

Department Of Physics

Telangana University



B.Sc Physics (V– VI Semesters)- revised syllabus Under CBCS scheme (from the academic year 2018-2019)

G. Lakshmi
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**B.Sc. PHYSICS SYLLABUS UNDER CBCS SCHEME
SCHEME OF INSTRUCTION**

| Semester | Paper [Theory and Practical] | Instructions Hrs/week | Marks | Credits |
|----------|--|--------------------------|-------|---------|
| I sem | Paper – I : Mechanics | 4 | 100 | 4 |
| | Practicals – I : Mechanics | 3 | 50 | 1 |
| II sem | Paper – II: Waves and Oscillations | 4 | 100 | 4 |
| | Practicals – II : Waves and Oscillations | 3 | 50 | 1 |
| III sem | Paper – III : Thermodynamics | 4 | 100 | 4 |
| | Practicals – III : Thermodynamics | 3 | 50 | 1 |
| IV sem | Paper – IV : Optics | 4 | 100 | 4 |
| | Practicals – IV : Optics | 3 | 50 | 1 |
| V sem | Paper – V : Electromagnetism | 3 | 75 | 3 |
| | Practicals – V: Electromagnetism | 3 | 25 | 1 |
| | Paper – VI : Elective – I Solid state physics/ Quantum Mechanics and Applications | 3 | 75 | 3 |
| | Practicals – VI : Elective – I Practical Solid state physics/ Quantum Mechanics and Applications | 3 | 25 | 1 |
| VI sem | Paper – VII : Modern Physics | 3 | 75 | 3 |
| | Practical – VII : Modern Physics Lab | 3 | 25 | 1 |
| | Paper – VIII : Elective – II Basic Electronics/ Physics of Semiconductor Devices | 3 | 75 | 3 |
| | Practicals – VIII : Elective – II Practical Basic Electronics/ Physics of Semiconductor Devices | 3 | 25 | 1 |

Total
Credits

36

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(w.e.f the academic year 2018-2019)

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.

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 for Reference

1. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
2. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal

Subject : (Physics)

B.Sc. Semester V-Theory Syllabus
(DSE- Elective-I)

42 hrs

Paper-VI-A – Solid State Physics
(w.e.f the academic year 2018-2019)

Unit-I (14hrs)

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Types of Lattices, Reciprocal Lattice. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.

Unit-II (14 hrs)

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia- and Paramagnetic Domains. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability.


Unit-III (14 hrs)

Elementary band theory: Kronig Penny model (Basic idea) . Band Gap. Brillouin zones, effective mass of electron. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect, Electric Conductivity by four probe method & Hall coefficient.

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors. Idea of BCS theory. D.C and A.C Josephson effects.

Text Books:

1. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
2. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
3. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
4. Solid State Physics – S. O. Pillai (New Age Publication)
5. Modern Physics by R.Murugesham


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Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid State Physics- R.K.Puri &V.K. Babbar (S.Chand Publication)2013
6. Lasers and Non linear Optics –B.B.Laud-Wiley Eastern.
7. LASERS: Fundamentals and Applications – Thyagarajan and Ghatak (McMillanIndia)

V SEMESTER Practicals Paper – VI A
Solid State Physics
(w.e.f the academic year 2018-2019)

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To study the PE Hysteresis loop of a Ferroelectric Crystal.
6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
7. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150^o C) and to determine its band gap.
8. To determine the Hall coefficient of a semiconductor sample.
9. Calculation of d-values of a given Laue's pattern.
10. Calculation of d-values of powder diffraction method.
12. To study the spectral characteristics of a Photo- Voltaic cell.
13. Verification of Bragg's equation.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

B.Sc. Semester V-Theory Syllabus

42 hrs

Subject : (Physics)

(DSE- Elective-I)

Paper-VI-B – QUANTUM MECHANICS AND APPLICATIONS (w.e.f the academic year 2018-2019)

Unit-I (14 hrs)

Schrodinger equation & the operators: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Hermitian operator, Eigen values and Eigen functions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

Unit II (14 hrs)

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle.

