# TUMKUR UNIVERSITY, TUMKUR

# CBCS PHYSICS SYLLABUS (UG)


## B.Sc. (Semester System)

2016

| Sem | Paper | Title of the paper | Hrs / Week | Credits | IA marks | SEE marks | Max. Marks |
|---|---|---|---|---|---|---|---|
| **I** | **I** | **Mechanics and special theory of relativity** | **T 4** | 4 | 10 | 90 | 100 |
| | **Practical** | | **P 4** | 2 | - | 50 | 50 |
| **II** | **II** | **electricity and magnetism** | **T 4** | 4 | 10 | 90 | 100 |
| | **Practical** | | **P 4** | 2 | - | 50 | 50 |
| **III** | **III** | **Thermodynamics, Low temperature, Radiation &Optics** | **T 4** | 4 | 10 | 90 | 100 |
| | **Practical** | | **P 4** | 2 | - | 50 | 50 |
| **IV** | **IV** | **waves, optics and statistical physics** | **T 4** | 4 | 10 | 90 | 100 |
| | **Practical** | | **P 4** | 2 | - | 50 | 50 |
| | **Open elective** | **Fundamentals of Phyics** | **T 2** | 2 | - | 50 | 50 |
| **V** | **V** | **Digital and analog circuits and instrumentation** | **T 3** | 3 | 10 | 90 | 100 |
| | **Practical** | | **P 3** | 1.5 | - | 50 | 50 |
| | **V1** | **Elements of modern physics, astrophysics & material science** | **T 3** | 3 | 10 | 90 | 100 |
| | **Practical** | | **P 3** | 1.5 | - | 50 | 50 |
| **VI** | **VII** | **Embedded system: introduction to microcontrollers, op-amp and quantum mechanics** | **T 3** | 3 | 10 | 90 | 100 |
| | **Practical** | | **P 3** | 1.5 | - | 50 | 50 |
| | **VIII** | **Nuclear & Solid State Physics** | **T 3** | 3 | 10 | 90 | 100 |
| | **Practical** | | **P 3** | 1.5 | - | 50 | 50 |

# Theory Question Paper Pattern

**Time Duration: 03 Hours** **Total: 90 Marks**

## Part –A

**Answer any five from the following. (5 x 8= 40 Marks)**

1.
2.
3.
4.
5.
6.
7.
8.

## Part – B

**Answer any six from the following. (6 x 5 = 30 Marks)**

9.
10.
11.
12.
13.
14.
15.
16.

## Part – C

**Answer any ten from the following. (10 x 2= 20 Marks)**

17.
18.
19.
20.
21.
22.
23.
24.
26.
27.

# Note: Equal weightage must be given to all Units

| Distribution of Marks for Practical Examination | |
|---|---|
| Writing Formula with explanation of terms and units : | 05 Marks |
| Figure/ Circuit diagram/ Flow Chart / Nature of Graph : | 05 Marks |
| Principle and Procedure : (02 + 03) | 05 Marks |
| Experimental Setup, Recording data or Writing Program : | 15 Marks |
| Calculations, Graphs and Result (Program Execution) : | 05 Marks |
| Experimental Skills and Accuracy (with 10% deviation) : (03 + 02) | 05 Marks |
| Certified and Completed Record : (For 8 Experiments) | 05 Marks |
| Viva-voce : | 05 Marks |
| **Total** | **50 Marks** |

**Note: Minimum Eight Experiment should be performed**

**Semester I**

## MECHANICS AND SPECIAL THEORY Of RELATIVITY

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

**Unit -1**

**Laws of Motion:** Frames of reference. Newton's Laws of motion; I Law explanation with illustration, Concept of inertial mass, II Law and its limitations, Forces like gravitational force, weight of a body. III Law explanation with illustration, applying newton's laws to solve problem by using free body diagrams, Dynamics of a system of particles. Centre of Mass. Problems **(09 Lectures)**

**Momentum and Energy:** Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.-Finding the acceleration and velocity of single stage and multistage rockets, external forces and internal energy changes. Problems **(06 Lectures)**

**Unit -2**

**Rotational Motion:** Angular velocity and angular momentum. MI of a body Torque. Conservation of angular momentum. Parallel and Perpendicular axes theorems with proof. Calculation of MI of a ring, disk & cylinder. Problems **(5 Lectures)**

**Gravitation:** Newton's Law of Gravitation. Gravitational potentaial and field intensity due to spherical distribution of matter (Solid sphere only) Motion of a particle in a central force field, Kepler's Laws (statements & Proof). Satellite in circular orbit, Orbital velocity,Escape velocity and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Problems **(10 Lectures)**

