GOVINDRAM SEKSARIA SCIENCE COLLEGE (AUTONOMOUS) BELAGAVI

TILAKWADI, BELAGAVI (KARNATAKA)

B.Sc. Physics Course

STRUCTURE AND SYLLABUS

FROM 2024-25 ONWARDS

as per Revised Curriculum Framework for Undergraduate Course

STATE EDUCATION POLICY-2024-25

I, II, III, IV, V and VI Semesters

FINAL APPROVED COPY

With Effect from the Academic Year 2024-25
STATE EDUCATION POLICY-2024-25
B.Sc. Program with Optional Subject: PHYSICS

B.Sc., PHYSICS First and Second Semester Syllabus as per SEP (With effect from the academic year 2024-25 and onwards)								
Sem	Part	Paper Code	Title of the Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
I	DSC	PHYDSCT1.1	Mechanics and Properties of Matter	4	20	80	100	3
		PHYDSCP1.1	Practical I	4	10	40	50	2
		Total: Hours / Credits		8			150	5
II	DSC	PHYDSCT2.1	Electricity & Magnetism	4	20	80	100	3
		PHYDSCP2.1	Practical II	4	10	40	50	2
		Total: Hours / Credits		8			150	5

T: Theory, P: Practical, DSC: Discipline Specific Course. Ele- Elective,

B.Sc., PHYSICS Third and Fourth Semester Syllabus as per SEP (With effect from the academic year 2025-26 and onwards)								
Sem	Part	Paper Code	Title of the Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
III	DSC	PHYDSCT3.1	Thermodynamics-I, Geometrical Optics, Sound and Waves	4	20	80	100	3
		PHYDSCP3.1	Practical III	4	10	40	50	2
	Ele-I	PHYELEP4.1	Medical Physics	3	10	40	50	2
		Total: Hours / Credits		11			200	7
IV	DSC	PHYDSCT4.1	Thermodynamics-II, and Physical Optics	4	20	80	100	3
		PHYDSCP4.1	Practical IV	4	10	40	50	2
	Ele-II	PHYELEP4.1	Lenses and Optical fibers	3	10	40	50	2
	Skill-1	PHYSKLP4.1	**DOMESTIC ELECTRICAL WIRING**	4	10	40	50	2
		Total: Hours / Credits		15			250	9

T: Theory, P: Practical, DSC: Discipline Specific Course. Ele- Elective,

B.Sc., 5 AND 6 SEMESTER PHYSICS Syllabus as per SEP (With effect from the academic year 2026-27 and onwards)								
Sem	**Part**	**Paper Code**	**Title of the Paper**	**Hours/ Week**	**Marks**			**Subject Credits**
					IA	**Exam**	**Total**	
V	**DSC**	PHYDSCT5.1	Classical Mechanics and Electronics	4	20	80	100	4
		PHYDSCT5.2	Mathematical and Nuclear Physics	4	20	80	100	4
		PHYDSCP5.3	Physics Practical V	4	10	40	50	2
	Skill -II	PHYSKLP5.4	Domestic Electrical Wiring	4	10	40	50	2
		Total: Hours / Credits		**16**			**300**	**12**
VI	**DSC**	PHYDSCT6.1	Quantum Mechanics, Atomic and Molecular Physics	4	20	80	100	4
		PHYDSCT6.2	Statistical mechanics and Condensed Matter Physics	4	20	80	100	4
		PHYDSCP6.3	Physics Practical VI	4	10	40	50	2
	Skill III	PHYSKLP6.4	Domestic Electrical Wiring	4	10	40	50	2
		Total: Hours / Credits		**16**			**300**	**12**

First Semester B.Sc. (Physics)

Paper Title: Mechanics and Properties of Matter

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20 **Total Hours: 60 Credits :** 3

Unit I

Conservation Laws

Law of conservation of linear momentum (statement). Centre of mass & Expressions for position vector, velocity, acceleration & force of center of mass. Concept of elastic and inelastic collisions. Derivation of final velocities in case of elastic collision in (i) laboratory frame of reference (ii) center of mass frame of reference. Derivation of final velocities in case of inelastic collision in (i) laboratory frame of reference (ii) center of mass frame of reference. Distinctions between laboratory frame of reference and center of mass frame of reference. Conservation of linear momentum in case of variable mass. Principle of rocket and derivation for equation of motion for single stage rocket. Necessity of multistage rocket (Qualitative). Basics of angular momentum and torque, relation between angular momentum & torque (qualitative). Law of conservation of angular momentum with examples. Concept of work & power in terms of line integral. Law of conservation of energy. Work energy Principle (Qualitative). Problems. **15 Hours**

Unit II

Gravitation

Newton's law of Gravitation (statement). Expressions for orbital velocity and escape velocity (derivations). Kepler's laws of planetary motion. Derivation for Kepler's 2^{nd} and 3^{rd} law. Concept of Satellite, derivation for binding energy of satellite. Artificial Satellite: Geostationary satellite and polar orbit satellite with different types of orbits (qualitative). Concept of weightlessness. Basic ideas of GPS and NAVIC. Problems.

Rigid Body Dynamics

Moment of Inertia. Radius of Gyration. Statements of theorem of parallel axis and theorem of perpendicular axis. Derivation of expressions for moment of inertia for (i) rectangular lamina (ii) thin uniform rod and (iii) circular disc. Theory of compound pendulum. Theory of flywheel and its applications. Problems. **15 Hours**

Unit III

Elasticity

Statement of Hook's law. Behavior of wire under stress. Moduli of elasticity. Derivation of expression for relations between elastic constants. Derivation of work done per unit volume in a deforming body. Derivation of twisting couple of cylindrical rod or wire. Torsion pendulum, Derivation for time-period of torsion pendulum. Derivation of bending moment. Derivation of Young's modulus by bending of beam supported at its ends and loaded at middle. Cantilever (mention expression for bending). Problems. **15 Hours**

Unit IV

Surface tension

Introduction to surface tension, derivations for Pressure difference across a curved liquid surface and expression for rise of liquid in a capillary tube. Determination of surface tension by Quincke's method with relevant theory. Effect of temperature and impurity on surface tension. Examples. Problems.

Viscosity

Introduction to viscosity, streamline and turbulent flow. Motion of body in a viscous medium-Stoke's law with derivation and expression for terminal velocity example: velocity of rain drop. Derivation of Poiseuille's formula for the flow of viscous fluid through a narrow tube. Problems.

15 Hours

REFERENCE BOOKS:

1) Fundamentals of Physics- R.Resnik, D. Halliday and Walker; Wiley (**2001**)
2) Physics-Classical and Modern, FJ Keller, E Gettys and J J Skove, McGraw Hill Second Revised Edition(**1993**)
3) Classical Mechanics-K N Sreenivasa Rao, Universities Press- Orient Longman (**2003** ed)
4) Concepts of Physics Vol (1)-H C Verma, Bharathi Bhavan Publishers, **2004** Edition
5) University Physics- F W Sears, M W Zemansky & H D Young, Pearson Education First ed.(**2014**)
6) Mechanics- J C Upadhaya, Himalaya (**2014** ed)
7) Properties of Matter- J C Upadhaya, Himalaya (**2014** ed)
8) Mechanics- Berkeley Physics Course Vol(1)- SI units Charles Kittel etal, McGrawHill Education (India) 2e (2011).
9) Elements of Properties of matter – D S Mathur, S.chand(GL) 7 Co Ltd,Dehi 1ed(**2010**)
10) Properties of Matter - Brijlal & Subramanyam, S Chand & Co, (**2002)**
11) Newtonian Mechanics- A P French, Nelson & Sons UK, (**1971**)
12) Mechanics & Thermodynamics, G Basavaraju & Dipan Ghosh, McGrawHill Education India) 1ed (**1985**)
13) A treatise on general properties of matter, Sengupta and Chatterjee, New Central Book Agency Pvt Ltd, Calcutta (7^{th} Revised edition -**2010**)
14) Advanced analytical Dynamics : Dynamic of rigid body, Utpal Chatterjee, Academic Publishers, first edition,(2016).
15) Theory of mechanics, kinematics and Dynamics : V. R. Gupta, I K International publishing house Pvt. Ltd, (2013).

