DR. BABASAHEBAMBEDKARMARATHWADA UNIVERSITY
AURANGABAD – 431 004 (MS) INDIA
"NAAC REACCREDITED 'A' GRADE"
DEPARTMENT OF PHYSICS
(UGC – SAP, DST – FIST and RUSA Funded)

Syllabus

For

Common Entrance Test (CET)

For admission

to

M. Sc. (Physics) First year

For the academicYear

(2019– 20)

B. Sc. I Year Physics (Semester-I)
(Mechanics, Properties of Matter and Sound)
Course Code – Phy101
Paper – I

1. Mechanics:
Compound Pendulum- expression of time period, Interchangeability of centre of suspension and oscillation, Kater's Pendulum.
Newton's law of Gravitation (Statement only) , Gravitational Field , Gravitational Potential, Gravitational Potential of mass, Gravitational potential and field due to spherical shell and solid sphere (at a point, outside , inside and on the surface).

2. Elasticity:
Introduction , Moduli of Elasticity (Elastic constants), Twisting couple on a cylinder, Bending of Beam – Bending moment, cantilever loaded at free end – (a) When weight of beam is ineffective, (b) When weight of beam is effective, Depression of Beam loaded at center.

3. Viscosity and Surface Tension:
Viscosity - Introduction, energy of liquid in motion, Bernoulli's Theorem, practical applications: (i) Law of hydrostatic pressure (ii) Filter pump, Poiseuille's formula.
Surface Tension - Introduction, Difference of pressure across a curved surface, Determination of S.T. by Jaeger's method.

4. Ultrasonic and Acoustics:
Ultrasonic - Piezo – electric effect, Piezo – electric Generator, Magnetostriction effect, Magnetostriction oscillator, Applications of ultrasonic – Depth of sea, Chemical effects, Medical applications.
Acoustics - Reverberation, Acoustical demands of an auditorium, Sabine's Law – Derivation of Reverberation time, conditions of good acoustical designs of room.

References:-
1) Elements of Properties of Matter – D. S. Mathur
(S. Chand , 11 th edition , 1992)
2) Physics for Degree students – C. L. Arora and P.S.Heme
(S. Chand , I st edition 2010)
3) Mechanics and Electrodynamics – Brijlal ,N. Subrahmanyam , JivanSeshan
(S.Chand , 7 th edition)
4) Text Book of sound – Khanna and Bedi
(Atma Ram and sons, 1989 edition)
5) Text Book of sound – N. Subrahmanyam and Brijlal
(Vikas Publishing House 2 nd Revised edition)

B. Sc. I Year Physics (Semester-I)
(Heat and Thermodynamics)
Course Code – Phy102

1) Thermal Conductivity:
Transference of heat, Coefficient of thermal conductivity, Rectilinear flow of heat along a metal bar, Methods of radial flow of heat-(i)spherical shell method and (ii)Flow of heat along the wall of a cylindrical tube, comparison of conductivities of different metals.

2) Real Gases and Transport Phenomena:
Real Gases – Introduction, Reason for modification of gas equation, Van der Waals equation of state , comparison with experimental curves, critical constants, constants of Van der Waals equation.
Transport phenomena–Introduction, Mean free path, sphere of influence, and expression for mean free path, variation of mean free path with temperature and pressure, transport phenomena, viscosity, Thermal conductivity (their interrelationship, dependence on temperature and pressure).

3) Thermodynamics:
Adiabatic process, Adiabatic equation of a perfect gas, Isothermal process, Indicator diagram, work done during isothermal process and adiabatic process, reversible and irreversible process, Second law of thermodynamics. (Kelvin and Clausius statement), Heat engines, Carnot's ideal heat engine, Carnot's cycle (work done and Efficiency).

4)Entropy and Thermodynamic relations:
General notation of entropy, change of entropy is independent of path, change of entropy in reversible and irreversible process, Formulation of second law in terms of entropy, Maxwell's thermodynamical relations, Applications of Maxwell's relations –i) Clausius – Clapeyron equation , ii) T-ds equations.