**Unit -3**

**Oscillations:** Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages.Compound pendulum as an example of SHM, Damped oscillations. Problems **(5 Lectures)**

**Elasticity:** Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and in twisting a wire - Twisting couple on a cylinder –Bending of beams, expression for bending moment, Single cantilever with theory, Determination of Rigidity modulus by static torsion and dynamic methods with theory- Torsional pendulum-Determination of elastic constant(q, n, k and $\sigma$) by Searle's method**.** Problems **(10 Lectures)**

**Unit -4**

**Special Theory of Relativity:** Inertial and non-inertial frames, Principal of Galilean relativity. Michelson- Morley experiment with a brief background , Significance of its negative results. Postulates of Special theory of relativity, Derivation of Lorentz transformation equations. Proper length, Lorentz- Fitzerald length contration, proper time, time dilation, illustration with twin paradox, and life time of mew- mesons. Simultaneity in relativity. Velocity transformation equations, Relativistic addition of velocity (velocity addition theorem). Variation of mass with velocity, Mass-energy and momentum-energy relations. Problems

**(15 Lectures)**

**Reference Books:**


1 University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. AddisonWesley

2 Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGrawHill.

3 Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley

4 Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press

5 University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

6.Elements of Properties of matter-D.S.Mathur, Shamala Charitable trust, New Delhi.


---

**Practicals**

1. Measurements of length & diameter using vernier calipers, screw gauge and travelling microscope.

2. To determine the Young's Modulus by single cantilever.

3. To determine the Moment of Inertia of a Flywheel.

4. To determine the Young's Modulus by Stretching.

5. To determine the Modulus of Rigidity of a Wire by Maxwell’s needle. (n by dynamic method)

6. To determine the Elastic Constants of a Wire by Searle’s method.

7. To determine g by Bar Pendulum.

8. To determine g by Kater’s Pendulum.

9. To verify parallel axes theorem.

10. To verify perpendicular axes theorem.

11. To study the Motion of a spring and calculate (a) Spring Constant (b) Value of g

12. To determine the Rigidity Modulus by Static torsion method.

**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. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

## SEMESTER –II

## ELECTROSTATICS AND MAGNETISM

**(Credits: Theory-04, Practicals-02)**

**Theory: 60 Lectures**

**UNIT I**

**Vector Analysis**: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Qualitative approach on Vector Integration, Line, surface and volume integrals of Vector fields.Gauss-divergence theorem and Stoke's theorem of vectors (statement only). Problems

**(5 Lectures)**

**Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric. Problems

**(10 Lectures)**

**UNIT II**

**Magnetism:**

**Magnetostatics:** Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

**Magnetic Fields and Force:** Motion of a charged particle in a magnetic field, Magnetic force on a current carrying conductor, Force and torque on a current loop, Concept of dead beat, Theory of Ballistic Galvanometer, Determination of high resistance by leakage. Problems

**(10 Lectures)**

**Electromagnetic Induction:** Review of laws of electromagnetic induction, Self and mutual inductance, L of single coil, M of two coils. Energy stored in a conductor, eddy currents and applications. Electromagnetic damping, induction furnace. induction motor, electric breaks and speedometers. Problems

**(5 Lectures)**

**UNIT III**

**Magnetic properties of materials:** Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Explanation of, para- dia- and ferro-magnetic materials. Derivation for paramagnetic susceptibility-Curie law. Hysteresis-loss of energy. Problems

**(5 Lectures)**

**Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. Problems

**(10 Lectures)**

**UNIT IV**

**Transient Currents:** Theory of CR circuit (charging and discharging)-LR circuit (growth and decay) -LCR circuit (charging and discharging)

**Alternating Currents:** Review of basic definitions, LCR series circuit to sinusoidal voltages- Impedance by using only j operators - series resonance, 'Q' factor and band width- Qualitative explanation of LCR parallel circuit. Problems

**(10 Lectures)**

**Network theorems:** Thevenin's theorem, Norton's theorem, Superposition theorem and maximum power transfer theorem. Problems

**(5 Lectures)**

**Reference Books:**


1. Electricity and Magnetism, Edward M. Purcell
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I
3. Electricity and Magnetism, D C Tayal
4. University Physics, Ronald Lane Reese
5. Introduction to Electrodynamics, D.J. Griffiths
6. Electrical Networks, B. L. Theraja
7. Electricity and Magnetism, K. K. Tiwari

**Practicals**

1. To use analog and digital multimeter for measuring (a) Resistances (b) capacitance (c) AC and DC Voltages, (d) DC Current, and (e) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem
11. To determine Self-inductance of a given coil by using Anderson's Bridge.
12. To determine L and C for two different values by equal voltage method.