16) Dynamics of Rigid Body : A. K. Sharma, Discovery Publishing Group,(2007).
17) Properties of matter : R. Murugeshan, S Chand & Co Ltd Publication.
18) Theory of Elasticity : P. N. Chandramouli, Yes Dee publishers(2017).
19) An introduction to the theory of elasticity : R. J. Atkin & N. Fox, Dover Publications Inc.(2005).
20) Theory of elasticity : Dr. Sadhu Singh, Khanna publishers, (1978).
21) B.Sc Physics - C. L. Arora.
22) Mechanics, S P Taneja, R Chand & Co New Delhi

Practical

Paper Title: Practical I

Teaching Hours: 4 Hrs / Week **Marks:** Th-40+IA-10 **Credits : 2**

Bridge Course: (04 Hours)

i) Study of some important terms regularly used in Physics (like, 1 newton, 1 calorie, 1 joule, 1 kelvin, 1 poise, etc..)
ii) Use of Logarithm and Trigonometric tables.
iii) Study of measuring instruments (vernier calipers, micrometer, travelling microscope)

Practicals:

1. Moment of Inertia of Fly wheel.
2. Young's modulus (Y) by uniform bending- Load Vs depression graph.
3. Bar pendulum- determination of g
4. Modulus of rigidity by Torsional pendulum
5. Spring Constant by Flat spiral Spring. Verification of Hook's law.
6. Verification of parallel axis theorem of Moment of Inertia.
7. Coefficient of viscosity by Stoke's method.
8. Capillary Rise- Surface Tension of liquid
9. Determination of Speed of Ceiling Fan (in RPM) (self-study/demonstration)
10. Surface tension by Quincke's method (self-study/demonstration).
11. One Physics experiment of student's choice (self-study/demonstration).

Note :

1. Experiments are of four hours duration.
2. Minimum of eight experiments to be performed.

References:

1. B Saraf etc, - Physics through experiments, Vikas Publications (**2013**)
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (**1985**)
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.
4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central

   Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (**2002)**
5. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (**2007**) Revised Edition.
6. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

Second Semester B.Sc. (Physics)

Paper Title: Electricity & Magnetism

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20 **Total hours:60 Credits :**3

Unit I

Vector Analysis

Scalar and Vector Products. Gradient of scalar and its physical significance. Divergence of vector and its physical significance. Curl of vector and its physical significance. Vector integration; line, surface & volume integrals of a vector field (Qualitative). Gauss Divergence theorem & Stokes theorem (statement).

Maxwell's Electromagnetic Theory

Derivation of Maxwell's equations in differential form. Mention of Maxwell's equations in integral form and their physical significances. Derivation for general plane wave equation in free space. Transverse nature of radiation. Derivation of Poynting's theorem.

15 Hours

Unit II

DC Circuit Analysis

Voltage and current sources. Kirchoff's current and voltage laws. Derivation of Thevenin's Theorem. Derivation of Norton's Theorem. Derivation of Superposition Theorem. Derivation of Maximum Power Transfer Theorem.

Transient Circuits

Theory of growth and decay of current in RL circuit. Theory of charging and discharging of capacitor in RC circuit. Time constants of RL and RC circuits. Measurement of high resistance by leakage method.

15 Hours

Unit III

Magnetostatics

Statement of Biot-Savart's law. Mention of expressions for Magnetic field at a point (i) due to a straight conductor carrying current (ii) along the axis of the circular coil carrying current (iii) along the axis of solenoid. Principle, construction and theory of Helmholtz Galvanometer.

Magnetic Properties

Magnetic intensity, Magnetic induction, Magnetic potential. Derivation of Magnetic intensity and magnetic potential due to dipole (magnet) at general point. Mention of expressions for magnetic intensity at axial and equatorial point. Permeability and magnetic susceptibility. Distinction between dia, para, and ferromagnetic materials. Ampere Circuital Law (statement).

Dielectrics

Types of dielectrics (polar and non-polar molecules). Electric field (E), Electric displacement (D), Electric dipole moment (p), electric polarization (P). Gauss law in dielectrics. Derivation for Relation between D, E and P. Derivation for relation between dielectric constant and electric susceptibility. Boundary conditions for E & D.

Electromagnetic induction

Faraday's law of electromagnetic induction. Lenz's law. Self and mutual inductance (Qualitative).

15

Hours

Unit IV

Alternating Current

Definitions of average, peak and rms values of AC. AC circuits containing LR, CR and their responses (using j operator). Expressions for impedance, current & phase angle in series LCR circuit using j operator. Expressions for admittance and condition for resonance in parallel LCR circuit using j operator. Concept of Series resonance & parallel resonance (sharpness, half power frequency, quality factor, voltage magnification). Comparison between Series resonance & parallel resonance. De Sauty's Bridge (Qualitative).

Electrical Instrument

Ballistic Galvanometer; Theory of Ballistic Galvanometer (Derivation for current and Charge). Constants of Ballistic Galvanometer and their relationship. Condition for moving coil galvanometer to be ballistic. Determination of self-inductance (L) by Rayleigh's method.

15 Hours

REFERENCE BOOKS :

1) Electricity and magnetism by Brij Lal and N Subrahmanyam, Rathan Prakashan Mandir, Nineteenth Edition, 1993**.**
2) Principles of Electronics by V K Mehta and Rohit Mehta, S Chand & Company, Eleventh Edition,**2008.**
3) Fundamentals of Magnetism & Electricity : d. N. Vasudeva, S Chand Publication, (2011).
4) Fundamentals of Electricity and Magnetism – Basudev Ghosh (Books & Allied New Central Book Agency, Calcutta, 2009).
5) Electricity & Magnetism : B. S. Agarwal, Kedarnath Ramnath Publication(2017).
6) Electricity & Magnetism : A. N. Matveev, Mir Publishers Moscow,(1987).
7) Electricity and Magnetism with Electronics **:** Dr. K.K.Tewari, S.Chand Publications(1995).
8) Fundamentals of electric circuit theory : Dr. D. Chattopashyay & Dr. P. C. Rakshit, S. Chand Publications, 7th Rev. Edn. (2006).
9) Electricity and Magnetism : John Yarwood, University Tutorial Press, (1973).
10) Feynman Lecture series, VolII, R P Feynnman et al, Narosa Publishing House, New Delhi
11) Electricity & Magnetism, N S Khare & S S Srivastava, AtmaRam & Sons, New Delhi.
12) Electricity & Magnetism, D L Sehgal, K L Chopra, N K Sehgal, S Chand & Co, Sixth Edition, (**1988**).

13) Electricity & Electronics, D C Tayal, Himalaya Publishing House, Sixth Edition(**1988**).
14) Basic Electronics & Linear Circuits, N N Bhargava, D C Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28th Reprint,(**1999**).
15) Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, (**1994**).
16) Introduction to Electrodynamics by D J Griffiths Pearson Education (**2015**).
17) Classical Electrodynamics : John David Jackson, John Wiley & Sons,(2007).
18) Electromagnetism by B B Laud 2ed.
19) An Introduction to vector analysis : B. Hague, Springer Science & Bussiness Media, (2012).
20) Electrical Networks, Theraja 3rd revised edition
21) Circuit Theory (Analysis & Synthesis) : A. Chankrabarti, Dhanpat Rai Publications,(1951).
22) Electricity and Magnetism, S P Taneja, R Chand & Co. New Delhi.
23) Introduction to Electromagnetic Theory, S P Taneja, R Chand & Co. New Delhi.

Practical

Paper Title: Practical II

Teaching Hours: 4 Hrs / Week **Marks:** Th-40+IA-10 **Credits :** 1

Bridge Course: (02 Hours)

i) Study of some important terms regularly used in Physics (like, 1 coulomb, 1 volt, 1 ampere, 1 tesla, 1 ohm, emf and pd, 1 farad, etc..)
ii) Study of Bread Board Connections. Working of rheostat/potentiometer.
iii) Resistance, Decade Inductance, Decade capacitors, AC/DC Sources and measuring devices.

