer-Lambert law.Application to proteins and nucleic acids.Basic principle and experimental technique of NMR spectroscopy.Resonance condition. Chemical shifts and spin-spin coupling.Application to proteins and nucleic acids.Basic principle and experimental technique of ESR spectroscopy.Application to proteins, nucleic acids and cellular constituents such as chloroplast.

Unit IV: X – Ray Diffraction

Structure determination – Amplitude and Phase information. Phase determination procedures: The Patterson method; Direct methods – Hauptman-Karle method, Hoppe-Zechmiester method.

The X-ray diffraction patterns of some protein fibers. Structure of globular proteins. Structure of polypeptide chains.Pleated sheaths and β-keratin.α - helix and α-keratin. X-ray diffraction of nucleic acid polymers.

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 Russel K, Hobby
5. Biophysical Chemistry - by A G Marshall
6. Experimental methods in Biophysical Chemistry - by C Nicolau
7. An introduction to spectroscopy for biochemists – by Brown

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 304A/T/BP

Paper - IVA

Physico – Chemical Techniques in Biophysics

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 (ϕ) and its relation to radius of gyration

Unit- II: 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: Electrophoresis

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

Unit-IV: 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 PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 304B/T/BP

Paper - IV B

Medical Biophysics

Unit I : Physics of Hematology and Hemodynamics

Blood and its constituents. Physiology of blood. Molecular composition of blood. Hemoglobin – oxy hemoglobin, methamoglobin, Carboxy hemoglobin, Glycated hemoglobin. Rheology of blood. Clinical and Physico – chemical properties of blood. Spectroscopic analysis of blood.

Unit II : Physics of Respiratory system

The airways. Interaction of blood and lungs. Pressure – airflow – volume relationship. Physics of the Alveoli.Breathing mechanism.Airway resistance. Work of breathing. Physics of some common diseases.

Unit III : Physics of Cardiovascular system

Major components of the cardiovascular system. Oxygen and carbon dioxide exchange in capillary system. Work done by the heart.Transmural pressure.Laminar and turbulent blood flow. Heart sounds. The physics of some cardiovascular diseases.

Unit IV : Physics of Renal system

Components of the Renal system; Anatomy and physiology of kidney; Osmotic pressure - some clinical examples; Volume transport through membrane; Solute transport through membrane; Artificial kidney; Gomerular filtration.

Recommended Books:

1. Medical Physics - John R, Cameron & G Skefrenick
2. Principles of medical electronics and Biomedical instrumentation - C Raja Rao & S K Guha, Universities Press
3. Medical Biophysics – R. N. Roy, Books 7 Allied Pvt.Ltd.,Calcutta
4. Medical Physiology – Guyton.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P-303T/MW

Paper – III
TRANSMISSION LINES - MICROWAVE PASSIVE DEVICES

Unit I: Introduction – Frequency spectrum – RF behavior of passive components – HF resistors, capacitors and inductors – chip components – surface mounted inductors.
Transmission Lines: Examples of transmission lines – two wire lines-Coaxial lines – Microstrip lines Equivalent circuit representation – General transmission line equation – Traveling voltage and current waves – Characteristic Impedance –lossless transmission – microstrip transmission lines – terminated lossless transmission line – voltage reflection coefficient – propagation constant and phase velocity – standing waves – Special termination conditions – Input impedance of a lossless line- short circuit transmission line – quarter wave transmission line – sourced and loaded transmission line- power considerations for a transmission line – input impedance matching – return loss and insertion loss.

Unit II: Strip Lines: Basic parameters – phase constant, Characteristic impedance (Z o), effective dielectric constant , Quality factor (Q). Some varieties of strip lines : Parallel strip lines –.Coplanar strip lines – Shielded strip lines. Variation of the characteristic impedance with frequency. Losses in Microstrip lines –Dielectric losses, ohmic losses and radiation losses. Example calculations.

Unit III: Smith Chart and Applications: From reflection coefficient to load impedance –Impedance transformation, Admittance transformations, Parallel and series connections.
Single and Multiport Networks: Introduction – Basic definitions – Matrix representation of Pi-network – Low-frequency hybrid network description of a BJT – Internal resistance and current gain of BJT based on h-parameters – Interconnecting networks – parallel connection of networks – cascading networks – ABCD representation – ABCD network representation of an impedance element – ABCD matrix computation of a T-network – ABCD-matrix coefficient computation of a transmission line section
Network properties and applications – Inter relations between Parameter Sets – Analysis of Microwave amplifier. Scattering Parameters – definition – meaning of S-Parameters – Determination of a T-network elements – Chain Scattering matrix – conversion between Z- and S-parameters
Unit IV: Microwave Passive Devices:
Wave guides : Introduction – reflections of waves from a conducting plane – parallel plane wave guide – cut off wave length – cut off frequency – group and phase velocity in wave guides – rectangular wave guides – circular wave guides - different modes – field patterns.
Wave guide coupling – methods of exiting wave guides – slop coupling – direct coupling to coaxial lines – choke coupling , tuning . Directional couplers , circulators , cavity resonators, Hybrid junctions. Microwave propagation in magnetic materials , Farady rotation in Ferrites – Gyrators, isolators and phase shifters.

Recommended Books :

1. R.F. Circuit Design - Theory and Applications - Reinhold Ludwig & Pavel Bretchko - Pearson Education Asia
2. Networks lines and fields – Ryder
3. Microwave engineering with wireless applications - Pennok & Shepherd
4. Microwave devices and circuits – Samuel Y. Liao
5. Electronic communication systems – Kennedy & Davis
6. Microwave integrated circuits – K.C. Gupta
7. Foundations for Microwave Engineering – R.E. Collin - McGraw Hill 51

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P- 304A/T/MW

Paper – IVA
MICROWAVE (ACTIVE) DEVICES AND CIRCUITS

Unit I: Klystron: Introduction – two cavity klystrons – velocity modulation – Bunching – output power – Beam heading - efficiency of klystron – power required to bunch the electron
Reflex klystron – velocity modulation – power output – efficiency
Magnetron – cylindrical magnetron Hull cutoff magnetic equations and cutoff voltage equations – cyclotron angular frequency – power output – efficiency
Travelling Wave Tube – Slow wave structure – amplification process

Unit II: Introduction: P – N Junction - PIN diode – Switching the PIN diode – Tunnel diode & back diode – Schottky barrier diode – IMPATT diode - Gunn .
Microwave transistors – BJTs – MESFETs – HEMETs – nonlinear effects–photo response.
Masers – Principle or working of Masers – practical masers and their applications.

Unit III: Detector diode – current sensitivity – Noise equivalent power and Tangential signal sensitivity
Mixers - Mixer components - Mixer parameters - Mixer circuits
Control circuits – Attenuators – Single diode circuits - Pi and T attenuators Limiters Switches - single diode Switch - Isolation and bandwidth extension.
Phase shifters – reflection based phase shifters – switched path – switched filter (Hi/Lo Phase shifter)

Unit IV: Amplifiers: reflection amplifier – Oscillation and gain condition – Parametric amplifiers – Manley-Rowe Power relations - two port transistor amplifier – Network Stability – Amplifier gain – amplifier noise- effects of parasitics and Matching Active Isolator - transistor oscillator.
Active filters: RC active filters – low pass and high pass filters (Butterworth, Bessal and Chebyshev types), band pass and band reject filters – notch filter - switched capacitor filters.
Amplifiers: instrumentation amplifiers – isolation amplifiers -

Recommended Books:

1. Microwave Engineering with wireless applications -- S.R. Pennock & P.R. Shepherd (MACMILLAN PRESS Ltd.)1998
2. Optical Fibre Communications – Keiser Gred McGraw-Hill
3. Optical Fibre Communication – Principle and Practice – SeniorJohn M. (PHI)
4. Optical Communication systems – Gowar John.
5. Microwave devices and circuits - Samuel Y Liao 3rd edition
6. Electronic communication systems - George Kennedy.
7. Linear integrated circuits - Roy Choudary and Jain(New age international private ltd.)

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P-304B/T/MW

Paper – IVB
INFORMATION THEORY AND COMPUTER COMMUNICATIONS

Unit I Information Theory: Discrete messages – the concept of amount of information – average information , entropy – information rate – coding to increase average information per bit – Shannon's theorem, channel capacity – capacity of a Gaussian channel – Bandwidth – S/N trade-off – Use of Orthogonal signals to attain Shannon's limit – efficiency of orthogonal signal transmission .
Coding: Introduction – parity check bit coding for error detection – coding for error detection and correction – block codes – upper bounds of the probability of error with coding – Block codes – coding and decoding – examples of algebraic codes. Burst error correction – convolutional coding – decoding a convolutional code – probability of convolutional codes.

Unit II Reference models - OSI reference model, TCP/IP reference model, comparison of OSI & TCP reference models. Example networks - ARPANET, Internet. Example Data Communication services: SMDS, X .25 networks, Frame Relay, Broad band ISDN, & ATM

Unit III Data Link Control - Flow control, Error detectors (CRC) , Error control, HDLC
Multiplexing - FDM, Synchronous TDM. Statistical TDM. FDMA, TDMA - ALOHA - SLOTTED ALOHA - Carrier Sense Multiple Access (CSMA)

Unit IV Circuit Switching: Switched networks, Circuit Switching networks, Switching concepts, Routing in circuit – Switched networks, Control Signalling Packet Switching : Packet switching Principles , Routing, congestion control.

Recommended Books
1. Principles of Communication Systems - Taub & Shilling (Tata McGraw Hill)
2. Data and Computer Communications – William Stalling (Prentice-Hall India Ltd.)
3. Data Communications and Networking - Behrouz A. Forouzan (Tata McGraw-Hill)
4. Computer Networks – Tanenbaum (Perintice-Hall India Ltd.) 97

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 303T/CMP

ELECTRICAL TRANSPORT PHENOMENA IN SOLIDS

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

Unit II: 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 III : Fermi Surface : Introduction, Characteristics of Fermi Surface, Construction of Fermi surface, Fermi surface and Brillouin zones, Dynamics of an electron in electric field; Dynamics of an electron in magnetic field –Cyclotron frequency, Cyclotron mass, Onsager-Lifshitz quantization condition, Cyclotron resonance, Energy levels and density of states in magnetic field, de-Haas van Alphen effect.

Unit IV : Electrical Transport Properties Of Insulators : Hopping conduction; Temperature variation of electrical conductivity; Seebeck coefficient; Polorons- small poloron band conduction; large poloron band conduction; small poloron hopping conduction; Mott transitions; Ionic Conductivity; Superionic Conductivity- structure, defects and conductivity.

Recommended books

1. Principles of theory Solids – Ziman
2. Solid state Physics - Singhal
3. Solid state Physics – H.C. Gupta
4. Elementary SolidState Physics – M.Ali Omar
5. SolidState Physics – M.A. Waheb
6. SolidState Physics – Kachchava,
7. Principles of the solid state – H.V. Keer

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 304A/T/CMP

Paper – IV A
PHYSICS OF PHONONS AND STRUCTURAL PHASE TRANSITIONS

Unit I : 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 – Liddane – Sach – Teller's (LST) relation – Applications – Infrared measurements, Raman effect – Theory of polaritons – Experimental measurement.

Unit II : 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.

Unit III : Ferroelectricity and structural phase transitions : Introduction to ferroelectricity and phase transitions, The free energy expression to summarize characteristics of ferroelectrics, Soft modes in ferroelectrics, Structural phase transitions, Comparison with experiments, Symmetry of low temperature phases, Microscopic model of soft modes, Optical properties of ferroelectrics, other related properties including pyroelectricity, Piezoelectricity, Ferroelasticity and Antiferroelectricity.