Reference Books:-
1) Heat Thermodynamics and Statistical Physics - Brijlal, N.Subrahmanyan , P.S. Heme (S.Chand , 2007 Edition) .
2) Text Book of Heat and Thermodynamics–J. B. Rajam, C.L. Arora (S. Chand, 9th Edition)
3) Heat and Thermodynamics– S. S. Singhal, J. P. Agarwala, S.Prakash (PragatiPrakashan)
4) Thermodynamics & Statistical physics-S. L. Kakani

B. Sc. I Year Physics (Semester- II)
(Geometrical and Physical Optics)
Course Code – Phy104

1) Geometrical Optics and Optical Instruments:
Cardinal points of optical system - Focal points, Principal points, Nodal points and corresponding planes, coaxial lens system - equivalent focal length and cardinal points. Huygens's Eyepiece, Ramsden's eyepiece and their cardinal points.

2) Interference:
Interference in thin film due to reflected and transmitted light, wedge shaped thin film, Newton's rings by reflected light, determination of wavelength, Michelson's Interferometer, type of fringes, determination of wavelength and difference in wavelength.

3) Diffraction:
Introduction, Diffraction at a thin wire ,Fraunhofer diffraction at double slit (Interference and diffraction maxima, minima), Plane Transmission diffraction grating, Determination of wavelength (Normal incidence), Resolving power of optical instruments (Rayleigh's criterion), R. P. of prism and grating.

4) Polarization: -
Introduction, Malus law, Double refraction, Huygens's theory of double refraction in uniaxial crystal, Nicol prism.
Optical activity, Fresnel's theory of optical rotation, specific Rotation, Laurentz's half – shade polarimeter, Determination of specific rotation of sugar solution.

Reference Books:-
1) Text Book of optics – N. Subrahmanyam&Brijlal (S. Chand, 1987 Edition)
2) Optics and Spectroscopy – R.Murugeshan, K. Sivaprasath(S. Chand , 7 th Revised Edition)
3) A text book of optics- D. S. Mathur.
4) Optics- Ghatak. IInd edition.
S-[F] NPW-02 June-2013-14 All Syllabus B.Sc. [Physics] Ist Year Semester-I & II.doc - 9 -

B. Sc. I Year Physics (Semester- II)
(Electricity and Magnetism)
Course Code – Phy105

1) Vector Algebra :
Dot and cross product (Revision), scalar triple product and it's geometrical interpretation, vector triple product, gradient of a scalar and it's physical interpretation, Divergence and curl of vector function and their physical interpretation, line, surface and volume integrals, Gauss's divergence theorem and Stoke's theorem .

2) Electrostatics:
Coulomb's Law , Electric field , field due to point charge, flux of electric field, Gauss's law (with proof) , Differential from of Gauss law , electric potential , potential due to a point charge, Potential and field due to electric dipole.
Dielectrics, polarization of dielectric, Gauss's law in dielectrics, Relation between D, E and P.

3) Magnetostatics:
Magnetic field , Magnetic induction , magnetic flux , Biot-Savart law, Magnetic induction due to straight conductor carrying current , magnetic induction on the axis of solenoid ,Ampere's Law, Differential form Ampere's Law, Moving coil ballistic Galvanometer - expression for charge.

4) Transient Currents:
Growth and decay of current in a circuit containing L and R , charge and discharge of a capacitor through resistor, Growth and decay of charge in LCR circuit.

Reference Books: -
1) Mathematical Methods in physics – D.Biswas(New central book agency , 2009 edition)
2) Electricity and Magnetism – R.Murugeshan(S. Chand, 2008 edition)
3) Electrodynamics – Gupta, Kumar, Singh (PragatiPrakashan, Meerut, 18th edition 2005)
4) Foundations of Electromagnetic Theory-Ritz, Milford, ChirsteyIIIrd edition.

