RANI CHANNAMMA UNIVERSITY BELAGAVI

THE COURSE STRUCTURE & SYLLABUS OF UNDER GRADUATE

BACHELOR OF SCIENCE

PHYSICS

1ST TO 6TH Semesters

w.e.f.

Academic Year 2020-21 and Onwards
Under

CHOICE BASED CREDIT SYSTEM (CBCS)

CHOICE BASED CREDIT SYSTEM [CBCS]
B.Sc. Program with Optional Subject: PHYSICS

B.Sc., PHYSICS Syllabus as per CBCS (With effect from the academic year 2020-21 onwards)								
Sem	Part	Paper Code	Title of the Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
I	Part – 1 DSC	PHYDSCT1.1	Mechanics and Theory of Relativity	4	20	80	100	3
		PHYDSCP1.1	Practical I	3	10	40	50	1
		Total : Hours / Credits		7			150	4
II	Part – 1 DSC	PHYDSCT2.1	Electricity & Magnetism	4	20	80	100	3
		PHYDSC P2.1	Practical II	3	10	40	50	1
		Total : Hours / Credits		7			150	4

B.Sc., PHYSICS Syllabus as per CBCS (With effect from the academic year 2021-22 onwards)								
Sem	Part	Paper Code	Title of the Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
III	Part – 1 DSC	PHYDSCT3.1	Thermodynamics-I, Sound and Waves	4	20	80	100	3
		PHYDSCP3.1	Practical III	3	10	40	50	1
	Part – 2 SEC	PHYSECT3.2	Weather Forecasting	2	10	40	50	2
		Total : Hours / Credits		9			200	6
IV	Part – 1 DSC	PHYDSCT4.1	Thermodynamics-II, Statistical Mechanics and Optics	4	20	80	100	3
		PHYDSCP4.1	Practical IV	3	10	40	50	1
	Part – 2 SEC	PHYSECT4.2	Renewable Energy sources and Energy Harvesting	2	10	40	50	2
		Total : Hours / Credits		9			200	6

CHOICE BASED CREDIT SYSTEM [CBCS]
B.Sc. Program with Optional Subject: PHYSICS

B.Sc., PHYSICS Syllabus as per CBCS (With effect from the academic year 2022-23 onwards)								
Sem	Part	Paper Code	Title of Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
V	Part – 1 DSE	PHYDSET5.1	Mathematical Physics – I, Nuclear and Particle Physics and Classical Mechanics	4	20	80	100	3
		PHYDSEP5.1	Practical V	3	10	40	50	1
		PHYDSET5.2A **(Elective I)**	Quantum Mechanics – I, Electronics and Optoelectronics	4	20	80	100	3
		PHYDSEP5.2A **(Elective I)**	Practical VIA	3	10	40	50	1
		PHYDSET5.2B **(Elective II)**	Modern Physics - I	4	20	80	100	3
		PHYDSEP5.2B **(Elective II)**	Practical VIB	3	10	40	50	1
	Part – 2 SEC	PHYSECT5.3	Basic Instrumentation Skills	2	10	40	50	2
		Total : Hours / Credits		16			350	10
Note: Students have to choose either Elective-I or Elective-II								
VI	Part – 1 DSE	PHYDSET6.1	Mathematical Physics – II, Atomic, Molecular and Optical Physics and Atmospheric Physics.	4	20	80	100	3
		PHYDSEP6.1	Practical VII	3	10	40	50	1
		PHYDSET6.2A **(Elective III)**	Quantum Mechanics – II, Condensed Matter Physics and Nanomaterials	4	20	80	100	3
		PHYDSEP6.2A **(Elective III)**	Practical VIIIA	3	10	40	50	1
		PHYDSET6.2B **(Elective IV)**	Modern Physics - II	4	20	80	100	3
		PHYDSEP6.2B **(Elective IV)**	Practical VIIIB	3	10	40	50	1
	Part – 2 SEC	PHYSECT6.3	Electrical Circuits And Network Skills	2	10	40	50	2
		Total : Hours / Credits		16			350	10
Note: Students have to choose either Elective-III or Elective-IV								

T: Theory, P: Practical, CC/EA: Co-curricular/Extension Activities. AECC: Ability Enhancement Compulsory Course, DSC: Discipline Specific Course. DSE: Discipline Specific Elective, SEC: Skill Enhancement Course)

Note: Duration of examinations is 03 Hrs for 80 Marks theory and 02 hrs for 40 marks theory. For practical's duration of examination is 03 Hrs.

Scheme of Evaluation for Practical Examination

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**

First Semester B.Sc. (Physics)

Paper Code: PHYDSCT1.1 **Paper Title:** Mechanics and Theory of Relativity
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 centre of mass. Distinction between laboratory frame of reference and centre of mass frame of reference. Concept of elastic and inelastic collisions. Derivation of final velocities in case of elastic collision in (i) laboratory frame of reference (ii) centre of mass frame of reference. Derivation of final velocities in case of inelastic collision in (i) laboratory frame of reference (ii) centre 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. **15 Hours**

Unit II

Gravitation

Newton's law of Gravitation (statement). Expressions for escape velocity and orbital velocity. 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 G.P.S. and NAVIC.

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. **15 Hours**

Unit III

Elasticity

Statement of Hook's law. Behavior of wire under stress. Modulus 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 moments. Theory of cantilever. Derivation of Young's modulus by bending of beam supported at its ends and loaded at middle.

15 Hours

Unit IV

Theory of Relativity

Inertial and non inertial frames of references. Newtonian principle of relativity. Galilean transformation equations. Michelson Morley experiment and negative results. Postulates of special theory of relativity. Lorentz transformation equations. Length contraction. Time dilation. Addition of velocities. Derivation of variation of mass with velocities. Derivation of Einstein's mass-energy relation.