Unit IV : Superconductivity : Instability of Fermi Sea and Cooper pairs, BCS ground state, manifestation of energy gap; consequence of BCS theory and comparison with experimental results, Quantization of magnetic flux, Giaver tunneling, Josephson effect – Phase coherence, D.C. and A.C. Josephson effects, Superconducting quantum interference devices (SQUIDS). Discovery of the phenomenon of High Temperature Superconductivity; Discovery of various types of HTSC materials, viz; - Y-, Bi-, Tl and Hg based materials. Preparation of HTSC materials by the solid state reaction method and their fundamental physical properties (Elementary treatment only).

Recommended Books

1. Solid state physics G.Burns;
2. Intermediate theory of crystalline solids – Animalu
3. Solid state physics – H.Ibach and H.Luth,
4. Solid state physics – Christ,
5. Solid state physics – Kachchava
6. Solid State Physics - Dekker
7. Solid State Physics --Wahab.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 304B/T/CMP

Paper – IVB

CRYSTAL PHYSICS AND PHYSICAL PROPERTIES

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, Mullikan symbolism, Symmetry species.

Unit II: Elements of Ligand field theory and Electronic spectra: Concept of ligand field and crystal field. Free ion configurations- terms and states. Derivation of free ion terms for d^1 and d^2 configuration. Energy ordering of terms- Hund's rules. Strength of crystal fields, Crystal field potentials for O_h and T_d fields. Meaning of Dq. Construction of ligand field energy level diagrams- effect of weak crystal fields on terms. Splitting due to lower symmetries Electronic spectra of d^1 and d^9 systems.

Unit III: Crystal symmetry and physical properties: Development of theoretical formalism, tensors, Physical property and its tensorial representation. Quotient theorem, Symmetry in crystals - point groups and space groups, Crystal classes. Neumann's principle, **Fumi's** method determining symmetry of physical properties, Pyroelectricity and crystal Symmetry, Dielectric constant and Crystal symmetry –triclinic, monoclinic, orthorhombic and cubic systems; Piezoelectricity and crystal symmetry- triclinic, monoclinic and cubic systems, Piezoelectricity in quartz. Elasticity and crystal symmetry –triclinic, monoclinic, orthorhombic and cubic systems.

Unit IV: Surface science: Introduction, Crystal shape and bond densities, Preparation clean surfaces, Low energy electron diffraction (LEED), Structure of surfaces, Examples of surface reconstruction, Interaction of gases with surfaces, Chemisorptions and co-adsorption, Photoelectron spectroscopy(PES), UPS, XPS, ESCA, Synchrotron radiation, Auger electron spectroscopy(AES), Electron Energy Loss spectroscopy (EELS), Extended X-ray absorption fine structure (EXAFS)

Recommended books

1. Chemical applications of group theory — F.A. Cotton
2. Spectroscopy of molecules — Veera Reddy
3. Ligand field theory — B.N. Figgs
4. Physical properties of crystals — J.F.Nye;
5. Physics of crystals — S.Bhagavantam and S.Radhakrishna,
6. Solid State Physics — G. Burn

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 303T/OE

Paper-III

INTRODUCTION TO OPTOELECTRONICS

Unit I : Introduction, Ray optics: postulates, differential equation of a light ray; wave optics: postulates, monochromatic waves, elementary waves, phase and group velocity, eikonal equation; electromagnetic optics: plane waves in a dielectric, reflection and refraction at a dielectric interface, wave propagation in an absorbing medium, reflection and transmission in the presence of absorbing media, reflection and transmission by a film.

Unit II : Polarization of light - linear, circular and elliptical polarizations, crystal optics: uniaxial and biaxial crystals, dielectric tensor, double refraction, plane waves in anisotropic media, the phase velocity and ray velocity, wave refractive index, ray refractive index, ray refractive surface, index ellipsoid, index ellipsoid in the presence of an external electric field.

Unit III: Electro-optic effect: Kerr effect, Pockels effect, electro-optic effect in KDP crystals, electro-optic retardation, electro-optic phase and amplitude modulation, photoelastic effect, Acousto-optic effect: Acousto-optic modulation, Raman-Nath and Bragg regimes and their modulators. Magneto-optic effect: Faraday effect, optical activity.

Unit IV : Quantum Optics: Quantization of free electromagnetic field - mode expansion, quantization in finite 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: uncertainity relation, squeeze operator.

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.
6. Quantum Optics - Marlan O.Scully and M.Suhail Zubairy, Cambridge university press.
7. Introductory quantum optics - Christoper C. Gerry and Peter L.Knight, Cambridge university press.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 304A/T/OE

Paper-IVA
OPTOELECTRONIC DEVICES

Unit I: Optical Processes in Semiconductors: Alloy semiconductors, Electron-hole pair formation and 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, Radiation in Semiconductors - Relation between absorption and emission spectra, near band gap radioactive transitions, Auger recombination, luminescence from quantum wells.

Unit II: Lasers Structures: Junction laser operating principles, threshold current, heterojunction lasers, distributed feedback lasers, cleaved coupled cavity laser, quantum well lasers, modulation of lasers - rate equations, steady state solution, transient phenomena and frequency response, relaxation oscillations and oscillating output, high frequency modulation of laser diodes, Auger recombination rates, mode-locking of semiconducting lasers.

Unit III:Light Emitting Diodes: Electroluminescent process, choice of LED materials, device configuration and efficiency, light output form LED, LED structures: heterojunction LED, surface-emitting LED, edge-emitting LED, device performance characteristics, frequency response and modulation bandwidth.
Photodetectors: Photoconductor, junction photodiodes - PIN photodiodes, heterojunction diodes, avalanche photodiodes; phototransistor, modulated-barrier photodiode, metal-semiconductor-metal photodiode, microcavity photodiodes.

Unit IV: Optoelectronic Integrated Circuits: Need for integration, materials and processing for optoelectronic integrated circuits (OEICs), front end photo receivers, OEIC transmitters, complex circuits and arrays, optical control of microwave oscillators.
Optoelectronic Devices: Optical amplifiers - Semiconductor laser amplifiers, Erbium-doped, Raman and Brillouin amplifiers, Integrated devices - Beam splitters, Direction couplers and switches, filters, polarization transformers, bistable optical devices, repeaters, fiber interferometers – Mach-Zehnder and Michelson

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.Hunperger, Springer, 6th edition.
5. Optical Fiber communications: principles and practice – John M.Senior, Pearson Education, 3rd edition.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 304B/T/OE

Paper IVB
LASER PHYSICS AND APPLICATIONS

UNIT I: Introduction, unique properties of laser, components of laser, laser gain media, radiative decay and non-radiative decay of excited states, transition probabilities, emission linewidth, homogeneous broadening, inhomogeneous broadening – collision and Doppler, absorption and stimulated emissions, absorption and stimulated emission coefficients.

UNIT II: Absorption and gain of radiative transitions, gain coefficient and stimulated emission cross section for homogeneous and inhomogeneous broadening, necessary and sufficient conditions for laser action, threshold requirements, gain saturation, optimum output power, laser tuning, frequency pulling, frequency fluctuations and stabilization.

UNIT III: Laser modes – properties, longitudinal and transverse modes, Fabry-Perot resonator, Stability condition of laser resonator, Matrix formulation of geometrical optics, Gaussian beam and ABCD law, unstable resonators, pulsed operation - Q-switching, techniques for Q-switching, gain switching, mode locking, active and passive techniques for mode locking.

UNIT IV: Applications of lasers: Material processing, laser generated plasma and laser deposition of thin film, isotope separation, lasers in medicine and surgery, laser interferometry and speckled metrology, laser induced fusion, LIDAR, laser gyros, laser cooling and trapping of atoms - magnetic and optical traps, lasers in communications, information storage systems, computing.

Reference books:

1. Laser Fundamentals - William T Silfvast, Cambridge University Press, 2nd ed., 2004
2. Laser Electronics - J T Vardeyan, PHI, 2nd ed., 1989
3. Lasers-Theory and Applications – Ajoy Ghatak and Thyagarajan, McMillan, 2002
4. Principles of lasers – Orazio Svelto, Springer, 5th ed., 2010.
5. Laser Physics and applications – L.Tarasov, Mir Publishers, 1986.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 301T/AE

Paper - I

DIGITAL SYSTEM DESIGN

Unit I :Basic 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, The 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 De-Mux, 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: 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, Design Procedure, Reduction, Race-Free of State Assignments and Hazards.

Unit IV : Counters and Algorithms: Registers, Shift Registers, Ripple and Synchronous Counters, Timing Sequences, RAM, Memory Decoding and Error-Correcting Codes**;** Algorithmic State Machines –ASM Charts, Timing and Control Implementation, Design with Muxs, PLA Control.

Text Books:

1. Digital Design By –M. Morris Mano
2. Switching theory & Logic design –By R.P.Jain TMH 2003
3. Digital System Principles & Applications By –Ronald J. Tocci

Reference Books:

01. Computer Architecture and Logic Design By –Thomas C. Bartee
02. Digital Principles & ApplicationsBy –A.P. Malvino andD.P.Leach
03. Digital Computer Design By –V. Rajaraman & T.Radhakrishnan
04. Digital Electronics - An Introduction to Theory and Practice By – WilliamH.Gothman
05. Digital Computer Electronics By –Malvino and Brown
06. Digital Integrated Circuits –A Design Perspective By –Jan M.Rabae
07. ICs & Microprocessors –Data Hand Book,BPB Publications, India
08. Digital Logic and Microprocessors By –FJ. Hill & GR. Peterson
9. Digital Circuits and Microprocessors By –Herbert Taub
10. Switching and Finite Automata Theory By –ZVI Kohavi
11. Digital Design –By John F wakerly

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P – 302T/AE

Paper –II

DIGITAL SIGNAL PROCESSING AND DIGITAL SIGNAL PROCESSORS

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 De convolution frequency analysis of Discrete time signals-systems-A/D conversion.

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

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

Unit III: FIR Filter- Introduction-Linear Phase FIR filters-their frequency response-Location of the zeros of LPFIR filters-Fourier series method of designing FIR filter-Design of a FIR filter using windows-Frequency sampling method of designing FIR filters-Realization of FIR filters-Effect of finite word length in digital filters-Introduction-Rounding and truncation errors-Quantization in A/D signals-O/P noise from a digital system-Co-efficient of quantization effect in direct form-realization in IIR-FIR filters-Quantization errors in the computation of DFT.

Unit IV: Digital Signal Processor-Architecture of TMS320C5X-Bus structure-Central Architecture logic unit (CALU)-Auxiliary Register (AR)-Index register (INDX)-ARCR-Block move address Register-Block Repeat Register-Parallel logic unit-memory mapped registers-program controller-some flags in status register-On-chip memory-On-chip peripherals.

TMS320C5X Language-Assembly language syntax-Addressing modes-Instructions-Load/Store-Addition/Subtraction-Move-Multiplication NORM-Program control-Peripheral control.

Instruction Pipelining In C5X-Pipeline structure-Operation-Application programs in C5X-C50 based DSP starter Kit (DSK)-Programs for familiarization of arithmetic instructions-Programs in C5X for processing Real Time signals.