Practicals:

1 Thevenin's & Norton's theorem
2 High resistance by leakage method
3 Time constant of RC circuit by charging and discharging method.
4 Calibration of Ammeter using Helmholtz Galvanometer
5 LCR series and parallel resonance circuit
6 De Sauty's AC bridge
7 L & C by Equal Voltage Method
8 Use of CRO to find voltage, frequency and phase.
9 Measurement of power consumption by various bulbs, domestic electrical instruments and estimation (self-study/demonstration)
10 Constants of Ballistic Galvanometer (self-study/demonstration)
11 One Physics experiment of student's choice (self-study/demonstration).

Note :

1. Experiments are of four hours duration.
2. Minimum of eight experiments to be performed.

References:

1. Physics through experiments. B Saraf etc,- Vikas Publications (**2013**)
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (**1985**)
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.
4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (**2002)**
5. BSC, Practical Physics, CL Arora, S Chand & Co, New Delhi, (**2007**) Revised Edition.
6. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

Third Semester B.Sc. (Physics)

Paper Code: PHYDSCT3.1 **Paper Title**: Thermodynamics-I, Geometrical Optics, Sound and Waves

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20 **Total hours:60 Credits :**3

Unit I

Kinetic Theory of Gases

Postulates of kinetic theory of gases. Derivations of Maxwell's law of distribution of velocities (assuming constants a and b). Derivations of average, RMS and most probable velocity. Mean free path. Derivation of Clausius expression of mean free path. Problems.

Transport Phenomena

Concept of viscosity (η), mention its expression. Derivation of expression for thermal conductivity (K). Relation between η & K. Concept of the coefficient of diffusion (D), mention its expression. Problems.

Black Body Radiation

Black body, Energy distribution in the black body spectrum. Radiation pressure, Derivation of Stefan's law. Derivation of Plank's law and deduction of Wien's displacement law and Rayleigh Jean's law. Problems.

15 Hours

Unit II

Thermodynamics

Mention of Four Fundamental thermodynamic potentials (Internal energy, Enthalpy, Helmholtz free energy and Gibbs free energy). Zeroth law of thermodynamics. First law of thermodynamics and its application to various processes viz cyclic, adiabatic, isothermal, Isochoric and isobaric processes. Second law of thermodynamics and entropy. Carnot's cycle. Working with an Otto engine, derivation of expression for efficiency. Diesel engines with mention of expression for efficiency. Change of entropy in reversible and irreversible processes. Entropy- Temperature diagram. Third law of thermodynamics. Derivation for Maxwell's thermodynamic relations. Clausius-Clapeyron's equation. Problems.

15 Hours

Unit III

Geometrical Optics:

Fermat's principle-statement and explanation, derivation of laws of reflection and refraction.

Cardinal points of optical system: Principal foci, principal points and nodal points. Equivalent focal length of two thin lenses separated by distance (derivation) and location of Cardinal Points.

Newton's formula and graphical construction of images. Mention expression for focal length of thick lens and power of thick lens (qualitative).

Aberrations:

Spherical (longitudinal and lateral), chromatic (longitudinal and lateral) aberrations. Methods to reduce spherical aberration (qualitative). Condition for Achromatism of two thin lenses in contact and separated by a distance. Ramsden's and Huygen's eyepieces: Construction and location of cardinal points. Differences between Ramsden's and Huygen's eyepieces.

Problems.

15 Hours

Unit IV

Waves

SHM, Equation of SHM, Differential equation of SHM, Composition of two co-linear oscillations having (i) equal frequencies (ii) Different frequencies (analytical method). Concept of beats. Composition of two perpendicular oscillations having (i) equal frequencies (ii) Different frequencies (analytical method). Lissajous figures with equal and unequal frequencies (qualitative). Problems.

Sound

Free vibrations forced vibrations and resonance. Theory of Helmholtz resonator. Intensity and loudness of sound-decibels. Intensity level- musical note and scale. Acoustics of building. Reverberation and time of reverberation- absorption coefficient. Derivation of Sabine's formula. Measurement of reverberation time. Acoustic aspects of hall and auditorium. Working principle of loudspeaker and microphone. Problems.

15 Hours

RFERENCE BOOKS:

1) Heat and Thermodynamics- M M Zemansky, McGrawHill Education (India) 8ed (**2011**).
2) Heat & Thermodynamics, M W Zemansky & RHDittman, McGraw Hill Book company,Inc.US Seventh Revised edition(**1997**).
3) Heat and Thermodynamics- Brij Lal and N Subramanyam, S Chand & Co, New Delhi -1985.
4) Heat and Thermodynamics – D S Mathur, SChand & Co, New Delhi, 5th Edition(2004).
5) Heat, Thermodynamics & Stastical Mechanics, BrijLal & Subramanyam, S. Chand & Company,Delhi; (**2008** ed).
6) Thermodynamics & Statistical Physics, Sharma & Sarkar, Himalaya Publishing House, Third Edition(1991).
7) Thermodynamics, Kinetic theory & Statistical Thermodynamics, F W Sears & G L Salinger, Narosa Publishing House (Third Edition **1998**).
8) Fundamentals of Classical Thermodynamics, Gordon J V Wylen & Richard E Sonntag, John Wiley Eastern Limited; 4th ed (**1994**).
9) Thermal Physics, S C Garg, R M Bansal & C K Ghosh, Mc Graw Hill Education (India) Second ed (**2013**).

10) Kinetic Theory of Gases (I – edition) – Ideal Book Service, Pune.(1967)
11) Kinetic Theory of Gases – Kelkar V N.
12) Kinetic theory of gases – R. S. Bhoosanurmath
13) Heat and Thermodynamics and Statistical Physics (XVII Edition) –Singhal, Agarwal and Satyaprakash
14) A Treatise on Heat: Meghnad N. Saha and B. N. Srivastava, Indian Press, (1958).
15) A Text Book of Heat and Thermodynamics for Degree Students : J. B. Rajam, S. Chand Publications, (1981).
16) Properties of Matter - Brijlal & Subramanyam, S Chand & Co, (**2002)**
17) Elements of Properties of matter – D S Mathur, S.chand(GL) 7 Co Ltd,Dehi 1ed(**2010**)
18) Fluid Mechanics: Robert W. Fox & Alan T. Mcdonald, Wiley India, 8th Edn.
19) Low-Temperature Physics: Hans- Christian Stahl, Siegfried Hunklinger, Springer Science & Business Media, (2005).
20) Waves & Oscillations, P K Mittal & Jai Dev Anand, Hari Anand Publications Pvt Ltd (2011ed).
21) Physics of Waves, University Leadership Project, Prasaranga, Bangalore University.
22) A text book of Sound (II Edition) – Brijlal and Subramanyam, Vikas Publishing House, 1977.
23) Text book of Sound (I Edition) – Khanna and Bedi, Atmaram and Sons,1985.
24) Text book of Sound (III Edition) – M. Ghosh, (S.Chand).
25) Waves and Optics, S P Taneja, R Chand & Co. New Delhi.
26) Thermal Physics, Ashok Kumar, S P Taneja, R Chand & Co. New Delhi.
27) Optics, Brij Lal and Subramaniam, S Chand & Company, 22nd Edition, (**1994**).
28) Principles of Optics, B K Mathur, Gopal Printing Press, Kanpur, 6th Edition, (**1996**).
29) Geometrical Optics (I-Edition) **–** D.P.Acharya (Oxford & IBH Pub. Co., 1970).
30) Optics and Spectroscopy (VI Edition) **–** Murugeshan, Kiruthiga and ShivaPrasad (S.Chand).
31) Fundamentals of Optics (V-Edition) **–** Khanna and Bedi (R.Chand, New Delhi).
32) Geometrical Optics: A. Verstraetin

Practical

Paper Code: PHYDSCP3.1 **Paper Title:** Practical III

Teaching Hours: 4 Hrs / Week **Marks:** Pr-40+IA-10 **Credits :** 2

1. Searle's Goniometer
2. Helmholtz Resonator
3. Velocity of sound through wire (Sonometer)
4. Thermal conductivity by Lee's method
5. Frequency of AC using sonometer.
6. Specific heat of solid by cooling.
7. Verification of Stefan's law of radiation.
8. Lissajous figures using CRO
9. Thermal Behavior of Bulb Filament.
10. Characteristics of Loudspeaker and Microphone.
11. The thermoelectric power of thermocouple.
12. Measurement and estimation of Power consumption by household electrical instruments.

