JSS COLLEGE FOR WOMEN

(AUTONOMOUS)

Saraswathipuram, Mysore-9

BACHELOR OF SCIENCE GRADUATE COURSE

CHOICE BASED CREDIT SYSTEM - 2018

SUBJECT: PHYSICS

Department Regulations

1. **Teaching instruction per week:**

   "Course duration: 16 weeks with 4 hours of instructions per week."

   a) Lecture classes: 4 Hrs of duration per paper per week.

   b) Practical classes: 4 Hrs of duration for I to VI semester per week.

2. **Examination:**

   a) Theory:

   C1- Will be assessed for I to VI semester for 10 marks after the completion first half of the semester by 8th week through test, assignment, attendance, seminar, projects in group and poster presentation (after the completion of 50% of the syllabus).

   C2- Will be assessed for I to VI semester for 10 marks after the completion second half of the semester by 16th week through test, assignment, attendance, seminar, projects in group and poster presentation (after the completion of rest 50% of the syllabus).

   C3- examinations for I to VI semester are conducted at the end of every semester for THREE hours of duration. The question paper shall be set for a maximum of 70 marks from I to VI semester and then after evaluation it will be reduced to 50 marks.

   b) Practical:

   C1- Will be assessed for I to VI semester for 05 marks after the completion first half of the semester by 8th week through experiment/continuous assessment of experimental work and record completion/procedure writing/viva/ attendance (after the completion of 50% of the experiments).

   C2- Will be assessed for I to VI semester 05 marks after the completion first half of the semester by 16th week through experiment/continuous assessment of experimental work and record completion/procedure writing/viva/ attendance (after the completion of 50% of the experiments).

C3- examinations for I to IV semester are conducted at the end of every semester for THREE hours of duration for a maximum of 40 marks and then after evaluation it will be reduced to 20 marks.

ONE experiment shall be conducted in each practical examination (I to VI semester).

3. **Eligibility criteria for students :**

   Only the students who have scored minimum 30% in C1 and C2 are eligible to take C3 examination.

4. **Eligibility criteria for teaching faculty:**

   a) Paper setting-the teacher with minimum of 5 years of teaching experience in the first grade college are eligible to set the question paper.

   b) Paper valuation and practical examination – the teacher with minimum of 3years of experience is eligible to become evaluator and examiner

SCHEME OF EXAMINATION
B.Sc. PHYSICS CBCS SCHEME SYLLABUS 2018-19

Sem	Course	Paper	Title of paper	Instruction per week (Hrs)	Credits	Theory & Practical exams Max marks			Sub Total Marks C1+C2+C3	Grand Total Marks	Exam Duration (Hrs)
					L:T:P	C1	C2	C3			
I	DSC-1	Theory	Mechanics, properties of matter and Waves	04	4:0:0	10	10	50	70	100	03
		Practicals	Practical-1	04	0:0:2	05	05	20	30		04
II	DSC-2	Theory	Thermal Physics, Sound and Electrostatics	04	4:0:0	10	10	50	70	100	03
		Practicals	Practical-2	04	0:0:2	05	05	20	30		04
III	DSC-3	Theory	Electricity and Electromagnetic theory	04	4:0:0	10	10	50	70	100	03
		Practicals	Practical-3	04	0:0:2	05	05	20	30		04
IV	DSC-4	Theory	Optics, Atomic and Molecular Spectroscopy	04	4:0:0	10	10	50	70	100	03
		Practicals	Practical-4	04	0:0:2	05	05	20	30		04
V	DSE-1	Theory	**1A)** Relativity, Nuclear Physics and Quantum Mechanics **1B)** Mathematical physics	04	4:0:0	10	10	50	70	100	03
		Practicals	Practical-**1A** Practical-**1B**	04	0:0:2	05	05	20	30		04
	SEC-1	Theory	**1)** Lasers and Fibre Optics **2)** Astronomy and Astrophysics **3)** Nano Materials	02	2:0:0	---	--	50	--------	50	02
VI	DSE-2	Theory	**2A)** Solid State Physics, Electronics and communication **2B)** Medical physics	04	4:0:0	10	10	50	70	100	03
		Practicals	Practical-**2A** Practical-**2B**	04	0:0:2	05	05	20	30		04
	SEC-2	Theory	**1)** Optoelectronics **2)** Renewable Energy Sources **3)** Solving Problems in Physics	02	2:0:0	--	---	50	--------	50	02

PREFACE

The syllabus proposed herein for the B.Sc., course in Physics has evolved through detailed discussions with members of Physics faculty in our college as well as many other Physicists and Physics teachers. The changes proposed have constantly kept in mind certain basic approaches in Physics education along with the dynamism resulting from autonomy in education. We are very much aware that Physics forms a major driving force for the present day developments in technology and the consequent socio-economic development of the world at large. The rapid changes in technology and vast variety of the present day technologies put enormous pressure on the practitioners to ensure that their education is extensive as well as intensive. Consequently there is a need for constant upgrading and revision of basic inputs in education at all levels, ensuring a judicial mix of the topics chosen. We have taken the advantage of impetus gained through autonomy, the consequent academic freedom and the possibility of achieving high quality at the institutional level. We are equally aware of the immense responsibility it entails in ensuring a proper match between the products of the education and the professions they might get into restrictions arising primarily from considerations of the available time, manpower and financial resources have also been emphasized during the formulation of the contents. We also believe that there is a vast scope for future improvements and a pressing need for constant up gradation and revision of the contents. We would also urge that the individual teachers feel free to add, delete or modify topics of their choice and provide the relevant feed back to help improve the content formulation.

We thank and gratefully acknowledge the help we have received from all the member of the Physics community and a special thanks to all the members of the board of Studies.

DSC-1: Mechanics, Properties of Matter and Waves

Objectives:

This paper is aimed to provide a knowledge in the basics of frames of references, vector derivatives, laws of conservation, properties of matter, fluid mechanics and simple harmonic motion and wave motion, complex waves analysis. Each topic includes problem solving which develops thinking process and application skills of the students.

Learning Outcome:

Familiarisation of the fundamental principles of formulations in mechanics the frames of references, vector derivatives, laws of conservation, properties of matter, fluid mechanics and simple harmonic motion and wave motion, complex waves analysis and development of applications skills.

Unit-1: 32 hours

Frames of reference: Inertial reference frames with examples. Uniform rectilinear motion in an inertial frame-Galilean transformation equation. The Galilean principle of relativity. Motion in a non-inertial reference frame uniformly accelerated rectilinear motion-concept of fictitious force-illustration; plumb line accelerometer and a freely falling elevator. Qualitative discussion of centrifugal force, Coriolis force and earth as a non-inertial frame, Numerical problems.

(5 hours)

Motion of a point particle: Point mass. The position vector $\vec{r}$ (t) of a moving point particle and its Cartesian components. Velocity and acceleration as the vector derivatives. Derivation of planar vector of a constant magnitude. Radial and transverse components of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion centripetal force. Numerical problems**.** **(4 hours)**

Rigid body dynamics: Review of definitions, Moment of inertia and radius of gyration. Review of statements of the theorems of the parallel and perpendicular axes. Expression for kinetic energy of a rigid body. Calculation of moment of inertia of thin uniform rod, rectangular lamina, circular lamina, and solid cylinder. Theory of compound pendulum. Numerical problems.

(6 hours)

Conservation of linear momentum: Conservation of the linear momentum for a system of two particles. Rocket motion in a uniform gravitational field (single stage rocket equation with and without gravity). Multistage rocket elementary ideas. Elastic and inelastic collisions-Elastic head-on collision and elastic oblique collision in a lab frame, Reduced mass. Numerical problems.

(6 hours)

Conservation of angular momentum: Review of angular momentum and Torque. Relation between angular momentum and torque. Law of conservation of angular momentum. Areal velocity derivation $\frac{dA}{dt} = \frac{1}{2} r^2 \dot{\theta} \hat{n}$. Central force Physical insight into the nature of central forces. Kepler's laws of planetary motion-derivation using Newton's law of gravitation. Numerical problems.