**Reference Books**


1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna
3. Engineering Practical Physics, S.Panigrahi and B.Mallick
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn

## Semester III

## THERMODYNAMICS, LOW TEMPERATURE PHYSICS, RADIATION &OPTICS

### UNIT-1: Kinetic theory of gases

Maxwell‘s law of distribution of velocities (qualitative) and its experimental verification. Degrees of freedom and principle of equipartition energy, Derivation of U = (3/2) RT. Average, r.m.s. and most probable velocity (derivation). M-B distribution function (qualitative), Mean free path (derivation), Mention of Clausius-Maxwell‘s expressions for mean free path, Brownian motion, Einstein‘s expression (derivation), Determination of Avogadro‘s number; Transport phenomena — Viscosity. Thermal conductivity, diffusion, Expression for η and κ (derivations) and relation between them. Real gases: Vander waal’s equation of state and correction, Critical constants (Mention).

Problems (15 **Lectures**)

### UNIT -2: Thermodynamics

Review of laws of thermodynamics, different processes, Carnot‘s engine. **Heat engines:** Otto engine, Otto cycle: Expression for efficiency, Diesel engine, Diesel cycle: Expression for efficiency and Carnot‘s theorem. **Entropy:** Concept of entropy, Change in entropy in reversible and irreversible processes, Entropy-temperature diagram. **Thermodynamic potentials:** Internal energy, Enthalpy, Helmholtz free energy and Gibbs free energy and their significance. Conditions of equilibrium of phases in terms of Gibbs potential. **Maxwell‘s relations:** Derivation of Maxwell‘s relations, Applications to- 1) Clausius Clapeyron‘s equation, 2) Clausius equations (specific heat of saturated vapours), Tds equations (energy equations).

Problems ( 15 **Lectures**)

### UNIT - 3: Low temperature and Radiation

**Measurement of low temperature:** Exhaust pump and its characteristics, Exhaust pressure, Degree of vacuum attainable, Speed of pump. 1) **Diffusion pump**-principle, construction and working 2) **Ionisation gauge**-principle,construction and working. **Production of low temperature:** Joule Thomson effect, Porous plug experiment with theory, Thermodynamical analysis of Joule Thomson effect. Temperature of inversion & its relation.

**Radiation:** Kirchoff’s laws of radiation (derivation). Radiation pressure, (qualitative), Stefan‘s law and its derivation using radiation pressure. Laboratory method for determination of Stefan‘s constant. Planck‘s law of radiation and its derivation, Wien’s displacement law with derivation, Rayleigh-Jean’s law (qualitative).

Problems (15 **Lectures**)

**UNIT -4: Optics**

**Wave Optics:** Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle

**Interference:** Division of amplitude and division of wavefront. Young'sDouble Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change onreflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shapedfilms. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness(Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.Theory and experiment of Air wedge.

**Michelson's Interferometer:** Idea of form of fringes (no theory), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.
Problems (15 **Lectures)**

**Reference Books:**


1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears &
6. G.L.Salinger. 1988, Narosa, University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7 Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.
8. Heat and thermodynamics, Subramanyam and Brijlal


---

**Practicals**

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To determine Dispersive Power of the Material of a given Prism using Mercury Light
10. To determine the value of Cauchy Constants of a material of a prism.
11. To determine wavelength of sodium light using Newton's Rings.
12.To determine the thickness of a material by air wedge.

**Reference Books:**


1. Advanced Practical Physics for students, B.L.Flint & 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, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.

**Semester IV**

## WAVES , OPTICS AND STATISTICAL PHYSICS
**(Credits: Theory-04, Practicals-02)**
**Theory: 60 Lectures**

**Unit-I**

**Superposition of Two Collinear Harmonic oscillations**: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Problems **(4 Lectures)**

**Superposition of Two Perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.
Problems **(3 Lectures)**

**Waves Motion- General**: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.
Problems **(8 Lectures)**

**Unit-II**

**Sound:** Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.
Problems **(6 Lectures)**

**Fluids:** Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical, cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. **Viscosity:** Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. **Physics of low pressure:** Production and measurement of low pressure - Rotary pump - Diffusion pump. Problems
**(9 Lectures)**

