CBCS -Syllabus

Physics
B.Sc. (M.P.C. & M.P.E)
(For the Students admitted in 2019-20 & onwards)

Department of Physics
Nizam College (Autonomous)
Osmania University
Hyderabad – 500 001

NIZAM COLLEGE (AUTONOMOUS)
CBCS Pattern for Undergraduate B.Sc. Program

Semester I to VI: Academic year 2019-20 onwards

Semester	Courses	Hours per week	Duration of Exam Hrs	Marks			No. of Credits
				Internal	External	Total	
SEM-I	**Theory**						
	DSC-102: **(**Paper-1) **Paper – I : Mechanics & Oscillations**	4	3	20	80	100	4
	Practicals						
	DSC-102: **Practicals – I : Mechanics & Oscillations** (Lab-1)	3	3		50	50	1
SEM-II	**Theory**						
	DSC-202: (Paper-2) **Paper – II: Thermal Physics**	4	3	20	80	100	4
	Practicals						
	DSC-202: **Practicals – II : Thermal Physics** **(**Lab 2)	3	3		50	50	1
SEM III	**Theory**						
	DSC-302: (Paper-3) **Paper – III : Electromagnetic Theory**	4	3	20	80	100	4
	Practicals						
	DSC-302: **Practicals – III : Electromagnetic Theory** (Lab-3)	3	3		50	50	1
	SEC –1 **BIOMEDICAL INSTRUMENTATION**	2	11/2	10	40	50	2

SEM IV	**Theory**						
	Paper – IV : Waves & Optics	4	3	20	80	100	4
	Practicals						
	DSC-402: **Practicals – IV :Waves & Optics** (Lab-4)	3	3		50	50	1
	SEC – 2: Digital Electronics	2	11/2	10	40	50	2

SEM V	**Theory**	**Hours/ week**	**Duration of Exam HRS**	**Internal marks**	**External marks**	**Total marks**	**No. of credits**
	DSE-502(A):. **Modern Physics** (Paper-5)	4	3	20	80	100	4
	DSE-502(B): (Paper-5) **Computational Physics**	4	3	20	80	100	4
	GE: Generic Elective **Renewable Energy & Energy Harvesting**	4	3	20	80	100	4
	Practicals:						
	DSE-502(A): **Modern Physics Lab** (Lab 5)	3	3		50	50	1
	DSE-502(B): Lab-5 **Computational Physics**	3	3		50	50	1

Semester	Courses	Hours per week	Duration of Exam Hrs	Marks			No. of Credits
				Internal	External	Total	
SEM VI	**Theory**						
	DSE-602(A):(Paper-6) **Electronics**	4	3	20	80	100	4
	DSE-602(B)**(**Paper-6) **Applied Optics**	4	3	20	80	100	4
	Project Report /	4	11/2	15 VV+ 10 PR	75	100	4
	Optional Paper	4	3	20	80	100	4
	Practicals						
	DSE-602(A): (Lab 6) **Electronics Lab**	3	3		50	50	1
	DSE-602(B): Lab 6 **Applied Optics**	3	3		50	50	1

SNO	COURSE CATEGORY	NO OF COURSES	CREDITS PER COURSE	TOTAL CREDITS
1	SEC	2	2	4
2	GE	1	4	4
3	PROJECT	1	4	4
4	DSC	4	4+1	20
5	DSE	4	4+1	20
		TOTAL CREDITS		52

CC: Core Course DSC: Discipline Specific Course, DSE: Discipline Specific Elective, VV: Viva –Voce, PR: Presentation

B.Sc. (Physics)- I Year
Semester – I
Paper – I: Mechanics and Oscillations
(DSC - Compulsory)

Total: 60 Hrs

Unit – I **(15 Hrs)**

Vector Analysis

Scalar and Vector fields, Gradient of a Scalar field and its physical significance. Divergence and Curl of a Vector field and related problems. Vector integration, line, surface and volume integrals. Stokes', Gauss's and Green's theorems- simple applications.

Unit – II **(15 Hrs)**

Mechanics of Particles (8)

Laws of motion, motion of variable mass system, motion of a rocket, multi-stage rocket, conservation of energy and momentum. Collisions in two and three dimensions, concept of impact parameter, scattering cross-section.

Mechanics of Rigid Bodies (7)

Definition of Rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum and inertial tensor. Euler's equation, precession of a top, Gyroscope.

Unit – III **(15 Hrs)**

Central Forces (8)

Central forces – definition and examples, conservative nature of central forces, conservative force as a negative gradient of potential energy, equation of motion under a central force, gravitational potential and gravitational field, motion under inverse square law, derivation of Kepler's laws.

Special theory of Relativity (7)

Galilean relativity, absolute frames, Michelson-Morley experiment, Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation. Concept of four vector formalism.

Unit – IV **(15 Hrs)**

Oscillations

Simple harmonic oscillator, and solution of the differential equation– Physical characteristics of SHM, torsion pendulum measurements of rigidity modulus, compound pendulum, measurement of g, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies, Lissajous figures.