Recommended Text Books:

1. Digital Signal Processing by Prokaies (PHI)
2. Digital Signal Processing by Sanjit K Mitra
3. Digital Signal Processing by Ramesh Babu- Sci-Tech Pub
4. Digital Signal Processers by B.Venkata Ramani et al (TMH)
5. Digital Signal Processers by Sen M Kuo et al –Pearson Education

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 303T/AE

Paper - III

Data Communications & Networking

UNIT-I Introduction: A Communications Model, The Need for a Protocol Architecture, The TCP/IP Protocol Architecture, The OSI Model, Standardization within a Protocol Architecture, Traditional Internet-Based Applications ,Multimedia ,
Data Transmission: Concepts and Terminology, 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 ,

Unit-II Digital Data Communication Techniques : Asynchronous and Synchronous Transmission ,Types of Errors ,Error Detection , Error Correction ,Line Configurations
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

Unit-III 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-IV **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
. Fred Hasal, Data communications computer network and open systems 4/e Pearson education 2005
4. William A .Shay, understanding Data communications & networks 2/e Thomson learning 2003.
5. R.P.Singh, S.D.Sapre communication systems, Analog and Digital
6. Prakash C.Gupta, Data communications PHI 1999

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 304A-T/AE

Paper - IVA

OPTICAL FIBRE AND MOBILE COMMUNICATION

Unit I : Optical Fiber Wave Guides : Ray theory transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew-rays. 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: Sources: LED - structure, surface emitter LEDs, edge emitter LEDs, LED characteristics, Optical output power, Output Spectrum, Modulation bandwidth and reliability. Injection Lasers : Introduction to semiconductor lasers, Threshold condition, Current due to spontaneous emission, Power out put, Hetro-junction lasers, Distributed feedback system, Quantum well Lasers, Characteristics of Injunction Lasers.

Detectors : Junction photo diode, Avalanche-photodiode, Phototransistor. Schotky barrier diode, Metal-Semiconductor-Metal (MSM) photo diodes.

Unit III :Introduction To Cellular Mobile Systems: Significance of cellular mobile systems, Frequency spectrum allocation , Trunking efficiency , A basic cellular system , Performance criteria , Operation of cellular systems , Hexagonal shaped cells , Planning a cellular system , Elements of cellular system design , Frequency reuse , Cochannel interference reduction factor , Hand-off mechanism , Cell splitting , The Concept of Spread Spectrum ,Frequency-Hopping Spread Spectrum , Direct Sequence Spread Spectrum, Code Division Multiple Access

Unit IV: 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) , TDMA, CDMA.

TEXT BOOKS :

1.Optical fiber communication- John M. Senior.
(Page nos, 12 to65to, 84,88,89,97,107to119, 160to171, 374to389, 399to410, 336to345, 532to572)
2.Optical fiber communication—G Keiser (page nos.130 to 142, 155 to 175)
3. Semiconductor opto electronics—Pallab Bhattacharya. (Page nos.395,396,435 to 475)
4. Mobile Cellular Telecommunications by William C. Y. Lee. [McGRAW HILL].
5. Wireless communications –theodore S Rapport [Pearson education]

REFERENCE BOOKS :

1. Optical communication system—J.Gower
2. Fundamentals of fiber optical communication and sensor system—Bishnu P Pal.
3. Integrated optics –Theory and technology—R.Ghunspurger.
4. Fiber optic communication—D.C.agarwal.
5. Introduction to fiber optics—A.R.Cherian.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2018-2019 onwards)

P 304B-T/AE

Paper - IVB

ELECTRONIC INSTRUMENTATION

Unit I
Measurement and Error

Definitions- 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. Specification and testing of dynamic response.

Unit II
Amplifiers and Signal Conditioning

Instrumentation amplifiers- Isolation amplifiers- Chopper amplifiers- Voltage to frequency and frequency to voltage converters-Frequency multipliers - Logarithmic amplifiers,- S/H Circuits-

Attenuators. Second order active filters –Low pass , High pass, Band pass, and Band stop filters- Butterworth and Chebychev filters- Frequency transformation- All pass filters. Phase sensitive detectors (PSD) - Phase lock loop (PLL) –Lock-in-amplifier.

Unit III
Signal Generation

Frequency synthesized signal generator- Frequency divider generator- RF signal generator- Signal generator modulation- Sweep frequency generator- Function generator –Noise generator. **Signal Analysis:** Wave Analyzer- Audio frequency Wave analyzer- Heterodyne wave analyzer-Harmonic distortion analyzer- Resonant harmonic distortion analyzer- Heterodyne harmonic distortion analyzer- Fundamental suppression harmonic distortion analyzer- Spectrum analyzer-Spectra of CW, AM, FM and PM waves.

Unit IV
Electronic Measuring Instruments

Q- meter- Vector impedance meter- Digital frequency meter –Digital voltmeter –Phase meter – RF power and voltage measurement –Power factor meter –Vector volt meter.

Display and Recording: X-t, X-Y Recorders –Magnetic tape Recorders- Laser printers –Ink jet printers. - Storage oscilloscope.

Characteristics of digital displays: LED- LCD –Dot matrix and seven segment display systems.

Recommended Books

6. Modern Electronic Instrumentation and Measurement Techniques –A.O. Helfrick and W.D.Cooper, Prentice Hall India Publications.
7. Instrumentation Devices and Systems –C.S Rangan, G.R. Sharma and VSV Mani, Tata Mc Graw Hill Publications.
8. Introduction to Instrumentation and Control –A.K Ghosh –Prentice Hall India Publications.
9. Electrical and Electronics Measurement and Instrumentation –A.K.Sawhney.
10. Transducers and Instrumentation- D.V.S Murty PHI Publications.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

REVISED SYLLABUS FOR M.Sc. (PHYSICS)

IV SEMESTER

With effect from the academic year 2018 -2019 onwards

S.No	Paper code	Paper	Paper title
1.	P401T	Paper I	Nuclear Physics
2	P402T	Paper II	Spectroscopy
Solid State Physics(SSP)			
3	P403T/SSP	Paper III	Optical Phenomena in solids
4	P404A/T/SSP	Paper IVA	Resonance Phenomena in solids
5	P404B/T/SSP	Paper IVB	Studies on reduced dimensionality in solids
Materials Science (MS)			
6	P403T/MS	Paper III	Electronic Materials and devices
7	P404A/T/MS	Paper IVA	Engineering Materials
8	P404B/T/MS	Paper IVB	Advanced Materials
Electronics Instrumentation (EI)			
9	P403T/EI	Paper III	Instrumentation for measurement and data transmission
10	P404A/T/EI	Paper IVA	Embedded systems and their applications
11	P04B/T/EI	Paper IVB	Process control instrumentation
Nano Science (NS)			
12	P403T/NS	Paper III	Nano composites
13	P404A/T/NS	Paper IVA	Nano Sensors and Nano devices
14	P404B/T/NS	Paper IVB	Nano Photonics and Nano technology in energy conversion and storage
Electronics Communications (EC)			
15	P403T/EC	Paper III	Mobile cellular communications
16	P404A/T/EC	Paper IVA	Data and Computer communications -II
17	P404B/T/EC	Paper IVB	Optical fiber communications
Bio Physics (BP)			
18	P403T/BP	Paper III	Cell and membrane biophysics
19	P404A/T/BP	Paper IVA	Radiation Biophysics
20	P404B/T/BP	Paper IVB	Biophysical Techniques in medicine
Microwaves (MW)			
21	P403T/MW	Paper III	Antennas and radars
22	P404A/T/MW	Paper IVA	Communication theory
23	P404B/T/MW	Paper IVB	Signal conditioning
Condensed Matter Physics (CMP)			
24	P403T/CMP	Paper III	Optical Phenomena on solids
25	P404A/T/CMP	Paper IVA	Resonance Phenomena in solids
26	P404B/T/CMP	Paper IVB	Semiconductor devises and nano materials
Opto-Electronics (OE)			
27	P403T/OE	Paper III	Fiber Optics
28	P404A/T/OE	Paper IVA	Fiber Optic communication systems
29	P404B/T/OE	Paper IVB	Fiber optic communication technology
Applied Electronics (AE)			
30	P401T/AE	Paper I	Digital system design using VHDL
31	P402T/AE	Paper II	Microcontroller and applications
32	P403T/AE	Paper III	Control systems
33	P404A/T/AE	Paper IVA	Microwave systems
34	P404B/T/AE	Paper IVB	Local area networks & TCP/IP protocols

Practical

35	P405P	Paper V	General Physics lab-I (Common to all specializations)

36	P406P	Paper VI	General Physics lab-II (Common to all specializations)
37	P407P	Paper VII	Special Lab - I
38	P408P	Paper VIII	Special Lab - II

Practical (Applied Electronics)

35	P405P/AE	Paper V	Lab-I
36	P406P/AE	Paper VI	Lab-II
37	P407P/AE	Paper VII	Lab-III
38	P408P/AE	Paper VIII	Lab-IV

Details of credits and marks	
Number instruction hours per each theory paper per week	4
Maximum marks for each theory paper	100(80 semester exam + 20 internal evaluation)
Number of credits for each theory paper	4
Number instruction hours per each practical paper per week	16 (3 x 5 + 1 Tutorial)
Maximum Marks per each practical paper	50
Number credits per each practical paper	2
Total Credits per semester	24

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 401T

Paper - I Core (Common for all Specializations)

NUCLEAR PHYSICS

Unit I:
Nuclear Force And Nuclear Models: Systematics of nuclear force-strength, range, charge independence; Deuteron problem and its contribution to the definition of the Nuclear force. Exchange force theories- Majoranna, Bartlett, Heisenberg and Yukawa.

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 quadruple moments

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

Unit III:
Nuclear Radiation 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 IV:
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, characteristics, cross-sections, examples and applications. Compound nucleus formation. Theory of Fission and fusion reactions. Nuclear structure information from nuclear reactions.

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, Quark model.

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

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 402T

Paper –II Core (Common for all Specializations)

SPECTROSCOPY

Unit I

Atomic Spectra: Different series in alkali spectra (main features), Ritz combination principle, Terms for equivalent & non-equivalent electron atom, Term values in alkali spectra and quantum defect, L-S and j-j coupling; Energy levels and spectra; Spectroscopic terms.

Spin-Orbit interaction, doublet structure in alkali spectra, selection rules, intensity rules, alkali-like spectra, Lamb shift, many electron atoms, isotope shift; hyperfine splitting of spectral lines, selection rules. Lande interval rule

Unit II

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

Unit III:

Raman and Infrared (IR) Spectra: Raman effect and its salient features, classical and quantum theory of Raman effect, normal vibrations of CO_2 and H_2O molecules, vibrational and rotational Raman spectra, Infrared spectroscopy; infrared spectroscopy –basic concept of IR spectroscopy –IR spectrophotometer –Principle and Instrumentation –FTIR principle and working –interpretation of data from Raman and IR spectroscopy.

Unit IV:

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 –quantum theory –design of ESR spectrometer –hyperfine structure of ESR absorptions, fine structure in ESR spectra, ESR instrumentation, Applications of ESR.