(5 hours)

Conservation of energy: Conservative force and non conservative forces with examples. Conservation of energy in a conservative force field. Applications: (i) Vertical oscillations of a loaded light spiral spring and (ii) Calculation of escape velocity in the gravitational field of the earth. Conditions for a geo-stationary satellite. Numerical problems.

(6 hours)

Unit-2: 32 hours

Fluid Mechanics: Viscosity-Basic concepts, Variation of viscosity of liquids with temperature and pressure. Theory of rotation viscometer.

(3 hours)

Surface Tension: Basic concepts. Pressure inside curved liquid surface, examples. Surface tension and interfacial tension by drop-weight method. Surface tension of mercury by Quincke's method-Theory Numerical problems.

(5 hours)

Elasticity: Concepts of moduli of elasticity, Hooke's Law and Poisson's ratio. Relation between the elastic constants q, k, n and σ limiting values for σ. Work done in stretching. Elastic potential energy. Bending moment. Theory of light single cantilever. I-section girders. Torsion-calculation of couple per unit twist. The Torsional pendulum, Static torsion, Searle's double bar experiment. Numerical problems.

(12 hours)

Analysis of complex waves: The Fourier series, evaluation of Fourier co-efficients, Example of the square wave, saw tooth wave.

(5 hours)

Superposition of simple harmonic motion Lissajous' figures. Equation for damped vibrations. Forced vibration, solution in exponential form, Resonance, Expression for amplitude and phase at resonance. Numerical problems.

(7 hours)

References

• Halliday D, Resnick R, and Walker J, Principles of Physics, 9th Edn., Wiley India Pvt. Ltd. (2013).
• Upadhyaya J C, Classical Mechanics, 2nd Edn., Himalaya Publishing House (2017).
• Arora C L, and Hemne P S, Physics for Degree Students, Revised Edn., S Chand and Company (2012).
• Charles Kittel, and Walter Knight, Berkeley Physics Course, Mechanics Vol. 1, 2nd Edn., Tata McGraw Hill (2011).
• Arora C L, Refresher Course in B.Sc. Physics Vol. 1, Revised Edn., S Chand and Company (2008).
• Mathur D S, Elements of Properties of Matter, S Chand and Company (2007).
• Mathur D S, Mechanics, S Chand and Company (2007).

• Brij Lal, and Subrahmanyam N, Properties of Matter, 6th Edn., S Chand and Company (2002).
• Shankara Narayana S R, Mechanics and Properties of Matter, 2nd Revised Edn., Sultan Chand and Sons (1998).
• Tewari K K, Electricity and Magnetism, S Chand and Company (2007).
• Brij Lal, and Subrahmanyam N, A Text Book of Electricity and Magnetism, 19th Edn., Ratan Prakashan Mandir (2016).

DSC-1: Practical

Any EIGHT of the following experiments:

1. Bar pendulum: Determination of the acceleration due to gravity and radius of gyration (graphical method).
2. Fly wheel: Determination of moment of inertia, mass and density.
3. Drop weight method: Determination of surface tension of liquid.
4. Drop weight method: Determination the interfacial tension between two liquids.
5. Quincke's method: Determination of surface tension and angle of contact of mercury.
6. Young's modulus: Single cantilever method using travelling microscope; Graphical method.
7. Searle's double bar: Determination of Young's modulus.
8. Searle's double bar: Determination rigidity modulus and Poisson's ratio (Assuming q).
9. Torsional pendulum: Determination of the rigidity modulus.
10. Determination of the Young's modulus by Dynamic method (using graph).
11. Spiral spring: Determination of the acceleration due to gravity (graphical Method).
12. Determination of Radius of Gyration and Moment of Inertia of a rectangular body in three different axis.

DSC-2: Thermal Physics, Sound and Electrostatics

Objectives:

This paper provides knowledge on Kinetic theory of gases, thermal physics, sound and electrostatics which enables the students to understand the fundamentals of thermodynamics, laws of thermodynamics, thermodynamic potentials, sound, electrostatics and magnetism .

Learning Outcome:

Clarity in the basic principles of thermodynamics, thermodynamic potentials, sound waves and electrostatics etc and development of problem solving skills.

Unit-1: 32 hours

Kinetic theory: Maxwell's law of distribution of molecular velocity (no derivation); its interpretation. Degrees of freedom. Principle of equipartition of energy based on Kinetic theory of gases. Derivation of U = 3=2RT. Mean free path, Probability of a particle having mean free path. Real gases, Andrew's isothermal, Vander Waals equations expression for critical constants, calculation of mean velocity, most probable velocity and RMS velocity. Numerical problems.

(8 hours)

Thermal conductivity: Equation for the flow of heat through a solid bar. Determination of thermal conductivity of a bad conductor by Lee and Charlton method. Numerical problems.

[3 hours]

Radiation: Planck's quantum theory of radiation .Induced and spontaneous emission of radiation. Derivation of Planck's law of radiation using Einstein's A and B coefficients. Deduction of Rayleigh-Jeans law, Stefan's law and Wien's displacement law from Planck's law. Numerical problems.

(6 hours)

Low temperature physics: Ideal gas and real gas. Vander Waals equation of state. Porous plug experiment and its theory. Joule-Thomson expansion expression for the temperature of inversion, inversion curve. Relation between Boyle temperature, temperature of inversion and critical temperature of a gas. Principle of regenerative cooling. Liquefaction of air by Linde's method. Adiabatic demagnetization. Numerical problems.

(8 hours)

Thermodynamics: Review of basic concepts, Carnot's theorem, thermodynamic scale of temperature and its identity with perfect gas scale. Clausius-Clapeyron -1st Latent heat equation, effect of pressure on melting point of a solid, effect of pressure on boiling point of a liquid. Numerical problems.

(7 hours)

Unit-2: 32 hours

Entropy: The concept of entropy. Change of entropy in reversible and irreversible cycles. Entropy and non available energy. Second law of thermodynamics in terms

of Entropy. Entropy of ideal gas, Entropy of Steam and Mixtures .T-S diagram, concept of absolute zero and the third law of thermodynamics. Numerical problems.

(7 hours)

Thermodynamic potentials and Maxwell's thermodynamic relations: Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs-Helmholtz equations. Derivation of Maxwell's thermodynamic relations, Tds equations for Cp and Cv, Heat capacity equations. Numerical problems.

(8 hours)

Sound: Waves in one dimension-Differential equation of wave motion , Expression for velocity of progressive waves in a medium, Laplace's Correction to Newton's formula. Expression for frequency of vibration of a stretched string harmonics, Longitudinal vibrations in a rod. Kundt's tube experiment, Numerical problems.

(7 hours)

Electrostatics: Mechanical force and electric pressure on a charged surface. The p ath traced by a charged particle in an electric field. The attracted disc electrometer-construction, theory and applications. Numerical problems.

(5 hours)

Galvanometers: Moving coil galvanometer-construction, theory, damping correction, current sensitivity and charge sensitivity. Helmholtz galvanometer
Theory. Numerical problems.

(5 hours)

References

• Halliday D, Resnick R, and Walker J, Principles of Physics, 9th Edn., Wiley (2013).
• Dittaman R H, and Zemansky M W, Heat and Thermodynamics, 7th Edn., The McGraw-Hill (2007).
• Blundell S J, and Blundell K M, Concepts in Thermal Physics, 2nd Edn., Oxford University Press (2006).
• Brij Lal, and Subramanyam N, Heat Thermodynamics and Statistical Physics, Multicolour Edn., S Chand Limited (2008).
• Gupta S C, Thermodynamics, 1st Edn., Pearson Education (2005).
• Satya Prakash, Optics and Atomic Physics, 11th Edn., Ratan Prakashan Mandir (1994).
• Arora C L, Refresher Course in B.Sc. Physics Vol. 1, Revised Edn., (2008).
• Shankara Narayana S R, Mechanics and Properties of Matter, 2nd Revised Edn., S Chand and Company (1983).
• Subramanyam N, Brij Lal, Waves and Oscillations, 2nd Edn., Vikas Publishing House Pvt. Ltd. (2005).
• Khanna D R, Bedi R S, A Textbook of Sound, Atma Ram and Sons (1971).
• Gupta S K, Verma O P, Waves and Oscillations, 3rd Edn., R Chand and Co. (1998).
• Saihgal R L, A Text Book of Sound, S Chand and Company (1990).