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance, velocity resonance.

Note: *Problems should be solved at the end of every chapter of all units.*

Suggested books :

1. Berkeley Physics Course. Vol.1, **Mechanics** by C. Kittel, W. Knight, M.A. Ruderman - *Tata-McGraw hill Company Edition 2008*.

2. **Fundamentals of Physics**. Halliday/Resnick/Walker *Wiley India Edition 2007*.

3. **First Year Physics** - *Telugu Academy*.

4. **Introduction to Physics for Scientists and Engineers**. F.J. Ruche. *McGraw Hill*.

5. **Sears and Zemansky's University Physics** by Hugh D. Young, Roger A. Freedman *Pearson Education Eleventh Edition.*

6. **Theory of relativity - Resnick**

7. **Fundamentals of Physics** by Alan Giambattista et al *Tata-McGraw Hill Company* Edition, 2008.

8. **University Physics** by Young and Freeman, *Pearson Education, Edition 2005*.

9. **An introduction to Mechanics** by Daniel Kleppner& Robert Kolenkow. *The McGraw Hill Companies*.

10. **Mechanics**. Hans &Puri. *TMH Publications*.

B.Sc. (Physics) – I year
Semester - I
Paper – I: Mechanics and Oscillations Practicals
(DSC - Compulsory)

1. Measurement of errors –simple Pendulum.
2. Calculation of slope and intercept of a Y= mX +C graph by theoretical method (simple pendulum experiment)
3. Study of a compound pendulum- determination of 'g' and 'k'.
4. Y by uniform Bending
5. Y by Non-uniform Bending.
6. Moment of Inertia of a fly wheel.
7. Rigidity moduli by torsion Pendulum.
8. Determine surface tension of a liquid through capillary rise method.
9. Determination of Surface Tension of a liquid by any other method.
10. Determine of Viscosity of a fluid.
11. Observation of Lissajous figures from CRO-Frequency ratio. Amlitude and phase difference of two waves.
12. Study of oscillations of a mass under different combination of springs-Series and parallel
13. Study of Oscillations under Bifilar suspension-Verification of axis theorems

***Note**: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.*

Suggested Books

1. D.P. Khandelwal, "**A laboratory manual for undergraduate classes**" (Vani Publishing House, New Delhi).

2. S.P. Singh, "**Advanced Practical Physics**" (Pragati Prakashan, Meerut).

3. Worsnop and Flint- **Advanced Practical physics for students**.

4. "**Practical Physics**" R.K Shukla, Anchal Srivastava.

B.Sc. (Physics) - I Year
Semester – II
Paper – II: Thermal Physics
(DSC - Compulsory)

Total: 60 Hrs

Unit – I **(15 Hrs)**

Kinetic theory of gases (6)

Introduction – Deduction of Maxwell's law of distribution of molecular speeds, Transport Phenomena – Viscosity of gases – thermal conductivity – diffusion of gases.

Thermodynamics (9)

Basics of Thermodynamics- Carnot's engine (qualitative)-Carnot's theorem -Kelvin's and Clausius statements – Thermodynamic scale of temperature – Entropy, physical significance – Change in entropy in reversible and irreversible processes – Entropy and disorder – Entropy of universe – Temperature- Entropy (T-S) diagram – Change of entropy of a perfect gas-change of entropy when ice changes into steam.

Unit – II **(15 Hrs)**

Thermodynamic potentials and Maxwell's equations (8)

Thermodynamic potentials – Derivation of Maxwell's thermodynamic relations – Clausius-Clayperon's equation – Derivation for ratio of specific heats – Derivation for difference of two specific heats for perfect gas. Joule Kelvin effect – expression for Joule Kelvin coefficient for perfect and Vanderwaal's gas.

Low temperature Physics (7)

Joule Kelvin effect – liquefaction of gas using porous plug experiment. Joule expansion – Distinction between adiabatic and Joule Thomson expansion – Expression for Joule Thomson cooling – Liquefaction of helium, Kapitza's method – Adiabatic demagnetization – Production of low temperatures – Principle of refrigeration, vapour compression type.

Unit – III **(15 Hrs)**

Quantum theory of radiation

Black body-Ferry's black body – distribution of energy in the spectrum of Black body – Wein's displacement law, Wein's law, Rayleigh-Jean's law – Quantum theory of radiation - Planck's law – deduction of Wein's law, Rayleigh-Jeans law, Stefan's law from Planck's law. Measurement of radiation using pyrometers – Disappearing filament optical pyrometer – experimental determination – Angstrom pyro heliometer - determination of solar constant, effective temperature of sun.