15 Hours

REFERENCE BOOKS:

1) Fundamentals of Physics- R.Resnik, D. Halliday and Walker; Wiley 6ed(**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) Mechanics- Berkeley Physics Course Vol(1)- SI units Charles Kittel etal, McGrawHill Education (India) 2e (2011).
8) Elements of Properties of matter – D S Mathur, S.chand(GL) 7 Co Ltd,Dehi 1ed(**2010**)
9) Properties of Matter - Brijlal & Subramanyam, S Chand & Co, (**2002)**
10) Newtonian Mechanics- A P French, Nelson & Sons UK, (**1971**)
11) Mechanics & Thermodynamics, G Basavaraju & Dipan Ghosh, McGrawHill Education India) 1ed (**1985**)
12) A treatise on general properties of matter, Sengupta and Chatterjee, New Central Book Agency Pvt Ltd, Calcutta (7^{th} Revised edition -**2010**)
13) Waves & Oscillations, P K Mittal & Jai Dev Anand, Hari Anand Publications Pvt Ltd (2011ed)
14) Perspectives of Modern Physics, Arthur Beiser, Mc- Graw Hill;
15) Introduction to Special Theory of Relativity, Rober Resnick, John Wiley and Sons First Edition
16) Special Relativity, A P French, MIT, w.w. Nortan and Company First Ed (**1968)**
17) Concepts of Modern physics McGraw hill Education(India) Pvt Ltd;6^{th} ed **(2000)**
18) Principles of Modern Physics, A.P. French, John Wiley, London (1958).
19) Modern Physics - S.N. Ghoshal, Part 1 and 2 S. Chand and Company (1996).
20) Advanced analytical dynamics : Dynamic of rigid body, Utpal Chatterjee, Academic Publishers, first edition,(2016).
21) Theory of mechanics, kinematics and dymanics : V. R. Gupta, I K International publishing house Pvt. Ltd, (2013).
22) Dynamics of Rigid Body : A. K. Sharma, Discovery Publishing Group,(2007).
23) Properties of matter : R. Murugeshan, S Chand & Co Ltd Publication.
24) Theory of Elasticity : P. N. Chandramouli, Yes Dee publishers(2017).
25) An introduction to the theory of elasticity : R. J. Atkin & N. Fox, Dover Publications Inc.(2005).
26) Theory of elasticity : Dr. Sadhu Singh, Khanna publishers, (1978).
27) B.Sc Physics - C. L. Arora.
28) Mechanics, S P Taneja, R Chand & Co New Delhi

Practical

Paper Code: PHYDSCP1.1 **Paper Title: Practical I**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Error analysis, data analysis technique and graphing technique to be learnt (mandatory).
2. Moment of Inertia of Fly wheel
3. Young's modulus (Y) by Cantilever- Load Vs depression graph.
4. Modulus of rigidity by Maxwell needle method.
5. Young's modulus (Y) by uniform bending- Load Vs depression graph.
6. Bar pendulum- determination of g
7. Modulus of rigidity by Torsional pendulum
8. Spring Constant by Flat spiral Spring.
9. Verification of parallel axis theorem of Moment of Inertia.
10. Verification of perpendicular axis theorem of Moment of Inertia.
11. Verification of Hook's law.
12. q by stretching method.
13. Searle's double bar method to determine Young's Modulus.
14. Torsional pendulum- to determine C and rigidity modulus.
15. Coupled oscillator- string coupled with change of tension.
16. To determine rigidity modulus by dynamic method.

Note :

1. Experiments are of three 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 Code:PHYDSCT2.1 **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. 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 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 (1) 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 Helmoltz Galvanometer.

Magnetic Properties

Magnetic intensity, Magnetic induction, Magnetic potential. Derivation of Magnetic intensity and magnetic potential due to dipole (magnet). Permeability and magnetic susceptibility. Distinction between dia, para, and ferromagnetic materials. Ampere Circuital Law (statement).

Electromagnetic induction

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

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.

15 Hours

Unit IV

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. CRO block diagram. Use of CRO in the measurement of Voltage, Frequency and Phase.

Dielectrics

Types of dielectric (polar and non polar molecules). 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.

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, 7^{th} 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, 28^{th} Reprint,(**1999**).
15) Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5^{th} 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 Code: PHYDSCP2.1 **Paper Title: Practical II**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1 Thevenin's & Norton's theorem (Ladder Network)
2 Thevenin's & Norton's theorem (Whestone Bridge)
3 High resistance by leakage method
4 Time constant of RC circuit by charging and discharging method.
5 Calibration of Ammeter using Helmoltz Galvenometer
6 Constants of Ballistic Galvanometer
7 LCR series and parallel resonance circuit
8 De Sauty's AC bridge
9 Self Inductance by Rayleigh's method
10 Use of CRO to find voltage, frequency and phase.
11 L & C by Equal Voltage Method
12 Black Box- Identify & Measure R, L & C
13 Anderson's Bridge to determine the self inductance of the coil (L).
14 Verification of Superposition Theorem
15 Verification of maximum Power Transfer Theorem

Note :

1. Experiments are of three 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.
6. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

Third Semester B.Sc. (Physics)

Paper Code: PHYDSCT3.1 **Paper Title**: Electricity, Thermodynamics-I, 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, r.m.s and most probable velocity. Mean free path. Derivation of Clausius expression of mean free path.

Transport Phenomena

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

Black Body Radiation

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

15 Hours

Unit II

Thermodynamics

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 of Otto and Diesel engines with expressions for efficiency. Change of entropy in reversible and irreversible process. Entropy- Temperature diagram. Third law of thermodynamics. Derivation for Maxwell's thermodynamic relations. Clausius-Clapeyron's equation.

15 Hours

Unit III

Fluids

Surface Tension. Surface temperature and surface energy. Excess pressure on curved liquid surfaces and special cases in liquid drop, cylindrical surface and soap bubble. Variation of surface tension with temperature (qualitative). Determination of surface tension by Jaeger's method. Viscosity. Rate of flow of fluid. Velocity gradient. Coefficient of viscosity. Derivation of Poiseuille's formula (for liquid). Determination of coefficient of viscosity by Stokes method. Variation of viscosity with temperature and pressure.

Low Temperature and Low Pressure Physics

Joule Thomson effect. Porous plug experiment. Theory of Porous plug experiment. Exhaust Pump and its characteristics (with deduction for speed of pump). Theory, construction and working of Diffusion pump. Theory, construction and working of Ionization Gauge.

15 Hours

Unit IV

Waves

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.

Sound

Simple harmonic motion. Analytical treatment of forced vibration and resonance. Theory of Helmoltz 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. **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.

Practical

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

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Viscosity by Stokes Method
2. Surface tension by Jaegers method
3. Helmoltz Resonator
4. Velocity of sound through wire (sonometer)
5. Characteristics of Loud speaker
6. Thermal conductivity by Lee's method
7. Verification of Newton's law of cooling
8. Specific heat by cooling.
9. Verification of Stefan's law of radiation.
10. Characteristics of microphone
11. Lissajous figures using CRO
12. Thermo-Electric Circuit to find Seebeck Effect
13. Thermal Behavior of Bulb Filament.
14. Calibration of thermistor for temperature measurement.
15. Calibration of thermocouple for temperature measurement.