Note :

1. Experiments are of four hours duration.
2. Minimum of eight experiments to be performed.

References:

1. Physics through experiments. B Saraf etc,- Vikas Publications (**2013**)
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (**1985**)
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.
4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (**2002)**
5. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (**2007**) Revised Edition.

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Medical Physics

Open Elective Course (24PHY303)

(Elective for 3rd Semester) From 2025-26

Total: 39 hours

Unit I: X Rays Basics **(12 hours)**

Qualitative Overview of human anatomy - cells, cell structure, type of cells and functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system. (03 Hours)

Outline of atomic structure, electromagnetic radiation waves and quanta, general properties of electromagnetic radiation- fundamentals of radioactivity radiations (alpha, beta and gamma). Light- intensity and quality, spectrum of white light, line spectra, photo-electric emission, photocell, fluorescence, phosphorescence. (05 Hours)

Principle, and production of X rays, Conditions necessary for production of x-rays, Heterogeneous nature of the x-ray beam, Electron emission, electron acceleration through electric field, Types of x-ray tubes: diagnostic, therapeutic, stationary anode, rotating anode, gas tubes (ionic), Coolidge tubes (thermionic) (04 Hours)

Unit II: Interaction of X-rays with Human body, Basics of Laser **(12 hours)**

Properties of x-rays, frequency, energy, the effect of voltage on these properties, absorption of x-rays, the absorption of primary radiation in striking matter, Secondary, scattered and characteristic radiation, Detection of x-radiation, action on the emulsion of the photographic film, physiological action on living tissue, ionizing effects. Unit of ionizing radiation quantity, the roentgen., Permissible dosage for x-ray operators (0.3 r per week) (04 Hours)

Interaction of X-rays with human body. Effect of x-ray exposure on human body, x-ray protection, permissible exposure, international recommendations for protection of persons exposed to ionizing radiation, the protective materials lead, Lead Aprons, building materials, lead equivalents and variation with quality and room protection, Use of X-rays in medical diagnosis, X-ray imaging systems. (04 Hours)

Laser : Induced absorption, spontaneous emission and stimulated emission. Einstein's A and B coefficients – Mention of relation between Einstein's coefficients and radiation energy density; Condition for amplification of light; Population inversion; Methods of pumping (qualitative); Requisites of laser – energy source, active medium and laser cavity; Qualitative discussion about

Helium-Neon Laser and Ruby Laser, Characteristics of laser light and its applications. (medicine, industry and defence). (04 Hours)

Unit III: Radiation Technology (Medical Diagnostics) (12 Hours)

Computed Tomography scan (CT scan): principle and generation of CT. – Basic Physics – Recent developments, applications etc. (02 Hours)

NMR (Nuclear Magnetic resonance) (Qualitative), MRI–Magnetic Resonance Imaging – basic principle and image characteristics. Strength of typical magnetic field, methods of production of high magnetic field, Superconducting coils, Effect of magnetic field on human body, Basic terms used in MRI Operations, Applications. (05 Hours)

Ultrasonics, – Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler. Types of ultrasound – Techniques of ultrasound scanning in different parts. (05 Hours)

Student activities and Mini Project: (09 hours)

The Student shall carry out following activities and understand the fundamentals and basics of X-Rays, CT, MRI and USG. He/she shall prepare a mini project report signed and attested, preferably by Radiologist/Lab technician. **It will be evaluated for 10 marks by staff in charge and shall be considered as Internal Assessment Marks.**

Student Activities:

1. Construction of models of human anatomy and physiology.
2. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines, X-ray films, CT Scan, MRI and USG..
3. Visit to radiotherapy centers to study the modalities of radiotherapy.

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.
2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.

3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.
4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.
5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.
6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.
2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.
3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.
4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.
5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.
6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.
7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.
8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.
9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.
10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.
11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.
12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.
13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.
14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.
15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.
16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.
17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002.
18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005.
19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.

Fourth Semester B.Sc. (Physics)

Paper Code:PHYDSCT4.1 **Paper Title:** Thermodynamics-II, and Physical Optics

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20 **Total hours :60** **Credits :**3

Unit I

Low Temperature and Low Pressure Physics

Production of low pressure: Rotary pump and its characteristics (Rotary pressure, degree of vacuum attainable and speed of pump).

Diffusion pump: Principle, construction & working.

Ionization gauge: Principle, construction & working.

Production of low temperature: Introduction, freezing mixtures, Joule Thomson Effect, Porous Plug Experiment, Principle of Regenerative Cooling. Different Methods of liquification of gases, liquification of air, oxygen and helium, production of low temperatures by an adiabatic demagnetization, Properties of materials at low temperatures.

Problems **15 Hours**

Unit II

Thermo-Electricity

Seebeck Effect –explanation. Variation of emf with temperature; Neutral Temperature and Temperature of inversion. Thermo-electric Series. Laws of Thermo-Electric effects. Peltier Effect- explanation. Peltier's Coefficients. Thermodynamics of Peltier's Effect. Thomson Effect

explanation. Thomson Coefficient.

Derivation of the relation $\pi = T\,\frac{dE}{dT}$ and $\sigma_A - \sigma_B = T\,\frac{d^2E}{dT^2}$

Thermo-Electric (Tait) diagrams, its applications to determine, (1) Total emf (2) Peltier emf (3) Thomson emf (4) Neutral temperature and (5) Temperature of inversion.

Thermocouple K and J types. Problems. **15 Hours**

Unit III

Interference

Interference due to division of wavefront & amplitude. Young's double slit experiment. Lloyd's mirror Fresnel biprism. Phase change on reflection: Stokes' treatment of reflection and transmission at interface. Interference in thin films – due to reflected light and transmitted light. Newton's rings due to reflected light and transmitted light & measurement of wavelength. Michelson's interferometer. Problems. **15 Hours**

Unit IV

Diffraction

Fresnel's Diffraction. Half Period Zone using rectilinear propagation of light. Zone plate: Construction, theory and working. Fresnel's diffraction pattern due to straight edge and position of minima and maxima. Fraunhofer's diffraction at single slit (qualitative). Diffraction grating. Theory of plane transmission grating (qualitative). Resolving power. Rayleigh's criteria. Resolving the power of prism. Resolving power of telescope. Resolving power of grating (qualitative). Problems.

Polarization

Transverse nature of light waves- plane of vibration and plane of propagation. Malu's law. Double refraction. Positive and negative plates. Retardation plates: Quarter wave plate and half wave plate. Production of Circular and elliptical polarization, Optical Activity: Fresnel's Theory of optical activity. Specific rotation. Problems. **15 Hours**

REFERENCE BOOKS:

1) Low Temperature Physics by Christian E and Siegfried H , Springer.
2) Thermal Engineering by S Singh, S Patil
3) Heat and Thermodynamics- Brij Lal and N Subramanyam, S Chand & Co, New Delhi -1985.
4) Heat and Thermodynamics – D S Mathur, SChand & Co, New Delhi, 5th Edition (2004).
5) Heat and Thermodynamics and Statistical Physics (XVII Edition) – Singhal, Agarwal and Satyaprakash.
6) Introduction to Thermoelectricity: H. Julian Goldsmith, Springer Science & Business Media, (2009).
7) Optics, Ajoy Ghatak, Tata Mc Graw Hill, 4th Edition
8) Introduction to Modern Optics, Ajoy Ghatak, Tata McGraw Hill Publications (**2009**).
9) Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, (**1994)**
10) A K Ghatak and K Thyagarajan, Contemporary Optics, Macmillan/Premium Publishing Corp(**1978**).
11) Jenkins and White, Optics, McGraw Hill Education India Pvt Ltd 4th ed(**2011**).
12) Optics, Brij Lal and Subramaniam, S Chand & Company, 22nd Edition, (**1994**).
13) Principles of Optics, B K Mathur, Gopal Printing Press, Kanpur, 6th Edition, (**1996**).
14) Geometrical Optics (I-Edition) – D.P.Acharya (Oxford & IBH Pub. Co., 1970).
15) Optics and Spectroscopy (VI Edition) – Murugeshan, Kiruthiga and ShivaPrasad (S.Chand).
16) Fundamentals of Optics (V-Edition) – Khanna and Bedi (R.Chand, New Delhi).
17) Geometrical Optics: A. Verstraetin

Practical

Paper Code: PHYDSCP4.1 **Paper Title: Practical IV**

Teaching Hours: 4 Hrs / Week **Marks:** Pr-40 + IA-10 **Credits :** 2

1. Dispersive Power of Prism
2. Determination of wavelength of monochromatic light using single slit/plane transmission grating.
3. Calibration of Spectrometer
4. Air wedge (Thickness of paper)
5. Newton's Rings : Determination of Radius of curvature of Plano Convex lens
6. Newton's Rings : Determination of RI of Water
7. Resolving Power of Telescope
8. Resolving Power of Grating
9. Resolving Power of Prism
10. Specific rotation of optically active solution using Polarimeter
11. Measurement of Sound Pollution.
12. Study of absorption of heat by various colored metal surfaces.