Unit – IV **(15 Hrs)**

Statistical Mechanics

Introduction, postulates of statistical mechanics. Phase space, concept of ensembles and some known ensembles ,classical and quantum statistics and their differences, concept of probability, Maxwell-Boltzmann's distribution law -Molecular energies in an ideal gas- Maxwell-Boltzmann's velocity distribution law, Bose-Einstein Distribution law, Fermi-Dirac Distribution law, comparison of three distribution laws.

NOTE: *Problems should be solved at the end of every chapter of all units.*

Suggested books:

1. **Fundamentals of Physics**. Halliday/Resnick/Walker.*C. Wiley India Edition 2007.*
2. **Second Year Physics** – *Telugu Academy.*
3. **Modern Physics** by R. Murugeshan and Kiruthiga Siva Prasath (for statistical Mechanics) *S. Chand & Co.*
4. **Modern Physics** by G. Aruldhas and P. Rajagopal, *Eastern Economy Education.*
5. Berkeley Physics Course. Volume-5. **Statistical Physics** by F. Reif. *The McGraw-Hill Companies.*
6. **An Introduction to Thermal Physics** by Daniel V. Schroeder.*Pearson Education Low Price Edition.*
7. **Thermodynamics** by R.C. Srivastava, Subit K. Saha & Abhay K. *Jain Eastern Economy Edition*.
8. **Modern Engineering Physics** by A.S. Vasudeva. *S.Chand & Co. Publications.*
9. B.B. Laud **"Introduction to statistics Mechanics"**(Macmillan 1981)

B.Sc. (Physics) – I year
Semester - II
Paper – II: Thermal Physics Practicals
(DSC - Compulsory)

1. Co-efficient of thermal conductivity of a bad conductor by Lee's method.
2. Measurement of Stefan's constant.
3. Specific heat of a liquid by applying Newton's law of cooling correction.
4. Heating efficiency of electrical kettle with varying voltages.
5. Calibration of thermo couple
6. Cooling Curve of a metallic body
7. Resistance thermometer
8. Thermal expansion of solids
9. Study of conversion of mechanical energy to heat.
10. Determine the Specific heat of a solid (graphite rod)

***Note**: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.*

Suggested Books

1. D.P. Khandelwal, "**A laboratory manual for undergraduate classes**" (Vani Publishing House, New Delhi).

2. S.P. Singh, "**Advanced Practical Physics**" (Pragati Prakashan, Meerut).

3. Worsnop and Flint- **Advanced Practical physics for students**.

4. "**Practical Physics**" R.K Shukla, Anchal Srivastava

B.Sc. (Physics) - II Year
Semester – III
Paper – III: Electromagnetic Theory
(DSC - Compulsory)

Total: 60 Hrs

Unit I : Electrostatics (15 Hrs)

Electric Field:- Concept of electric field lines and electric flux, Gauss's law (Integral and differential forms), application to linear, plane and spherical charge distributions. Conservative nature of electric field 'E', Irrotational field. Electric potential:- Concept of electric potential, relation between electric potential and electric field, potential energy of a system of charges. Energy density in an electric field. Calculation of potential from electric field for a spherical charge distribution.

Unit II : Magnetostatics (15Hrs)

Concept of magnetic field 'B' and magnetic flux, Biot-Savart's law, B due to a straight current carrying conductor. Force on a point charge in a magnetic field. Properties of B, curl and divergence of B, solenoidal field. Integral form of Ampere's law, Applications of Ampere's law: field due to straight, circular and solenoidal currents. Energy stored in magnetic field. Magnetic energy in terms of current and inductance. Magnetic force between two current carrying conductors. Magnetic field intensity. Ballistic Galvanometer:- Torque on a current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

Unit III: Electromagnetic Induction and Electromagnetic waves (15 Hrs)

Faraday's laws of induction (differential and integral form), Lenz's law, self and mutual Induction. Continuity equation, modification of Ampere's law, displacement current, Maxwell equations. Maxwell's equations in vacuum and dielectric medium, boundary conditions, plane wave equation: transverse nature of EM waves, velocity of light in vacuum and in medium. Poynting's theorem.

UNIT IV: (15 Hrs)

Varying and alternating currents (8)

Growth and decay of currents in LR, CR and LCR circuits - Critical damping. Alternating current, relation between current and voltage in pure R, C and L-vector diagrams - Power in ac circuits. LCR series and parallel resonant circuit - Q-factor. AC & DC motors-single phase, three phase (basics only).

Network Theorems (7)

Passive elements, Power sources, Active elements, Network models: T and π Transformations, Superposition theorem, Thevenin's theorem, Norton's theorem. Reciprocity theorem and Maximum power transfer theorem (Simple problems).

Suggested books:

1. Fundamentals of electricity and magnetism By Arthur F. Kip (McGraw-Hill, 1968)
2. Telugu Academy
3. Electricity and magnetism by J.H.Fewkes& John Yarwood. Vol.I (Oxford Univ. Press, 1991).
4. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin Cummings,1998).
5. Electricity and magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)
6. Electricity and magnetism. By D C Tayal (Himalaya Publishing House,1988)
7. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata McGraw Hill, 2006).