DSC-2: Practical

Any EIGHT of the following experiments:

1. Verification of Gaussian distribution law and calculation of standard deviation Monte Carlo experiment.
2. Specific heat of a liquid by cooling graphical method.
3. Determination of thermal conductivity of a bad conductor by Lee-Charlton method.
4. Verification of Stefan-Boltzmann law using Meter Bridge or a potentiometer.
5. Determination of boiling point of a liquid using platinum resistance thermometer.
6. Determination of moment of inertia of irregular body using torsional pendulum.
7. Determination of Young's modulus by Koenig's method.
8. Determination of rigidity modulus by the static torsion method.
9. Determination of Young's modulus by uniform bending method travelling microscope (using graph).
10. Kundt's tube experimental velocity of sound in air at room temperature.
11. Study of stationary wave on a stretched string Determination of speed of the transverse waves over the sonometer wire.
12. Helmholtz resonator Determination of frequency of a tuning fork.

DSC-3: Electricity and Electromagnetic theory

Objectives:

This course on thermoelectricity, network theorems, magnetism and AC circuits enables the students to understand the fundamentals of electrostatics, magnetostatics, electromagnetic induction, electromagnetic theory, network analysis and applications of AC circuits.

Learning Outcome:

Clarity and good understanding in the basic principles of thermoelectricity, magnetism and electromagnetic theory, network theorems, analysis and AC circuits development of problem solving skills.

Unit-1: 32 hours

Thermoelectricity: The Thermocouple. Seebeck, Peltier and Thomson effects. Thermodynamic theory of thermoelectric effect. Neutral temperature. Temperature of inversion, The law of intermediate metals, and the law of intermediate temperatures. Numerical problems.

(6 hours)

Network Theorems: Mesh analysis circuits using KVL and KCL. Statement and proof of Thevenin's theorem, Norton's theorem, and Superposition theorem. Applications to DC circuits. Numerical problems.

(9 hours)

Electromagnetism: Scalar and Vector fields. The gradient of a scalar field. The divergence and curl of a vector field. The physical significance of gradient, divergence and curl. Statement and theorems of Gauss and Stokes. Numerical problems.

(5 hours)

Electromagnetic theory: Equation of continuity, Maxwell's modification of Ampere circuital law; Displacement current. Setting up of Maxwell's -field equations. Maxwell's -field equations in free space, Poynting vector (definition). Wave equation for the field vectors in free space and in isotropic dielectric. Energy density of electromagnetic wave and Poynting Theorem (Proof). Plane monochromatic electromagnetic waves-Transverse nature. Helmholtz equation. Characteristic impedance of free space. Accelerated charges and oscillating dipole. Hertz's experiment. Radiation loss-Synchrotron radiation. Numerical problems.

(12 hours)

Unit-2: 32 hours

CRO: Construction and working.Measurement of voltage, frequency and phase using a CRO.

(3 hours)

DC currents: Growth and decay of Current in RL, RC, and RLC Circuits, Numerical problems.

(6 hours)

Alternating current: Average, Peak, and RMS values. Response of LR, CR, and LCR circuits to sinusoidal voltages (discussion using the `j' symbols). Series Resonance and parallel resonance-half-power frequencies, bandwidth and Q-factor.

Power in electrical circuits-power factor. Maximum power transfer theorem for ac circuits (statement and proof). Numerical problems.

(11 hours)

Applications of ac circuits: i) ac bridges-Anderson's bridge, Maxwell's bridge, de-Sauty bridge, Robinson's bridge. Numerical problems. **(6 hours)**

ii) Frequency filters -High-pass and low-pass _filters with LC, LR, and CR combinations.
Expression for cut-off_ frequency. Band pass _filters. Numerical problems including designing the _filters. **(6 hours)**

References

• Tewari K K, Electricity and Magnetism, Revised Edn., S Chand and Company (2007).
• Vasudeva D N, Fundamentals of Magnetism and Electricity, 9th edn, S.Chand and Company (2013).
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• David J Gri_ths, Introduction To Electrodynamics, 4th Edn., Prentice Hall of India (2017).
• Hayt W H, and Buck J A, Engineering Electromagnetism, 8th Edn., Tata Mc Graw Hill (2017).
• Mehta V K, Principles of Electronics, S Chand and Co. (2005).
• Brij Lal, and Subrahmanyam N, A Textbook of Electricity and Magnetism, 19th Edn., Ratan Prakashan Mandir (2016).
• Bhattacharya A B, and Bhattacharya R, Undergraduate Physics Vol. 2, New Central Book Agency (2008).

DSC-3: Practical

Any EIGHT of the following experiments:

1. Anderson's bridge Determination of the self-inductance of the coil.
2. de-Sauty bridge Verification of laws of combination of capacitances.
3. Maxwell's bridge.
4. B_H using Helmholtz double coil galvanometer and potentiometer.
5. LCR series circuit-Determination of L and Q-factor.
6. Voltage triangle-Measurement of phase difference.
7. Low and High pass filters Determination of the cut-o_ frequency.
8. LCR parallel circuit Determination of L and Q-factor.
9. To study the variation of X_C with f and determination of C.
10. CRO determination of voltage and frequency.
11. High resistance by leakage method.
12. Measurement of low resistance using potentiometer.

DSC-4: Optics, Atomic and Molecular Spectroscopy

Objectives:

This paper is on optics and atomic and molecular Spectroscopy enables the students to understand the fundamentals of theoretical explanation of the phenomenon of interference, diffraction and polarization, Laser, atomic and molecular Spectroscopy.

Learning Outcome:

Clarity in the basic principles of phenomenon interference, diffraction, polarization etc and development of problem solving and application skills.

Unit-1: 32 hours

Interference: Concept of coherent sources. Interference by division of wave Front Theory of Fresnel's biprism, Interference by division of amplitude Thin films of uniform thickness, anti-reflective coatings, Newton's rings. Interference at a wedge. Michelson's interferometer Measurement of λ and $d\lambda$. Numerical problems.

(8 hours)

Diffraction: Fresnel and Fraunhofer diffraction. Explanation of rectilinear propagation of light. Theory of the zone plate. Comparison with a convex lens. Fresnel diffraction at a straight edge. Fraunhofer diffraction at a single slit. Transmission grating theory for the case of normal incidence, resolving power and dispersive power of plane grating. Numerical problems.

(8 hours)

Polarization: Double refraction in uniaxial crystals. Huygen's theory. Positive and negative crystal. Principal refractive indices. Huygen's constructions of O and E wave fronts in a uniaxial crystal ,(i) optic axis in the plane of incidence and parallel to the crystal surface at normal incidence, (ii) optic axis in the plane of incidence and perpendicular to the crystal surface at normal incidence. Retarding plates. Production and analysis of linearly, Circularly and elliptically polarized light. Optical activity, Fresnel's theory, Rotatory polarization. Use of biquartz. Elementary idea of Babinet compensator, Interference of polarized light-Expression for resultant intensity, calculation of thickness of wedge shaped crystal plate(negative and positive), calculation of fringe width. Numerical problems.

(11 hours)

Lasers: Properties, Metastable state. Spontaneous emission, stimulated emission, population inversion. Three level laser. The He-Ne laser, Ruby laser. Laser applications: Nuclear fusion, medical, communications, and industrial applications.

(5 hours)

Unit-2: 32 hours

The Electron: Determination of e/m of an electron by Thomson's method. Determination of charge of an electron by Millikan's oil drop method. Numerical problems.