Note :

1. Experiments are of four hours duration.
2. Minimum of eight experiments to be performed.

References:

1. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (**1985**)
2. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.
3. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (**2002)**
4. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (**2007**) Revised Edition.
5. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

LENSES AND OPTICAL FIBERS

BSC 4TH SEMESTER OPEN ELECTIVE COURSE

Unit I:

Basics of lenses and spherical mirrors. 15 Hours

Types of lenses, Important terms (Principal axis, Principal focus, Focal length, Optical center), Sign convention, Magnification, Thick and thin lenses (qualitative). Image types, convex concave and plane mirrors, Mirror formula (mention only), Image formation by plane mirror, image formation by lenses and spherical mirrors, Lens formula (mention only), Lens makers formula (mention only). Power of a lens, unit of power.

Lens combination (derivation), Power of lens combination.

Types of glass used in lens making.

Aberrations:

Spherical (longitudinal and lateral), chromatic (longitudinal and lateral) aberrations. Methods to reduce spherical aberration (qualitative). Condition for Achromatism of two thin lenses in contact and separated by a distance.
Numerical problems.

Unit II:

Introduction of Fiber Optics: 15 Hours

History and Evolution of Fiber Optics, Concept of refractive index, construction of optical fibres, TIR condition, Light propagation through optical fibres. Types of optical fibres: step index, graded index, concept of modes, single mode and multimode fibres, Numerical aperture, acceptance angle and their relation, skew rays, attenuation (absorption, scattering and bending losses) and dispersion (material, waveguide and intermodal dispersion) in optical fibres. Optical sources: Light emitting diodes: Principle and efficiency, Laser diodes: Principle and efficiency, comparison between real laser light and light produced by laser diode. Fiber Bragg grating (qualitative, mention applications)

Effective refractive index, optical fibre refractive index sensor, mention of other applications (temperature, displacement, pressure, force, level sensors) of optical fibre sensors. Mention of Plastic optical fibres.

Unit III:

Applications of Lenses 15 Hours

Microscope, Telescope (different types and differences between them, Ray diagrams, mention of corresponding formulae).

Visual angle and accommodation of eye, Use of lenes in Eyesight correction, (myopia, hyperopia, astigmatism, presbyopia, cataract and glaucoma), corresponding ray diagrams, significance of eyesight correction number. Resolution of optical instrument (qualitative).

Eyesight vision, 6/6 and 6/9 vision. 20/20, 20/200 and 20/10 vision. Normal vision range.

Ramsden's and Huygen's eyepieces (qualitative), uses. Differences between Ramsden's and Huygen's eyepieces.

Basics of communication, Need for optical fibre communication, advantages of optical fibres in communication, Block diagram of optical fibre communication system, working of each block, Principle of fibre optic sensors.

SKILL SYLLABUS (PRACTICAL BASED)

DOMESTIC ELECTRICAL WIRING (SKILL ENHANCEMENT)

FOR 4TH, 5TH AND 6TH SEMSESTER FROM 2025-26 ONWRADS

Teaching Hours: 04 Per week **Total Teaching Hours: 45**

Marks: Pr-40+IA-10 **Credits :**2

Instructions:

1. The theory part given in each unit is to be taught qualitatively for 1 ½ hours (90 minutes).

2. Experiment part of each unit should be conducted for 2 ½ hours (150 minutes)

3. Drawing Block diagram for each experiment showing positions of electrical components on the board is compulsory.

4. The Pattern for practical examination is given below. The answers to Viva-Voce questions (minimum 05 questions for 2 marks each) should be written in the answer sheet.

UNIT 1 **(04 Hours)**

Introduction to Electricity, an Atom, electricity Electron flow, conductors, Insulators. Sources of Electricity. Electrical terms: Electromotive force, Current, Resistance, Potential difference.

Concept of AC and DC, AC current, AC voltage, generating sinusoidal voltage. SINE Wave, cycle, period, frequency, Peak value, average value, R.M.S. value.

EXPERIMENT:

Handling of all instruments (toolbox). AC voltmeter and ammeter. Identification of phase, neutral and earthing. Different types of fuses. Determination of fusing current by test. Inverter. Verification of Ohm's Law.

UNIT 2 **(04 Hours)**

General idea of wiring tools and their specifications. Applications of power tools in wiring. Electrical Accessories, Mounting Accessories' specifications.

Simple Electric circuit, Closed Circuit, Open Circuit and short circuit. Ohm's law Relationship between E, I and R in D.C. Circuits.

EXPERIMENT:

One lamp, one switch and two lamps, two switches with MCB.

UNIT 3 **(04 Hours)**

Laws of Resistance, Resistivity. Connection of Resistances: Series Circuit Parallel Circuit, Series and Parallel Circuit.

Calculation of power in AC, amperage, Voltage, Wattage, kWh, Calculation of load energy consumption.

Study of different type of switch used in domestic installations, two-way switches, D.P. Switches, Fan regulator: working and types, Dimmer.

EXPERIMENT:

To control two lamps through two switches to burn dim or one bright, indicators. Two sockets with switches. Staircase wiring (Single floor and two floor staircase).

UNIT 4 **(04 Hours)**

Conducting materials: Copper, Aluminum, Lead, Tin, Nickel, Chromium, silver, Zinc, Brass, Mercury. (conducting abilities, resistivities of these materials), Resistance materials: Nichrome, tungsten, Manganin, Constantan, Eureka, Carbon.

Insulating Materials: Marble, Slate, Porcelain, Mica, Rubber, Bitumen, Asbestos, Wood, Paper, cotton, Jute, Silk, P.V.C., Synthetic Materials: Resins, Plastics, Fiberglass, Bakelite, Paints, Varnishes.

EXPERIMENT:

One room wiring with 6 lights with switches.

UNIT 5 **(04 Hours)**

Transformer, (principle and working), types of transformers Step-up and step-down transformer: principle, design and fabrication, (Oil and Air type).

Generation and transmission of electrical power, High voltage transmission lines, Use of transformer in distribution of electrical power

EXPERIMENT:

One room wiring with 6 lights with switches, 1 fan with regulator and two sockets.

UNIT 6 **(04 Hours)**

Different types of wires and cables used in house wiring. Terms used in Electric Cables, Differences, current bearing capacity and advantages of these cables and wires. Conducting material used for different types of cables and wires. (Demonstration).

EXPERIMENT:

Kitchen wiring with 3 lights with switches, 1 fan with regulator, 1 exhaust fan and three sockets, heating points (fridge, mixer, oven).

UNIT 7 **(04 Hours)**

Earthing systems, Testing of domestic wiring and installations.

Principle and working of electrical power measuring meter.

EXPERIMENT:

One room wiring with 4 lights with switches (2 lights with two way switches). 1 fan with two-way switches.

UNIT 8 **(04 Hours)**

Effect of Electric Current: Heating, Magnetic, Chemical. Principle and working of water heaters, specifications, wiring diagram.

Electric Shock prevention measures, First aid. Fuses. (material specifications), Different types of control devices, principle and working, (MCB, MCCB, RCB, RCD, ELCB, RCCB, RCBO, SPD)

Filament lamps working, types. Fluorescent lamps, working and use of choke, starter, circuit diagram and uses. LED lamps. Advantages of LED bulbs over filament bulbs.

EXPERIMENT:

Bathroom wiring, 1 light, 1 heating point, 1 socket, 1 exhaust.

UNIT 9 **(04 Hours)**

Preparing load chart for AEH installation and selection of cables. Load Distribution for lighting circuit.