B.Sc. (Physics) – II year
Semester - III
Paper – III: Electromagnetic Theory Practicals
(DSC - Compulsory)

PHYSICS LABORATORY

1. To verify the Thevenin Theorem
2. To verify Norton Theorem
3. To verify Superposition Theorem
4. To verify maximum power transfer theorem.
5. To determine a small resistance by Carey Foster's bridge.
6. To determine the (a) current sensitivity, (b) charge sensitivity, and (c) CDR of a B.G.
7. To determine high resistance by leakage method.
8. To determine the ratio of two capacitances by De Sauty's bridge.
9. To determine self-inductance of a coil by Anderson's bridge using AC.
10. To determine self-inductance of a coil by Rayleigh's method.
11. To determine coefficient of Mutual inductance by absolute method.
12. LR circuit
13. RC circuit
14. LCR series circuit
15. LCR parallel circuit

***Note**: Minimum of eight experiments should be performed.*
Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Suggested books:

1. B. L. Worsnop and H. T. Flint, **Advanced Practical Physics**, Asia Publishing House, New Delhi.

2. InduPrakash and Ramakrishna, A Text Book of **Practical Physics**, KitabMahal

B.Sc. (Physics) – II
Semester –III
SKILL ENHANCEMENT COURSE

BIOMEDICAL INSTRUMENTATION

(Credits: 02) **Total: 30 Hrs**

Unit I **(15 Hrs)**

FUNDAMENTALS OF BIOMEDICAL ENGINEERING

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

Unit II **(15 Hrs)**

ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

IMAGING MODALITIES AND ANALYSIS

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

NOTE: *Problems should be solved at the end of every chapter of all units.*

Suggested books:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill

2. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons

B.Sc. (Physics) - II Year
Semester – IV
Paper – IV: Waves and Optics
(DSC - Compulsory)

Total: 60 Hrs

Unit I: Waves **(15 Hrs)**

Fundamentals of Waves -Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones, energy transport, transverse impedance.

Longitudinal vibrations in bars- wave equation and its general solution. Special cases (i) bar fixed at both ends ii) bar fixed at the mid point iii) bar free at both ends iv) bar fixed at one end. Transverse vibrations in a bar- wave equation and its general solution. Boundary conditions, clamped free bar, free-free bar, bar supported at both ends, Tuning fork.

Unit II: Interference **(15 Hrs)**

Principle of superposition – coherence – temporal coherence and spatial coherence – conditions for Interference of light.

Interference by division of wave front: Fresnel's biprism – determination of wave length of light. Determination of thickness of a transparent material using Biprism – change of phase on reflection – Lloyd's mirror experiment.

Interference by division of amplitude: Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (Cosine law) – Colours of thin films – Non-reflecting films – interference by a plane parallel film illuminated by a point source – Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film) – Determination of diameter of wire-Newton's rings in reflected light with and without contact between lens and glass plate, Newton's rings in transmitted light (Haidinger Fringes) – Determination of wave length of monochromatic light – Michelson Interferometer – types of fringes – Determination of wavelength of monochromatic light, Difference in wavelength of sodium D_1,D_2 lines and thickness of a thin transparent plate.

Unit III: Diffraction **(15 Hrs)**

Introduction – Distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction:- Diffraction due to single slit and circular aperture – Limit of resolution – Fraunhofer diffraction due to double slit – Fraunhofer diffraction pattern with N slits (diffraction grating).

Resolving Power of grating – Determination of wave length of light in normal and oblique incidence methods using diffraction grating.

Fresnel diffraction-Fresnel's half period zones – area of the half period zones –zone plate – Comparison of zone plate with convex lens – Phase reversal zone plate – diffraction at a straight edge – difference between interference and diffraction.

Unit IV: Polarization **(15 Hrs)**

Polarized light : Methods of Polarization, Polarizatioin by reflection, refraction, Double refraction, selective absorption , scattering of light – Brewster's law – Malus law – Nicol prism polarizer and analyzer – Refraction of plane wave incident on negative and positive crystals (Huygen's explanation) – Quarter wave plate, Half wave plate – Babinet's compensator – Optical activity, analysis of light by Laurent's half shade polarimeter.

NOTE: *Problems should be solved at the end of every chapter of all units.*

Suggested books:

1. **Optics** by Ajoy Ghatak. *The McGraw-Hill companies*.
2. **Optics** by Subramaniyam and Brijlal. *S. Chand & Co*.
3. **Second Year Physics** – *Telugu Academy.*
4. **Modern Engineering Physics** by A.S. Vasudeva. *S.Chand & Co. Publications*.
5. **Fundamentals of Optics** by Jenkins A. Francis and White E. Harvey, *McGraw Hill Inc.*
6. K. Ghatak, **Physical Optics**
7. D.P. Khandelwal, **Optical and Atomic Physics** (Himalaya Publishing House, Bombay,1988)
8. Jenkins and White: **Fundamental of Optics** (McGraw-Hill)
9. Smith and Thomson: **Optics** (John Wiley and sons).