Unit-III (14 hrs)

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions ground state, zero point energy & uncertainty principle.

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. SternGerlach Experiment. Basic idea on Zeeman Effect and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

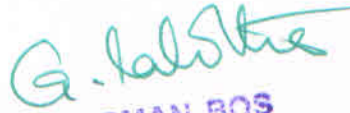
Text Books:

1. A Text book of Quantum Mechanics, P. M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.

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Reference Books:

1. Quantum Mechanics, G. Aruldas, 2nd Edn. 2002, PHI Learning of India.
2. Cohen-Tannoudji, B Diu and F Laloë, Quantum Mechanics (2 vols) Wiley-VCH 1977 • Basic Quantum Mechanics –A.Ghatak (Mc Millan India) 2012
3. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson • Quantum Physics----S. Gasiorowicz (Wiley India) 2013


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V – SEMESTER Practicals Paper – VI B
Quantum Mechanics and Applications
 (w.e.f the academic year 2018-2019)

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom: Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take $e = 3.795$ (eVÅ)^{1/2}, $hc = 1973$ (eVÅ) and $m = 0.511 \times 10^6$ eV/c².
2. Solve the s-wave radial Schrodinger equation for an atom: where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take $e = 3.795$ (eVÅ)^{1/2}, $m = 0.511 \times 10^6$ eV/c², and $a = 3$ Å, 5 Å, 7 Å. In these units $hc = 1973$ (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.
3. Solve the s-wave radial Schrodinger equation for a particle of mass m : For the anharmonic oscillator potential for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940$ MeV/c², $k = 100$ MeV fm⁻², $b = 0, 10, 30$ MeV fm⁻³ In these units, $ch = 197.3$ MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.
4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule: Where μ is the reduced mass of the two-atom system for the Morse potential Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: $m = 940 \times 10^6$ eV/C², $D = 0.755501$ eV, $\alpha = 1.44$, $r_0 = 0.131349$ Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs

Reference Books:

1. Science, volume of Programming with C++ | Updated, 2002, McGraw-Hill Publishers
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al., 3rd Edn., 2007, Cambridge University Press.
3. An introduction to computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ. Press • Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer.
4. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
5. Scilab Image Processing: L.M. Surhone. 2010 Betascript Publishing ISBN: 978-613345927

B.Sc. Semester VI-Theory Syllabus

42 hrs

Subject : (Physics)

(DSC- Compulsory)

Paper-VII – MODERN PHYSICS
(w.e.f the academic year 2018-2019)

UNIT-I (14hrs)

Atomic Spectra and Models (Inadequacy of classical physics):

Brief Review of Black body Radiation , Photoelectric effect, Compton effect, dual nature of radiation, wave nature of particles. Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle. Alpha Particle Scattering, Rutherford Scattering Formula, Rutherford Model of atom and its limitations, Bohr's model of H atom, explanation of atomic spectra, correction for finite mass of the nucleus, Bohr correspondence principle, limitations of Bohr model, discrete energy exchange by atom, Frank Hertz Expt. Sommerfeld's Modification of Bohr's Theory.

UNIT-II (14hrs)

Wave Particle Duality de Broglie hypothesis, Experimental confirmation of matter wave, Davisson Germer Experiment, velocity of de Broglie wave, wave particle duality, Complementarity. Superposition of two waves, phase velocity and group velocity , wave packets ,Gaussian Wave Packet , spatial distribution of wave packet, Localization of wave packet in time. Time development of a wave Packet; Wave Particle Duality, Complementarity . Heisenberg Uncertainty Principle, Illustration of the Principle through thought Experiments of Gamma ray microscope and electron diffraction through a slit. Time independent and time dependent Schrodinger wave equation. Estimation of ground state energy of harmonic oscillator and hydrogen atom, non-existence of electron in the nucleus. Uncertainty and Complementarities.