Note :

1. Experiments are of three 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.
6. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

Third Semester B.Sc. (Physics) Skill Enhancement Course

Paper Code: PHYSECT3.2 **Paper Title:** Weather Forecasting
Teaching Hours: 2Hrs / Week **Marks:** Th-40+IA-10
TOTAL HOURS :30 **Credits :**2

The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques

Unit I

Introduction to atmosphere: Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics.

Measuring the weather: Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws.

Weather systems: Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.

15 Hours

Unit II

Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate.

Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.

15 Hours

Unit III

Demonstrations and Experiments:

1. Study of synoptic charts & weather reports, working principle of weather station.
2. Processing and analysis of weather data:

(a) To calculate the sunniest time of the year.
(b) To study the variation of rainfall amount and intensity by wind direction.
(c) To observe the sunniest/driest day of the week.
(d) To examine the maximum and minimum temperature throughout the year.
(e) To evaluate the relative humidity of the day.
(f) To examine the rainfall amount month wise.

3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind

charts and its analysis.

4. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation)

References:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman & Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

Fourth Semester B.Sc. (Physics)

Paper Code:PHYDSCT4.1 **Paper Title:** Thermodynamics-II, Statistical Mechanics and Optics
Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20
Total hours :60 **Credits :**3

Unit I

Thermodynamic Relations

Four Fundamental thermodynamic potentials (Internal energy, Enthalpy, Helmoltz free energy and Gibbs free energy). Maxwell's equations from thermodynamic potentials. Derivation for (C_p-C_v) and $\frac{C_p}{C_v}$ using Maxwell's Equations. Three Tds equations using Maxwell's relations.

Statistical Mechanics

Concepts of thermodynamic ensembles (micro-canonical, canonical and grand canonical ensembles). Phase Space- Micro state & Macro state. Thermodynamic probabilities. Maxwell-Boltzman Statistics. Derivation for Maxwell- Boltzman distribution function. Limitations Maxwell-Boltzman 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

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 $\pi = T\frac{dE}{dT}$ & $\sigma_A - \sigma_B = T\frac{d^2E}{dT^2}$ 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.

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.

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. Diffraction grating. Theory of plane transmission grating. Resolving power. Rayleigh's criteria. Resolving power of prism. Resolving power of telescope. Resolving power of grating (qualitative).

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

15 Hours

REFERENCE BOOKS:

1) Statistical Mechanics, An Introduction, **Evelyn Guha**, Narosa (**2008**)
2) Statistical Mechanics, ***R.K.Pathria***, 2nd edition, Pergamon Press (**1972**)
3) Statistical and Thermal physics, ***F.Reif***, McGraw Hill International(**1985**)
4) Statistical Mechanics, ***K.Huang***, Wiley Eastern Limited, New Delhi (**1975**).
5) Fundamentals of Statistical Mechanics: B. B. Laud, New Age International Publishers, 2nd Edn.
6) Heat and Thermodynamics- Brij Lal and N Subramanyam, S Chand & Co, New Delhi -1985.
7) Heat and Thermodynamics – D S Mathur, SChand & Co, New Delhi, 5th Edition (2004).
8) Heat and Thermodynamics and Statistical Physics (XVII Edition) –Singhal, Agarwal and Satyaprakash.
9) Introduction to Thermoelectricity: H. Julian Goldsmith, Springer Science & Business Media, (2009).
10) Optics, Ajoy Ghatak, Tata Mc Graw Hill, 4th Edition
11) Introduction to Modern Optics, Ajoy Ghatak, Tata McGraw Hill Publications (**2009**).
12) Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, (**1994)**
13) A K Ghatak and K Thyagarajan, Contemporary Optics, Macmillan/Premium Publishing Corp(**1978**).
14) Jenkins and White, Optics, McGraw Hill Education India Pvt Ltd 4th ed(**2011**).
15) Optics, Brij Lal and Subramaniam, S Chand & Company, 22nd Edition, (**1994**).
16) Principles of Optics, B K Mathur, Gopal Printing Press, Kanpur, 6th Edition, (**1996**).
17) Geometrical Optics (I-Edition) **–** D.P.Acharya (Oxford & IBH Pub. Co., 1970).
18) Optics and Spectroscopy (VI Edition) **–** Murugeshan, Kiruthiga and ShivaPrasad (S.Chand).
19) Fundamentals of Optics (V-Edition) **–** Khanna and Bedi (R.Chand, New Delhi).
20) Geometrical Optics: A. Verstraetin

Practical

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

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Dispersive Power of Prism
2. Determination of thermo emf
3. Thermoelectric power using potentiometer
4. Determination of wavelength of monochromatic light using single slit / plane transmission grating.
5. Diffraction Grating in minimum Deviation Position
6. Diffraction Grating in Normal Position
7. Newton's Rings : Determination of Radius of curvature of Plano Convex lens
8. Newton's Rings : Determination of RI of Water
9. Fresnel's Biprism – Determination of wavelength of monochromatic light.
10. Resolving Power of Telescope
11. Resolving Power of Grating
12. Resolving Power of Prism
13. Specific rotation of optically active solution using Polarimeter
14. Verification of Brewster's Law
15. Stefan's constant by black body radiation.

Note :

1. Experiments are of three 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

Fourth Semester B.Sc. (Physics) Skill Enhancement Course

Paper Code: PHYDSCT4.2 **Paper Title:** Renewable Energy Sources
Teaching Hours: 2Hrs / Week **Marks:** Th-40+IA-10
Total hours:30 **Credits :**2

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Unit I

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems. Sun tracking systems.

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics. Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.

15 Hours

Unit II

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications. Carbon captured technologies, cell, batteries, power consumption.
Environmental issues and Renewable sources of energy, sustainability.

15 Hours

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

References:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.

3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004,
5. Oxford University Press, in association with The Open University.
6. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
7. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
8. http://en.wikipedia.org/wiki/Renewable_energy

Fifth Semester B.Sc. (Physics)

Paper Code:PHYDSCT5.1 **Paper Title:** Mathematical Physics – I, Nuclear and Particle Physics and Classical Mechanics

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

Total hours:60 **Credits :**3

Unit I

MATHEMATICAL PHYSICS – I

INTEGRAL TRANSFORMS

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.

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

15 Hours

Unit II

NUCLEAR AND PARTICLE PHYSICS - I

RADIOACTIVE DECAY, DETECTORS AND ACCELERATORS

Radioactive Decay : Laws of radioactive decay, half – life, mean life, decay constant; theory of successive disintegration (expression for number of atoms of n^{th} element in the chain – Bateman equations); radioactive equilibrium (secular and transient - cases of long lived parent, short lived parent, daughter and parent of nearly equal half – life).