B.Sc. (Physics) – II year
Semester - IV
Paper – IV: Waves and Optics Practicals
(DSC - Compulsory)

1. Thickness of a wire using wedge method.
2. Determination of wavelength of light using Biprism.
3. Determination of Radius of curvature of a given convex lens by forming Newton's rings.
4. Resolving power of grating.
5. Study of optical rotation-polarimeter.
6. Dispersive power of a prism
7. Determination of wavelength of light using diffraction grating minimum deviation method.
8. Wavelength of light using diffraction grating – normal incidence method.
9. Resolving power of a telescope.
10. Refractive index of a liquid and glass (Boys Method).
11. Pulfrich refractometer – determination of refractive index of liquid.
12. Wavelength of Laser light using diffraction grating.
13. Verification of Laws of a stretched string (Three Laws).
14. Velocity of Transverse wave along a stretched string
15. Determination of frequency of a bar-Melde‟s experiment

***Note**: Minimum of eight experiments should be performed Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.*

Suggested books:

1. D.P. Khandelwal, "**A laboratory manual for undergraduate classes**" (Vani Publishing House, New Delhi).

2. S.P. Singh, "**Advanced Practical Physics**" (Pragati Prakashan, Meerut).

3. Worsnop and Flint- **Advanced Practical physics for students**.

4. "**Practical Physics**" R.K Shukla, Anchal Srivastav.

B.Sc. (Physics) – II
Semester: IV
SKILL ENHANCEMENT COURSE
DIGITAL ELECTRONICS

(Credits: 02) **Total: 30 Hrs**

Unit I **(15 Hrs)**

Number Systems: Decimal, Binary, Octal and Hexadecimal.

Conversion: Binary to Decimal, Octal to Decimal, Hexadecimal to Decimal, Decimal to Binary, Decimal to Octal and Decimal to Hexadecimal.

Binary coded decimal, Exess-3 code, grey code, ASCII code.
Logic Gates: OR, AND, NOT, EX-OR, NAND, NOR, Universal gates.
Half adder and Full adder.

Unit II **(15 Hrs)**

Boolean algebra: Boolean laws, DeMorgan's theorems, Sum of products, Product of sums and Karnaugh maps. Multiplexers and Demultiplexers.

Flip-Flops: RS flip-flop, D flip-flop, JK flip-flop and MS flip-flop.

Registers: Types of registers

Counters: Synchronous and Asynchronous counters and their differences.

NOTE: *Problems should be solved at the end of every chapter of all units.*

Suggested books:

1. Digital Electronics by Gothman
2. Digital principles and applications by Malvino and Leach

B.Sc. (Physics) - III Year
Semester –V
Renewable Energy Resources
(General Elective)

Total: 60 Hrs

Unit I: Principles of Solar Radiation and Collection (Qualitative only) (15 Hrs)

Non-renewable energy resources – Principles of power generation and transmission. A model of conventional thermal power plant. Advantages and disadvantages of conventional power plants. Role and potential of new and renewable sources, the solar energy option, environmental impact of solar power, physics of the sun, the solar constant, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Unit II: Solar Energy Storage and Applications: (15 Hrs)

Solar energy collectors - Flat plate and concentration collectors, classification of concentration collectors and orientation, advanced collectors. Different sensible, latent heat and stratified storage, solar ponds. Solar Applications – solar heating/ cooling technique, solar distillation and drying, photovoltaic energy conversion.

Unit III: Wind and Bio-Mass Energy: (15 Hrs)

Resources and potentials, horizontal and vertical axis windmills, performance characteristics. Principles of Bio-Conversion, Energy from waste, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, LPG and CNG.

Unit IV: Geothermal and Ocean Energy: (15 Hrs)

Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants, land and their economics.

Suggested books:

1. Non-Conventional Energy Sources - G.D Rai, Khanna Publishers 2. Renewable Energy Resources- Twidell & Wier, CRC Press (Taylor & Francis)

2. Renewable energy resources - Tiwari and Ghosal, Narosa. 2. Renewable Energy Technologies - Ramesh & Kumar, Narosa 3. Non-Conventional Energy Systems - K Mittal, Wheeler 4. Renewable energy sources and emerging technologies by D.P. Kothari, K.C. Singhal.

B.Sc. (Physics) - III Year
Semester – V
Paper – V: (A) Modern Physics
(DSE – Elective I)

Total:60 Hrs

UNIT - 1: SPECTROSCOPY (15 Hrs)

Atomic Spectra: Introduction - Drawbacks of Bohr's atomic model - Sommerfeld's elliptical orbits - relativistic correction (no derivation). Stern & Gerlach experiment, Vector atom model and quantum numbers associated with it. L-S and j-j coupling schemes. Spectral terms, selection rules, intensity rules - spectra of alkali atoms, doublet fine structure, Zeeman Effect, Paschen-Back Effect and Stark Effect (basic idea).