UNIT-III (14 hrs)

Nuclear Physics: Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Text Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Modern Physics ---Murugesan and Sivaprasad --(S. Chand Higher Academics)
3. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
4. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
5. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning. •
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Reference Books

1. Modern Physics – Bernstein, Fishbane and Gasiorowicz (Pearson India) 2010
2. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles -- R. Eisberg (Wiley India) 2012 Additional Books for Reference
3. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
4. Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
5. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
6. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
7. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill
8. Modern Physics-Serway (CENGAGE Learnings) 2014
9. Physics of Atoms and Molecules – Bransden (Pearson India) 2003

VI SEMESTER Practicals Paper – VII :**Modern Physics****(w.e.f the academic year 2018-2019)**

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 Ridge berg'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.

Reference 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

Subject : (Physics)

(DSE- Elective-II)

Paper-VIII-A : Basic Electronics
(w.e.f the academic year 2018-2019)**Unit-I: (14 hrs)****Network Elements and Network Theorems**

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).

Two-port Networks – Introduction- Z-parameters, Y-parameters, h-parameters and ABCD-parameters (Simple problems).

Unit – II: (14 hrs)

Energy band in solids (band theory), valence band, Fermi level, continuity equation.

Diodes: P-N junction diode, Bridge rectifier. Zener diode & its Characteristics. Zener diode as voltage regulator.

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. (Qualitative analysis)

Feedback Concept & Oscillators: Feedback, General theory of feedback–Concepts of a Oscillators, Barkhausen criteria, Phase shift Oscillator.

Unit-III: (14hrs)**Digital Electronics**

Binary number system, converting 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 – vice versa and Decimal to Hexadecimal 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 – Statement and proof.

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

Textbooks

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.*

Reference Books

1. Basic Electronics – Bernod Grob.
2. Third year Electronics – Telugu Academy
3. Digital Principles & Applications – A.P. Malvino and D.P. Leach
4. Circuit theory- Umesh.

VI SEMESTER Practicals Paper – VIII A :
Basic Electronics
(w.e.f the academic year 2018-2019)

1. AND, OR, NOT, gates – Truth table Verification
2. AND, OR, NOT – gates constructions using universal gates – Verification of truth tables.
3. NAND and NOR gates 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. Verification Thevenin's theorem.
9. Maximum Power Transfer theorem
10. P-n junction diode V- I characteristics.
11. Zener diode as a voltage regulator
12. Construction of a model D.C. power supply
13. R C phase shift Oscillator –determination of output frequency

Text 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.

Subject : (Physics)**(DSE- Elective-II)****Paper-VIII-B : Physics of Semiconductor Devices**
(w.e.f the academic year 2018-2019)**Unit-I: (14 hrs)**

Semiconductor Physics: Conductors, Semiconductors, forbidden orbits, energy levels, crystals and covalent bonds, free electrons and holes, recombination and life-time, energy bands. Intrinsic Semiconductor- intrinsic carrier concentration, density of electrons in conduction band, fermi-level, mass action law. Carrier transport phenomena- mobility, resistivity, diffusivity, Einstein's relation, current density equation. Extrinsic semiconductor-n-type semiconductor, p-type semiconductor, energy band diagram of extrinsic semiconductor.

Unit – II: (14 hrs)

P-N junction-Depletion layer, Energy level diagram of p-n junction, Band structure of an open circuited p-n junction, Biasing of p-n junction, effect of barrier potential on forward bias, reverse leakage current, reverse breakdown, P-n junction under various conditions-thermal equilibrium, forward and reverse bias, current-voltage characteristics. Derivation of ideal diode equation of p-n junction, diode model and its approximations. Forward and reverse resistance of diode. Dynamic characteristic of diode. Zener diode, Light –emitting diode (LED), Photo-diode, Schottky diode, Backward diodes and Tunnel diode.