Books Recommended

1. Elements of Spectroscopy - Gupta, Kumar, Sharma
2. Atomic Spectra & Atomic Structure - Gerhard Hertzberg
3. Introduction to Molecular Spectroscopy - G.M.Barrow
4. Molecular Spectroscopy - J.D.Graybeal
5. Atomic and Molecular Spectroscopy - Raj Kumar
6. Molecular Structure & Spectroscopy - G.Aruldhas
7. Introduction to Atomic Spectra - H.E.white
8. Fundamentals of Molecular Spectroscopy - C.N. Banwell and EM Mc Cash
9. Spectra of Diatomic Molecules - Herzberg
10. Spectroscopy Vol. I, II, III - Walker and Straughen
11. Principles of Magnetic Resonance - C.P.Slitcher
12. Electron Spin Resonance: Their Applications - Wertz and Bolton

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 403T/SSP

Paper – III

OPTICAL PHENOMENA IN SOLIDS

Unit I : Optical Properties Of Solids: Introduction, 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 - Absorption coefficients.
Optical Band Transitions: 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, Electro 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
Photoconductors-dc and ac photo conductors, gain & band width, noise in photo conductors, junction photo diodes, PIN diodes, quantum efficiency & frequency response – hetero junction photo diodes, avalanche photo diodes, noise performance of avalanche photo diodes – comparison of avalanche and PIN diodes.

Unit IV : Photo-voltaics
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, Variation of open-circuit voltage and short circuit current with intensity of incident light, effect of temperature on I-V characteristics. .

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 2018-2019 onwards)

P404A/T/SSP

Paper – IVA

RESONANCE PHENOMENON IN SOLIDS

Unit I : Magnetism In Solids

Ferromagnetism - Ferromagnetic coupling, Theory of spin waves, magnons in Ferro magnets; Bloch $T^{3/2}$ law, **Anti-ferromagnetism** – Molecular field theory, susceptibility and Neel temperature; **Ferrimagnetism** – susceptibility variation with temperature, Neel's theory, **Ferrites** - Structure, properties and applications; Novel magnetic materials – GMR/ CMR materials.

Unit II : Nuclear Magnetic Resonance

Nuclear magnetic resonance (NMR), Basic principles of NMR, Resonance condition, Spin-lattice and Spin-spin relaxation mechanisms, Bloch's equations and complex susceptibility, Chemical shift, Bloch diagram of NMR spectrometer, Analysis of the spectra, Applications of NMR.

Unit III : Electron Spin Resonance

Principle of Electron spin resonance , Nuclear hyperfine interaction, crystal field theory, splitting of energy levels for octahedral and tetrahedral fields in transition metals; rare earth and actinide ions, Experimental details of Electron spin resonance spectrometer; Analysis of ESR spectra.
Elements of Nuclear Quadrupole Resonance (NQR), construction and working of NQR spectrometer

Unit IV : 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, Isomer shift, Magnetic hyperfine interactions, Electric quadrupole interactions, Applications of Mossbauer effect.

Recommended books

1. Elementary theory of solid state Physics -- J.P. Srivastava.
2. Mossbauer effect- Principles and applications – G.K.Wertheim,
3. Mossbauer spectroscopy – N.N.Greenwood and T.C.Gibb,
4. Solid State Physics – Singhal;
5. Horizons of Physics, Vol. I, --Wiley Eastern Publishers

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 404B/T/SSP

Paper – IV B

STUDIES ON REDUCED DIMENSIONALITY IN SOLIDS

Unit I

Two Dimensional Solids - Quantum-Well Device Structures

A review of quantum mechanics - infinite deep rectangular potential well, Basic concepts of artificial structures; Introduction to Semiconductor hetero-junction super lattices, Properties of semiconductor super lattices - Optical absorption, Resonance tunneling, Negative differential conductivity, Modulation doped hetero-junction super lattices, n-i-p-i structures, Inversion layers in MOSFETS and MODFETS, Metallic super lattices and their preparation, characterization and properties.

Unit II

One and Zero Dimensional Solids

Definitions, Zero-dimensional systems, Fullerenes, Quantum dots and their optical and electronic properties; One-dimensional systems: one-dimensional metals, Peirls distortion, conjugated polymers, Nano-tubules, Quantum wires (elementary treatment only)

Unit III

Preparation of Thin Films

Vacuum evaporation: Types of evaporation sources – Resistive heating, electron beam evaporation, two source evaporation – Flash evaporation – Laser ablation, Epitaxial deposition: Vapor-phase epitaxy, Liquid-phase epitaxy, molecular bean epitaxy- Thickness distribution of evaporated films (Point and Ring sources). Sputtering : Glow discharge, dc and RF sputtering, Reactive sputtering, magnetron sputtering, Ion beam deposition. Chemical methods: Chemical Vapor deposition (CVD), Plasma chemical vapor deposition(PCVD), Metal organic chemical vapor deposition (MOCVD).

Unit IV

Insulator Thin Films

Metal insulator contact-Mott-Gurney contact- Schottky contact- Conduction in insulator films-Schottky emission-Poole-Frenkel emission-Thermally activated hopping-Direct tunneling-Space charge limited current-Photo conduction-Photovoltaic effect-Voltage controlled negative resistance-Experimental techniques for photo conduction.

Recommended Books:

1. Fundamentals of thin films - Goswamy
2. Thin films - K.L.Chopra
3. Semiconductor Devices - Physics and Technology - S.M.Sze
4. Hand book of nanostructred materials and nanotechnology
   (Vol. 1-4) Ed. By Hari Singh Nalwa
5. Nano crystalline materials – H. Gleiter
6. Nanophase materials - R.W. Seigel
7. Solid State Physics – G.Burns
8. Physics and Chemistry of Solids - S.R.Elliott
9. Non-Conventional energy sources, B.H. Khan, Tata Mc Graw-Hill, 2006
10. Non-Conventional energy sources, G.D. Rai, Khanna Publishers, 4th Edn, 2000.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 403 T/MS

Paper – III
ELECTRONIC MATERIALS AND DEVICES

Unit I

Semiconductor Materials

Classification of semiconductors - Elemental and compound semiconductors, Direct band and indirect band gap semiconductors, Charge carriers in extrinsic semiconductors, Diffusion currents, Mobility and its dependence on temperature and doping, Excess carriers in semiconductors, Recombination of electron -hole pairs - various recombination mechanisms.

Unit II

Semiconductor Junctions

Types of junctions, abrupt and graded junctions, potential distribution, space charge, built in voltage and junction capacitance, carrier concentration across the junctions, Recombination Preparation of junctions wafer selection, Oxidation, lithography photolithography, doping, metallization, terminals, packaging. Metal - semiconductor junctions: energy-band relation, surface states and depletion layer, Schottky-effect- current transport process –thermo ionic emission, tunneling, device structures.

Unit III

Optoelectronic Devices

The ideal hetero junction, current-voltage characteristics, Light emitting diodes Electroluminescent process, LED materials, device configuration and efficiency, light output, LED structures, Device performance characteristics, Manufacturing processes: semiconductor lasers – Emission and absorption of radiation in a two level system, Gain in a two level lasing medium, Lasing condition in a semiconductor, Threshold condition for lasing Junction laser - operating principle, threshold current, power output, hetero junction lasers, laser diode materials, Device fabrication, laser mounting and fiber coupling.

Unit IV

Photonic Devices

Photo detectors : photoconductors –absorption coefficient, D.C. and A.C. conductors. Junction photo detectors – Photodiodes, PIN diodes, quantum efficiency and frequency response, noise, hetero junction diodes, avalanche photo diode, Solar cells – basic principle, efficiency, spectral response, cascaded solar cells, thin film solar cells, materials and design considerations.

Recommended Books:

1. Introduction to Semiconductor materials and devices –MS .Tyagi , Wiley.
2. Semiconductor optoelecronic devices –Pallab Bhattacharya, PHI
3. Physics of semiconductor devices –S.M Sze, John Wiley.
4. Physics and technology of semiconductor devices –S.M. Sze, John Wiley.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 404A/ T/MS

Paper – IVA
ENGINEERING MATERIALS

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
Composites

Basic Concepts, Definition of Composite materials, reinforcements, Classification of composites- Particle reinforced, Fiber reinforced and structural composites, Particle reinforced composites- large particle composites, dispersion strengthened composites, Types of Fibers, Fiber-reinforced composites- influence of fiber length, orientation and concentration, Structural composites- Laminar Composites, sandwich panels, The Matrix phase, Matrix materials, Polymer matrix composites, Metal matrix composites, Ceramic matrix materials, Carbon-Carbon Composites, Hybrid Composites, Applications of composites.

Unit III
Polymers

Polymers: Classification of polymers**,** polymer molecules**,** chemistry of polymer molecules, molecular weight, molecular structure of polymers, thermoplastic and thermosetting polymers, polymer crystallanity, 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.

Unit IV
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, mechanism of plastic deformation, Microstructure of ceramics, Grain growth in ceramics, Sintering and verification of ceramics, 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

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 404B/T/MS

Paper – IVB
ADVANCED MATERIALS

Unit I
Synthesis of Nanomaterials

Introduction, particle size, particle shape, surface interaction of nanoparticles, DLVO theory, Classical nucleation theory for cluster formation

Physical methods: inert gas condensation, Chemical vapor deposition, sputtering, Arc discharge, PLD, mechanical milling, MBE, Electro-deposition, laser pyrolysis.

Chemical methods: Introduction, Sol-gel process, Hydro-thermal process, Solvo-thermal synthesis, Metal reduction method, Photo-chemical synthesis.

Unit II
Characterization Of Nanomaterials

Introduction; XRD, Scanning probe microscopy (AFM, STM), SEM, TEM, UV-visible-IR, Raman spectroscopy, mass spectroscopy

Properties of nano materials: Mechanical, electrical, Magnetic, optical properties.

Applications of nano materials: Carbon nanotubes, nano-coatings, quantum dots, nano –wires and other applications.

Unit III
Bio-Materials

Implant materials: Introduction, Conditions for implant materials, Classification of Implant materials: Polymers- synthetic and natural

Metals- S.S, Co and its alloys, Al and its alloys, Ti and alloys, Mg and its alloys Ceramics- Alumina, Zirconia, Bio-glass ceramics, Hydroxyapatites

Application biomaterials

Unit IV
Magnetic Materials

Hysteresis and its importance, Magnetic anisotropy, magnetostriction, magnetoresistance, GMR, CMR materials, Domain and magnetization process- Domain wall motion- Magnetostatic energy, Domain wall energy, observation of Domains,

Classification of magnetic materials, soft magnetic materials- crystalline alloys, soft ferrites, and amorphous alloys, Applications of soft magnetic materials,

Hard magnetic materials: alnico alloys, Nd-Fe-B magnets, hard ferrites. Applications of hard magnetic materials

Books Recommended:

1. Nano crystalline materials- H. Gleiter
2. Biomaterials Science and Engineering. –J.B. Park
3. Materials Science and Engineering. –C. M. Srivastava
4. Nanoparticle Technology Hand book- Masuo Hosokawa, K. Nogi, M. Naito, T. Yokoyama, Elsevier
5. Hand book of nanotechnology- ed. Perag Diwan , Pentagon Press

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 403 T/EI

Paper-III

INTRUMENTATION FOR MEASUREMENT AND DATA TRANSMISSION

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, Quarter bridge- Half bridge and Full bridge –Temperature compensation – Calibration of strains gauges –Strain gauge load cell.

Unit II: Pressure Measurement: Bourdon Tube- Bellows - Diaphragms – Transduction methods- Potentiometer device- Strain gauge transducer –LVDT type transducer –Variable capacitance device –Force- balance transducer –Piezoelectric transducer- Digital Pressure Transducer-Pressure calibration.

Temperature Measurement: Classification of temperature measuring devices-Resistance type temperature sensors (platinum resistance thermometer, thermistors) –Resistance thermometer circuits- Thermocouples –Types of thermocouples -Cold junction compensation – Solid State Sensors – Temperature measurement by radiation methods – Calibration of thermometers.

Flow Measurement: Classification of flow meters –Head type flow meters-Orifice meter-Venturi Tube- Pitot tube –Rota meter- Anemometer –Electromagnetic flow meter - Ultrasonic flow meter.