Molecular Spectroscopy: Types of molecular spectra, pure rotational energies and spectrum of diatomic molecule. Determination of inter nuclear distance. Vibrational energies and spectrum of diatomic molecule. Raman Effect, classical theory of Raman effect. Experimental arrangement for Raman effect and its applications.

UNIT – II: QUANTUM MECHANICS (15Hrs)

Inadequacy of classical Physics: Spectral radiation - Planck's radiation law (only discussion). Photoelectric effect - Einstien's photoelectric equation. Compton's effect - experimental verification.

Matter waves & Uncertainty principle: de Broglie's hypothesis - wavelength of matter waves, properties of matter waves. Phase and group velocities. Davisson and Germer experiment. Double slit experiment. Heisenberg's uncertainty principle for position and momentum (x and p_x), Energy and time (E and t). Gamma ray microscope. Diffraction by a single slit. Position of electron in a Bohr orbit. Complementary principle of Bohr.

Schrodinger Wave Equation: Schrodinger time independent and time dependent wave equations. Wave function properties - Significance. Basic postulates of quantum mechanics. Operators, eigen functions and eigen values, expectation values.

Unit – III: NUCLEAR PHYSICS (15 Hrs)

Nuclear Structure: Basic properties of nucleus - size, charge, mass, spin, magnetic dipole moment and electric quadrupole moment. Binding energy of nucleus, deuteron binding energy, p-p, n-n, and n-p scattering (concepts), nuclear forces. Nuclear models- liquid drop model, shell model.

Alpha and Beta Decays: Range of alpha particles, Geiger - Nuttal law. Gammow's theory of alpha decay (Qualitative). Geiger - Nuttal law from Gammow's theory. Classification of beta decay, Beta spectrum - neutrino hypothesis,

Particle Detectors: GM counter, proportional counter, scintillation counter.

UNIT- IV: SOLID STATE PHYSCIS & CRYSTALLOGRAPHY (15 Hrs)

Crystal Structure : Crystalline nature of matter. Space lattice, Unit Cell, Crystal systems, Bravais lattices. Atomic packing fraction of SC, BCC, FCC, Simple crystal structures of CsCl, NaCl, diamond and Zinc Blende), Miller indices.

X-ray Diffraction: Diffraction of X -rays by crystals, Bragg's law, Experimental techniques - Laue's method and powder method.

Bonding in Crystals: Types of bonding in crystals - characteristics of crystals with different bondings. Lattice energy of ionic crystals - determination of Madelung constant for NaCl crystal. Calculation of Born Coefficient and repulsive exponent. Born-Haber cycle.

Suggested books:

1. Modern Physics by G. Aruldhas & P. Rajagopal.Eastern Economy Edition.
2. Concepts of Modern Physics by Arthur Beiser.Tata McGraw-Hill Edition.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath.S. Chand & Co.
4. Nuclear Physics by D.C. Tayal, Himalaya Publishing House.
5. Molecular Structure and Spectroscopy by G. Aruldhas.Prentice Hall of India, New Delhi.
6. Spectroscopy -Atomic and Molecular by Gurdeep R Chatwal and Shyam Anand -Himalaya Publishing House.
7. Third Year Physics - Telugu Academy.
8. Elements of Solid State Physics by J.P. Srivastava. (for chapter on nanomaterials)-Prentice-hall of India Pvt. Ltd.

B.Sc. (Physics) – III year
Semester – V
Paper - V: A. Modern Physics Practicals
(DSE)

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine the Planck's constant using LEDs of at least 4 different colors.
4. To determine the ionization potential of mercury.
5. To determine the absorption lines in the rotational spectrum of Iodine vapour.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To setup the Millikan oil drop apparatus and determine the charge of an electron.
8. To show the tunneling effect in tunnel diode using I-V characteristics.
9. To determine the wavelength of laser source using diffraction of single slit.
10. To determine the wavelength of laser source using diffraction of double slits.
11. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
12. To determine the value of e/m for electron by long solenoid method.
13. Photo Cell – Determination of Planck's constant.
14. To verify the inverse square law of radiation using a photo-electric cell.
15. To find the value of photo electric work function of a material of the cathode using a photo-electric cell.
16. Measurement of magnetic field – Hall probe method.
17. To determine the dead time of a given G.M. tube using double source.
18. Hydrogen spectrum – Determination of Rydberg's constant
19. Energy gap of intrinsic semi-conductor
20. G. M. Counter – Absorption coefficients of a material.
21. To draw the plateau curve for a Geiger Muller counter.
22. To find the half-life period of a given radioactive substance using a G.M. Counter.