Unit-III: (14 hrs)

Transistors- Bipolar junction transistor (BJT), transistor characteristics, transistor equation in active region, field effect transistor (FET), Phototransistor and MOSFETs.

Control devices- Shockley Diode, Silicon Controlled Rectifier (SCR), Silicon Controlled Switch (SCS), Unijunction transistor (UJT), Solar Cells, Opto-couplers.

Text books

1. A First Course in Electronics- Anwar A. Khan & Kanchan K. Dey, PHI
2. Physics of Semiconductor Devices- S. M. Sze
3. Physics of Semiconductors- Streetman

VI SEMESTER Practicals Paper – VIII-B :

Physics of Semiconductor Devices
(w.e.f the academic year 2018-2019)

1. Characteristics of a Transistor in CE configuration
2. Zener diode V-I characteristics.
3. P-n junction diode V- I characteristics.
4. Zener diode as a voltage regulator
5. Determination of carrier concentration using Hall effect
6. Thermistor characteristics
7. Efficiency of a LED
8. Solar cell: fill factor and efficiency
9. FET characteristics
10. SCR characteristics
11. UJT characteristics

Text Books for LAB

1. Basic electronics, Grob
2. Practical Electronics, Zbar


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**B.Sc. PHYSICS SYLLABUS UNDER CBCS SCHEME
SCHEME OF INSTRUCTION
(Revised and effective from academic year 2019-2020)**

| Semester | Paper [Theory and Practical] | Instructions Hrs/week | Marks | Credits |
|----------|---|-----------------------|-------|---------|
| I | Paper – I : Mechanics & Oscillations | 4 | 100 | 4 |
| | Practicals – I : Mechanics & Oscillations | 3 | 50 | 1 |
| II | Paper – II: Thermal Physics | 4 | 100 | 4 |
| | Practicals – II : Thermal Physics | 3 | 50 | 1 |
| III | Paper – III : Electromagnetic Theory | 4 | 100 | 4 |
| | Practicals – III : Electromagnetic Theory | 3 | 50 | 1 |
| IV | Paper – IV : Waves & Optics | 4 | 100 | 4 |
| | Practicals – IV :Waves & Optics | 3 | 50 | 1 |
| V | Paper –V : A. Modern Physics B. Computational Physics | 4 | 100 | 4 |
| | Practicals – V: A. Modern Physics B. Computational Physics | 3 | 50 | 1 |
| VI | Paper – VI : A. Electronics B. Applied Optics | 4 | 100 | 4 |
| | Practicals VI: A. Electronics B. Applied Optics | 3 | 50 | 1 |

Total credits: 30

Skill Enhancement Courses

1. Experimental methods and Errors analysis
2. Electrical circuits and Networking
3. Basic Instrumentation
4. Biomedical Instrumentation
5. Digital Electronics

Generic Elective:

1. Renewable Energy & Energy Harvesting

Project work /Optional (Nano science)

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

Unit – I

1. Vector Analysis (10)

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

2. Mechanics of Particles (6)

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.

3. Mechanics of Rigid Bodies (6)

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

4. Central Forces (7)

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.

5. 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

6. Oscillations(12)

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.


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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.*



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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. Amplitude 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.


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

Unit – I

1. Kinetic theory of gases: (4)

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

2. Thermodynamics: (8)

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

3. Thermodynamic potentials and Maxwell's equations: (6)

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.

4. Low temperature Physics: (6)

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

5. Quantum theory of radiation: (12)

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

6. Statistical Mechanics: (12)

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.

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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. Murugesan and Kiruthiga Siva Prasath (for statistical Mechanics) *S. Chand & Co.*
4. **Modern Physics** by G. Aruldas 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)


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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 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


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

Unit I : Electrostatics (11 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 (12 hrs)

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 (13)

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:

Varying and alternating currents (6)

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(6):

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).

Text 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.

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 for Reference:

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


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

Unit-I Waves(12)

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: (12)

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: (12)

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 (12)

Polarized light : Methods of Polarization, Polarization 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 Subramaniam 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.