Unit III: Process Control: Open loop control –Closed loop control –Examples- Block diagram algebra -Block diagram of Closed loop system - Closed loop transfer function –DC AND AC Servomotors-Stepper motor-Temperature Control-Liquid level control.

Analog and Digital Data Acquisition Systems: Interfacing transducers to electronic control and measuring systems –Digital to analog multiplexer - Analog to Digital multiplexer - IEEE 488 Bus.

Unit IV :Data Transmission and Telemetry : Methods of data transmission–General telemetry system-Functional blocks of telemetry system –Types of telemetry systems–Land line telemetering system-Voltage telemetering systems–Current telemetering system-Position telemetering system– Land line telemetry feedback system-Radio frequency telemetry - PAM, PCM Telemetering– Multiplexing in telemetering system- Transmission channels- Digital data transmission.

Recommended Books:

1. Modern Electronic Instrumentation and Measurement Techniques –A.O.Helfrick and W.D.Cooper, Prentice Hall India Publications.
2. Instrumentation Devices and Systems- C.S.Rangan, G.R. Sharma and VSV Mani, Tata Mc.Graw Hill 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.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 404A/T/EI

Paper –IVA

EMBEDDED SYSTEMS AND ITS APPLICATIONS

Unit I: The 8051 Microcontroller

Introduction to Microcontrollers : History of Microcontrollers and Microprocessors, Embedded Versus External Memory Devices, CISC and RISC Processors, Harvard and Von Neumann Architectures, Block diagram of the 8051; **Inside the 8051**, Assembling and Running an 8051 Program, The Program Counter and ROM space, Date 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 the 8051

Instruction Set- Arithmetic instruction Programs- Add, Subtract, Multiplication and Division of Signed and Unsigned 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 an interrupts Programming.

Unit III : PIC Microcontrollers

Overview and Features, **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 –IV : Industrial Applications of Microcontrollers

Connecting 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, RPM Meter, Digital Thermo Meter and Strain Gauges

Automation and Control Applications of –PID Controllers, D C 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. Design with PIC Microcontrollers - By J B Peatman, MH, Pearson Education Asia, 2003

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 404B /T/EI

Paper – IVB

PROCESS CONTROL INSTRUMENTATION

Unit –I :PROCESS CONTROL: Control Systems: Process-Control Principles, Servomechanism, Discrete-State Control System- Process- Control Block Diagram: Identification of Elements, Block diagram-Control System Evaluation: Stability, Steady-State Regulation, Transient Regulation, Evaluation Criteria- Analog and Digital Processing: Data representation, ON/OFF Control, Analog Control, Digital Control, Programmable Logic Controllers.

ANALOG AND DIGITAL SIGNAL CONDITIONING: Principles of Analog Signal Conditioning: signal-Level and Bias Changes, Linearization, Conversions, Filtering and Impedance Matching, Concept of Loading- Passive and Operational Amplifier Circuits in instrumentation-Digital fundamentals- Programmable Logic Controllers-Computer Interface-Converters: Digital-to-Analog Converters (DACs), Analog-to-Digital Converters (ADCs),Frequency –Based Converters.

Unit-II : DISCRETE STATE PROCESS CONTROL : Definition of Discrete state process control – characteristics of the system: Discrete state variables, process specifications, event sequence description – Process characteristics: Process equation, Process load, Process Lag, Self – regulation – Control System parameters: Error, variable range, Control parameter range, Control Lag, Dead Time, Cycling, Controller modes- Discontinuous controller Modes: Two – position Mode, Multi-position Mode, Floating control Mode - Continuous control mode: Proportional control Mode, Integral- Control Mode, Derivative – control Mode- Composite control Mode: Proportional-Integral Control (PI) , Proportional – Derivative control Mode (PD), Three Mode controller (PID).

Unit – III : ANALOG, LOGIC AND COMPUTER BASED CONTROLLERS: General features of analog controllers: Physical layout, front panel, side panel – Electronic controllers: Error detector, Single mode and composite controller mode – Pneumatic controllers: General features, Modes Implementation – Relay Controllers: Background, Ladder diagrams- Programmable Logic Controllers: Relay sequences, Programmable Logic Controller Design, PLC operation, Programming, Functions of PLC software.

Digital applications: Simple and multivariable Alarms, Two - position control – Computer based controllers: Hardware configuration, Smart sensors, multi-loop controllers-Software requirements-algorithms to implement the control equations: errors, proportional mode, integral mode, derivative mode, PID control mode- Data Loggers-Supervisory control-Process control system networks, field bus operations, General characteristics of buses.

Unit – IV : CONTROL LOOP CHARACTERISTICS: Control System configuration: Single variable, Cascade Control – Multivariable control system: analog control, supervisory and direct digital control – Control system quality: definition of quality, measure of quality – Stability: Transfer function frequency dependence, stability criteria - process Loop tuning: Open Loop Transient response Method, Ziegler-Nichols Method, Frequency Response Method.

TEXT BOOK

1. Curtis D. Johnson, Process Control Instrumentation Technology, 8th edition, PHI (2006)
2. Bela G. Liptak, Process Control Butterworth-Heinemann
3. Frank D. Petruzella, Programmable Logic Controllers, 3rd edition, Tata McGraw Hill (2010)
4. Micheal P. Lukas, Distributed Control Systems, Van Nostrand Reinfold Company (1995).

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P403/T/NS

PAPER –III

NANO COMPOSITES

Unit-I: Introduction: Definition of nano-composites, nanofillers, classification of nanofillers, carbon and non-carbon based nanofillers-synthesis and properties of fillers
Properties of various polymer nanocomposites: 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.

Unit-II: Synthesis of Nano composite: 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.

Unit-III: Properties of Nano composites : Mechanical properties, 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.

Unit-IV: Functionalized Nanocomposites: Nano composites containing functionalized nanoparticles : organic and polymer materials for light –emitting diodes, luminescent polymer for device applications, photo-oxidation of emitting polymers, nanoparticles approaches to enhance the lifetime of emitting polymers.

Barrier properties of polymer nanocomposites, permeation and diffusion models relevant to polymer nanocomposites, polymer nanocomposites diffusivity, polymer nanocomposites sorption, polymer nanocomposites permeability, wear resisting polymer nanocomposites: preparation and properties, surface treatment, composites manufacturing, wear performance and mechanism.

Reference Books:

1. Encyclopedia of Nanotechnology –Hari Singh Nalwa
2. Springer Handbook of Nanotechnology – Bharat Bhushan
3. Handbook of Semiconductor Nanostructures and Nanodevices,Vol1-5-ABalndin,K.L Wang.
4. Nanostructures and Nanomaterials- Synthesis, Properties and Applications –Cao,Guozho

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P404A/T/NS

PAPER –IVA
NANO SENSORS AND NANO DEVICES

Unit-I:

Quantum Devices: Quantum Electronic Devices- Electrons in mesoscopic structures- short channel , MOS Transistor-split Gate transistor – Electron wave transistor – Electron spin transistor-Quantum Dot array-Quantum computer –Bit- Q bit.

Unit- II:

Super Conducting Devices: Basics- Macroscopic model – super conducting switching devices – cryotron – Josephson tunneling devices – elementary circuits –Associative or content- addressable memory –SQUID –Flux Quantum device –LC Gate –Magnetic Flux Quantum –Quantum cellular Automata-Quantum computer with single flux devices-SFQD-RSFQD- Application of super conducting devices.

Nanosensors: Introduction to sensors. Characteristics and terminology - static and dynamic characteristics. Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, Packaging and characterization of sensors, Sensors for aerospace and defense. Organic and inorganic nanosensors.

Unit-III:

Nanotechnology enabled devices: Nanomaterials and nanostructured films, Nanoscale electronic and ionic transport. Sensor for bio-medical applications. Nanoparticle biomaterial hybrid systems for sensing applications, Gas sensor, Biosensors: Magnetic Nanoparticles for Imaging and Therapy, Photo-detectors, Nanophotonics. Nano electronic Devices, Biosensors, generation of biosensors. Nanomaterial based biosensors. Biosensors based on nucleotides and DNA. Electron transfer of biomolecules

Unit-IV:

NEMS: Inertial sensors –accelerometer-gyroscope –micromechanical pressure sensors-piezo-resistive –capacitors –micro robotics –optical MEMS-Visual display –precision optical platform –optical data switching- RF MEMS-MEMS variable capacitors –MEMS switches –resonators.

Reference Books:

1. Nanoelectronics and Nanosystems –From Transistors to Molecular Quantum Devices K.Goser, P.Glosekottter and J.Dienstuhl , springer,2004.
2. NanoPhotonics Herve Rigneault ,Jean –Michel Lourtioz, Claude Delalande ,Ariel Levenson.
3. Nanotechnolgy and Nanoelectronics- Materials, Devices and Measurement Techniques W.R.Fahrner Springer ,2006.
4. Sensors: Micro& Nanosensors,Sensor Market trends (Part1&2) H.Meixner
5. Nanoscience & technology :Novel structure and Phenomena Ping Sheng(Editor)
6. MEMS & Microsystems Design and Manufacture Tai-Ran Hsu Tata McGraw –Hill
7. MEMS and MOEMS technology and applications PHI Learning private Ltd.2009
8. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester, 2002.
9. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.
10. . Nanomaterials for Biosensors, Cs. Kumar, Wiley – VCH, 2007.
11. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006. nit-III
12. MS Handbook Mohammed Gad-el-Hak CRC Press 2002.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P404B/T/NS

PAPER –IVB
NANOPHOTONICS & ENERGY CONVERSION

Unit-I:

Foundations for Nanophotonics: photons and electrons: similarities and differences, free space propagation, confinement of photons and electrons, prorogation through a classically forbidden zone: tunneling, localization under a periodic potential Band gap. Cooperative effects for photons and electrons, nanoscale optical interactions axial and lateral nanoscopic localization, nanoscale confinement of electronic interactions: Quantum confinement effects, nanoscale interaction dynamics, nanoscale electronic energy transfer, Cooperative emissions.

Unit-II:

Photonic Crystals: Basics Concepts, Features of Photonic Crystals, wave propagation, photonic band gaps, light guiding. Theoretical modeling of Photonic crystals, methods of fabrication, Photonic Crystal Optical Circuitry. Nonlinear Photonic Crystals, Photonic Crystals and optical communications Application to high efficiency emitters, miniaturized photonic circuits and dispersion engineering Photonic crystal sensors.

Unit-III:

Renewable Energy: Energy conversion process. Introduction to Semiconductor physics, Conducting and semiconducting materials, Semiconductor nanostructures, Electronic structure and physical process, material aspect of solar cells, Thin film solar cells, Solar cell characteristics and characterization techniques. Nano-, micro-, and poly crystalline and amorphous Si for solar cells, Si deposition techniques.

Plastic/flexible solar cells: Organic solar cells, Polymer composites for solar cells, p-n junction, Device fabrication and characterization, Nanomaterials for solar cells, Dye-sensitized solar cells, Organic-inorganic hybrid solar cells, Current status and future prospects.

Unit-IV

Fuel Cells: Polymer membranes for fuel cells, Acid/ alkaline fuel cells, design of fuel cells, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, Use of nanoscale catalysts to save energy and increase the industrial productivity.