**Unit-III**

**Diffraction:**

**Fraunhofer diffraction:** Sing le slit; Double Slit. Multiple slits & Diffraction grating.

**Fresnel Diffraction:** Half-period zones. Zone plate. Fresnel Diffraction pattern at a straight edge, at a slit and at a wire using half-period zone analysis. **(10 Lectures)**

**Polarization:** Transverse nature of light waves. production and detection of linear , Circular and elliptically polarized lights. Optical activity-Fresnel's explanation. Specific Rotation-Polarimeter – constructin & working Problems **(5 Lectures)**

**Unit-IV**

**Statistical Mechanics:** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity -Quantum statistics - Fermi-Dirac distribution law - Fermi sphere and Fermi energy, Fermi gas, Bose-Einstein distribution law -

Bose's derivation of Planck's law, Rayleigh-Jeans law, Wein's law - comparison of three statistics. Problems

**(15 Lectures)**

**Reference Books:**


1.Principles of Optics-B.K.Mathur
2.Laser & Optics- A.K. Ghatak
3. Optics- Brijilal & Subramanium
4. Properties of Matter- Brijilal & Subramanium
5.Elements of Properties of matter- D. S. Mathur
6. Optics- Jenkins & White, Mc grow Hills
7.Statistical Mechanics- Agarwal& Eisner.


**Practicals**

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda 2 - T$ Law.
3. To determine the unknown frequency of of a given tuning fork using Helmholtz resonator.
4. To determine the Surface tension by Jaegar's method.
5. To determine the Coefficient of Viscosity of liquid by Stoke's method.
6. To determine the wavelength of Laser light using Diffraction at a Single Slit.
7. To determine wavelength of (1) Sodium & (2) Spectrum of Mercury light using plane diffraction Grating
8. To determine the wavelength of sodium light using Fresnel Biprism.
9. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.
10. To determine the Surface tension of water and interfacial tension between water and kerosene by drop weight method
11. To determine the Resolving Power of a Telescope.
12. To determine the specific rotation of sugar solution using polarimeter.

**Reference Books:**


1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.16
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, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

## Semester- v

## Paper- 5

## DIGITAL , ANALOG CIRCUITS AND SEMICONDUCTOR DEVICES
## Theory: 45 Lectures

**UNIT-1: Digital Circuits**

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. Problems

**(4 Lectures)**

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Problems

**(5 Lectures)**

Binary Addition. Binary Subtraction using 2's Complement Method).Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor. Problems

**(4 Lectures)**

**Introduction to CRO:** Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Problems

**(2 Lectures)**

**UNIT-2: Semiconductor Devices and Amplifiers:**

**Semiconductor Diodes**: p and n type semiconductors. Barrier Formation in PN Junction Diode. Principle and Working of (1) LEDs (2) LDR (3) Solar Cell.

**Bipolar Junction transistors**: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains $\alpha$ and $\beta$. Relations between $\alpha$ and $\beta$. Load Line analysis of Transistors.

DC Load line and Q-point.Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit.Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Problems

**(15 Lectures)**

**UNIT-3:**

**Embedded system introduction:** Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers. Problems

**(8 Lectures)**

**Review of microprocessors:** Organization of Microprocessor based system, 8085μp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts. Problems

**(7 Lectures)**

**Reference Books:**


1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
2. Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
3. Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,1990, PHI Learning
4. Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7th Ed.,2011, Tata McGraw Hill
5. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
6. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
7. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.


**PRACTICALS**

1. To measure (a) Voltage (b) Frequency of a periodic waveform & (3) Setting of lissajous pattern using CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. Digital Half-adder & Full-adder circuits.
4. Adder-Subtractor using Full Adder I.C.
5. To study the characteristics of a Transistor in CE configuration and calculation of h-parameters..
6. To study the CE amplifier(R-C) of a given transistor.
7. LED characteristics and determination of plank's constant (Minimum four colours)
8. LDR characteristics – dark resistance – saturation resistance and material constant.
9. Transistor as a switch and an active device.
10. Solar cell characteristics- Open Circuit voltage, Short circuit current and efficiency.
11. Addition and subtraction of two 8- bit number using 8085 μp
12. To write a program and execute to sort given 'n' numbers in ascending order using 8085 μp

**Reference Books:**


1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill
5. Digital electronics- R.P. Jain.