Alpha decay : Range and energy, Geiger- Nuttal law , Characteristics of alpha spectrum, Gamow's theory of alpha decay [Barrier height, tunneling effect, $\lambda=Pf$, f is the frequency of collision of nucleon with the potential barrier; P is the probability of transmission through the barrier); Barrier penetrability factor (no derivation). Derivation of Q-value-of alpha decay; Exact energy of alpha particle emitted.

Alpha particle scattering : Rutherford's theory of alpha scattering (assuming the path to be hyperbolic).

Beta decay : Types of beta decay (electron, positron decay and electron capture) Characteristics of beta spectrum and Pauli's neutrino hypothesis.

Detectors : Variation of ionization current with applied voltage in a gas counter, Proportional counter, GM Counter (Construction, working, characteristics, efficiency and quenching).

Particle accelerators : Linear accelerator, Cyclotron, Betatron

15 Hours

Unit III

NUCLEAR AND PARTICLE PHYSICS - II

NUCLEAR REACTIONS AND PARTICLE PHYSICS

NUCLEAR REACTIONS : Types of reactions, Conservation laws in nuclear reactions with examples, derivation of Q – value for reactions using the energy – momentum conservation, exoergic and endoergic reactions, threshold energy , reaction rate, reaction cross – section, concept of direct and compound reactions, resonance reaction; Power reactors.

ELEMENTARY PARTICLES : Classification of elementary particles, Fundamental interactions

(Gravitational, Electromagnetic, Weak, strong – range, relative strength, particle interactions for each); Symmetries and Conservation Laws (momentum, energy, charge, parity, lepton number, baryon number, isospin, strangeness and charm); Concept of Quark Model, Color quantum number and gluons.

15 Hours

Unit IV

CLASSICAL MECHANICS

Lagrangian Mechanics: Constraints, generalized co-ordinates, D Alembert's principle, Lagrange equation from D'Alemberts Principle. Advantage of Lagrangian equation, Velocity dependent potentials and dissipation function. Applications of Lagrangian formulation in case of simple pendulum and Atwood Machine. Hamilton's principle, Derivation of Lagrange's equation from Hamilton's Principle. Symmetry and conservation laws: momentum conservation, cyclic co-ordinates, angular momentum conservation and conservation of energy.

15 Hours

Reference Books:

1) Mathematical Physics ---H. K. Dass and Dr. Rama Verma
2) Mathematical Methods for Physicists (4^{th} 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) Mathematical Physics - M.L.Boas
6) Atomic and Nuclear Physics, S. N. Ghoshal: Vol. II. (2000)
7) Alpha, beta and gamma spectroscopy, K. Seighbahn: Vol. I and II, John Wiley (1967)
8) Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
9) Nuclear Physics, D C Tayal, Himalaya Publishing House, 5^{th} Edition
10) Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
11) Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
12) Introduction to Elementary Particles, D. Griffith, John Wiley & Sons 2^{nd} revised ed (**2008**)
13) Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi(**2008**)
14) Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, (2004).
15) Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, (**2000**).
16) Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., (**1991**)
17) Classical Mechanics: Goldstein, Narosa Publishing Pvt. Ltd. (1998).
18) Introduction to Classical Mechanics: R. G. Takwale & P. S. Puranik.-Tata McGraw Hill, New Delhi (1997).
19) Classical Mechanics, Aruldas

Practical

Paper Code: PHYDSCP5.1 **Paper Title: Practical V**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Characteristics of GM Tube
2. Verification of Inverse Square law using GM Tube.
3. Attenuation of B-ray using G.M. counter
4. Ionization potential of xenon or mercury
5. Frank Hertz Experiment
6. Calibration of Thermocouple using Meter bridge (Whetsone's bridge)
7. Astable Multivibrator using Transistor
8. Phase Shift Oscillator using Op-Amp
9. Wein Bridge Oscillator using Op-Amp
10. Millikan's oil drop experiment.
11. Determination of e/m by Thomson's method.
12. Op-Amp inverting and non-inverting amplifier – ac or dc.
13. Op-Amp as a differiantial amplifier- Common mode and Differential mode.
14. Op-Amp as summing amplifier- ac and dc.
15. Op-Amp as integrator and differentiator.

Note :

1. Experiments are of three 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

Fifth Semester B.Sc. (Physics) Elective I

Paper Code: PHYDSCT5.2A **Paper Title:** Quantum Mechanics–I, Electronics and Optoelectronics.

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

Total hours:60 **Credits :**3

Unit I

QUANTUM MECHANICS – I

Failure of Classical Physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photoelectric effect, Compton effect and specific heat of solids, Planck's quantum theory, Explanation of the above effects on the basis of quantum mechanics [Experimental observation, failure of classical theory, quantum mechanical explanation, Photoelectric effect -Einstein's explanation, Compton Effect – mention of expression for wavelength shift (no derivation), Specific heat of solids -Einstein's and Debye's explanation of specific heat (qualitative). Stability of atom and atomic spectra, Black body radiation [Mention of Planck's equation, arrive at Wien's and Rayleigh-Jean's equation for energy distribution from Planck's equation].

de Broglie's hypothesis of matter waves (λ in terms of momentum, energy, temperature for monatomic gas molecules); Thomson's experiment; Davisson and Germer's experiment – normal incidence method; Concept of wave packet, Group velocity and particle velocity (relation between group velocity and particle velocity) Heisenberg's uncertainty principle - different forms; Gamma ray microscope experiment; Application to Non – existence of electron in nucleus.

15 Hours

Unit II

ELECTRONICS - I

Semiconductors

Distinction between metals, semiconductors and insulators based on band theory (qualitative). Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration (derivation for both holes and electrons) and electrical conductivity – extrinsic semiconductors – concept of doping. Formation of P-N junction, depletion region, barrier potential (qualitative), Biased P-N junction, drift and diffusion current –expression for diode current.

Special Diodes: Zener diode – characteristics and its use as a voltage regulator. Photo diodes, Solar cells and LED (working principle with energy level diagram).

Transistors: Transistor action, Characteristics (CE mode), DC Biasing , Load line analysis (Operating Point, Fixed Bias – Forward bias of Base – Emitter, collector – emitter loop, transistor saturation, Load line analysis ; Voltage divider bias – Transistor saturation, Load line analysis)

Transistor as an amplifier(CE mode); . H-parameters.