References Books:

1. Nanophotonics –Paras N. Prasad, John Wiley & Sons (2004)
2. Photonic crystals: Towards Nanoscale Photonic Devices –Jean Michel Lourtioz, Springer ISBN 354024431X
3. Photonic crystals –John D.Joannopoulos, Princeton University Press ,ISBN 0691037442
4. The Handbook of Photonics – Mool Chand Gupta,John Ballato.
5. Solar cells: Operating principles, technology and system applications by Martin A Green, Prentice Hall Inc, Englewood Cliffs, NJ, USA, 1981.
7. Semiconductor for solar cells, H J Moller, Artech House Inc, MA, USA, 1993.
9 Organic P hotovoltaics – Materials, Device Physics and Manufacturing Technologies, (eds. C. Brabec, V. Dyakonov, U. Scherf), 2nd Ed., Wiley-VCH, Germany, 2014.
10. Hand book of Batteries and fuel cells, Linden, McGraw Hill, 1984.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P403/T/EC

Paper - III

MOBILE CELLULAR COMMUNICATIONS

Unit I Cellular Concepts: Mobile communications-évolution, International Mobile Satellite, Personnel Communication System [PCS], Standards, Mobile Personnel Computers, Speech Coder.

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

Unit II 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, Synchronization. Applications.

Concept of Diversity Branch and Signal Paths, Combining and Switching Methods, Carrier-to-Noise and Carrier- to- Interference Ratio, Performance Improvements.

Unit III: 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 packer reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhabit 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 IV Satellite Systems: History, Applications, Basics, GEO, LEO, MEO, Routing, Localization, Handover, Examples.

Satellite applications: Communication satellites, surveillance satellite, navigation satellites. Global positioning system (GPS) space segment, control segment, GPS receivers, GPS applications.

Broadcast Systems: Overview, cyclic repetition of data, Digital audio broadcasting, Multimedia object transfer protocol, Digital video broadcasting,

Recommended Books:

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

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P404A/T/EC

Paper-IVA

DATA AND COMPUTER COMMUNICATIONS- II

Unit I : Protocol Architecture
Basic protocol functions. OSI Model: Model, standardization within the OSI framework. Service Primitives and Parameters, Functions of OSI layers. TCP/IP Model: TCP/IP layers and their functions, Operation of TCP/IP, TCP/IP application

Internetwork Protocols Principles of Internetworking: Requirements, architectural approaches. Connectionless Internetworking: Operation of a connectionless internetworking scheme, Design issues. 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.

Unit II: Internetwork Operation
Multicasting: Practical applications, multicasting in an internet environment, requirements for multicasting. Routing protocols: Autonomous systems, approaches to routing, Border Gateway Protocol (BGP) and Open Short Path First (OSPF) Protocol.
Transport Protocols
Connection Oriented Transport Protocol Mechanisms: Reliable sequencing network service, Unreliable network service. TCP: TCP services, TCP header format, TCP mechanisms. TCP congestion control: Retransmission Timer Management, window management. UDP.

Unit III: Network Security
Security Requirements and Attacks: Passive attacks and Active attacks. Confidentiality with Symmetric Encryption: Symmetric encryption, encryption algorithms, location of encryption devices, key distribution and traffic padding. Message Authentication and Hash Functions: Approaches to message authentication, secure hash functions, SHA-1 secure hash function. Public-Key Encryption and Digital Signatures: Public key encryption, digital signature, RSA public key encryption algorithm, Key management. IPV4 and IPV6 security: Applications of IPsec, scope of IPsec, security associations, authentication header and encapsulating security payload.

Unit IV: Distributed Applications
Electronic Mail SMTP and MIME: SMTP and MIME. Hypertext Transfer Protocol (HTTP): HTTP overview, messages, request messages, response messages and entities. Network Management SNMP: Network management systems.

Recommended Books:

1.Data and Computer Communications William Stallings [SEVENTH & EIGHTH Edition]
2..Computer Networks A.S.Tanenbaum [Third Edition]

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P404B/T/EC

Paper-IVB
OPTICAL FIBER COMMUNICATIONS

Unit I: Optical Fibers: Fiber modes and Configurations**:** Fiber types and their structures. Ray optics representation. Mode theory for circular waveguides: Step index fibers, single mode fibers, and Graded index fibers - WKB Approximations for estimating number of modes.

Fiber Materials for glass fibers and plastic fibers. Fiber fabrication methods: Outside Vapor Pressure Oxidation; Vapor axial deposition; Modified chemical vapor deposition; Plasma activated chemical vapor deposition; Double crucible method. Fiber drawing processes.

Fiber optic cable design: Fiber to fiber joints, fiber splicing & Optical fiber connectors.

Unit II: Transmission Characteristics: Signal attenuation in optical fibers: Absorption, scattering and bending losses in fibers, core and cladding losses.

Signal distortion in optical wave guides: Material dispersion, wave guide dispersion, intermodes distortion. pulse broadening.

Unit III: Optical Sources And Detectors: Optical Sources: Basic semiconductor properties, materials, p-n junction hetro structures. (a) Light Emitting Diodes (LEDs): Structures, light source materials, internal quantum efficiency, modulation capability, transient response, power bandwidth product. (b) Laser diodes: Modes and resonant frequencies, reliability.

Optical Detectors: Physical principles of PIN photo detectors, Avalanche photo detectors. Detector noise: Noise in PIN photo diodes and Avalanche photo diodes

Unit IV: Digital Transmission Systems: Optical receivers: Fundamental receiver operation, receiver structures, receiver performance. Point to point links, link power budget.

Review of multiplexing techniques: Optical Time Division Multiplexing (OTDM), Wavelength Division Multiplexing (WDM).

Coherent Optical Detection: Basic System, Practical constraint, Modulation and Demodulation Formats.

Recommended Books:

1.Optical Fiber Communications Gerad Keiser
2.Optical Fiber Communications John M. Senior (PHI)
3. Optical Fibers T. Gowar

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 403 T/BP

Paper – III

Cell and Membrane Biophysics

403 Paper III (Main): Cell and Membrane Biophysics

Unit I :Cellular Oscillations and Physics of charged membrane

Cellular Oscillations Electrical oscillatory phenomenon associated with cellular reproductive cycle. Electrical oscillations related to the contact inhibition of reproduction in cells.

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

Charged Cell Membrane: Membrane models, membrane channels, membrane capacitance, relation among capacitance, resistance and diffusion between two conductors. Fick's first law of diffusion and Fick's 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.

Unit III: Physics of Sensory organs

Physics of Muscle: Action potential, properties of action potential. Molecular basis of muscle contraction – sliding filament theory. Sarcomere and molecular mechanism of muscle contraction. Microscopic and X-ray diffraction studies on cross bridge structures.

Physics of Nerve : Chemical and electrical properties of mylinated and non-mylinated nerves. Charge distribution in resting nerve cell. Leakage current across the cell membrane. Electrotonus. Hodgkin-Huxley model for membrane current. Propagating nerve impulse. Properties of mylinated conduction.

Physics of Eye : Structure of eye, Photochemistry of visual process. Quantum effects in dark adapted vision. Refraction of the eye.

Physics of Ear : Human auditory system, Structure of choclea. Scanning electron micrographs of inner and outer hair cells of the organ of corti. Cochlear patterns. The growth of loudness. Audiometry.

Unit IV: Physics of natural flying machine

Flight surface (wing); Flight muscles; Sensory organs; 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. 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. Bio Aerodynamics of avian flight – N.Chari.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 404A/T/BP

Paper – IV A

Radiation Biophysics

Unit I :Action spectra and Quantum yield

Introduction – Light sources and materials; monochromators; intensity measurements; Definition and theory of action spectra; Inactivation of proteins and DNA; Light action on respiratory pigments; Photosynthesis, examples. Cooperative events in light action - the Poisson's distribution, examples.

Unit II : Ionizing radiation of cellular constituents

Nature of ionizing radiation; Measure of radiation – the roentgen; Ionisation by X-rays, γ rays or neutrons; Bethe's equation - derivation and application; Dosimetry; Action of ionizing radiation on molecular systems; Target theory;Variable linear energy transfer; Radiation sensitivity of large molecules; Ionising radiation interaction with tissues and chromosomes.

Unit III: Physics of diagnostic x-rays

Production of X-ray beams – X-ray machine; Properties of X-rays; Absorption of X-rays; X-ray image intensifier T.V.; Radiation to patient from X-ray; Live X-ray imaging – fluoroscopy, Mamography;

Principle, theory, instrumentation, working of CT scan, MRI scan and PET scan.

Unit IV: Nuclear medicine Physics

Radioactivity and radiation sources. Statistical aspects of nuclear medicine. Basic instrumentation and its clinical applications. Nuclear medicine imaging devices. Physical principles of nuclear medicine imaging procedures and RIA. Therapy with radioactivity.

Biological effects of radiation - principles of radiation therapy, mega voltage therapy, Brachy therapy.

Recommended Books:

1. Molecular Biophysics – Richard B.Setlow and Ernest C.Pollard.
2. Medical physics - John R, Cameron & G Skefrenick.
3. Basic radiological physics – K. Thayalan,J B Medical Publishers.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 404B /T/BP

Paper – IVB

Biophysical Techniques in Medicine

Unit I : Bio – instrumentation

Bioelectric signals and electrodes- Electrode and electrolytic interface; Surface and metal plate electrodes; Needle and wire electrodes; Microelectrodes. Physiological transducers – Variable resistance transducers; Variable inductance transducers; Variable capacitance transducers; thermo resistive transducers; Photoelectric transducers; Piezoelectric transducers. Biomedical amplifiers – Basic requirements; Differential amplifiers; Carrier amplifier; Chopper amplifier; Phase sensitive detector. Recording systems – Characteristics of recording systems; Moving coil recorder; moving iron recorder; Recording techniques – Heat stylus; optical light and ink jet.

Unit II: Image processing in medicine

Principle, description, working, analysis and clinical applications of ECG; EMG; EEG & ERG.

Unit III: Ultrasonic Imaging

Principle, theory, instrumentation, working and analysis of A scan, B scan and M scan; Doppler effect – 2D echo, color Doppler and analysis; Diagnosis of some cardiac, abdominal, renal diseases; Ultrasonic fetal monitoring.

Unit IV: Bio informatics

What is Bioinformatics? Various definitions of Bioinformatics; Bioinformatics in pharmaceutical industry**;** Skills required by bioinformatics professionals; Defining Bioinformatics: New perspectives.

Nucleotide & Protein sequences.

Structural Bioinformatics: Protein structure basis Protein structure Prediction. RNA structure Prediction.

Recommended Books:

1. Principles of medical electronics and Biomedical instrumentation - C Raja Rao& S K Guha, Universities Press.
2. Medical physics - John R, Cameron & G Skefrenick.
3. Essential Bioinformatics – Jin Xiong.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P-403T/MW

Paper-III
ANTENNAS & RADARS

Unit I:

Antennas: Introduction – antenna equivalent circuits – coordinate system – radiation fields-polarization – isotropic radiator – power gain of an antenna – effective area of an antenna – effective length of an antenna. Hertzian dipole – Half wave dipole vertical antennas – Ground reflections – grounded vertical antennas – folded elements loop and ferrite rod receiving antennas – non-resonant antennas – long wire antenna – rhombic antenna Driven arrays – Broad side array – end-fire array – turnstile antenna Parasitic arrays- Parasitic reflectors – Parasitic directors – Yagi-Uda array – Plane reflector arrays UHF antennas – Discone Omni- Helical antenna – Log periodic antenna Microwave antennas – Horns – Parabolic reflector antenna – variations on the parabolic reflector – Dielectric lens antennas – slot antennas

Unit II:

Introduction- Radar principle, Range, Resolution ,RCS , Doppler Shift, Clutter, Noise, False alarm probabilities, Radar equation. Tracking system properties and parameters, Conical scan angle tracking, Lobbing angle tracking, Amplitude Comparison monopulse Angle tracking, tracking accuracy, receivers and displays.