B.Sc. II year Physics (Semester-III)
(Mathematical, Statistical Physics and Relativity)
Course code PHY-201

1. Differentiation and ordinary differential equation:

Limit of function, partial differentiation, successive differentiation, total differentiation, exact differentiation, chain rule.
Ordinary differential equation, order and degree of differential equation, solution of first order differential equation, and solution of second order linear differential equation with constant coefficient

a) Homogeneous equations, b) Inhomogeneous equation, Special case of exponential right hand to find P.I.

2. Statistical basis and classical statistics:

Introduction, probability, principle of equal a priori probability, probability and
frequency, some basis rules of probability theory, permutation and combination,macrostates and microstates, phase space, thermodynamic probability, division ofcompartments into cells, Maxwell-Boltzmann energy distribution law, evaluation of gi, α and β, M.B. distribution function for ideal gas, M.B. Speed distribution law.

3. Quantum statics:
Need of quantum statistics, Bose-Einstein distribution law, Planck's radiation law,
Fermi-Dirac distribution law, electron gas, Fermi level and Fermi energy, EFO for electrons in a metal, comparison of three static, difference between classical and quantum statistics.

4. Theory of relativity:
Introduction, frame of reference, Galilean transformation equations, Michelson Morleyexperiment, special theory of relativity, Lorentz transformation equation, lengthcontraction, time dilation, addition of velocities, variation of mass-energy equivalence.

Reference Books:

1. Mathematical Physics- Gupta, Kumar
2. Mathematical Physics- B.S. Rajput (PragatiPrakashan)
3. Heat, thermodynamics & statistical Physics- Brijlal, N. Subrahmanyam, P.S. Hemne.
S. Chand Publication
4. Text book of heat and thermodynamics- J.B. Rajam& C. L. Arora.
5. Modern physics – R. Murgeshan, KiruthigaShivprasath, S. Chand Publication.

B.Sc. II year Physics (Semester-III)
(Modern and Nuclear Physics)
Course code PHY-202

1. Photoelectric Effect:

Introduction, Lenard's method to determine e/m for photoelectrons, Richardson and Compton experiment, Relation between photoelectric current and retarding potential, Relation between velocity of photoelectrons and frequency of light, photoelectric cells-

(1) Photo- emissive cell (2) Photo- voltaic cell (3) Photoconductive cell, Applications of photoelectric cells.

2. X-rays:

Introduction, The absorption of X-ray's, Laue's experiment, Bragg's Law, The Bragg's X-ray spectrometer, powder crystal method, The Laue method, X-ray spectra, Main features of continuous X-ray spectrum, Characteristics x-ray spectrum.

3. Nuclear forces and models:

Introduction, Binding energy, Nuclear stability, Nuclear forces , Meson theory of nuclear forces, liquid drop model, shell model, Energy released in Fission , Chain reaction, Atom bomb, Nuclear Reactors, Nuclear fusion, Source of stellar energy.

4. Particle Accelerators and Detectors:

Linear accelerator, Cyclotron, Synchrocyclotron, Betatron, Ionisation chamber, proportional counter, Geiger – Muller counter.

Reference Books:

1. Modern Physics-J. B. Rajan
2. Modern Physics- R. Murugeshan, Er.Kirutyhiga, Sivaprasath. S. Chand Publication
3. Nuclear Physics- Kaplan
4. Nuclear Physics- B.N. Srivastava
5. Atomic and nuclear physics-N. Subramanyan andBrijlal.

B.Sc. IInd year Physics (Semester-IV)
(General Electronics)
Course code PHY-205

1. Semiconductor:
Introduction, Construction, Working and Characteristics of semiconductor diode, Zener diode, Zener diode characteristics, Transistor (PNP and NPN), Transistors characteristics (CE, CB and CC), Construction, Working and Characteristics of FET & MOSFET.