(4 hours)

Atomic Spectra: A qualitative account of Sommerfeld relativistic atom model. Excitation and Ionization potentials Franck-Hertz experiment. Vector model of atom. Electron spin. Space quantization. Magnetic moment of an electron due to its orbital motion. Stern-Gerlach experiment. Spin-orbit interaction and the fine structure of

spectral lines. Quantum number and selection rules. Pauli's exclusion principle. Electronic configuration of atoms. Valance electron. Brief mention of LS and JJ coupling for multi-electron atoms.

(12 hours)

Zeeman effect: Normal and anomalous effects, Experimental details of normal Zeeman effect, explanation of normal Zeeman effect on the basis of classical model, expression for the Zeeman shift. Numerical problems.

(4 hours)

Molecular spectra and The Raman effect: Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules. Theory of pure rotation spectra. Theory of rotational-vibrational spectra. Raman effect Salient features, experimental setup to study Raman effect. Quantum Theory of Raman effect; Intensity and polarization of Raman lines; Applications. Fluorescence and phosphorescence. Numerical problems.

(12 hours)

References

• Bhattacharya A B, and Bhattacharya R,Undergraduate Physics, Vol. 2, New Central Book Agency (2008).
• Subrahmanyam N, Brij Lal, and Avadhanulu M N, A Textbook of Optics, 24th Revised Edn., S Chand and Company (2015).
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• Murugeshan R, Kiruthiga Sivaprasath, Optics and Spectroscopy, 17th Revised Edn., S Chand and Company (2011).
• Jenkins F A, and White H E, Optics, 3rd Edn., McGraw-Hill (1957).

DSC-4: Practical

Any EIGHT of the following experiments:

1. Newton's rings-Determination of radius of curvature of a Plano convex lens.
2. Air wedge -Determination of thickness of a thin paper/diameter of a thin wire.
3. Diffraction grating -Determination of grating constant and wavelength (minimum deviation method).
4. Diffraction at a straight wire- Determination of diameter of a wire.
5. Cauchy's constants using spectrometer.
6. Polarization-Determination of unknown concentration of sugar solution by graphical method using a polarimeter.
7. Determination of refractive indices of calcite and quartz crystal using spectrometer and sodium light.
8. Determination of resistance using time constant of RC circuit by discharging process.
9. Biprism-determination of wavelength.
10. Determination of capacitance using time constant of RC circuit by charging process.
11. Study of hydrogen spectrum using gas discharge tube-Determination of Rydberg constant.
12. Resolving power of plane transmission grating using spectrometer.

DSE-1A: Relativity, Nuclear Physics and Quantum Mechanics

Objectives:

This paper is on relativity, quantum mechanics and nuclear Physics enables the students to understand the fundamentals of theoretical explanation of the special theory of relativity, cosmic rays and particle physics, nuclear Physics and quantum mechanics.

Learning Outcome:

Clarity in the basic principles theoretical explanation of the special theory of relativity, cosmic rays and particle physics, nuclear Physics and quantum mechanics.

Unit-1: 32 hours

Special theory of relativity: Michelson-Morley experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz transformations (no derivation). Lorentz contraction. Time dilation. Relativistic transformation of velocity, Relativistic addition of velocities. Variation of mass with velocity. Rest mass. Massless particles. Mass energy equivalence, $E = mc^2$. The energy-momentum relation. The principle of equivalence.

(8 hours)

Cosmic rays and particle physics: Cosmic ray discovery: Primary and secondary cosmic rays-their composition. Cosmic ray showers. Origin of cosmic rays, Mention of the basic interactions in nature; Particles and anti-particles. Types of interaction between elementary particles, Classification of particles. Conservation laws. A qualitative introduction to quark model – gluons, mention of standard model. Numerical problems.

(8 hours)

Mass spectrographs: Theory of Dempster's and Aston mass spectrograph. Numerical problems.

(2 hours)

Nuclear detectors: G.M. Counter, scintillation detector, photomultiplier tube, semiconductor detectors, Nuclear emulsions. **(5 hours)**

The nucleus: Properties of nucleus. Discovery of neutron. The proton-neutron hypothesis. Nuclear forces and their characteristics. Yukawa's theory (qualitative).

(2 hours)

Radioactive decay: Successive disintegration, Radioactive equilibrium- transient and secular, Radioactive series, Range and energy of alpha-particle and their measurements. Theory of alpha-decay (qualitative). Geiger-Nuttal law. Beta Decay-Pauli's neutrino hypothesis, Kelectron capture, internal conversion. Nuclear isomerism. Mirror nuclei. Numerical problems.

(7hours)

Unit-2: 32 hours

Accelerators: Cockroft-Walton voltage multiplier, Cyclotron, and Betatron, LINAC. Numerical problems. **(4 hours)**

Nuclear reactions: Conservation laws, Q-values. Threshold energy of an endoergic reaction. Reactions induced by proton, deuteron and particles. Numerical Problems.

(3hours)

Nuclear models: Liquid-drop model. Semi-empirical mass formula. Shell model, and magic numbers. Numerical problems.

(3 hours)

Nuclear fission, and fusion: Estimation of the fission energy on the basis of the liquid drop model, chain reactions – controlled and uncontrolled chain reactions, The four-factor formula, Thermo-nuclear reactions sources of stellar energy. The C-N cycle, Nuclear reactors – swimming pool Type and fast breeder reactor (qualitative only). Numerical problems.

(6 hours)

Matter waves: Failure of classical mechanics in the microscopic domain. Black body radiation, Hydrogen atom, Speci_c heats of solids, Fine structure of spectral lines, Particle and wave nature in classical mechanics. Dual nature of light and Matter, de Broglie's concept of matter waves, Expression for de Broglie's wave, Phase and group velocity. Experiments of Thomson and of Davisson and Germer. Heisenberg's uncertainty principle, Examples of position-momentum uncertainty-the gamma ray microscope (thought experiment). Numerical problems.

(7 hours)

Schrodinger's equation: Eigen values, Eigen functions; Eigen value equation, Dynamical variables as operators, Hermitian operators. Postulates of quantum mechanics. Setting up the time-independent Schrodinger equation and time dependent Schrodinger equation. The notion of probability and Born's interpretation of the wave function. Solution of the time-independent Schrodinger equation for particle in one-dimensional infinite potential calculation of its energy eigenvalues. Harmonic oscillator mention of energy eigen values and eigen zero-point energy. Numerical problems.

(9 hours)

References

• Halliday D, Resnick R, and Walker J, Principles of Physics, 10th Edn., Wiley India Pvt. Ltd. (2013).
• Duggal B D, and Chabra C L, Fundamentals of Modern Physics, 8th Edn., S Nagin Chand and Co. (1997).
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• Guptha S L, Kumar V, and Sharma H V, Quantum Mechanics, 28th Edn., Jai Prakash Nath and Co. (2009).
• Beiser A, Concepts of Modern Physics, 6th Edn., TMH, New Delhi (2008).
• Kaplan I, Nuclear Physics, 2nd Edn., Narosa Publishing House (2002).

DSE-1A- Practical

Any TEN of the following experiments:

1. Characteristics of GM tube.
2. Absorption coefficient of gamma rays.
3. Verification of inverse square law for gamma rays.
4. Solar cell: IV characteristics, efficiency and fill factor.
5. Dielectric constant of a solid.
6. Dielectric constant of a liquid.
7. Determination of wavelength of laser light.
8. e=m of an electron by Thomson's method.
9. Cockcroft-Walton voltage multiplier.
10. Transistor characteristics (CE mode).
11. Determination of Planck's constant using photocell.
12. Determination of charge by Millikan's oil drop method.
13. Zener diode characteristics.
14. Study of Divergence of a diode laser.
15. Determination of mass of an electron.
16. Determination of ionization potential of Xenon.
17. Verification Thevenin's theorem.
18. Half life of ^{40}K.
19. Determination of range of electrons in aluminium using GM Counter.
20. Study of X-ray photograph-determination of interplanar distance.
21. Phase measurement in LCR circuit using CRO.
22. To determine value of Boltzmann constant using V I characteristic of a diode.
23. Triode characteristics.
24. V I characteristics of a thermistor.