Suggested books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011,Kitab Mahal

Note: *Minimum of eight experiments should be performed.*

B.Sc. (Physics) - III Year
Semester – V
Paper – V: B Computational Physics
(DSE – Elective II)

Total: 60 Hrs

Unit I **(15Hrs)**

Programming in C

Flow charts, Algorithms, Integer and floating point arithmetic, Precision, Variable types, Arithmetic sta tements, Input and output statements, Control statements, Executable and non-executable statements, Arrays, Repetitive and logical structures, Subroutines and functions, Operation with files, Operating systems, Creation of executable programs.

UNIT II **(15Hrs)**

Numerical Methods of Analysis:

Solution of algebraic and transcendental equations: Iterative, bisection and Newton-Raphson methods, Solution of simultaneous linear equations: Matrix inversion method, **Interpolation:** Newton and Lagrange formulas, Numerical differentiation, Numerical Integration, Trapezoidal, Simpson and Gaussian quadrature methods, Least-square curve fitting, Straight line and polynomial fits

UNIT III **(15 Hrs)**

Numerical solution of ordinary differential equations: Euler and Runge - Kutta methods, Simulation Generation of uniformly distributed random integers, Statistical tests of randomness, Monte-Carlo evaluation of integrals and error analysis, Non-uniform probability distributions, Importance of sampling, Rejection method

Unit IV **(15 Hrs)**

Metropolis algorithm, Molecular diffusion and Brownian motion as random walk problems and their Monte Carlo simulation.

Finite element and finite difference methods, boundary value and initial value problems, density functional methods.

NOTE: *Problems should be solved at the end of every chapter of all units.*

Suggested books:

1. Computational Methods in Physics and Engineering: Wong.

2. Computer Oriented Numerical Methods: Rajaraman.

3. Computer Programming in FORTRAN 77: Rajaraman.

4. Applied Numerical Analysis: Gerald.

5. A Guide to Monte Carlo Simulations in Statistical Physics: Land

B.Sc. (Physics) - III Year
Semester – V
Paper – V: B Computational Physics Practicals
(DSE – Elective II)

1. Jacobi Method of Matrix Diagonalization
2. Solution of transcendental or polynomial equations by the Newton Raphson method
3. Linear curve fitting and calculation of linear correlation coefficient
4. Matrix summation, subtraction and multiplication
5. Matrix inversion and solution of simultaneous equation
6. Lagrange interpolation based on given input data
7. Numerical integration using the Simpson's method
8. Numerical integration using the Gaussian quadrature method
9. Solution of first order differential equations using the Runge-Kutta method
10. Numerical first order differentiation of a given function
11. Fast Fourier Transform
12. Monte Carlo integration
13. Use of a package for data generation and graph plotting.
14. Test of randomness for random numbers generators

Note: *Minimum of eight experiments should be performed*. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

B.Sc. (Physics) - III Year
Semester – VI
Paper – VI: A. Electronics
(DSE- Elective I)

Total: 60 Hrs

Unit I **(15 Hrs)**

Band theory of P-N junction

Energy band in solids (band theory), valence band, conduction band and forbidden energy gap in solids, insulators, semiconductors and pure or intrinsic semiconductors and impure or extrinsic semi-conductors. N-type semi-conductors, P-type semi-conductors, Fermi level, continuity equation. Carrier concentration in intrinsic, P – type and N – type (qualitative)

Diodes: P-N junction diode, Half-wave, full-wave and bridge rectifier. Zener diode & its characteristics. Zener diode as voltage regulator.

Unit II **(15 Hrs)**

Bipolar Junction Transistor (BJT) – p-n-p and n-p-n transistors, current components in transistors, CB, CE and CC configurations – transistor as an amplifier - RC coupled amplifier – Frequency response (Qualitative analysis).

Feedback concept & Oscillators: Feedback, General theory of feedback – Concepts of oscillators, Barkhausen's criteria, Phase shift oscillator – Expression for frequency of oscillation.

Unit III **(15 Hrs)**

Special devices- Construction and Characteristics: Photo diode - Shockley diode - Solar cell, Opto-couplers - Field Effect Transistor (FET) - FET as an Amplifier - Uni Junction Transistor (UJT), UJT as a relaxation oscillator - Silicon controlled rectifier (SCR) - SCR as a switch.

Unit IV **(15 Hrs)**

Digital Electronics

Binary number system, convertion of binary to decimal and vice-versa. Binary addition and subtraction (1's and 2's complement methods). Hexadecimal number system. Conversion from binary to hexadecimal and vice-versa, Decimal to hexadecimal and vice-versa.

Logic gates:

OR, AND, NOT gates, truth tables, realization of these gates using discrete components. NAND, NOR as universal gates, Exclusive – OR gate (EX-OR). De Morgan's Laws – Verification. Half – adder, Full – adder.

NOTE: Problems should be solved from every chapter of all units.