Unit III:

Introduction - Time signals and systems, Frequency domain representation, Z-transform and its properties , Inverse Z-transform methods. Fourier transform of a sequence, relationship between Z-transform, Fourier Transform and discrete transform. Signal Integration, correlation, convolution Spectrum Analysis. Processing errors and windows (cosine family windows and clipped windows)
Recovery from samples – Interpolation, Doppler and moving target indicator (MTI) fundamentals, MTI principles and methods, Blind Doppler shifts, and PRF, Stagger, Destaggering and processing.

Unit IV:

Introduction - Evaluation of waveforms for Range and Doppler Resolution, Analog pulse compression, Digital pulse compression, High cross range resolution. Doppler beam sharpening (DBS) , Side looking synthetic Aperture Radar(SSAR), Airborne Surveillance Radar for Air Traffic control – Doppler processing to combat clutter problems.

Recommended Books:

1. Electronic communications – D. Roddy & J. Coolen 4th edition (PHI) , 16th chapter
2. RADAR Principles, Technology, Applications – Byran Edde (Prentice-Hall)
3. Theory and Application of Digital Signal Processing – L.R. Rabiner and Bernard Gold (Prentice-Hall) 98
4. Electronic communications 4th edition – D. Roddy & J. Coolen

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P-404A/T/MW

Paper – IVA
Communication Theory

Unit I

Noise: introduction – thermal noise – shot noise – partition noise – low frequency noise – burst noise – avalanche noise – bipolar transistor &FBT noise – equivalent input noise generators – signal to noise ratio - cascaded amplifiers - s/n ratio of a tandem connection – noise factor – amplifier input noise in terms of noise factor (f) – noise factor of amplifier in cascade – noise factor and equivalent input noise generators – noise temperature – measurement of noise temperature and noise factor – narrow band pass noise .

Unit II

Digital Communications – Synchronization, Asynchronous Transmission – Probability of Bit error in Base band Transmission – The Matched Filter – Bit-timing recovery –
Eye diagrams – Digital carrier systems – Carrier recovery Circuits – Differential Phase Shift Keying (DPSK) - Hard and Soft Decoders – Error control coding

Unit III

Radio-Wave Propagation : Propagation in free space – Tropospheric Propagation -Ionospheric Propagation – Surface Wave – Low Frequency Propagation and Very Low Frequency Propagation – Extremely Low-Frequency Propagation

Unit IV

Satellite Communications: Introduction – Kepler's Laws – Orbits – Geostationary orbit – Power systems – Attitude Control – Satellite Station keeping – Antenna Look Angles – Limits of visibility – Frequency plans and polarization – Transponders – Uplink power budget calculations – Down link power budget calculations – Overall link budget – Digital carrier Transmission – Multiple-access Methods

Recommended books:

1. Principles of communication systems – Taub &Shilling (TMH) 1999
2. Communications - Dennis Roddy & John Coolen (PHI) 2000
3. Electronic communication systems – George Kennedy (Tata McGraw Hill)

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P-404B/T/MW

Paper – IVB
Signal Conditioning

Unit I:
Introduction: Measurement of errors: accuracy, precision, resolution, sensitivity – absolute and relative errors, types of errors – gross error, systematic error and random error - Statistical Analysis - Probability of errors - Limiting errors. Standards of measurements – classification of standards, time and frequency standards, electrical standards, standards of temperature and luminous intensity. IEEE - standards

Unit II:
Classification of electrical transducers – basic requirement of a transducer - active and passive transducers – Strain gauge – Gauge Factor, Metallic sensing elements, gauge configuration, unbounded strain gauge.
Displacement transducers –inductive, LVDT, Capacitive, Ionization, Oscillation, Photoelectric, PZT, Potentiometric, Velocity transducers. Temperature Measurements - thermocouple.

Unit III:
Signal Conditioning Circuits:
Phase locked loops & applications**:** introduction, basic principle of phase lock loop, phase detector comparator, voltage controlled oscillator – low pass filter – PLL applications
D/A & A/D conversion: methods of D/A (R-2R type) and A/D conversions (successive approximation, dual slope integration and flash types) conversion specifications.

Unit IV:
Methods Of Data Acquisition: interfacing and control for data acquisition - **on-line** and **off-line** data acquisition - case studies (block diagram approach) – software techniques in signal processing and analysis using virtual instruments **(LABview)**

Recommended Books:

1. Modern electronic instrumentation – W.D. Cooper
2. Instrumentation – Rangan, Sarma & Mani.
3. Transducers and instrumentation – DVS murthy.
4. Linear integrated circuits - Roy Choudary and Jain(New age international private ltd.)
5. Lab view Software Manual

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

PEI 403/T/CMP

Paper – III

OPTICAL PHENOMENA IN SOLIDS

Unit I : Optical Properties Of Solids: Introduction, 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.
Optical Band Transitions: 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, Electro 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
Photoconductors-dc and ac photo conductors, gain & band width, noise in photo conductors, junction photo diodes, PIN diodes, quantum efficiency & frequency response – hetero junction photo diodes, avalanche photo diodes, noise performance of avalanche photo diodes – comparison of avalanche and PIN diodes.

Unit IV : Photo voltaics
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, Variation of open-circuit voltage and short circuit current with intensity of incident light, effect of temperature on I-V characteristics. .

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 2018-2019 onwards)

PEI 404A/T/CMP

Paper – IVA

RESONANCE PHENOMENON IN SOLIDS

Unit I : Magnetism In Solids

Ferromagnetism - Ferromagnetic coupling, Theory of spin waves, magnons in ferromagnets; Bloch T 3/2 law, **Anti-ferromagnetism** – Molecular field theory, susceptibility and Neel temperature; **Ferrimagnetism** – susceptibility variation with temperature, Neel's theory, **Ferrites** - Structure, properties and applications; Novel magnetic materials – GMR/ CMR materials.

Unit II : Nuclear Magnetic Resonance

Nuclear magnetic resonance (NMR), Basic principles of NMR, Resonance condition, Spin-lattice and Spin-spin relaxation mechanisms, Bloch's equations and complex susceptibility, Chemical shift, Bloch diagram of NMR spectrometer, Analysis of the spectra, Applications of NMR.

Unit III : Electron Spin Resonance

Principle of Electron spin resonance , Nuclear hyperfine interaction, crystal field theory, splitting of energy levels for octahedral and tetrahedral fields in transition metals; rare earth and actinide ions, Experimental details of Electron spin resonance spectrometer; Analysis of ESR spectra.
Elements of Nuclear Quadrupole Resonance (NQR), construction and working of NQR spectrometer.

Unit IV : 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, Isomer shift, Magnetic hyperfine interactions, Electric quadrupole interactions, Applications of Mossbauer effect.

Recommended books

1. Elementary theory of solid state Physics -- J.P. Srivastava.
2. Mossbauer effect- Principles and applications – G.K.Wertheim,
3. Mossbauer spectroscopy – N.N.Greenwood and T.C.Gibb,
4. Solid State Physics – Singhal;
5. Horizons of Physics, Vol. I, --Wiley Eastern Publishers

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

PEI 404B/T/CMP

PAPER – IVB
SEMICONDUCTOR DEVICES AND NANO MATERIALS

Unit- I: SEMICONDUCTOR MATERIALS :-
Direct band and indirect band gap semiconductors, Charge carriers in extrinsic semiconductors, Effect of heavy doping, Diffusion currents, Mobility and its dependence on temperature and doping , Excess carriers in semiconductors – low level and high level injection, Recombination of electro – hole pairs – various recombination mechanism. Types of junctions, abrupt and graded junctions, - potential distribution, space charge, built in voltage and junction capacitance, carrier concentration across the junction, Recombination.

Unit-II: QUANTUN WELL DEVICES
Review of the quantum mechanics of infinitely deep coupled potential wells. Artificial structures resembling such coupled potential wells; semiconductor hetero junction super lattices; their preparation by various epitaxial techniques; Properties of semiconductor super lattices-optical absorption, resonance tunneling, negative differential conductivity, modulation doped semiconductors; n-i-p-i structures; Inversion layers in MOSFETS and MODFETS; metallic super lattices -their preparation, characterization and properties.

Unit -III : NUCLEAR MAGNETIC RESONANCE :-
Nuclear Magnetic Resonance(NMR), Basic principles of NMR, resonance conditions, Spin-lattice and spin–spin relaxation mechanism, Bloch's equations and complex susceptibility, chemical shift, block diagram of NMR spectrometer, analysis of the spectra, application of NMR.

Unit -IV : OPTOELECTRONIC DEVICES :-
The ideal heterojunction, current – voltage characteristics, common anion rule. Light emitting diodes – Electroluminescent process. Excitation and emission, LED materials, Device configuration and efficiency, light output, LED structures, Manufacturing process; semiconductors lasers – lasing condition in a semiconductor, threshold condition for lasing junction laser – operating principle, threshold current, power output, hetrojunction lasers, losses, laser diodes material, Device fabrication, laser mounting and fiber coupling.

Recommended Books
1. Semiconductors material and devices – Thyagi, John Wiley
2. Semiconductors optoelectronic devices – Pallab Bhattachary
3. Physics of semiconductor devices – Sze , John Wiley
4. Physics and Technology of semiconductor devices – Sze , John Wiley
8. Solid state Physics – G.Burns
9. Hand Book of nanostructured materials and Nanotechnology (Vols 1-4)
Ed: Hari Singh Nalwa
10. Nano crystalline materials -H.Gleiter
11. Nanophase materials – R.W.Seigel

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 403/T/OE

Paper-III - FIBER OPTICS

Unit I

Optical fiber Guide: Ray theory transmission: total internal reflection, numerical aperture, planar wave guides, classification of modes, TE and TM modes in a symmetric step-index planar wave guide, radiation modes, Goos-Haenchen shift, Nonplanar waveguides, skew rays, modes in cylindrical waveguides, modal analysis for a step-index and parabolic index fibers, single mode fibers.

Unit II

Transmission Characteristics of Optical Fibers: Attenuation, material absorption losses, linear and nonlinear scattering losses, fiber bend loss, fiber alignment and joint losses, Dispersion, intermodal dispersion in step and graded index multimode fibers, intramodal dispersion, dispersion modified single-mode fiber, fiber birefringence, polarization-mode dispersion.

Unit III

Nonlinear effects of optical fibers: Fiber nonlinearities, nonlinear refraction, group velocity dispersion, cross phase modulation, self-phase modulation, Four wave mixing, stimulated Raman scattering, stimulated Brillouin scattering, concept of solitons - Nonlinear Schrödinger equation, formation of solitons, fundamental solitons, dark solitons.

Unit IV

Fabrication of Optical Fibers: Glass fiber drawing. Liquid-phase technique, vapor-phase deposition techniques: outside vapor-phase oxidation process, vapor axial deposition, modified chemical vapor deposition, plasma-activated chemical vapor deposition.