15 Hours

Unit III

ELECTRONICS - II

Oscillators:Transistor as an oscillator, comparison between amplifier and oscillator, Classification of oscillators-damped and undamped oscillators, the oscillatory circuit, Barkhausen Criterion, frequency of oscillatory current, essentials of a feedback LC oscillator. Hartely and Phase shift oscillators

Field Effect Transistor (FET)

FET-Types, characteristics and parameters. FET as a common source amplifier (Qualitative).

Operational amplifiers

Block Diagram of an OPAMP, Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open loop configuration - Limitations, Gain Bandwidth Product, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground.

Feedback concepts, Advantages of feedback, types of feedback, Expression for Gain; OPAMP as a feedback amplifier – Non – Inverting and Inverting amplifier, Modification of input and output impedances with feedback ; Voltage follower; Differential amplifier with feedback.

Linear Applications - frequency response of Low pass, high pass and band pass filters (first order), inverting summing amplifier, ideal Differentiator, Integrator.

DIGITAL ELECTRONICS

Number Systems : binary, octal, hexadecimal (interconversions); Number codes : BCD, Gray Code (conversions to other systems); Signed Numbers; Arithmetic using Radix and Radix -1 complement.

Logic gates and truth tables : OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR.

15 Hours

Unit IV

OPTOELECTRONICS

Light Emitting Diodes, Photo Diodes, Principle of LED with energy level diagram, Semiconductor Laser Diodes: homojunction and heterojunction laser diodes principle (Pin, Avalanche diodes), Photo transistor, Opto-coupler.

Optical fiber: description and classification; Why glass fibers? Types of Optical fibers (Single mode, Multi mode optical fibres), Ray dispersion in multi-mode step index fibers. Grading, Numerical aperture (derivation), Coherent bundle, Transmission loss: bending loss and splicing loss, Attenuation and Distortion, Fiber Optical communication system (Block diagram with each block explanation).

15 Hours

Reference Books:

1) Quantum Mechanics, B.H. Bransden and C.J. Joachain, 2nd Edition, Pearson Education (2004)
2) Introduction to Quantum Mechanics, David J. Griffiths, 2nd Edition, Pearson Education ,(2005)
3) Modern Quantum Mechanics, J.J. Sakurai, Pearson Education, (2000)
4) Principles of Quantum Mechanics, Ghatak and Lokanathan, Macmillan, (2004)
5) Concepts of Modern Physics, Beiser 3rd edition, Student edition, New Delhi (1981).
6) Principles of Electronics by V K Mehta and Rohit Mehta, SChand & Company, Eleventh Edition, (2008).
7) Electricity & Electronics, D C Tayal, Himalaya Publishing House, Sixth Edition(1988)
8) Basic Electronics & Linear Circuits, NN Bhargava, DC Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28th Reprint, (1999).
9) Basic electronics by B Basavraj, Vikas publication, 2nd edition.
10) Op-amp and linear integrated circuits, R. A. Gayakwad, Pearson education.
11) Electronic devises, Thomas Floyd, Pearson publications (ninth edition 201).
12) Optoelectronics – By Ajay Ghatak.
13) Fiber optic communication – By D.C. Agarwal.
14) Fiber optical communication – By Keiser.
15) Introduction to Optical Electronics – By J.Wilson & Hawkes PHI.

Practical: Elective I

Paper Code: PHYDSCP 5.2 **Paper Title:** **Practical VIA**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Transistor as CE Amplifier
2. H- Parameter of transistor
3. Heartley Oscillator using Transistor
4. Phase Shift Oscillator using Transistor
5. FET Characteristics
6. FET as an Amplifier
7. Use of Basics gates to verify and design AND, OR, NOT and XOR gates using NAND gates.
8. De Morgan Theorems.
9. To covert Boolean Expression in to Logic gate circuit and assemble it using logic gate IC's.
10. Low Pass Filter Using Op-Amp
11. High Pass Filter Using Op-Amp
12. Band Pass Filter Using Op-Amp
13. Transistor as an Emitter Follower.
14. Regulated power supply using Zener diode.

Note :

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

References :

1. Worsnop and Flint , Advanced practical physics for students, Asia Pub.(**1979**)
2. Singh and Chauhan, Advanced practical physics, 2 vols., Pragati prakashan, (**1976**)
3. Misra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
4. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
5. Ramalingom & Raghuopalan : A Lab. Course in Electronics
6. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)

Fifth Semester B.Sc. (Physics) Elective II

Paper Code:PHYDSCT5.2B **Paper Title:** Mathematical Physics, Nuclear and Particle Physics and Classical Mechanics

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

Total hours:60 **Credits :**3

Unit I

ELECTRONICS - I

Semiconductors

Distinction between metals, semiconductors and insulators based on band theory (qualitative). Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration (derivation for both holes and electrons) and electrical conductivity – extrinsic semiconductors – concept of doping. Formation of P-N junction, depletion region, barrier potential (qualitative), Biased P-N junction, drift and diffusion current –expression for diode current.

Special Diodes: Zener diode – characteristics and its use as a voltage regulator. Photo diodes, Solar cells and LED (working principle with energy level diagram).

Transistors: Transistor action, Characteristics (CE mode), DC Biasing , Load line analysis (Operating Point, Fixed Bias – Forward bias of Base – Emitter, collector – emitter loop, transistor saturation, Load line analysis ; Voltage divider bias – Transistor saturation, Load line analysis)

Transistor as an amplifier(CE mode); . H-parameters.

15 Hours

Unit II

ELECTRONICS - II

Oscillators:Transistor as an oscillator, comparison between amplifier and oscillator, Classification of oscillators-damped and undamped oscillators, the oscillatory circuit, Barkhausen Criterion, frequency of oscillatory current, essentials of a feedback LC oscillator. Hartely and Phase shift oscillators

Field Effect Transistor (FET)

FET-Types, characteristics and parameters. FET as a common source amplifier (Qualitative).

Operational amplifiers

Block Diagram of an OPAMP, Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open loop configuration - Limitations, Gain Bandwidth Product, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground.

Feedback concepts, Advantages of feedback, types of feedback, Expression for Gain; OPAMP as a feedback amplifier – Non – Inverting and Inverting amplifier, Modification of input and output impedances with feedback ; Voltage follower; Differential amplifier with feedback.

Linear Applications - frequency response of Low pass, high pass and band pass filters (first order), inverting summing amplifier, ideal Differentiator, Integrator.

DIGITAL ELECTRONICS

Number Systems : binary, octal, hexadecimal (interconversions); Number codes : BCD, Gray Code (conversions to other systems); Signed Numbers; Arithmetic using Radix and Radix -1 complement.

Logic gates and truth tables : OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR.