## PAPER- 06
## ELEMENTS OF MODERN PHYSICS, ASTROPHYSICS AND MATERIAL SCIENCE
**(Credits: Theory-04, Practicals-02)**
**Theory:45 Lectures**

**Unit-I**

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Problems

**(8 Lectures)**

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. Problems

**(4 Lectures)**

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle. Problems

**(3 Lectures)**

**Unit-II**

**Astrophysics**

**Parallax and distance:** Helio-centric parallax, Definition of parsec (pc), Astronomical unit (AU), light year (ly) and their relations.

**Luminosity of stars:** Apparent brightness, Apparent magnitude - scale of Hipparchus. Absolute magnitude - distance - modulus relationship. Distinction between visual and bolometric magnitudes, Radius of a star. Problems

**(3 Lectures )**

**Stellar classification:** Pickering classification and Yerke's luminosity classification. H-R diagram, Main sequence stars and their general characteristics. Gravitational potential energy or self energy of a star based on the linear density model, Statement and explanation of Virial theorem. Surface or effective temperature and color of a star : Wien's displacement law. Expressions for - average temperature, core temperature, hydrostatic equilibrium, core pressure of a star based on the linear density model of a star. Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star. Problems

(**7 Lectures )**

**Evolution of stars:** Stages of star formation (GMC – Protostar- T-Tauri) and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion- its types, Chandrasekhar limit. Event horizon, singularity and Schwarzchild's radius(qualitative) Sun spots-Their effect on earth . (qualitative) Problems

**( 5 Lectures)**

**Unit-3: Material Science**

**Nanomaterials -** Synthesis techniques(Top down & bottom up)- Electron confinement-Size effect-Surface to volume ratio; distinction between nanomaterials and bulk materials in terms of energy band. Distinct properties of nano materials. Classification of Nanosystems – quantum dots, nanowires and nanofilms. Multilayered materials- Graphene, Fullerene, Carbon Nano Tube (CNT), Mention of applications of nanomaterials. Problems

**( 5 Lectures)**

**Dielectrics** : Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric breakdown, electrostriction (qualitative), electrets. Piezo electric effect, cause, examples and applications. Problems

**(5 Lectures)**

**Liquid Crystals** : Classification-Thermotropic and lyotropic. Properties - anisotropy in dielectric constant, electrical conductivity, magnetic susceptibility, refractive index and elasticity. Applications: construction and operation of twisted nematic display and thermography.
Problems **(5 Lectures)**

**Reference Books:**


1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
   Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
3. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
4. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning
5. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Modern Physics- C L .Arora., S Chand.


**Practicals**

1. To determine the Planck's constant using photocell.
2. Study of Solar spectrum-Fraunhofer lines and determination of Rydbeg constant.
3. Characteristics of Photo emissive cell
4. To determine the value of e/m by Thomson's method.
5. Parallax Method – Distance of objects using trigonometric parallax.
6. H.R Diagram & the physical properties of stars.

7. Analysis of stellar spectra.
8. Analysis of sunspot photographs & solar rotation period.
9. Mass luminosity curve – Estimation of mass of a star.
10 Mass of binary stars.
11**.**Determination of dielectric constant of a material of a capacitor
12.Spectral response of a Selenium photocell

**Reference Books:**


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

**SEMESTER VI**
**PAPER 07**
**(Electronics)**

## EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS, OP-AMP AND QUANTUM MECHANICS

**(Credits: Theory-04, Practicals-02)**
**Theory: 45 Lectures**

**UNIT-1**

**Integrated circuits**

Monolithic IC - description of discrete IC - Techniques of manufacturing thin film and thick film IC.

**(2 Lectures)**

**Operational Amplifiers:**

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator. Problems

**(8 Lectures)**

**Oscillators** Feedback concepts - oscillator circuits - Feedback amplifier - oscillator operation – Barkhausen Criterion - phase and frequency considerations- phase shift oscillator and Wienbridge oscillator (using op amp). Problems **(5 Lectures)**

**UNIT-2**

**8051 microcontroller:** Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming.

Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions. Problems

**(12 Lectures)**

**8051 I/O port programming:** Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description and their functions. Problems

**(3 Lectures)**

**UNIT-3 : Quantum Mechanics**

**Time dependent Schrodinger equation**: 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. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. Problems

**(5 Lectures)**

**Time independent Schrodinger equation**-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy Eigen functions; General solution of the time independent Schrodinger equation in terms of linear

combinations of stationary states; Application to the 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. Problems

**(10 Lectures)**

**Reference Books:**


1. Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole
4. Embedded Systems and Robots, Subrata Ghoshal, 2009, Cengage Learning Introduction to embedded system, K.V. Shibu, 1st Edition, 2009, McGraw Hill
5. Microcontrollers in practice, I.Susnea and M.Mitescu, 2005, Springer.
6. Embedded Systems: Design & applications, 1/e S.F. Barrett, 2008, Pearson Education India
7. Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning
8. Electron principles- Malvino
9. Operational amplifer- Ramakanth, Gayakwad.