Measurements: Fiber attenuation, dispersion, refractive index profile, cutoff wavelength, numerical aperture, outer and inner diameters, mode field diameter, Eye patterns

Reference Books:

1. Optical Fiber communications: principles and practice - John M.Senior, Pearson Education, 3rd edition.
2. Optical Fiber communications - Gerd Keiser, McGraw-Hill, 4th edition.
3. Fiber Optics communications - Govind P.Agarwal, Academic Press, 3rd edition.
4. Introduction to Fiber Optics - A.Ghatak and K.Thyagarajan, Cambridge University Press
5. Fiber optic measurement techniques - Rongqing Hui and Maurice O'Sullivan, Elsevier/Academic Press.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 404A/ T/OE

Paper-IVA
FIBER OPTIC COMMUNICATION SYSTEMS

Unit I

Optical Fiber Systems: Elements of fiber optic system, analog and digital signals, noise effects, analog systems – signal-to-noise ratio, digital systems - power budgeting, bit error ratio, sampling and quantizing the analog signal, line coding, optical transmitter circuit - source limitations, drive circuits for LED and LASER; optical receiver circuit-preamplifier; direct modulation techniques.

Unit II

Coherent Optical Fiber Systems: Detection principles, practical constraints, modulation formats, demodulation schemes - heterodyne synchronous and nonsynchronous, homodyne detection, receiver sensitivities. Advanced multiplexing systems: optical time division multiplexing, subcarrier multiplexing, orthogonal frequency division multiplexing, wavelength division multiplexing, optical code division multiplexing

Unit III

Fiber Connection: Cable Design, fiber splices, fiber connectors, expanded beam connectors, fiber couplers, optical isolators.

Optical Sensor Systems: Intrinsic and extrinsic sensors, Intensity modulation sensors, frequency modulated sensors, wavelength sensitive sensors, phase modulation sensors, multiplexing of phase sensors, polarization modulation, interferometric sensors, Fiber Bragg gratings, fiber-optic gyroscopes.

Unit IV

Optical Networks: Network topologies – bus, ring, star, mesh; performance features of networks, local area networks – ATM, SONET, FDDI, Fiber net, SOLAR net, Ethernet, broadband ISDN, WDM light wave networks – single-hop and multi-hop operations, ultrahigh capacity networks, wavelength conversion, performance features.

Reference Books:

1. Optical Fiber communications: principles and practice - John M.Senior, Pearson. Education, 3rd edition.
2. Optical Fiber communications - Gerd Keiser, McGraw-Hill, 4th edition.
3. Fiber Optic Communications - Joseph C. Palais, Pearson, 5th Edition.
4. WDM optical Networks – C. Siva Ram Murthy and Mohan Guruswamy, Prentice Hall, 2002.
5. WDM Technologies: Optical Networks - Achyut K. Dutta, Niloy K. Dutta, Masahiko Fujiwara, Academic Press, 2004.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2018-2019 onwards)

P 404B/T/OE

Paper IVB
OPTICAL FIBER SENSOR TECHNOLOGY

Unit I: Introduction, light waves in optical fiber sensors, advantages and general features of optical fiber sensors, fields of applications, components of OFS - illuminating sources; types of fibers, detectors; modulation schemes (intensity, polarization, phase and wavelength); measurands, classification of OFS –intrinsic and extrinsic sensors; single point and distributed measurement, simple fiber sensors for displacement, temperature and pressure measurements.

Unit II: Intensity modulated fiber sensors: general features, intensity modulation through light interruption between two multimode fibers, reflective fiber optic sensor, fiber optic liquid level sensing, fiber optic refractometer, fiber optic sensor based on side polished fiber half-couplers, light transmission in micro bend fibers – micro bend OFS- measurements with micro bend sensors- evanescent wave phenomenon- evanescent wave FOS- chemical sensors using EWFOS

Unit III: Interferometric FOS: basic principle, interferometric configurations - Mach-Zander, Michelson, Fabri-Perot and Sagnac- applications of interferometric FOS.
Phase modulated fiber sensors: general features, Fiber optic acoustic sensors, Fiber optic current sensor, fiber-optic gyroscopes, Polarization modulated sensor.

Unit IV: Distributed optical fiber sensor – basic principle, Rayleigh, Raman and Brillouin scattering based techniques and applications, quasi-distributed optical fiber sensor. Fibre Bragg grating sensors - Fibre Bragg gratings, Bragg grating into interferometer, FBGS interrogators, applications, fiber optic sensor arrays.

Reference books:

1. Fibre optic sensors, principles and applications - B D Gupta, New India publishing agency, 2006.
2. Fundamentals of fibre optics in telecommunications and sensor systems - B.P. Pal, Wiley Eastern, 1994.
3. Handbook of optical sensors - edited by Jose Louis Santos and Faramarz Farahi, CRC press.
4. Optical fibre sensor technology- devices and technology, vol. 2- K.T.V.Grattan and B.T.Meggitt, Springer science, 1998.
5. Optical Fibre sensors, components and subsystems Vol. 3- Brain Culshaw and John Dakin, Artech House Inc.,1996.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 401T/AE

Paper - I

DIGITAL SYSTEM DESIGN USING 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, Null statement, Loop statement, Exit statement, Next statement, Assertion statement, Report statement, other sequential statements, Multiple processes, Postponed processes.

Unit -II :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 -III: 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 block statements, Shared variables, Groups, More details on ports.

Unit-IV :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 test bench 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 Moore FSM, Modeling a Measly FSM.

Recommended Books :

1. A VHDL Primer- By J.Bhasker., Pearson Education Asia, 11th Indian Reprint, 2004.
2. VHDL Programming by Example - By Douglas L. Perry, 4th Ed., TMH., 2002.
3. Introductory VHDL : From Simulation to Synthesis-By Sudhalar Yalamanchili., Pearson Education Asia 2001..
4. Fundamentals of Digital Logic with VHDL Design-ByStephen Brown & Zvonko Vranesic., THM 2002.
5. Digital Systems Design usingVHDL by Charles H.Roth Jr.PWS Pub., 1998.
6. VHDL –Analysis & Modeling of Digital Systems-By Zainalabedin Navabi., 2nd Ed., MH., 1998.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 402T/AE

Paper –II

MICROCONTROLLER AND APPLICATIONS

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, Date 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 the 8051

Instruction Set- Arithmetic instruction Programs- Add, Subtract, Multiplication and Division of Signed and Unsigned 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 an interrupts Programming

Unit III: Interfacing and Applications of 8051

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

Unit IV: Programming, RTOS and Development Tools

Assembly and C programming - programming basics –Structure of the CPU registers and Internal RAMs –Programming in Assembly language –assemblers –saving CPU Status During Interrupts – Passing Parameters –Control Computing Branch Destination at Run time –Programming in C and use of GNU tools - Stacks –Queue –Table –Strings –State Machine –Key parsing.

Real Time Operating System for System Design- Real Time Operating System, Exemplary RTX51, RTOS of Keil, Uses of RTOS in Design, Microcontroller Application Development Tools- Development Phases of Microcontroller- Based System, Software Development Cycle and Applications, Software Development Tools, Exemplary IDE-Microvision and Tools from Keil, Emulator and In-circuit Emulator(ICE), Target Board, Device Programmer.

Recommended Books:

1. The 8051 Microcontrollers and Embedded Systems- By Muhammad Ali Mazidi and Janice Gillispie Mazidi, Persong Education , Asia, 4th Reprint, 2002

2. The 8051 Microcontroller- Architecture, Programming & Applications –By Kenneth J. Ayala, Penram International Publising , 1995

3. Microcontrollers Architecture, Programming Interfacing and System Design- By Raj Kamal, Pearson Education.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2018-2019 onwards)

P 403T/AE

Paper - III

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 Masons Gain formula, Reduction of signal flow Graphs, Applications of signal flow Graph - .

Unit – II: 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.

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

Unit – III : 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 – resonant peak , resonant angular frequency and band width of 2^{nd} Order System - Nyquist Stability Criterion – Applications.

Unit – IV : 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 – Polo 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 2^{nd} edition 2002 (MGH)
4. Control and Systems Engineering – I J 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 2018-2019 onwards)

P 404A/T/AE

Paper - IVA

MICROWAVE SYSTEMS

Unit I : Microwave 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 II: Passive Microwave Devices

Scattering Matrix formulation , Properties of S-matrix, Symmetry of Scattering Matrix, Scattering Matrix for lossless junction, Scattering Matrix for a two-port junction, S-matrix of E-plane and H-plane Magic Tee, Hybrid Rings, Directional Couplers and Circulators. Termination, Phase Shifters , Rotary Phase Shifters , Electronically controlled Phase shifters , Hybrid Ring , Power Dividers - Farady rotation and its applications : Gyrator, Isolator and Three-port Circulator.

Unit III : Strip Lines

Microstrip Lines , Characteristic Impedance of Microstrip lines , Losses in Microstrip lines , Quality Factor Q of Microstrip lines , Parallel strip lines : Distributed parameters , Characteristic impedance , Attenuation losses , Coplanar strip lines , Shielded strip lines.

Monolithic Microwave Integrated Circuits [MMICs] , Materials (Substrate, Conductor, Dielectric and Resistive) , MMIC Fabrication Technique.

Unit IV : Avalanche Transit-Time Microwave Devices

Negative resistance devices , Tunnel diode, Avalanche effect , IMPATT , TRAPATT and BARITT Diodes, Parametric devices : Physical Description , Non-linear reactance and Manley-Rowe power relations Parametric Amplifiers **,** Parametric Up and Down –Converters.

TEXT BOOKS :

1. Microwave Devices and circuits - By S.Y.Liao
2. Fundamentals of Microwave Engineering - R.E.Collin -McGraw-Hill International
3. Composite Satellite and Cable Television - R.R.Gulati - New Age International Publishers
4. Electronic Communication - IV Edition - Dennis Roddy and John Coolen
5. Electronic Communications Systems - G.Kennedy - Tata-McGraw-Hill Series

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
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P 404B/T/AE

Paper - IVB

Local Area Networks & TCP/IP Protocols

Unit-I: Local Area Network Overview : Topologies and Transmission Media, LAN Protocol Architecture, Bridges ,Layer 2 and Layer 3 Switches ,**High-Speed LANs:** The Emergence of High-Speed LANs ,Ethernet, Fiber Channel , **Wireless LANs :**Overview, Wireless LAN Technology , IEEE 802.11 Architecture and Services , IEEE 802.11 Medium Access Control ,IEEE 802.11Physical Layer, IEEE 802.11 Security Considerations

Unit-II: Internetwork Protocols : Basic Protocol Functions ,Principles of Internetworking , Internet Protocol Operation ,Internet Protocol ,IPv6 586, Virtual Private Networks and IP Security ,
Internetwork Operation : Multicasting, Routing Protocols, Integrated Services Architecture ,Differentiated Services, Service Level Agreements, IP Performance Metrics ,

Unit-III: Transport Protocols: Connection-Oriented Transport Protocol Mechanisms ,TCP ,TCP Congestion Control ,UDP
Network Security : Security Requirements and Attacks ,Confidentiality with Conventional Encryption , Message Authentication and Hash Functions , Public-Key Encryption and Digital Signatures ,Secure Socket Layer and Transport Layer Security , IPv4 and IPv6 Security ,Wi-Fi Protected Access ,

Unit-IV: Internet Applications—Electronic Mail and Network Management : Electronic Mail: SMTP and MIME7,Network Management: SNMP
Internet Directory Service and World Wide Web : Internet Directory Service: DNS , Web Access: HTTP

Multimedia: Audio and Video Compression ,Real-Time Traffic , Voice Over IP and Multimedia Support—SIP , Real-Time Transport Protocol (RTP) ,

Recommended Text Books

1. Data and Computer Communications - William Stallings (Seventh & Eighth edition)
2. Data Communication and Networking, Behrouz A. Forouzan, 3/e, THM
3. Computer Networks –A.S.Tanenbaum (Third edition)