15 Hours

Unit III

OPTOELECTRONICS

Light Emitting Diodes, Photo Diodes, Principle of LED with energy level diagram, Semiconductor Laser Diodes: homojunction and heterojunction laser diodes principle (Pin, Avalanche diodes), Photo transistor, Opto-coupler.

Optical fiber: description and classification; Why glass fibers? Types of Optical fibers (Single mode, Multi mode optical fibres), Ray dispersion in multi-mode step index fibers. Grading, Numerical aperture (derivation), Coherent bundle, Transmission loss: bending loss and splicing loss, Attenuation and Distortion, Fiber Optical communication system (Block diagram with each block explanation).

15 Hours

Unit IV

QUANTUM MECHANICS – I

Failure of Classical Physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photoelectric effect, Compton effect and specific heat of solids, Planck's quantum theory, Explanation of the above effects on the basis of quantum mechanics [Experimental observation, failure of classical theory, quantum mechanical explanation, Photoelectric effect -Einstein's explanation, Compton Effect – mention of expression for wavelength shift (no derivation), Specific heat of solids -Einstein's and Debye's explanation of specific heat (qualitative). Stability of atom and atomic spectra, Black body radiation [Mention of Planck's equation, arrive at Wien's and Rayleigh-Jean's equation for energy distribution from Planck's equation].

de Broglie's hypothesis of matter waves (λ in terms of momentum, energy, temperature for monatomic gas molecules); Thomson's experiment; Davisson and Germer's experiment – normal incidence method; Concept of wave packet, Group velocity and particle velocity (relation between group velocity and particle velocity) Heisenberg's uncertainty principle - different forms; Gamma ray microscope experiment; Application to Non – existence of electron in nucleus.

15 Hours

Reference Books:

16) Quantum Mechanics, B.H. Bransden and C.J. Joachain, 2nd Edition, Pearson Education (2004)
17) Introduction to Quantum Mechanics, David J. Griffiths, 2nd Edition, Pearson Education ,(2005)
18) Modern Quantum Mechanics, J.J. Sakurai, Pearson Education, (2000)
19) Principles of Quantum Mechanics, Ghatak and Lokanathan, Macmillan, (2004)
20) Concepts of Modern Physics, Beiser 3rd edition, Student edition, New Delhi (1981).
21) Principles of Electronics by V K Mehta and Rohit Mehta, SChand & Company, Eleventh Edition, (2008).
22) Electricity & Electronics, D C Tayal, Himalaya Publishing House, Sixth Edition(1988)
23) Basic Electronics & Linear Circuits, NN Bhargava, DC Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28th Reprint, (1999).
24) Basic electronics by B Basavraj, Vikas publication, 2nd edition.
25) Op-amp and linear integrated circuits, R. A. Gayakwad, Pearson education.
26) Electronic devises, Thomas Floyd, Pearson publications (ninth edition 201).
27) Optoelectronics – By Ajay Ghatak.
28) Fiber optic communication – By D.C. Agarwal.
29) Fiber optical communication – By Keiser.
30) Introduction to Optical Electronics – By J.Wilson & Hawkes PHI.

Practical: Elective II

Paper Code: PHYDSEP5.2B **Paper Title:** **Practical VIB**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Transistor as CE Amplifier
2. H- Parameter of transistor
3. Heartley Oscillator using Transistor
4. Phase Shift Oscillator using Transistor
5. FET Characteristics
6. FET as an Amplifier
7. Use of Basics gates to verify and design AND, OR, NOT and XOR gates using NAND gates.
8. De Morgan Theorems.
9. To covert Boolean Expression in to Logic gate circuit and assemble it using logic gate IC's.
10. Low Pass Filter Using Op-Amp
11. High Pass Filter Using Op-Amp
12. Band Pass Filter Using Op-Amp
13. Transistor as an Emitter Follower.
14. Regulated power supply using Zener diode.

Note :

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

References :

1. Worsnop and Flint , Advanced practical physics for students, Asia Pub.(**1979**)
2. Singh and Chauhan, Advanced practical physics, 2 vols., Pragati prakashan, (**1976**)
3. Misra and Misra, Physics Lab. Manual, South Asian publishers (**2000**)
4. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)
5. Ramalingom & Raghuopalan : A Lab. Course in Electronics
6. Bharagav et al : Electronics, TTI tata MacGraw Hill 33rd Reprint (**2002**)

Fifth Semester B.Sc. (Physics) Skill Enhancement Course

Paper Code:PHYSECT5.1 **Paper Title:** Basic Instrumentation Skills

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

Total hours :30 **Credits :**2

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics

Unit I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. **Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance.

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

15 Hours

Unit II

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

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

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

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time-base stability, accuracy and resolution. **15 Hours**

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit

9. Balancing of bridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

References:

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

Sixth Semester B.Sc. (Physics)

Paper Code: PHYDECT6.1 **Paper Title:** Mathematical Physics – II. Atomic Molecular and Optical Physics and Atmospheric Physics

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

Total hours:60 **Credits :**3

Unit I

MATHEMATICAL PHYSICS - II

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 Polynomials: Rodrigues Formula, generating functions and recursion relations, Orthogonality and normalization. Bessel function of the first kind, recursion relations, orthogonality. Hermite functions, generating functions and recursion relations, orthogonality. and Laguerre and associated Laguerre polynomials, recursion relations.

15 Hours

Unit II

ATOMIC PHYSICS.

Vector Model of the Atom

Review of Bohr's theory of hydrogen atom, Sommerfeld's modification of the Bohr atomic model (qualitative). Spatial quantization and spinning electron. Different quantum numbers associated with the vector atom model, Spectral terms and their notations, Selection rules, Coupling schemes(*l*-s and j-j coupling in multi electron systems), Pauli's Exclusion Principle, Expression for maximum number of electrons in an orbit. Spectra of alkali elements (sodium D-line), Larmor precession, Bohr magneton, Stern-Gerlach Experiment **.** Zeeman Effect- Experimental study, theory of normal and anomalous Zeeman effect based on quantum theory. Paschen Back effect (qualitative).

15 Hours

Unit III

MOLECULAR PHYSICS AND LASERS.

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

Lasers

Introduction; Spontaneous and stimulated emission; Einstein's coefficients and optical amplification; Population inversion; Main components of a laser; Lasing action; Ruby Laser - construction and working - energy level diagram; He-Ne Laser - construction and working - energy level diagram; Spatial Coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density.