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

UNIT - 1 : SPECTROSCOPY (12)

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 (14)

Inadequacy of classical Physics: Spectral radiation - Planck's law (only discussion). Photoelectric effect - Einstein'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. Standing de Broglie waves of electron in Bohr orbits. 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 (10)

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, Gamow's theory of alpha decay. Geiger - Nuttal law from Gamow's theory, Beta spectrum - neutrino hypothesis,


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

UNIT: IV: Solid State Physics & Crystology (12)

Crystal Structure : Crystalline nature of matter. Crystal lattice, Unit Cell, Elements of symmetry. Crystal systems, Bravais lattices. Miller indices. Simple crystal structures (S.C., BCC, FCC, CsCl, NaCl, diamond and Zinc Blende)

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.


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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. Murugesan 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.


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B.Sc. (Physics Practical) – 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.

Reference 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.


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

Unit I Programming in C (14 hours)

Flow charts, Algorithms, Integer and floating point arithmetic, Precision, Variable types, Arithmetic statements, 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 (14 hours)

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 (14 hours)

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 sampling, Rejection method,

Unit IV (14 hours)

Metropolis algorithm, Molecular diffusion and Brownian motion as random walk problems and their MonteCarlo 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



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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.


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

Unit – I: (12 Hrs)

Band theory of P-N junction

1. 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.
2. **Diodes:** P-N junction diode, Half-wave, full-wave and bridge rectifier. Zener diode & its characteristics. Zener diode as voltage regulator.

Unit-II: (12 Hrs)

1. **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).
2. **Feedback concept & Oscillators:** Feedback, General theory of feedback – Concepts of oscillators, Barkhausen's criteria, Phase shift oscillator – Expression for frequency of oscillation.

Unit-III : (10 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: (14 Hrs)

1. Digital Electronics

Binary number system, conversion 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.


2. 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.

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*


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


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
- ❖ Every student should complete minimum 06 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.

Note: Minimum of eight experiments should be performed.


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Subject : (Physics)

B.Sc. Semester VI-Theory Syllabus
(DSE- Elective-II)
Paper-VI:: B. APPLIED OPTICS

Unit I (11hrs)

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. – Properties of Laser beams. Classification of laser systems – Gas, Liquid and Solid Lasers: He- Ne, and Argon lasers, their energy level schemes - Ruby laser and YAG laser, GA-As laser, and their applications in various fields.

Unit II (11 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 (10 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 (10 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.

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


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Subject : (Physics)

**B.Sc. Semester VI-Theory Syllabus
(DSE- Elective-II)
Paper-VI:: B.APPLIED OPTICS Practical**

Applied Optics

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


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Skill Enhancement course I

Experimental methods and error analysis

(Credits: 02)

30 hours

Experimental methods (15 hrs):

Least count of instruments, Instruments for measuring mass, length, time, angle, current, voltage. Fundamental units. Precision and accuracy of measurements, source of error in measurements, necessity of estimating errors, types of errors, reading error of instrument, calibration error, random error, systematic error, significant digits, order of magnitude and rounding of numbers, rounding error, absolute and relative errors, Errors of computation- addition, subtraction, multiplication, division, error in power and roots, Propagation of errors, analysis of data, standard deviation, calculation of mean value.

Unit II


Statistical Analysis of errors (15 hours)

Mean, Mean mode and standard deviation, standard deviation of mean, Least squares fitting, Normal distribution, covariance and correlation, Binomial distribution, poisson distribution, chi square test

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

References:

1. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency- 2010


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Skill Enhancement course II

ELECTRICAL CIRCUIT NETWORKING

(Credits: 02)

30 Hours

Unit I (15 hours)

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.)

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop, (4 Lectures)

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources

Unit II (15 hours)

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

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

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn..