DSE-1B: MATHEMATICAL PHYSICS

Objectives:
The emphasis of the course is on applications in solving problems of interest to physicists.

Learning Outcome:
Students will be able to solve problems of different mathematical series..

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

(6 hours)

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series.

(10 hours)

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **(16 hours)**

Unit-2: 32 hours

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). **(6hours)**

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. **(12 Lectures)**

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula.

(14 Lectures)

Reference Books

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
- An Introduction to Ordinary Differential Equations, Earl A Coddington, 1961, PHI
- Learning.
- Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- Essential Mathematical Methods, K.F. Riley and M.P. Hobson, 2011, Cambridge
- University Press
- Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover
- Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva
- Books.

DSE -1B- PRACTICALS

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics problems (applications)
- The course will consist of lectures (both theory and practical) in the Computer Lab
- Evaluation done not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use anyone operating system Linux or Microsoft Windows.

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflowemphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and

	printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (*If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While-Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D&2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects.
Programs: using C/C++ language	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search.
Random number generation	Area of circle, area of square, volume of sphere, value of pi (**π)**
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation solving $\alpha = \tan\alpha$; $I = I_0(\sin\alpha/\alpha)^2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. *sin θ, cos θ, tan θ, etc.*
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods.	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Attempt following problems using RK 4 order method: • Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x3}{3}; \frac{dy}{dx} = -x$ for four initial conditions x(0) = 0, y(0) = -1, -2, -3, -4. Plot x vs y for each of the four initial conditions on the same screen for $0 \le t \le 15$ The differential equation describing the motion of a

	pendulum is $d^2\theta/dt^2 = -\sin(\theta)$. The pendulum is released from rest at an angular displacement α, i. e $\theta(0) = \alpha$ and $\theta^1(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot θ as a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small θ $\sin(\theta) = \theta$

Reference Books

- Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt.Ltd.
- Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.
- Numerical Recipes in C++: The Art of Scientific Computing, W.H. Pressetal., 3rdEdn., 2007, Cambridge University Press.
- A first course in Numerical Methods, Uri M. Ascher and Chen Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3 r dEdn. , 2007, Wiley India Edition.
- Numerical Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to Computational Physics, T. Pang, 2ndEdn., 2006, Cambridge Univ. Press

SEC-1: Lasers and Fibre Optics

(Course duration: 16 weeks with 2 hours of instruction per week.)

Objectives: *To learn basic Optical components and devices and communication methods.*
Learning Outcome: *Familiarity with Optical components and devices and communication methods.*

Unit-1: 16 hours

Laser basics: Coherence properties of laser light, temporal coherence, monochromaticity, spatial coherence, directionality, line width, brightness, divergence, line shape broadening, focusing properties of laser radiation, laser modes axial and transverse, mode selection, single mode operation, selection of laser emission line. **(5 hours)**

Laser oscillator: Pumping schemes, Gain{threshold conditions; Optical resonators. **(3 hours)**

Types of lasers: Construction and principles of working of Nd-YAG, CO2 and dye lasers and semiconductor laser. **(4 hours)**

Laser diodes: Lasing conditions and gain in a semiconductor, selective amplification and coherence, Materials for laser diodes, quantum well lasers, surface emitting lasers, characterization and modulation of lasers. **(4 hours)**

Unit-2: 16 hours

Fibre optics and dielectric wave guides: Wave Guide-Slab wave guide, Modes, V number, Modal material and waveguide dispersions, Numerical problems. **(3 hours)**

Optical fibre: Types, functions, light propagation, optical power, velocity of propagation, critical angle, acceptance angle, numerical aperture, mode of propagation. Numerical problems. **(4 hours)**

Index profile: Single mode step-index optical fibre, multimode step-index fibre, graded index fibre; advantages and disadvantages. Numerical problems. **(3 hours)**

Energy losses in optical fibre: Bit rate, dispersion optical fibre communication, and optical bandwidth, Absorption and scattering, optocoupler. **(6 hours)**

References

• Wilson J, and Hawkes J, Optoelectronics: An Introduction, 3rd Edn., Prentice Hall (1998).
• Singh J, Optoelectronics: An Introduction to Materials and Devices, McGraw-Hill (1996).
• Bhattacharya P, Semiconductor Optoelectronic Devices, Prentice Hall International (1997).

• Nambiar K R, Lasers: Principles, Types and Applications, New Age International Publisher (2004).
• Tomasi W, Electronic Communication Systems, 5th Edn., Pearson Education (2008).
• Roddy D, and Coolen J, Electronic Communication, 4th Edn., Pearson Education (2008).

SEC-2: Astronomy and Astrophysics

(Course duration: 16 weeks with 2 hours of instruction per week.)

Objectives: *To make the students familier with an introduction of astrophysics, measuring scales and units, stars and their characteristics and Cosmology.*

Learning Outcome: *Familiarity with an introduction of astrophysics, measuring scales and units, stars and their characteristics and Cosmology.*

Unit-1: 16 hours

Astronomical scales: Astronomical distance, mass and time; scales; brightness, radiant ux and luminosity, measurement of astronomical quantities astronomical distances, stellar radii, masses of stars, stellar temperature. Basic concepts of positional astronomy|celestial sphere, geometry of a sphere, spherical triangle, astronomical coordinate systems, geographical coordinate systems, horizon system, equatorial system, diurnal motion of the stars, conversion of coordinates. Measurement of time|sidereal time, apparent solar time, mean solar time, equation of time, calendar the Julian date and its importance in astronomical observation. Basic parameters of stars|determination of distance by parallax method; brightness, radiant ux and luminosity, apparent and absolute magnitude scale, distance modulus. Numerical problems. **(16 hours)**

Unit-2: 16 hours

Stars: Surface or e_ective temperature, and color of a star. Intrinsic temperature of a star. Expression for average temperature, core temperature and core pressure of a star based on the linear density model of a star. Numerical problems. **(3 hours)**

Stellar characteristics: Spectral classification, Edward Charles Pickering classification (i.e., OBAFGKM), Harvard sequence and Yerke's luminosity Classification, Size (radius) of a star. Expression for radius using Stefan-Boltzman law. Spectral signature of elements present in the stellar atmosphere. Mass luminosity relationship and expression for lifetime of a star. Color index HD classification and HR diagram. Main sequence stars and their general characteristics. The stellar evolution. The evolutionary track of stars Protostars, premain sequence stars, main sequence stars. Evolution of a star to white dwarf stage through red giant stage. Supernova explosion. Formation of a pulsar or neutron star and black hole (qualitative). Numerical problems. **(10 hours)**

Cosmology: Basic assumptions and limitations of cosmology; Expansion of the Universe and its evidence; Hubble's Law: Big bang theory and thermal history of the universe. Size and age of the universe. **(3 hours)**

References

• Carroll B W, and Ostlie D A, Modern Astrophysics, 2nd Edn., Addison-Wesley (2007).
• Zeilik M, and Gregory S A, Introductory Astronomy and Astrophysics, 4th Edn., Saunders College Publishing (2009).
• Shu F, The Physical Universe: An Introduction to Astronomy, 1st Edn., University Science Books (1982).
• Karttunen H, Kr□oger P, Oja H, Poutanen M, and Donner K J, Fundamental Astronomy, 4th Edn., Springer (1987)
• Krishnasamy K S, Astrophysics: A Modern Perspective, Reprint, New Age International
(2006).
• Basu B, An Introduction to Astrophysics, Second Printing, Prentice Hall of India (2001).
• Bhatia V B, Textbook of Astronomy and Astrophysics with Elements of Cosmol-ogy, Alpha Science International (2001).

SEC-3: Nano Materials

(Course duration: 16 weeks with 2 hours of instruction per week.)