Distribution board for Heating and Power installation. Calculation of Load of different circuits and selection of size of wires, cables.

Panel Board wiring, Meter Board, Single phase service mains, accessories and wiring.

EXPERIMENT:

Panel Board Wiring (Meter Board)

UNIT 10

Site Visit and Mini Project: (09 hours)

The Student shall visit a site under construction and study details of electrical wiring used. He/she shall prepare a mini project report signed and attested, preferably by site engineer/electrician. **It will be evaluated for 10 marks by staff in charge and shall be considered as Internal Assessment Marks.**

Reference Books:

1. https://ncert.nic.in/vocational/pdf/kvcj103.pdf
2. Home Electrical Wiring: A Complete Guide to Home Electrical Contractor by David W Rongey
3. Residential Electrical Wiring by PD Murugesh
4. Complete handbook of electrical and house wiring By Duncan, S. Blackwell
5. Electrician Theory Level 1, 2,3,4,5 (I & II Year) by NSQF
6. Electrical Wiring: An Introduction: by Satheesh Kumar
7. NSQF Level Workshop Calculation & Science Electrician I & II Year (Paperback, DC Gupta)

Fifth Semester B.Sc. (Physics)

Paper Code: PHYDSCT 5.1 **Paper Title**: Classical Mechanics and Electronics

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20

Total hours: 60 **Credits:** 4

UNIT I: Classical Mechanics

Introduction to Newtonian Mechanics: Newton's laws of motion, Frames of references: inertial and non-inertial frames (qualitative). Mechanics of system of particles, Conservation of linear momentum (derivation), Relation between Angular momentum and Torque (derivation), conservation of angular momentum (derivation), work done by a force, conservative force and conservative energy. Basic principle of gyroscopic motion and motion of top. Problems

Lagrangian formulation: Constraints, Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints. Generalized coordinates (position vector, velocity and force), degrees of freedom, Principle of virtual work, D'Alembert's principle, Lagrange equations (derivation). Newton's equation of motion from Lagrange equations (proof), simple pendulum (derivation from Lagrange equation), Atwood's machine (explanation with theory to find g from Lagrange). Problems

15 Hours

UNIT II: Relativity

Newtonian principle of relativity. Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Michelson-Morley Experiment and its outcome. Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, Relativistic transformation: frequency and wave number (qualitative). Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. Relativistic Doppler effect. Problems

15 Hours

Unit III: Electronics 1

Semiconductor devices: Classification of materials based on band theory. Semiconductor, Intrinsic and Extrinsic semiconductors, semiconductor diode (p-n junction) and its I-V Characteristics (Forward & Reverse bias).

Rectifier: Rectifications, Half-wave rectifier, Full-wave rectifier-i) Full wave centre tap ii) Full wave Bridge (Qualitative). Comparison between them. Ripple factor,

Filters: Capacitor filter, Inductor filter, LC filter, π - section filter (study of waveforms qualitative), Comparison between them.

Zener diode: I-V Characteristics, Explanation of Zener Breakdown mechanism (Avalanche & Zener). Voltage regulator -Zener diode used as voltage regulator using unregulated DC voltage bridge rectifier. Problems.

Photodiode and Solar cell: Principle and working.

Junction Transistors: Basics of Bipolar Junction (BJT), construction and operation transistors, Transistor configuration, Common Base, Common Emitter and Common Collector Characteristics

(qualitative), h-parameters of a transistor and their determination in CE configuration, Transistor as an Amplifier (CE) with frequency response. Problems
Feedback: Feedback and types of feedback (positive and negative feedback).
Oscillators: Oscillators and their types, Essentials of a feedback LC oscillator. Hartley oscillators. Problem

15 Hours

Uni IV: Electronics 2

FET: n-channel and p-channel, characteristics and parameters.

Operational Amplifier: Basics of differential amplifier, Op-Amp, symbol, polarity convention and Pin diagram of IC-741, Characteristics of ideal and practical Op-Amp, Input modes and parameters, open loop Op-Amp configuration, Feedback concepts, types of feedback, Expression for Gain; Op-Amp as a negative feedback amplifier: Non– Inverting, Inverting and differential amplifier, Modification of input and output impedances with feedback (qualitative). Op-Amp Applications-Voltage Follower, Adder and Subtractor. Problems

Number system: Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary and vice-versa, Octal number system, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary. Problems

Digital Electronics and Boolean Algebra: Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, IC-7400 Pin diagram, NOR Gate, Algebraic Simplification, Implementation of NAND and NOR functions to obtain basic gates. Boolean algebra, Truth tables, De- Morgan's theorems. Problems

15 Hours

Reference Books

1 Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2 Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer
3 Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4 Classical Mechanics, Takwale and Puranik-1989, Tata Mcgraw Hill, new Delhi
5 Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009.
6. Electronic Devices and Circuits, David A. Bell, 2004, PHI, New Delhi
7. Integrated Electronics, Jacob Millman and CC Halkias
8. Digital Fundamentals, Floyd, 2001, PHI, New Delhi

Fifth Semester B.Sc. (Physics)

Paper Code: PHYDSCT 5.2 **Paper Title**: Mathematical and Nuclear Physics.

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20
Total hours: 60 **Credits:** 4

Unit I: Mathematical Physics

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. Application. Summing of Infinite Series.

Fourier transforms: Definition, inverse FT.

Laplace transform: Definition, transform of elementary functions, inverse transforms, transform of derivations, differentiation and integration of transforms. Difference between Laplace and Fourier transform.

15 Hours

Unit II: Atmospheric and Space Physics

Atmospheric Physics: Earth's atmosphere: composition, layers. Fixed and variable gases, Temperature structure of atmosphere, variation of pressure with altitude.

Solar System: Solar System, Terrestrial and Gas Giant Planets, Primitive and Secondary Atmosphere, Bode Titius Law, Evolution of Asteroids, Meteorites, Comets, Energy Source of the Sun, Structure of the Sun, Solar Wind, Solar Radiation

Stars: Formation and Evolution of Stars (qualitative), Stages of Stars, Stellar Luminosity and Magnitude (Apparent and Absolute), Stellar Spectra and its components, Stellar Temperature (Ionization Temperature, Excitation Temperature, Colour Temperature, Effective Temperature), Units of Stellar distances Expression for the relation between Luminosity and Radius of the Star, Spectral Classification, Hertzsprung-Russel (HR) Diagram

15 Hours

Unit III: Nuclear Physics I

General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, main features of binding energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments. Radioactivity: Definition of radioactivity, Decay law (derivation), half-life, mean life, radioactivity equilibrium (a) Alpha decay: basics of α-decay processes, theory of α decay (Gamow theory). Geiger-Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays' emission & kinematics, internal conversion (Definition).

15 Hours

Unit IV: Nuclear Physics II

Interaction of Nuclear Radiation with matter: Gamma ray interaction through matter, photoelectric effect, Compton scattering- derivation for change in wavelength, pair production (qualitative).

Nuclear Fission and Fusion: Nuclear fission and fusion, Controlled chain reaction. Nuclear reactor and its components, types of reactors : fast breeder reactor, heavy water reactor and research reactor (qualitative).

Nuclear models: Saliant features of liquid drop model, explanation of semiempirical formula. Explanation of nuclear fission on the basis of liquid drop model.

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).

Accelerators: Linear accelerators and Cyclotrons.

Elementary particles: Classification of elementary particles. Concept of Quark model.

15 Hours

Reference Books:

1. Mathematical Physics ---H. K. Dass and Dr. Rama Verma
2. Mathematical Methods for Physicists (4th Edition) George Arfken and Hans J. Weber Academic Press San Diego(1995).
3. Mathematical Physics - P.K. Chatopadhyay-Wiley Eastern Limited New Delhi (1990).
4. Introduction to mathematical Physics – Charlie Harper, Prentice-Hall of India Private Limited New-Delhi (1995)
5. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
6. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
7. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
8. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP) Publishing, 2004).
9. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
10. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier,(2007).
11. Introduction to atmospheric physics, David G Andrews, Cambridge university press publisher, 2nd edition.
12. Atmospheric science, John M Wallace, Peter V Hobbs, Academic press publisher, 2nd edition.
13. Introduction to Astrophysics(XV ed)- Baidyanath Basu-Prantice Hall of India2006.
14. Astrophysics(III ed)- K.D.Abhyankar-Universities Press India Pvt. Ltd. 2009.
15. Introduction to Astrophysics and Astronomy- M. Zeilik, Gregory and Smith.