Suggested books:

1. Electronic devices and circuits – Millman and Halkias. *Mc.Graw-Hill Education.*
2. Principles of Electronics by V.K. Mehta – *S. Chand & Co.*
3. Basic Electronics (Solid state) – B. L. Theraja , S. Chand & Co.
4. A First Course in Electronics- Anwar A. Khan &Kanchan K. Dey, PHI.
5. Physics of Semiconductor Devices- S. M. Sze
6. Physics of Semiconductors- Streetman.
7. Basic Electronics – Bernod Grob.
8. Third year Electronics – Telugu Academy
9. Digital Principles & Applications – A.P. Malvino and D.P. Leach

B.Sc. (Physics) – III year
Semester – VI
Paper: VI: A. Electronics Practicals

1. Construction of logic gates (AND, OR, NOT, gates) with discrete components – Truth table Verification
2. AND, OR, NOT – gates constructions using universal gates – Verification of truth tables.
3. Construction of NAND and NOR gates with discrete components and truth table verification
4. Characteristics of a Transistor in CE configuration
5. R.C. coupled amplifier – frequency response.
6. Verification of De Morgan's Theorem.
7. Zener diode V-I characteristics.
8. P-n junction diode V- I characteristics.
9. Zener diode as a voltage regulator
10. Construction of a model D.C. power supply
11. R C phase shift Oscillator –determination of output frequency

Note: *Every student should complete minimum of 08 experiments.*

Suggested books:

1. B.Sc. Practical Physics – C. L. Arora – S. Chand & Co.
2. Viva-voce in Physics – R.C. Gupta, Pragathi Prakashan, Meerut.
3. Laboratory manual for Physics Course by B.P. Khandelwal.
4. Practical Physics by M. Arul Thakpathi by Comptex Publishers.
5. B.Sc. practical physics – Subbi Reddy.

B.Sc. (Physics) - III Year
Semester – VI
Paper-VI: B. APPLIED OPTICS
(DSE- Elective-II)

Total: 60 Hrs

Unit I **(15 Hrs)**

Principles of Lasers: Emission and absorption of Radiation – Einstein Relations. Properties of Laser, Pumping Mechanisms – Optical feedback - Classification of laser systems – Gas, Liquid and Solid Lasers: He- Ne and Argon lasers, their energy level schemes - YAG laser, GA-As laser and their applications in various fields.

Unit II **(15 Hrs)**

Holography: Basic Principles of Holography- Recording of amplitude and phase- The recording medium- Reconstruction of original wave front- Image formation by wave front reconstruction- Gaber Hologram- Limitations of Gaber Hologram-Off axis Hologram- Fourier transform Holograms- Volume Holograms, Applications of Holograms.

Unit III **(15 Hrs)**

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.

Unit IV **(15 Hrs)**

Optical Fibers: Fiber types and their structures. Ray optics representation, acceptance angle and numerical aperture. Step index and graded index fibers, single mode and multimode fibers. Fiber Materials for glass fibers and plastic fibers. Signal attenuation in optical fibers: Absorption, scattering and bending losses in fibers, core and cladding losses. Material dispersion, wave guide dispersion, intermodes distortion and pulse broadening, Fiber drawing methods.

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested 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 nd Thyga Rajan.
5. Principles of Lasers – O. Svelto
6. Optical Fiber Communications – by Gerad Keiser
7. Optical Fiber Communications – by John M. Senior (PHI)

B.Sc (Physics)
Semester VI
(DSE- Elective-II)
Paper-VI: B. APPLIED OPTICS Practicals

1. Study of the profile of a laser beam.
2. Determination of the diameter of a thin wire using laser.
3. Determination of wavelength of He-Ne laser by transmission grating.
4. Construction and recording of a hologram.
5. Study of Fourier transforming properties of lenses.
6. Study of second harmonic generation by KDP crystal.
7. Measurement of numerical aperture of an optical fiber.
8. Measurement of coupling losses in optical fibers.
9. Measurement of bending losses in optical fibers.
10. Study of audio signal transmission through optical fibers.
11. To study the interference of light using optical fibers.

Note: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Suggested books:

1. Introduction to Fourier Optics – J. Goodman
2. Optical Fiber Communications- John M. Senior
3. Principles of Lasers- O. Svelto
4. Modern Optics- Grant Fowles.
5. Principles of Optics – Born & Wolf
6. Fundamentals of Optics- Jenkins & White

PAPER IN LIEU OF PROJECT
NANO SCIENCE

(Credits: 04) **Total: 60 Hrs**

Unit I **(15 Hrs)**

Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods)**,** Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement in 3D, 2D, 1D nanostructures and its consequences.

Unit II **(15 Hrs)**

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots.

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.

Unit III **(15 Hrs)**

OPTICAL PROPERTIES: Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals.

Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

ELECTRICAL TRANSPORT PROPERTIES: Carrier transport in nano structures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

Unit IV **(15 Hrs)**

APPLICATIONS: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation).

CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers,

optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)
3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
5. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).
6. Bharat Bhushan, Springer Handbook of Nanotechnology (Springer -Verlag, Berlin, 2004).