2. Transistor Biasing and Amplifiers:
Transistor biasing, Selection of operating point, bias stability, transistor biasing circuits - fixed bias or base bias, collector feedback bias, emitter feedback bias or self-bias. Single stage transistor amplifier, frequency response of RC coupled amplifier, Noise in amplifiers, feedback in amplifiers, Op-Amp characteristics, inverting & non-inverting amplifier, Op-Amp as an adder and subtractor.

3. Oscillators and Multivibrators:
Two port network representation of a transistor, Hybrid parameters or h – parameters, Positive feedback, Basic principle of Oscillators, requirements of feedback, RC Oscillator (Phase shift Oscillator), LC Oscillator (Hartley Oscillator) Transistorised. Astablemultivibrator, monostablemultivibrator, bistableMultivibrator,

4. Modulation and demodulation:
Modulation, Amplitude modulation, Modulation index, frequency modulation, phase modulation, demodulation, advantages of frequency modulation over amplitude modulation.

Reference Books:

1. Basic principle of electronics- V. K. Mehta.
2. Basic Electronics & Linear circuits- N.N. Bhargawa.
3. An introduction to Electronics edition-II or III – A.P. Malvino.
4. Radio engineering- M.L. Gupta.
5. An introduction of Electronics – K. J. M. Rao.

B.Sc. IInd year Physics (Semester-IV)
(Solid State Physics)
Course code PHY-206

1. Crystal Structure:
Introduction, Crystal lattice- plane lattice, space lattice, translation vectors, Unit cell, (Primitive, non primitive Wigner-Sietz primitive cell) Basis, symmetry operations, point groups and space groups, type of lattices (two dimensional and three dimensional lattices), lattice directions and planes, Miller indices, Inter planer spacing, simple crystal structure.

2. Bonding and Band theory of solids:
Introduction, concept of inters–atomic forces, cohesive energy and types of bonding, Primary bonds- (ionic bonds, covalent bond and metallic bond), secondary bonds- (Vander Walls bonds and hydrogen bonds).
The Kroning-Penney model, Energy versus Wave vector relationship, different representations (Brillouin zone)

3. Thermal properties of solids:
Classical theory of lattice heat capacity (Concept and comparison with experimental values), Einstein's theory of lattice heat capacity, Debye's model of lattice heat capacity, density of modes, limitations of Debye's model.

4. Free electron theory of metals and Transport properties:
Drude-Lorentz's classical theory, electrical conductivity, thermal conductivity, Wiedemann Franz law, significance of Fermi energy level, Hall effect, Hall voltage and Hall coefficient, experimental determination of Hall coefficient, Importance of Hall effect.

Reference Books:

1. Physics for degree student – C. L. Arora& Dr. P. S. Hemne – S. Chand publication
2. Solid State Physics and Electronics – R. K. Puri& V.K. Babbar- S. Chand publication
3. Fundamentals of Solid State Physics- Saxena, Gupta, Saxena – Pragatiprakashan, Meerat
4. Solid State Physics, Revised VIth Editions, S.O. Pallai.
5. Introduction to Solid State Physics, VIIth Edition, C. Kittel.

B.Sc. IIIrd year Physics (Semester-V)
Classical and Quantum Mechanics
Course code PHY-301

Chapter 1. Classical Mechanics

Mechanics of Particle, Mechanics of system of particles Constraints, Classification of Constraints, Virtual Work, D'Alembert's principle, Lagrange's equation, Simple application of Lagrangian formulation –Simple Pendulum, Particle in space, Linear Harmonic Oscillator, Atwood's Machine .

Chapter 2. Origin of Quantum theory

Introduction, Failure of Classical mechanics, Black body Radiation (Distribution of Energy), Plank's Quantum theory-Plank's Quantum postulates, linear momentum of photon in terms of wave vector, Plank's radiation law-Wein's law and Rayleigh's law, Einstein's equation: Quantum theory of photoelectric effect, Quantum effect.