Fifth Semester B.Sc. (Physics)

Paper Code: PHYDSCP 5.3 **Paper Title**: Physics Practical V

Teaching Hours: 4 Hrs / Week **Marks:** Th-40+IA-10

Credits: 2

LIST OF EXPERIMENTS FOR 5th SEM

1. Attenuation of B-ray using G.M. counter
2. Characteristics of GM tube (find operating voltage)
3. Astable Multivibrator using Transistor
4. Phase Shift Oscillator using Op-Amp
5. Use of Basics gates to verify and design AND, OR, NOT and XOR gates using NAND gates. De Morgan Theorems.
6. Low Pass Filter Using Op-Amp, High Pass Filter Using Op-Amp
7. Regulated power supply using Zener diode.
8. Hartley Oscillator using Transistor/Wein bridge Oscillator using op-amp.
9. To determine 'g', the acceleration due to gravity, at a given place, from the $L - T^2$ graph, for a simple pendulum.

   Studying the effect of mass of the bob on the time period of the simple pendulum.

   Studying the effect of amplitude of oscillation on the time period of the simple pendulum.
10. To study the spectral characteristics and I-V characteristics of a photodiode.
11. Construct a DC power supply using a bridge rectifier and a π section filter. Measure ripple factor with and without filter and compare them with theoretical values.
12. Study the conservation of energy and momentum using projectile motion.

Note: Minimum of **Eight (8)** experiments to be performed in a semester

ACTIVITY: INDUSTRY VISIT AND RELATED MINI PROJECT.

Reference Books

1. B.Sc Practical Physics by C.L Arora.
2. B.Sc Practical Physics by Harnam Singh and P.S Hemne.
3. Practical Physics by G.S Squires.
4. Practical Physics, D.C. Tayal, First Millennium Edition, 2000, Himalaya Publishing House.
5. B.Sc. Practical Physics, C.L. Arora, Revised Edition, 2007, S. Chand & Comp.Ltd.
6. An Advanced Course in Practical Physics, D. Chatopadhyaya, P.C. Rakshith, B. Saha, Revised Edition, 2002, New Central Book Agency Pvt. Ltd.
7. Physics through experiments, B. Saraf, 2013, Vikas Publications.

Sixth Semester B.Sc. (Physics)

Paper Code: PHYDSCT 6.1 **Paper Title**: Quantum Mechanics, Atomic and Molecular Physics

Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20
Total hours: 60 **Credits:** 4

Unit I: Introduction to Quantum Mechanics

Failure of classical physics to explain Black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms.

Matter waves: de Broglie hypothesis of matter waves, Wave description of particles by wave packets, Group and Phase velocities and relation between them (qualitative), Experimental evidence for matter waves: Davisson- Germer experiment, G.P Thomson's experiment and its significance. Principle of Electron microscope, expression for electron wavelength. Problems.

Heisenberg uncertainty principle: Elementary proof of Heisenberg's relation between momentum and position, energy and time, Illustration of uncertainty principle by Gamma ray microscope thought experiment. Consequences of the uncertainty relations: Diffraction of electrons at a single slit, reasons for non-existence of electron in nucleus. Two-slit experiment with photons and electrons. Problems.

15 Hours

Unit II: Foundation of Quantum Mechanics

Probabilistic interpretation of the wave function Ψ and its physical significance, normalization and orthogonality of wave functions, Admissibility conditions on a wave function.

Schrödinger equation: Equation of motion of matter waves - Schrodinger wave equation for a free particle in one dimension, derivation for time-independent and time-dependent wave equations, Probability current density, equation of continuity and its physical significance, Postulates of Quantum mechanics: States as normalized wavefunctions.

Applications of Schrodinger's equation – for free particle, particle in one-dimensional box, derivation of Eigen values and Eigen function for infinite and finite potential well. Quantum mechanical Tunnelling, Transmission across a potential barrier (potential step).

15 Hours

Unit III: **Atomic Physics**

Vector atom model: Spatial quantization, spinning electron; Quantum numbers associated with vector atomic model; Optical spectra – spectral terms, spectral notations, selection rules. Spin-orbit coupling (qualitative). Coupling schemes – L-S and j-j schemes; Pauli's exclusion principle; Magnetic dipole moment due to orbital motion of electron – derivation; Magnetic dipole moment due to spin motion of electron; Stern-Gerlach experiment; Experimental arrangement and Principle; Fine structure of spectral lines with examples.

Zeeman effect: Experimental study, Types: normal and anomalous Zeeman effect, Quantum theory of normal Zeeman effect. Energy level diagram for Sodium-D lines. Paschen back effect and Stark effect (qualitative). Lande g-factor and its calculation for different states.

15 Hours

Unit IV: Molecular and Laser Physics

Molecular Physics: Types of molecules based on their moment of inertia; Types of molecular motions: Rotational and Vibrational motions and energies. Microwave Spectra: Theory of rigid rotator – energy levels and spectrum. Infra-Red Spectra: Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum. Raman effect – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical and quantum theory of Raman effect. Experimental set up of Raman Effect. Applications of Raman effect.

Laser Physics: Interaction of radiation with matter: Induced absorption, spontaneous emission and stimulated emission. Einstein's A and B coefficients and relation between Einstein's coefficients and radiation energy density; Condition for amplification of light; Population inversion; Methods of pumping; Requisites of laser – energy source, active medium and laser cavity; Three level energy diagram. Construction and Working principle of Ruby Laser. Characteristics of laser light and its applications.

15 Hours

Reference Books:

1. Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
2. Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut.
3. Atomic Physics, S.N. Ghoshal, Revised Edition, 2013, S. Chand & Company Ltd.
4. Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
5. Concepts of Modern Physics, Arthur Beiser, Seventh Edition, 2015, Shobhit Mahajan, S. Rai Choudhury, 2002, McGraw-Hill.
6. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, Fourth Edition, 2008,Tata McGraw-Hill Publishers.
7. Elements of Spectroscopy – Atomic, Molecular and Laser Physics, Gupta, Kumar and Sharma, 2016, Pragati Publications.
8. BASICS OF QUANTUM COMPUTING April 2023, Anand Kumar Pandey, Mrs. Rashmi Pandey, Navi Publications

Sixth Semester B.Sc. (Physics)

Paper Code: PHYDSCT 6.2

Paper Title: Statistical mechanics and Condensed Matter Physics

Teaching Hours: 4 Hrs / Week
Total hours: 60

Marks: Th-80+IA-20
Credits: 4

Unit I Statistical Mechanics

Concepts of thermodynamic ensembles (micro-canonical, canonical and grand canonical ensembles). Phase Space- Micro state & Macro state. Thermodynamic probabilities. Maxwell-Boltzmann Statistics. Derivation for Maxwell- Boltzmann distribution function. Limitations of Maxwell- Boltzmann Statistics. Concepts of Bosons and fermions. Bose-Einstein Statistics. Derivation for Bose Einstein distribution function. Fermi-Dirac Statistics. Derivation for Fermi-Dirac distribution function. Comparison of Maxwell- Boltzmann Statistics, Bose-Einstein Statistics, Fermi-Dirac Statistics.

15 Hours

Unit II : Condensed Matter Physics I

Crystal systems and X-rays: Crystal structure: Space Lattice, Lattice translational vectors, Basis of crystal structure, Unit cells, primitive, non-primitive cells. Seven crystal system, Coordination numbers, Miller Indices, Expression for inter planner spacing in cubic system (relation between d and a). X Rays: Production and properties of X rays, Coolidge tube, Continuous and characteristic X-ray spectra; Moseley's law. X-Ray diffraction, Scattering of X-rays, Bragg's law. Crystal diffraction: Bragg's X-ray spectrometer- powder diffraction method, Intensity vs 2θ plot (qualitative).

Free electron theory of metals: Classical free electron model (Drude-Lorentz model), expression for electrical and thermal conductivity, Weidman-Franz law, Failure of classical free electron theory; Quantum free electron theory, Fermi level and Fermi energy, Fermi-Dirac distribution function (expression for probability distribution F(E), statement only); Fermi Dirac distribution at T=0 and E=Ef, F(E) vs E plot at T = 0 and T≠ 0. Density of states for free electrons (statement only, no derivation). Qualitative discussion of lattice vibration and concept of Phonons.; Specific heats of solids: Classical theory, Einstein's and Debye's theory of specific heats.