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Skill Enhancement course III

BASIC INSTRUMENTATION

(Credits: 02)

30 hours

Unit I (15 hours)

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance)

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only- no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

Unit II (15 hours)

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters: Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

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

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India


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Skill Enhancement course IV

BIOMEDICAL INSTRUMENTATION

(Credits: 02)

30 hours

Unit I (15 hours)

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 hours)

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.

References:

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


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Skill Enhancement course IV

B.Sc. (Physics) – II/III Year
Semester –III/IV/V/VI
Digital Electronics

(SEC)

UNIT-I :

Semi-Conductor Theory: Energy Levels, Intrinsic and Extrinsic Semiconductors, Mobility, Diffusion and Drift current, Hall Effect, Characteristics of P-N Junction diode, Parameters and Applications. Rectifiers: Half wave and Full wave Rectifiers (Bridge, center tapped) with and without filters, ripple regulation and efficiency. Zener diode regulator.

Bipolar Junction Transistor: BJT, Current components, CE, CB, CC configurations, characteristics, Transistor as amplifier. Analysis of CE, CB, CC Amplifiers (qualitative treatment only) . JFET: Construction and working, parameters.

UNIT-II

Photo diode, Photo Transistor, LED, LCD, SCR, UJT Construction and Characteristics only.

Display Systems: Constructional details of C.R.O and Applications.

Feedback Concepts – Properties of Negative Feedback Amplifiers, Classification, Parameters.

Oscillators – Barkhausen Criterion, LC Type and RC Type Oscillators and Crystal Oscillators (Qualitative treatment only).

Digital Systems: Basic Logic Gates, half, Full Adder and Subtractors.

Suggested Readings:

1. Jacob Millman, Christos C. Halkias and Satyabrata Jit, Electronics Devices and Circuits, 3rd Edition, McGraw Hill Education (India) Private Limited, 2010.
2. Rama Kanth A. Gaykward, Op-AMPS and Linear Integrated Circuit, 4th Edition Prentice Hall of India, 2000.
3. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India, 2002.
4. William D Cooper, and A.D. Helfrick, Electronic Measurements and Instrumentations Techniques, 2nd Edition, Prentice Hall of India, 2008.
5. S. Shalivahan, N. Suresh Kumar, A. Vallava Raj, Electronic Devices and Circuits, 2nd Edition., McGraw Hill Education (India) Private Limited, 2007.


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**B.Sc. (Physics)- III Year
Semester –V
Renewable Energy Resources
(GE)**

**Total: 48 hrs
(4 Hrs / week)**

Unit I: Principles of Solar Radiation and Collection (Qualitative only): (12 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: (12 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: (12 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: (12 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. 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.


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(Credits: 04)

Paper in lieu of project

56 hours

Nano Science

Unit I

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. (14 Lectures)

Unit II

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Photolithography. 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. (7 Lectures)

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy. (7 Lectures)

Unit III

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 heterostructures and nanostructures.

ELECTRON TRANSPORT: Carrier transport in nano structures. Coulomb blockade effect, thermionic emission, tunneling and hopping conductivity. Defects and impurities: Deep level and surface defects. (14 Lectures)

Unit IV


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). (14 Lectures)

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

Reference 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).


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Question paper pattern

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Title of the paper:
Paper:

Duration: 3Hrs]

[Max. Marks : 80

Section-A: Short Answer Questions
Answer any EIGHT questions


(8 x 4 = 32)

1. Unit - I
2. Unit - I
3. Unit - I (Problem)
4. Unit - II
5. Unit - II
6. Unit - II (Problem)
7. Unit - III
8. Unit - III
9. Unit - III (Problem)
10. Unit - IV
11. Unit - IV
12. Unit - IV (Problem)

Section B: Essay Answer Questions

(4 x 12 = 48)

- 13 (a) Unit - I
OR
(b) Unit - I
- 14 (a) Unit - II
OR
(b) Unit - II
- 15 (a) Unit - III
OR
(b) Unit - III
- 16 (a) Unit - IV
OR
(b) Unit - IV


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