Chapter 3. Wave Particle duality

Introduction, de-Broglie's hypothesis for matter waves, de-Broglie's wavelength in terms of energy and temperature, de-Broglie phase velocity and particle velocity (relation between them), Group velocity, Relation between group velocity and phase velocity, Davisson-Germer Experiment, Heisenberg uncertainty principle, Applications of Heisenberg uncertainty principle (1) Nonexistence of electrons in nucleus (2) Binding energy of an electron in an atom.

Chapter 4. The Schrodinger Equation and its applications

Wave Function (Ψ) of a moving particle, Time dependent Schrodinger's wave equation, Expectation value, Operators, Time independent Schrodinger equation (steady state form), particle in one dimensional box, Quantization of energy and momentum.

Reference Books

1) Classical Mechanics- H- Goldstein
2) Classical Mechanics – N.C. Rana and P.S. Joag
3) Classical Mechanics – Gupta, Kumar and Sharma
4) Introduction of Classical Mechanics – R.G. Takwale& P.S. Puranik.
5) Physics for degree student – C.L. Arora, P.S. Hemne (Ist edition S. Chand Publication).
6) Quantum Chemistry- Donald Allan Macquarie (Viva-Books Pvt. Ltd.).
7) Mathematics for Chemistry- Donald Allan Macquarie (Viva Books Pvt. Ltd.).
8) Concepts of Modern Physics - Arthur Beiser, ShobhitMahajan, S. RaiChoudhary (VIth Edition- Mc- Graw Hill).
9) Perspective of Modern Physics – Arthur Beiser.

B.Sc. IIIrd year Physics (Semester-V)
Electrodynamics)
Course code PHY-302

Chapter 1. Electrostatics
Introduction : Electric field lines , electric flux and Gauss law, the divergence of E, Curl of E, Application of Gauss law: i) Electric field due to a uniform charged sphere ii) Electric field due to charged cylinder, Gaussian pillbox, Poisson's equation, Laplace's equation, Uniqueness theorem (First and Second)

Chapter 2. Time varying field
Faraday's Law of Electromagnetic induction, Lenz's law, Self-Induction, Mutual Induction, equation of continuity, Maxwell's displacement current, Maxwell's equation (Derivation, Differential form)

Chapter 3. Electromagnetic waves III
Origin of electromagnetic waves, characteristics of electromagnetic wave, electromagnetic wave equations in a conducting medium, transverse nature of electromagnetic wave, plane polarized electromagnetic wave, The Poynting Vector, Poynting theorem, Polarization of Electromagnetic waves.

Chapter 4. Interaction of Electromagnetic waves with matter
Boundary condition for the electromagnetic field vector –B,E,D and H at the interface between the two media, reflection and refraction at the boundary of two non conducting media.

Reference Books:

1. Introduction to Electrodynamics-David J. Griffiths, Third Edition.

2. Mechanics and Electrodynamics - Brijlal N. Subrahmanyam, JivanSeshan

3. Classical Electrodynamics – S.P. Pure

4. Electrodynamics- B.B. Laud

5. Electrodynamics-Gupta, Kumar and Singh, PragatiPrakashan, Meerut

6. Electromagnetic waves and fields –R.N.Singh

B.Sc. IIIrd year Physics (Semester-VI)
(Atomic, Molecular Physics and LASER)
Course code PHY-305

Chapter 1. The Atom model
Introduction, Thomson atom model, the Rutherford nuclear atom model, drawbacks of Rutherford atomic model, the Bohr's atom model, Bohr's theory of origin of spectral lines, diagrammatic representation of the series spectrum of the H-atom in the light of Bohr's theory.

Chapter 2. Vector Atom Model
Introduction-vector atom model, Quantum numbers associated with the vector atom model, L-S coupling, j-j coupling, The Pauli's exclusion principle, Selection rules, Intensity Rules, Interval Rule, Normal Zeeman effect, Anomalous Zeeman effect, Stark effect and its experimental study.