15 Hours

Unit IV

ATMOSPHERIC PHYSICS

Fixed gases and variable gases; Temperature structure of the atmosphere; Hydrostatic balance,

Variation of pressure with altitude, scale height; Relative and Absolute humidity.
Beer's law (derivation); Global energy balance for earth – atmosphere system, Greenhouse effect; Atmosphere dynamics –Accelerated rotational frames of reference – Centripetal and Coriolis force (derivation), Gravity and pressure gradient forces (with derivation), Applications of Coriolis force – Formation of trade winds, cyclones, erosion of river banks

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) Mathematical Physics - M.L.Boas
6) Introduction to Atomic Physics – H.E. White
7) Introduction to Modern Physics – H.S. Mani, G.K. Mehta-West Press (1989)
8) Physics of Atoms and Molecules – 2nd Ed., Brans den B.H. and JoachainC.J., Pearson Education, India (2006)
9) Principles of Modern Physics, A.P. French, John Wiley, London (1958).
10) Modern Physics - S.N. Ghoshal, Part 1 and 2 S. Chand and Company (1996).
11) Physics of the Atom, Wehr et. al. McGraw Hill
12) Lasers and Non-Linear Optics: B.B.Laud, Wiley Eastern Ltd., New Delhi (1991).
13) Principles of Lasers : O. Svelto, Plenum Press, N. Y. (1982).
14) Laser Electronics : Joseph T. Verdeyen, Prentice-Hall of India Pvt. Ltd. NewDelhi (1989).
15) Lasers : Theory & Applications : K. Thyagarajan & A. Ghatak, MacMillan India, New Delhi (1981).
16) Laser Fundamentals : W.Q. Silfvast
17) Laser Principles & Applications : J. Wilson & J.F.B. Hawkes, Prentice-Hall Intl. Inc. (1983)
18) An Introduction to Lasers & their Applications : Donald C. O' Shea, W. Russell Callen & William T. Rhodes, Addison-Wesley, N. Y. (1977).
19) Introduction to atmospheric physics, David G Andrews, Cambridge university press publisher, 2nd edition.
20) Atmospheric science, John M Wallace, Peter V Hobbs, Academic press publisher, 2nd edition.

Practical

Paper Code: PHYDSCP6.1 **Paper Title: Practical VII**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Air Wedge: Thickness of thin paper by measuring width of fringes produced by Air wedge film

2. Divergence of laser beam and finding angular spread
3. Determination of unknown wavelength by Grating element (using red and green diode lasers)
4. Zeeman Effect experiment.
5. Rydberg Constant: wavelength of spectral lines of Hydrogen and Rydberg constant calculation (assignment)
6. Study of Hydrogen Spectrum
7. Determination of e/m by Thomson Method.
8. Characteristics of Laser Diode
9. Optical fibre; Bending loss and attenuation
10. Zener Diode as Voltage regulator
11. Photoconductive cell characteristics
12. Photovoltaic Cell characteristics
13. Verification of Beer's law.
14. Relative humidity using hair hygrometer.
15. Estimation of relative humidity using wet and dry bulb thermometer.

Note :

1. Experiments are of three hours duration.
2. Minimum of eight experiments to be performed
3. **References :**

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practcal physics, Pragati prakashan, 1976.

Sixth Semester B.Sc. (Physics) Elective III

Paper Code:PHYDECT6.2A **Paper Title:** Quantum Mechanics-Ii, Condensed Matter Physics – I and nanomaterials

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

Total hours :60 **Credits :**3

Unit I

QUANTUM MECHANICS-II

The concept of wave function, physical significance of wave function. Development of time dependent and time independent Schrodinger's wave equation. Max Born's interpretation of the wave function. Normalization and expectation values, Quantum mechanical operators, Eigen values and Eigen functions. Applications of Schrodinger's equation – free particle, particle in one dimensional box- derivation of Eigen values and Eigen function for infinite and finite potential well and tunnelling; Development of Schrodinger's equation for One dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom – mention of Eigen function and Eigen value for ground state. **15 Hours**

Unit II

CONDENSED MATTER PHYSICS – I

Crystal systems and X-rays: Crystal structure **:**Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, Coordination numbers, Bravais lattices, Seven crystal system, Miller Indices, Expression for inter planner spacing, Crystal structure of NaCl and KCl. Crystal diffraction: 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. Bragg's X-ray spectrometer-powder diffraction method of crystal structure determination.

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 $E<E_f$, at $T\neq 0$ and $E>E_f$, F(E) vs E plot at $T = 0$ and $T\neq 0$. Density of states for free electrons (no derivation); Specific heats of solids: Classical theory, Einstein's and Debye's theory of specific heats. Hall Effect in metals.

Superconductivity : Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect, Type I and type II superconductors.

15 Hours

Unit III

Magnetic Properties of Matter and Dielectrics

Magnetic Properties of Matter

Review of basic formulae : Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia – , Para –, and ferro – magnetic materials;

Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft magnetic materials

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

15 Hours

Unit IV

NANOMATERIALS

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). Characterisation 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); Mention of applications: (Fuel cells, catalysis, phosphors for HD TV, elimination of pollutants, sensors).

SPECIAL MATERIALS

Liquid crystals: Classification of liquid crystals, Display system. Introduction to polymers, classification and applications.

15 Hours

Reference Books:

1) Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (**2004**)
2) Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education , (**2005**)
3) Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (**2000**)
4) Principles of Quantum Mechanics, ***Ghatak and Lokanathan***, Macmillan, (**2004**)
5) Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
6) Solid State Physics- **A J Dekker**, MacMillan India Ltd, (**2000**)
7) Elementary Solid State Physic, **J P Srivastava**,PHI,(**2008**)
8) Essential of crystallography**, M A Wahab**, Narosa Publications (**2009)**
9) Solid State Physics-**F W Ashcroft and A D Mermin**-Saunders College (**1976**)
10) Solid State Physics-**S O Pillai**-New Age Int. Publishers (**2001**)
11) Solid State Physics-R. K. Puri and V.K. Babber., S.Chand publications,1st Edition(2004).
12) Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragati prakashan Meerut(2017).
13) Condensed Matter Physics by Atulkumar Agarwal,Oxford Book Company(2013)
14) Nano materials, A K Bandopadhyay. New Age International Pvt. Ltd. Publishers (**2007**)
15) Nanocrystals, C. N. Rao, P. John Thomas.
16) Nanotubes and wires, C. N. Rao, A. Govindaraj

Practical: Elective III

Paper Code: PHYDSCP 6.2A **Paper Title: Practical VIIIA**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1. Determination of Plank's constant by Photo Cell
2. Hall Effect in semiconductor: determination of mobility, hall coefficient.
3. Eenergy gap of semiconductor (diode/transistor) by reverse saturation method

4. Thermistor energy gap
5. Fermi Energy of Copper
6. Analysis of X-ray diffraction spectra and calculation of lattice parameter.
7. Plank's constant by LED
8. Solar Cell: Fill Factor and Efficiency
9. Specific Heat of Solid by Electrical Method
10. Determination of Dielectric Constant of polar liquid.
11. Determination of dipole moment of organic liquid
12. B-H Curve Using CRO.
13. Calibration of Semiconductor temperature Sensor
14. Spectral Response of Photo Diode and its I-V Characteristics.
15. Determination of particle size from XRD pattern using Debye-Scherrer formula.