Objectives: *To make the students familier with an introduction of Nanotechnology, nanoscale, synthesis of nano materials, modern instrumentation and optical properties.*

Learning Outcome: *Familiarity with an introduction of Nanotechnology, nanoscale, synthesis of nano materials, modern instrumentation and optical properties.*

Unit-1: 16 hour

Nanoscale systems: 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: Applications of Schrodinger equation Quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences. **(8 hours)**

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. **(8 hours)**

Unit-2: 16 hours

Characterization: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy. **(8 hours)**

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, Radiative processes: General formalization absorption, emission and luminescence. Optical properties of hetero structures and nanostructures. **(8 hours)**

References

• Poole Jr P C, Owens F J, Introduction to Nanotechnology, Wiley India (2003).
• Kulkarni S K, Nanotechnology: Principles and Practices, Capital Publishing Company
(2015).
• Chattopadhyay K K, and Banerjee A N, Introduction to Nanoscience and Technology, PHI Learning (2009).
• Booker R, and Boysen E, Nanotechnology, John Wiley and Sons (2005).

DSE-2A: Solid State Physics, Electronics and communication

Objectives:

This paper is on Solid state Physics,Electronics and Communication enables the students to understand the fundamentals of theoretical explanation of the concepts, devices and communication system.

Learning Outcome:

Clarity in the basic principles theoretical explanation of the concepts, construction and working of semiconducting devices, their identification. About communication system

Unit-1: 32 hours

Semiconductors: Concept of bands in solids. Intrinsic and extrinsic semiconductors. Depletion region, drift velocity, expression for electron and hole concentration in intrinsic semiconductor under thermal equilibrium. Derivation of the expression for electrical conductivity of intrinsic semiconductors; electron and hole mobilities; Expression for the energy gap; Hall effect in semiconductors. Numerical problems.

(6 hours)

Semiconductor devices: Diode current equation, IV characteristics, Bridge rectifier, Expression for ripple factor and efficiency. Filters-Zener breakdown and avalanche breakdown. Phenomenon of photoconductivity, photovoltaic cells, LED, FET. Numerical problems.

(4 hours)

Transistors: Type and configuration, h parameters; Methods of transistor Biasing voltage divider bias; Fixing operating point, drawing load line. Effect of temperature on the operating point.

(2 hours)

Amplifier: Two stage transistor RC coupled amplifier, mathematical analysis, frequency response curve, half power frequency bandwidth.

(2 hours)

Oscillators: The feedback concept-positive and negative feedback. Mention of the Barkhausen-criterion. Hartley oscillator. **(2 hours)**

Operational amplifiers : Ideal OP Amp - characteristics and its applications-Summing amplifiers/Adder, averaging amplifier, Scale changer, Subtractor, Integrator and Differentiator, derivation for the output voltage in each case. Comparator & Schmitt trigger. **(4hours)**

Radio wave propagation- Ionosphere, AM and FM-equation for FM (**2hours)**

Radio receivers: Demodulation –principle of detection of an FM–modulated wave-super heterodyne receiver, Block diagram of FM receiver, microphone as a transducer. **(5hours)**

Principle of communication: Satellite communication, mobile communication, cable TV communication and DTH. **(5hours)**

Unit-2: 32 hours

Statistical physics: Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac energy distribution formulae (no derivation). A qualitative comparison of the three distribution formulae.

(2 hours)

Dielectric properties: Dielectric materials; their properties. Method of determining dielectric constant for solids and liquids.

(2 hours)

Thermal properties of solids: Dulong and Petit's law; its limitations. Einstein's theory of specific heat. Debye's theory of specific heat. Numerical Problems. **(3 hours)**

Electrical properties of metals: Band theory of solids review, Free electron theory of metals classical theory and quantum theory. Expression for electrical conductivity Ohm's law, Wiedemann-Franz law. Statement of number of the available energy states between E and E+dE. Expression for the Fermi energy. Hall effect and magnetoresistance in metals. Expression for Hall coefficient in metals. Numerical problems. **(6 hours)**

Logic gates: Construction of AND, OR, and NOT logic gates using Diodes and transistors (two input). Symbols and discussion of truth table using Boolean expressions for NOR, NAND, and XOR logic gates. Half adder and full adder.

(3 hours)

Superconductivity: Elementary ideas and experimental facts. Meissner effect. Magnetic properties of type-I and type-II superconductors, Critical magnetic field. Influence of external agents on superconductivity, Cooper pairs, BCS theory (qualitative). Applications of superconductivity. Introduction to high temperature superconductors. **(4 hours)**

Liquid crystals: Symmetry, structure, and classification of liquid crystals; polymorphism in thermotropics. **(2 hours)**

X-rays: Brag's law and the Bragg spectrometer. A brief mention of the different types of crystals. Miller indices, structure of NaCl and KCl crystals. Continuous X-ray spectrum and its origin, Duane and Hunt limit. Characteristic X-ray spectra and its origin. Mosley law and its significance. Compton effect Expression for Compton shift, Compton wavelength, Verification of change in wavelength; Reason for non-observance of Compton effect in visible light. Numerical problems.

(10 hours)

References

• Sedha R S, A Textbook of Applied Electronics, 2nd Edn., S Chand Limited (2007).
• Theraja B L, and Sedha R S, Principles of Electronic Devices and Circuits, 2nd Edn., S.Chand Limited (2008).
• Mehta V K, Principles of Electronics, 2nd Edn., S Chand and Company (2005).
• Leach D P, Malvino A P, and Saha G, Digital Principles and Applications, 8th Edn., McGraw Hill (1993).
• Beiser A, Mahajan S, Rai Choudhary S, Concepts of Modern Physics, 6th Edn.,

McGraw Hill (2009).
• Eisberg R M, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, 2nd Edn., Wiley India (2006).
• Blackmore J B, Solid State Physics, 2nd Edn., Cambridge University Press (1998).
• Dekker A J, Solid State Physics, Macmillan (1971).
• Kittel C, Introduction to Solid State Physics, 7th Edn., Wiley (2008).
- R R Gulati, "Monochrome and color television", 1994, Wiley eastern
- David Bell , "Operational Amplifiers"

DSE-2A : Practical

Any TEN of the following experiments:

1. Basic logic gates using transistors.
2. Harteley oscillator.
3. Transistor characteristics (CB mode).
4. Characteristics of LED.
5. CE Amplifier gain and bandwidth.
6. Verification of maximum power transfer theorem.
7. Phase shift oscillator.
8. Zener diode as voltage regulator.
9. Energy gap of a semiconductor using meter bridge.
10. Determination of enery gap of a semiconductor using four probes.
11. Negative feedback amplifier.
12. Calculation h parameters by drawing static characteristics of a transistor in CE mode.
13. Bridge rectifier with C and Pi filter.
14. Fermi energy of copper using meter bridge.
15. Logic gates-AND, OR, NOT, NOR, and X-OR using IC 7400 and 7402.
16. Half adder.
17. Full adder.
18. Phototransistor characteristics.
19. Two stage RC coupled amplifier- gain and bandwidth.
20. Verification of inverse square law of light Using photodiode.
21. Wein bridge oscillator.
22. FET characteristics.
23. Measurement of susceptibility of a paramagnetic solution.
24. DC load line Determination of Q point of a transistor using voltage divider bias.

DSE-2B: MEDICAL PHYSICS

Objectives:

This paper is on mechanics, acoustics optical systems diagnostic and therapeutic systems related to human body. Which enables the students to understand the fundamentals of theoretical explanation.

Learning Outcome:

Clarity in the mechanics, acoustics optical systems diagnostic and therapeutic systems related to human body..

Unit 1: 64 hours

PHYSICS OF THE BODY-I

Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity with terms like- Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal and Distal.

Mechanics of the body: Skeleton, forces, and body stability. Muscles and dynamics of body movement. Physics of Locomotors Systems: joints and movements, Stability and Equilibrium.