Chapter 3. Molecular spectra
Introduction, origin of pure rotational spectrum of a molecule, origin of vibrationrotation spectrum of a molecule, Rayleigh's law of scattering, Raman effect-Discovery, experimental study, Applications of Raman effect-molecular structure, Nature of liquids, Crystal Physics, Nuclear Physics, Chemical effects.

Chapter 4. LASER
Introduction, induced absorption, spontaneous emission, stimulated emission, population inversion, properties of laser beam, laser pumping, Types of laser-Ruby laser, He-Ne laser, carbon dioxide (CO2) laser, Applications of laser-Biological, medical and industrial.

Reference Books
1. Atomic Physics – J.B. Rajam, S. Chand & Company Ltd.
2. Physics for degree students – C.L. Arora, Dr. P.S. Hemne, S. ChandPublication
3. Modern Physics – R. Murugeshan, Er. KiruthigaSivaprasath, S. ChandPublication
4. Introduction of Atomic Spectra-white.
5. Fundamentals of Molecular Spectroscopy- C.N. Banwell and E.M. McCash (McGraw Hill International Edition)

B.Sc. IIIrd year Physics (Semester-VI)
(Non-conventional energy sources and Optical fiber)
Course code PHY-306

Chapter1. Non-conventional energy sources
Introduction, Biomass, wind energy, tidal energy/Ocean energy, geothermal energy, biogas hydro energy, wind energy, solar energy,Biogas plant-fixed dome type.
Wind energy: Introduction to wind energy, terms and definition: wind, wind farm, wind turbine, vertical axis wind turbine (VAWT), horizontal axis wind turbine (HAWT), propeller (wheel), wind mill,types of wind turbines generator units, monoblade HAWT, twin blade HAWT, merits and limitation of wind energy.

Chapter 2. Solar Photovoltaic Systems:
Introduction to photovoltaic systems, Solar Cell fundamentals: i) Semiconductor, ii) P-N junction, iii) Generation of electron-hole pair by photon absorption, iv) I_V characteristics of solar cell,
Electrical storage: Lead acid battery, basic battery theory.

Chapter 3. Introduction of optical fiber
Introduction, importance of optical fiber, classification of optical fiber- stepped index fiber, stepped index monomode fiber, Disadvantages of monomode fiber, plastic fiber, latest developed types of optical fibers- HPSUV; HPSIR; Halide; Tapered.

Chapter4. Fiber cables and fabrication
Fiber fabrication: Classification of fiber fabrication techniques; external chemical vapour deposition (external CVD), axial vapour deposition (AVD), internal chemicalvapour deposition (internal CVD)
Fiber Cables: Construction, Strength members, cable tensile loading, minimum bend radius losses incurred during installation of cables or during subscriber service testing of cable, selection criteria, optical cable fiber laying in telephone.

References:
1) Optoelectronics; R. A. Barapate (Tech-Max Publication, Pune)
2) Principles of Solar Cells, LEDs and Diodes: The role of the PN junction; ADRIAN KITAI (2011 John Wiley & Sons, Ltd)
3) Light Sources: Technologies and Applications; SpirosKitsinelis (CRC Press Taylo& Francis Group, FL 33487-2742) - 2011
4) Energy technology (non-conventional, renewable, and conventional) - S. Rao, Dr. B.B. Parulekar, Khanna Publishers.
5) Non-conventional energy resources- B.H. Khan, G.D. Rai, R.P. Khare, IInd edition, McGraw Hill Education (India) Private Limited, New Delhi.
6) Non-conventional Energy Sources- G.D. Rai, Khanna Publisher
7) Solar energy and Rural development- S.H. Pawar, C.D. Lokhande& R.N. Patil
8) Solar energy, Fundamentals and applications- Garg, Prakash Tata McGraw Hill
9) Fiber Optics and Optoelectronics – R.P. Khare, Oxford University Press.