15 Hours

Unit III: **Condensed Matter Physics II**

Magnetic Properties of Matter: Magnetic susceptibility (χ), magnetization (M), Classification of Dia, Para, and ferro magnetic materials; Langevin theory of diamagnetism (derivation). Langevin Classical Theory of Paramagnetism (derivation). Curie's law, Ferromagnetism and Ferromagnetic Domains (qualitative). M-H Hysteresis Curve and Energy Loss, Hard and Soft magnetic materials.

Dielectric Materials: Static dielectric constant, Types of polarization (electronic, ionic and orientation), Clausius-Mossotti equation (derivation), dielectric loss. Ferroelectricity and Piezo electric effect and its application.

Superconductivity: Definition, Experimental results – Zero resistivity and Critical temperature– Meissner effect, The critical magnetic field – Type I and type II superconductors. BCS Theory (qualitative).

15 Hours

Unit IV: **Nano Physics**

Nanomaterials – Introduction, size effect-Surface to volume ratio; distinction between nanomaterials and bulk materials in terms of energy band. Classification – Electron confinement 0D, 1D, 2D- energy levels as a particle in a box (no derivation). Quantum dots, nanowires and nanofilms, Multilayered materials- Fullerene, Carbon Nano Tube (CNT), Graphene (Mention of structures and properties);

Synthesis techniques (Top down- Explanation of Milling & bottom up - Sol gel process). Characterization techniques- (brief description of SEM, TEM, AFM). Determination of particle size from XRD pattern using Debye-Scherrer formula. Distinct properties of nano materials (Mention- optical, electrical, mechanical and magnetic properties).

Applications: Fuel cells, catalysis, phosphors for HD TV, elimination of pollutants, sensors.

15 Hours

Reference Books:

1. Solid State Physics-R. K. Puri and V.K. Babber., S.Chand publications,1st Edition(2004).
2. Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragati prakashan Meerut (2017).
3. Introduction to solid State Physics, Charles Kittel, VII edition, (1996)
4. Solid State Physics- A J Dekker, MacMillan India Ltd, (2000)
5. Essential of crystallography, M A Wahab, Narosa Publications (2009)
6. Solid State Physics-S O Pillai-New Age Int. Publishers (2001).
7. Statistical and Thermal physics, F.Reif, McGraw Hill International(1985)
8. Statistical Mechanics, K.Huang, Wiley Eastern Limited, New Delhi (1975).
9. Fundamentals of Statistical Mechanics: B. B. Laud, New Age International Publishers, 2nd Edn.
10. Nano: The Essentials- T.Pradeep(TMH,New Dehli,2007
11. Nanotechnology: Principles & practices- S.K.Kulkarni
12. Introduction to Nanotechnology- C.P.Poole&F.J.Owens

Sixth Semester B.Sc. (Physics)

Paper Code: PHYDSCP 6.3 **Paper Title**: Physics Practical VI

Teaching Hours: 4 Hrs / Week **Marks:** Pr-40+IA-10
Credits: 2

LIST OF EXPERIMENTS FOR 6th SEM

1. To determine Planck's constant using Photocell / To determine Planck's constant using LED.
2. Photoconductive cell characteristics
   Photovoltaic Cell characteristics. Solar Cell: Fill Factor and Efficiency
3. Hall Effect in semiconductor: determination of mobility, hall coefficient.
4. Energy gap of Thermistor.
5. Verification of inverse square law using photovoltaic cell.
6. Study of the divergence of LASER light.
7. Specific Heat of Solid by Electrical Method
8. Calibration of a low range voltmeter using a potentiometer
   Calibration of an ammeter using a potentiometer
9. Design and construct a square wave generator using μA 741 op-amp. Determine its frequency and compare with the theoretical value. Also measure the slew rate of the op-amp. If the 741 is replace by LM318, study how does the waveform compare with the previous one.
10. Study the characteristics of a LED (variation of intensity of emitted light).
11. Determination of e/m by Thomson's method.
12. Determination of quantum efficiency of Photodiode.

Note: Minimum of **Eight (8)** experiments to be performed in a semester

ACTIVITY: INDUSTRY VISIT AND RELATED MINI PROJECT.

Reference Books

1. B.Sc Practical Physics by C.L Arora.
2. B.Sc Practical Physics by Harnam Singh and P.S Hemne.
3. Practical Physics by G.S Squires.
4. Practical Physics, D.C. Tayal, First Millennium Edition, 2000, Himalaya Publishing House.
5. B.Sc. Practical Physics, C.L. Arora, Revised Edition, 2007, S. Chand & Comp.Ltd.
6. An Advanced Course in Practical Physics, D. Chatopadhyaya, P.C. Rakshith, B. Saha, Revised Edition, 2002, New Central Book Agency Pvt. Ltd.
7. Physics through experiments, B. Saraf, 2013, Vikas Publications.

Scheme of Evaluation for Practical Examination

Examination duration: 04 hours

S.No	Particulars	Marks+ Allotted
1.	Basic formula with description, nature of graph if any & indication of unit	04
2.	Tracing of schematic ray diagram/Circuit diagram with description	04
3.	Tabulation	04
4.	Experimental skill & connection	04
5.	Record of observation and performance of experiment	08
6.	Calculation including drawing graph	06
7.	Accuracy of result with unit	02
8.	Journal assessment	04
9.	Oral performance	04
	Total	**40**

Question Paper pattern

First/Second/Third/Fourth Semester B.Sc. Degree Examination

PHYSICS

Time: 3 hours **Max. Marks: 80**

1.		**Answer any 10 sub question**	**10 x 2 = 20**
	i.		
	ii.		
	iii.		
	iv.		
	v.		
	vi.		
	vii.		
	viii.		
	ix.		
	x.		
	xi.		
	xii.		
2.			
	(a)		5 marks
	(b)		10 marks
		OR	
3.	(a)		5 marks
	(b)		10 marks
4	(a)		5 marks
	(b)		10 marks
		OR	
5	(a)		5 marks
	(b)		10 marks

6.	(a)	5 marks
	(b)	10 marks
		OR
7.	(a)	5 marks
	(b)	10 marks
8.	(a)	5 marks
	(b)	10 marks
		OR
9.	(a)	5 marks
	(b)	10 marks

****

Instruction to set the question paper.

1. Question number 1 has 12 sub questions consisting of 3 questions from each unit. Each question carries two marks. Student has to answer any ten questions. Problems appropriate to three marks may be asked.
2. Question number 2 and 3 are from unit I.
3. Question number 4 and 5 are from unit II.
4. Question number 6 and 7 are from unit III
5. Question number 8 and 9 are from unit IV.
6. Sub-questions b in Q No. 2,3,4,5,6,7,8 and 9 should be numerical problems for 5 marks wherever possible. Or else a suitable 5 mark question may be asked.
7. Student has to answer either question number 2 or 3, 4 or 5, 6 or 7 and 8 or 9.
   Note: In case student answered both the questions from the same unit in full or in part, highest marks from any one choice has to be considered.

Question Paper Pattern

Elective Papers

Time : 02 Hours **Maximum Marks: 40**

Question No : I

Answer any FIVE **2 x 5 = 10**

1	**02 questions from each unit**	**Total Marks = 10**
2		
3		
4		
5		
6		

Question No: II

Answer any FIVE **3 x 5 = 15**

7	**02 questions from each unit**	**Total Marks = 15**
8		
9		
10		
11		
12		

Question No: II

Answer any THREE **5 x 3 = 15**

13	**Minimum 01 questions from each unit**	**Total Marks = 15**
14		
15		
16		

Practical Examination Pattern For

DOMESTIC ELECTRICAL WIRING

Time : 04 Hours **Maximum Marks: 40**

S.No	Particulars	Marks Allotted
1.	Block diagram of experiment	05
2.	Circuit diagram with description	10
3.	Experimental skill & connection	10
4.	Working of Circuit	05
5.	Viva-voce questions (Write the answers to any 5 questions out of 9)	10
	Total	**40**