Energy household of the body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Thermal Regulation.

Pressure system of body: Physics of breathing, Physics of cardiovascular system.

(8 hours)

PHYSICS OF THE BODY-II

Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound.

Optical system of the body: Physics of the eye.

Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer. **(10 hours)**

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I

X-RAYS: Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung, Characteristic x-ray.

X-ray tubes & types: Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, quality and intensity of x-ray. X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, types of X-Ray Generator, high frequency generator, exposure timers and switches, HT cables, HT generation.

(8 hours)

Radiation Physics: Radiation units exposure, absorbed dose, units: rad, gray, relative biological effectiveness, effective dose, inverse square law. Interaction of

radiation with matter Compton & photoelectric effect, Rem & Sievert, linear attenuation coefficient.

Radiation Detectors: Thimble chamber, condenser chambers, Geiger Muller counter, Scintillation counters and Solid State detectors, ionization chamber, Dosimeters, survey methods, area monitors, TLD, Semiconductor detectors.

(8 hours)

Medical imaging physics: Evolution of Medical Imaging, X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Ultrasound imaging, Physics of Doppler with applications and modes, Vascular Doppler. Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy.

Computed tomography scanner- principle & function, display, generations, mammography. Thyroid uptake system and Gamma camera (Only Principle, function and display).

(9 hours)

Radiation oncology physics: External Beam Therapy (Basic Idea): Telecobalt, Conformal Radiation Therapy (CRT), 3DCRT, IMRT, Image Guided Radiotherapy, EPID, Rapid Arc, Proton Therapy, Gamma Knife, Cyber Knife. Contact Beam Therapy (Basic Idea): Brach therapy-LDR and HDR, Intra Operative Brachytherapy. Radiotherapy, kilo voltage machines, deep therapy machines, Telecobalt machines ,Medical linear accelerator. Basics of Teletherapy units, deep x-ray, Telecobalt units, medical linear accelerator, Radiation protection, external beam characteristics, dose maximum and build up – bolus, percentage depth dose, tissue maximum ratio and tissue phantom ratio, Planned target Volume and Gross Tumour Volume.

(9 hours)

Radiation and radiation protection: Principles of radiation protection, protective materials-radiation effects , somatic, genetic stochastic and deterministic effect. Personal monitoring devices: TLD film badge , pocket dosimeter, OSL dosimeter. Radiation dosimeter. Natural radioactivity, Biological effects of radiation, Radiation monitors**.** Steps to reduce radiation to Patient, Staff and Public. Dose Limits for Occupational workers and Public. AERB: Existence and Purpose.

(6 hours)

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II

Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose in radiation treatment.

Medical Instrumentation: Basic Ideas of Endoscope and Cautery, Sleep Apnea and Cpap Machines, Ventilator and its modes.

(6 hours)

References:

- Medical Physics, J.R. Cameron and J.G. Skofronick, Wiley (1978)
- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
- Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)
- Physics of the human body, Irving P. Herman, Springer (2007).
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
- Handbook of Physics in Diagnostic Imaging: R.S. Livingstone: B.I. Publication Pvt Ltd.
- The Physics of Radiology-H E Johns and Cunningham.

DSE-2B: PRACTICALS

Any EIGHT of the following experiments:

1. Understanding the working of a manual Hg Blood Pressure monitor and measure the
Blood Pressure.
2. Understanding the working of a manual optical eye-testing machine and to learn eye-testing.
3. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.
4. Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.
5. To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation.
6. Familiarization with Geiger-Muller (GM) Counter and to measure background radiation.
7. Familiarization with Radiation meter and to measure background radiation.
8. Familiarization with the Use of a Vascular Doppler.

References:

- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
- Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)
- The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and

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Boone Lippincot Williams and Wilkins, Second Edition (2002)

- The Physics of Radiology-H E Johns and Cunningham.
- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- Handbook of Physics in Diagnostic Imaging: Roshan S. Livingstone: B. I. Publications Pvt Ltd.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SEC-4: Optoelectronics

(Course duration: 16 weeks with 2 hours of instruction per week.)

Objectives: *This paper is to make the students familiar with an introduction of opto electronic devices, its working and their application.*

Learning Outcome: *Familiarity with opto electronic devices, its working and their application.*

Unit-1: 16 hours

Optical process in a semiconductor: Electron-hole pair formation and recombination, absorption in semiconductor direct and indirect band gap semiconductors, effect of electric field on absorption, Franz-Keldysh effect in semiconductors.

(4 hours)

Optoelectronic devices: Light Emitting Diodes Materials for light emitting diodes, Principle of action of LED, expression for light power in terms of photon energy, homo structured LED and Hetero junction LED, drawbacks of homo structured LED. Types of LED structures planar, dome type, surface emitter, edge emitter, super luminescent structure. Performance characteristics of LED-Optical output power-current characteristics, forward current voltage characteristics, Modulation bandwidth, power bandwidth product, Lifetime, Rise time/fall time, reliability, Internal quantum efficiency , advantages / disadvantages of using LED. Numerical problems.

(10 hours)

Organic optoelectronic devices: Organic light emitting diodes (OLED), The principle of OLED, characterisation, structure, efficiency, multilayer OLED.

(2 hours)

Unit-2: 16 hours

Photo detectors: Important parameters of photo-detectors, Detector responsivity, spectral response range, response time, quantum efficiency, capacitance, noise characteristics. Absorption of radiation-absorption coefficient, mention of expression for photocurrent, long wavelength cut off, direct and indirect absorption. Types of photodiodes-Junction photodiodes, pin diode, avalanche photodiodes, CCD photo-

detectors; Comparison of different detectors, Photo-multiplier tubes. Phototransistors-characteristics. Photo conductive Detectors-expression for photoconductive gain (as in the book of Kasap S. O.). Numerical problems.

(10 hours)

Photovoltaic devices: Solar cell-IV characteristics, efficiency, materials. Organic photovoltaic diodes (OPVD)-fundamental process, exciton-absorption, exciton dissociation, charge transport, charge collection, characterisation. Numerical problems.

(6 hours)

References

• Keiser G, Optical Fibre Communications, 3rd Edn., McGraw Hill (2000).
• Agarwal D C, Fibre Optic Communication, 2nd Edn., Wheeler Publications (1996).
• Katiyar S, Optical Communication, 1st Edn., S K Kataria and Sons (2010).
• Kasap S O, Optoelectronics and Photonics: Principles and Practices, 2nd Edn., Pearson (2013).
• Wilson J and Hawkes J F B, Optoelectronics An Introduction, 3rd Edn., Prentice Hall (1998).

SEC-5: Renewable Energy Sources

(Course duration: 16 weeks with 2 hours of instruction per week.)

Objectives: *This paper is to make the students to understand renewable energy sources.*
Learning Outcome: *Familiarity with renewable energy sources, uses and applications.*
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Unit-1: 16 hours

Solar energy: Basic ideas-Origin, Spectral distribution of solar radiation, Attenuation of beam radiation, Basic earth solar angle and derived solar angle, GMT, LCT, LST, Day length, Estimation of average solar radiation, sunshine recorder. Numerical problems.

(6 hours)

Solar collectors: Principle of conversion of solar energy into heat, classification of solar collectors, Flat plate and concentrating collectors, construction, Thermal efficiency and coating, Heat losses, Solar cell and its efficiency, PV Panels. Numerical problems.

(6 hours)

Photothermal devices: Solar cooker, Solar dryer, solar hot water systems. Principles and working.

(2 hours)

Photovoltaic systems: Solar lantern, water pumps and street lights- principles and working.

(2 hours)

Unit-2: 16 hours

Wind energy: Origin, estimation of energy obtainable from wind, velocity and power duration curves, energy, pattern factors. Theory of power-Momentum transfer, power coefficients, principle of wind turbine, power vs velocity characteristics of wind turbine generator, cutin speed and cutout speed. Numerical problems.