**Practicals**

1.To study inverting and non-inverting amplifier of given Op-amp 741
2. To investigate the use of an op-amp as a Differentiator
3. To design a Wien Bridge Oscillator using an op-amp.
4. Op-amp-summer (Adder) & integrator
5. Phase shift oscillator using op –amp
6. To toggle '1234' as '1324' in the seven segment LED.
7. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
8. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.
9. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
10. Perform 8-bit arithmetic operation using 8051 microcontroller : 1. Addition 2. Subtraction 3.Multiplcation 4.Division.
11. Program to run a countdown from 9-0 in the seven segment LED display.
12. To solve the Schrödinger equation for a quantum particle in a 1D box numerically and obtain the ground state energy and the wave function.

**Reference Books:**


1. Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole Embedded System, B.K. Rao, 2011, PHI Learning Pvt. Ltd.
4. Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning

**PAPER 08**
**Nuclear & Solid State Physics**
**Theory: 45 Lectures**

**Unit-I**

**Nuclear Models**: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. Problems

**(15Lectures)**

**Unit-II**

**Radioactivity decay: (a) Alpha decay:** basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. **(b) β-decay:** energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. **(c) Gamma decay:** Gamma rays emission & kinematics, internal conversion. Problems

**(10 Lectures)**

**Detector for Nuclear Radiations: Gas detectors:** estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle and photon detection (concept of charge carrier and mobility). Problems

**(5 Lectures)**

**Unit-III**

**Solid State Physics**

**Crystal systems and X-rays:** Crystal systems-Bravais lattice; Miller indices– Spacing between lattice planes of cubic crystals, Continuous and characteristic X-ray spectra; Moseley's law, Scattering of X-rays - Compton effect, Bragg's law. Problems

**(4 Lectures)**

**Free electron theory of metals :** Electrical conductivity- classical theory (Drude-Lorentz model) ; Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons; Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero. Hall Effect in metals. Problems

(**5 Lectures)**

**Molecular Physics:** Pure rotational motion, Spectrum and selection rules; Vibrational motion, vibrational spectrum and selection rules; Rotation-Vibration spectrum; Scattering of light-Tyndall scattering, Rayleigh scattering and Raman scattering. Experimental study of Raman effect, Quantum theory of Raman effect - Applications. Problems

**(6 Lectures)**

**References**


1. Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole
4. Embedded Systems and Robots, Subrata Ghoshal, 2009, Cengage Learning Introduction to embedded system, K.V. Shibu, 1st Edition, 2009, McGraw Hill
5. Microcontrollers in practice, I.Susnea and M.Mitescu, 2005, Springer.
6. Embedded Systems: Design & applications, 1/e S.F. Barrett, 2008, Pearson Education India
7. Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning
8. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
9. Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education
10. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer


**Practicals**

1. Analysis of rotational spectrum of nitrogen. (Raman spectrum)
2. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
3. Characteristics of GM counter
4. Analysis of X-Ray powder diffractogam of NaCl
5. Verification of Inverse square law using GM counter
6. Determination of mass absorption coefficient of Aluminum for β-rays
7. Determination of Fermi energy of copper.
8. Analysis of band spectra of PN molecule
9. Summerfield fine structure of H-alpha by measuring fine structure seperation of Na doublet.
10. Determination of binding energy of nucleus
11. Absorption spectrum of $KMnO_4$
12. Determination of resistivity of a material by Four probe technique .

## OPEN ELECTIVE IN PHYSICS
# Fundamentals of Physics

**(Credits: 02)**
**30 Lectures**

**Introduction:** Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc.

**(5 Lectures)**

**Electrical and Electronic Skill**: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply.

**(10 Lectures)**

**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.

**(5Lectures)**

**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

**(5 Lectures)**

**Basics of Atomic and Nuclear Physics:** Basic concept of atomic structure; X rays characteristic and production; The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half-life, basic concept of alpha, beta and gamma decay, fission and fusion reactions .

**(5 Lectures)**

**Reference Books:**


1. A text book in Electrical Technology - B L Theraja – S. Chand and Company.
2. A text book in Electronics & Electrical Technology – V K Mehtha .
3. Text book of Nuclear Physics- D.C. Tayal,