Note :

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

References :

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics, Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, (**2000**)
6. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)

Sixth Semester B.Sc. (Physics) Elective IV

Paper Code: PHYDECT6.2B **Paper Title:** Modern physics-II
Teaching Hours: 4 Hrs / Week **Marks:** Th-80+IA-20
Total hours :60 **Credits :**3

Unit I

CONDENSED MATTER PHYSICS – I

Crystal systems and X-rays: Crystal structure **:**Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, Coordination numbers, Bravais lattices, Seven crystal system, Miller Indices, Expression for inter planner spacing, Crystal structure of NaCl and KCl. Crystal diffraction: 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. Bragg's X-ray spectrometer-powder diffraction method of crystal structure determination.

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 $E<E_f$, at $T\neq 0$ and $E>E_f$, F(E) vs E plot at T = 0 and $T\neq 0$. Density of states for free electrons (no derivation); Specific heats of solids: Classical theory, Einstein's and Debye's theory of specific heats. Hall Effect in metals.

Superconductivity : Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect, Type I and type II superconductors.

15 Hours

Unit II

Magnetic Properties of Matter and Dielectrics

Magnetic Properties of Matter

Review of basic formulae : Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia – , Para –, and ferro – magnetic materials;

Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft magnetic materials

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

15 Hours

Unit III

NANOMATERIALS

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). Characterisation 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); Mention of applications: (Fuel cells, catalysis, phosphors for HD TV, elimination of pollutants, sensors)

SPECIAL MATERIALS

Liquid crystals: Classification of liquid crystals, Display system. Introduction to polymers, classification and applications.

15 Hours

Unit IV

QUANTUM MECHANICS-II

The concept of wave function, physical significance of wave function. Development of time dependent and time independent Schrodinger's wave equation. Max Born's interpretation of the wave function. Normalization and expectation values, Quantum mechanical operators, Eigen values and Eigen functions. Applications of Schrodinger's equation – free particle, particle in one dimensional box- derivation of Eigen values and Eigen function for infinite and finite potential well and tunnelling; Development of Schrodinger's equation for One dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom – mention of Eigen function and Eigen value for ground state.

15 Hours

Reference Books:

1) Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (**2004**)
2) Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education , (**2005**)
3) Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (**2000**)
4) Principles of Quantum Mechanics, ***Ghatak and Lokanathan***, Macmillan, (**2004**)
5) Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
6) Solid State Physics- **A J Dekker**, MacMillan India Ltd, (**2000**)
7) Elementary Solid State Physic, **J P Srivastava**,PHI,(**2008**)
8) Essential of crystallography**, M A Wahab**, Narosa Publications (**2009)**
9) Solid State Physics-**F W Ashcroft and A D Mermin**-Saunders College (**1976**)
10) Solid State Physics-**S O Pillai**-New Age Int. Publishers (**2001**)
11) Solid State Physics-R. K. Puri and V.K. Babber., S.Chand publications,1st Edition(2004).
12) Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragati prakashan Meerut(2017).
13) Condensed Matter Physics by Atulkumar Agarwal,Oxford Book Company(2013)
14) Nano materials, A K Bandopadhyay. New Age International Pvt. Ltd. Publishers (**2007**)
15) Nanocrystals, C. N. Rao, P. John Thomas.
16) Nanotubes and wires, C. N. Rao, A. Govindaraj

Practical: Elective IV

Paper Code: PHYDSCP .2B **Paper Title: Practical VIIIB**

Teaching Hours: 3 Hrs / Week **Marks:** Th-40+IA-10

Credits : 1

1) Determination of Plank's constant by Photo Cell
2) Hall Effect in semiconductor: determination of mobility, hall coefficient.
3) Eenergy gap of semiconductor (diode/transistor) by reverse saturation method
4) Thermistor energy gap
5) Fermi Energy of Copper
6) Analysis of X-ray diffraction spectra and calculation of lattice parameter.
7) Plank's constant by LED
8) Solar Cell: Fill Factor and Efficiency
9) Specific Heat of Solid by Electrical Method
10) Determination of Dielectric Constant of polar liquid.
11) Determination of dipole moment of organic liquid
12) B-H Curve Using CRO
13) Calibration of Semiconductor temperature Sensor
14) Spectral Response of Photo Diode and its I-V Characteristics.
15) Determination of particle size from XRD pattern using Debye-Scherrer formula.

Note :

1. Experiments are of three hours duration.
2. Minimum of eight experiments to be performed.
3. **References :**

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics, Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, (**2000**)
6. Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)

Sixth Semester B.Sc. (Physics) Skill Enhancement Course

Paper Code: PHYDECT6.3 **Paper Title:** Electric circuits and Networks skills
Teaching Hours: 2 Hrs / Week **Marks:** Th-40+IA-10
Total hours:30 **Credits :**2

The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode

Unit I

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

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

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

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

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

15 Hours

Unit II

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

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

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

15 Hours

Reference Books:

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

Question Paper pattern

First Semester B.Sc. Degree Examination, December 2020
(CBCS Scheme-2020-21: Regular)
PHYSICS
PHYDSC T11: Mechanics and Theory of relativity

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.
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. 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 part, highest marks from any one choice has to be considered.

Question paper pattern for skill enhancement course, SEC

Third Semester B.Sc. Degree Examination, December 2021
(CBCS Scheme-2020-21: Regular)
PHYSICS
PHYSEC T32: Skill Enhancement Course

Time: 2 hours Max. Marks: 40

1.		**Answer any 5 sub question**	**5 x 2 = 10**
	i.		
	ii.		
	iii.		
	iv.		
	v.		
	vi.		
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

Instruction to set the question paper.

7. Question number 1 has 6 sub questions consisting of 3 questions from each unit. Each question carries two marks. Student has to answer any five questions.
8. Question number 2 and 3 is from unit I.
9. Question number 4 and 5 is from unit II.
10. Student has to answer either question number 2 or 3, 4 or 5.
    Note: In case student answered both the question from the same unit in full or part, highest marks from any one choice has to be considered.