(8 hours)

Wind driven machines: Characteristics of wind turbine; Types-Horizontal and vertical axis types, vertical axis darrieus rotor wind turbine, Horizontal axis propeller type-twin blade and three blade. Blade pitch control. Advantages and disadvantages of two blade and three blade systems. Numerical problems.

(8 hours)

References

• Rai G D, Non-Conventional Energy Sources, 4th Edn., Khanna Publishers (2009).
• Aarwal M P, Solar Energy, S Chand and Co. (1985).
• Sukhatme S P, Nayak J K, Solar Energy, 3rd Edn., Tata McGraw-Hill (2008).
• Boyle G, Renewable Energy, Power for a Sustainable Future, 2nd Edn., Oxford University Press (2004).
• Jayakumar P, Resource Assessment Handbook, APCTT (2009).
• Balfour J, Shaw M, and Jarosek S, Introduction to Photovoltaics, Jones and Bartlett Learning (2013).

SEC-6: Solving Problems in Physics

(Course duration: 16 weeks with 2 hours of instruction per week.)

Objectives: *This paper is to make the students to develop the skill of solving problems under different branches of physics.*

Learning Outcome: *Students will be able to solve problems under different branches of physics.*

Unit-1: 16 hours

Topics 1:

Frames of reference, Rigid body dynamics Conservation of Linear and angular momentum, Conservation of energy, Surface Tension, Elasticity, Kinetic theory, Thermal conductivity, Radiation, Joule-Thomson expansion, Clausius-Clapeyron first latent heat equation, Entropy, Thermodynamic potentials. Sound waves motion in one dimension, Superposition of simple harmonic motion, Mechanical force and electric pressure on a charged surface, Galvanometers moving coil Helmholtz, Thermoelectricity, DC currents, Alternating current fundamentals AC bridges, Network theorems, Frequency filters.

Unit-2: 16 hours

Topics 2:

Interference|division of wave front and division of amplitude, Diffraction Fresnel and Fraunhofer diffraction, Polarization, Laser fundamentals. Atomic Spectra-Bohr and vector atom model, Zeeman effect, Molecular Spectra and Raman Effect, Special theory of relativity, Matter waves, Schrodinger's equation-particle in a box, Mass spectrographs, Radioactive decay, Nuclear reactions, Particle accelerators, Nuclear fission, Electrical properties of metals, Semiconductors and devices, X-rays Bragg's law and crystal structure, Moseley's law, Compton effect.

References

• Halliday D, Resnick R, and Walker J, Fundamentals of Physics, 6th Edn., Wiley India Pvt. Ltd. (2001).
• Kamal A A, Solutions to Halliday and Resnick Physics Part 2, Wiley Eastern Pvt Limited (1994).
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• Christman R J, and Derringh E, Fundamentals of Physics Students' Solution Manual, 6th Edn., Wiley (2008).
• Jain K C, and Arora C L, Numerical Problems in Physics, S Chand and Company (2013)
• Serway R A, College Physics Vol. 2, 9th Edn., Charles Hartford (2012).
• Brij Lal, and Subramanyam N, Atomic an Nuclear Physics, Revised by Jivan Sheshan, S Chand Publications (2008).
• Young H D, Freedman R A, Sears F, and Zeemansky M, University Physics Vols. 1 and 12, 13th Edn., Pearson (2011).

Scheme of Valuation for Practicals

The student has to compulsorily submit the practical record for evaluation during **C1** and **C2**. For **C3**, the record has to be certified by the internal examiner.

• The student is evaluated for 10 marks in **C1** and **C2** as per the following scheme:

Experiment: 8, Record: 2, Total=10
The marks scored are then normalized for 5.

• The student is evaluated for 40 marks in **C3** as per the following scheme:

1. Experiment=30
2. Viva =05
3. Record= 5
4. Total =40
5. The marks scored are then normalized for 20.

The experiment portion of evaluation is carried out as per the following scheme:

Diagram/Circuit diagram	**03**
Formula with units, explanation of terms	**03**
Circuit connections and handling	**05**
Tabular column with units	**03**
Observations/method of taking reading/Tabulation	**07**
Calculation	**06**
Result with accuracy and unit	**03**
Record	**05**
Viva	**05**
Total marks for practical examination	**40**

Question Paper Pattern

DSC and DSE Courses

I SEMESTER to VI SEMESTER

THEORY

Maximum marks: 70 **Time: 3Hrs**

PART- A

I. Answer any SEVEN questions: **7x2=14**

7 out of 12 questions

(6 questions from each unit has to be set)

II Answer any FOUR questions choosing any two from Part-B and C

PART – B **2x12=24**

(THREE questions has to be set from unit-1 and TWO question to be answered)

PART - C **2x12=24**

(THREE questions has to be set from unit-2 and TWO question to be answered)

PART – D

(Problems/APPLICATION ORIENTED QUESTIONS)

III Answer any TWO questions: **2x4=8**

(2 out of 4 questions: two questions from each unit)

Question Paper Pattern

SEC Courses:

Max Marks: 50 Time: 2 hours

PART – A

I. Answer any FIVE questions: 5 x 2 = 10

(3 questions from each unit to be set.)

II Answer any FOUR questions choosing any two from Part-B and C

PART – B 2x10=20

(THREE questions has to be set from unit-1 and TWO question to be answered)

PART - C 2x10=20

(THREE questions has to be set from unit-2 and TWO question to be answered)

JSS college for women(Autonomous), Saraswathipuram, Mysore

Department of Physics

PANEL OF EXAMINERS

SL.NO	NAME OF EXAMINER	NAME OF THE COLLEGE	CONTACT NO
1.	Prof.Sridevi Dyvanagoudar	JSS College, Ch.Nagar	
2.	Vinay kumar.L	JSS College ooty road, Mysore	
3.	Kum.Chaithra	JSS College ooty road, Mysore	
4.	Prof Vijaya manjunatha guru	JSS College ooty road, Mysore	
5.	Prof Mallikarjunswamy	JSS College chamarajanagar	
6.	Smt. Lakshmi	JSS College chamarajanagar	
7.	Prof C. Nagesh babu	Yuvaraja's College, Mysore	
8.	Prof B.C. Manjunath	Yuvaraja's College, Mysore	
9.	Prof T.Sadashiviah	Yuvaraja's College, Mysore	
10.	Dr H.C.Devarajegowda	Yuvaraja's College, Mysore	
11.	Prof. M.R.Ananthanarasimha	Yuvaraja's College, Mysore	
12.	Dr S R Kumaraswamy	Maharani's Science College,Mysore	
13.	Prof. Manjunath M.V.	Maharani's Science College,Mysore	
14.	Dr. G.B.Thippeswamy	Maharani's Science College,Mysore	
15.	Krishnamohan	Maharani's Science College,Mysore	
16.	Dr H N Ranganatharao	Maharani's Science College,Mysore	
17.	Prof. N Bharathi	SDM college, Mysore	
18.	Prof.G.Vishwanath	Saradavilas college, Mysore	
19.	Prof.K.J.Muralidhar	Saradavilas college, Mysore	
20.	Dr Mahadevu	Saradavilas college, Mysore	
21.	Prof.Rajalakshmi	St Philomenas college Mysore	

22.	Prof. Shobana Thomas	St Philomenas college Mysore	
23.	Prof.Gunasheelan	St Philomenas college Mysore	
24.	Prof.Jayasheelan	St Philomenas college Mysore	
25.	Prof.Nagaraj Urs	St Philomenas college Mysore	
26.	Prof.R Manjunatha	Mahajanas college Mysore	
27.	Prof.Roopa	Govt First grade college Gundlupet	
28.	Prof.Manjunath	GovtFirst grade college,Hullahalli	
29.	Dr Sudha Rao	Teresian college, Mysore	
30.	Prof.Annie Mathew	Teresian college, Mysore	
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39.	Sri. Sunilkumar K C	JSS College ooty road, Mysore	
40.	Kum.Shwetha	Yuvaraja's College, Mysore	

Chairman, BOE is authorized to approve additional members if required.