DAV UNIVERSITY JALANDHAR

Scheme & Syllabus

For

B.Sc. (HONOUR SCHOOL) PHYSICS

(Program ID-)

1st TO 6th SEMESTER

Examinations 2015–16 Session

Syllabi Applicable For Admissions in 2015 onwards

Scheme of Courses B. Sc.-2015-16

B.Sc. (HONOUR) PHYSICS

Semester 1

S. No	Course Code	Course Title	Course Type	L	T	P	Cr
1	PHY101A	Mechanics	Core	4	0	0	4
2	PHY102A	Electricity and Magnetism	Core	4	0	0	4
3	PHY121	Mathematical Physics-I	Core	4	0	0	4
4	PHY104A	Physics Laboratory-I	Core	0	0	4	2
5	SGS107	Human Values and General Studies	AECC	4	0	0	4
6	Generic Elective-I		GE				6
7	Generic Elective-II		GE				4
Total							28

GE (Generic Electives)-I (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	CHE153	Organic Chemistry	4	0	0	4
	CHE154	Organic Chemistry Lab	0	0	4	2
2.	MTH325	Analytical Geometry	5	1	0	6

GE (Generic Electives)-II (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	MTH 155A	Matrices and Infinite series	4	0	0	4
2	MTH121	Calculus	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses B. Sc.-2015-16

B.Sc. (HONOUR) PHYSICS

Semester 2

S. No.	Course Code	Course Name	Course Type	L	T	P	C
1	PHY111A	Vibrations and Waves	Core	4	0	0	4
2	PHY131	Analog System and Application	Core	4	0	0	4
3	PHY132	Waves and Analog Electronics Laboratory	Core	0	0	4	2
4	ENG151A	Basic Communications Skills	AECC	3	0	0	3
5	ENG152	Basic Communications Skills Lab		0	0	2	1
6	EVS100	Environment Education	AECC	4	0	0	4
7	Generic Elective-III		GE				6
8	Generic Elective-IV		GE				4
Total							28

GE (Generic Electives)-III (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	CHE155	Spectroscopy	4	0	0	4
	CHE156	Chemistry Lab	0	0	4	2
2	MTH327	Discrete Mathematics	5	1	0	6

GE (Generic Electives)-IV (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	MTH 156A	Calculus & Geometry	4	0	0	4
2	MTH181	Linear Algebra	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses B. Sc.-2015-16

B.Sc. (HONOURSCHOOL) PHYSICS

Semester 3

S. No	Course Code	Subject	Course type	L	T	P	C
1	PHY221	Digital Systems and Application	Core	4	0	0	4
2	PHY222	Mathematical Physics-II	Core	4	0	0	4
3	PHY223	Mathematical Laboratory	Core	0	0	4	2
4	PHY224	Digital Electronics Laboratory	Core	0	0	4	2
5	Skill Enhancement Course-I		SEC	2	0	0	2
6	Generic Elective-V		GE				6
7	Generic Elective-VI		GE				4
Total							24

GE (Generic Electives)-V (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	CHE253	Inorganic Chemistry	4	0	0	4
	CHE254	Inorganic Chemistry Laboratory	0	0	4	2
2	MTH328	Probability & Statistics	5	1	0	6

GE (Generic Electives)-VI (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	MTH 255A	Differential Equations and Fourier series	4	0	0	4
2	MTH206A	Number Theory	4	0	0	4

SEC (Skill Enhancement Course)-I (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	PHY225	Weather Forecasting	2	0	0	2
2	PHY226	Radiation Safety	2	0	0	2

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses B. Sc.-2015-16

B.Sc. (HONOURSCHOOL) PHYSICS

Semester 4

S. No	Course Code	Subject	Course type	L	T	P	Cr
1	PHY231	Optics	Core	4	0	0	4
2	PHY232	Elements of Modern Physics	Core	4	0	0	4
3	PHY233	Optics and Modern Physics Laboratory	Core	0	0	4	2
4	PHY234	Thermal and Statistical Physics	Core	4	0	0	4
5	PHY235	Thermal and Statistical Physics Laboratory	Core	0	0	4	2
6	Discipline Specific Elective-I		DSE	4	0	0	4
7	Generic Elective-VII		GE				4
Total							24

GE (Generic Electives)-VII (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	CSA350	C Programming	3	0	0	3
	CSA351	C Programming Lab	0	0	2	1
2	CHE403	Spectroscopy and Natural Molecules	4	0	0	4

DSE (Discipline Specific Elective)-I (Choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	PHY324	Physics of the Earth	4	0	0	4
2	PHY325	Laser Physics	4	0	0	4
3	PHY326	Biological Physics	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses B. Sc.-2015-16
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Semester 5

Sr. No.	Course Code	Subject	Course type	L	T	P	Cr
1	PHY303A	Solid State Physics	Core	4	0	0	4
2	PHY322	Quantum Physics	Core	4	0	0	4
3	PHY323	Quantum and Solid State Laboratory	Core	0	0	4	2
4	Generic Elective-VIII		GE				6
5	Generic Elective-IX		GE				4
6	Discipline Specific Elective-I		DSE	4	0	0	4
Total							22

Generic Elective-VIII (choose One)

S. No.	Course code	Course Name	L	T	P	Cr.
1	CHE353	Physical Chemistry	4	0	0	4
	CHE354	Physical Chemistry Laboratory	0	0	4	2
2	MTH333	Linear Programming	5	1	0	6

GE (Generic Electives)-IX (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	MTH 351A	Integral Transforms and Complex Analysis	4	0	0	4
2	MTH 309A	Special Functions & Integral Transforms	4	0	0	4

Discipline Specific Elective-II (Choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	PHY327	Experimental Techniques	4	0	0	4
2	PHY328	Physics of Devices and Communication	4	0	0	4
3	PHY329	Embedded systems- Introduction to Microcontroller	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses B. Sc.-2015-16

B.Sc. (HONOURS) PHYSICS

Semester 6

Sr. No.	Course Code	Course Name	Course type	L	T	P	C
1	PHY330	Electromagnetic Theory	Core	4	0	0	4
2	PHY331	Nuclear Physics	Core	4	0	0	4
3	PHY332	EMT and Nuclear Physics Laboratory	Core	0	0	4	2
4	PHY341	Matlab	Core	2	0	0	2
5	Skill Enhancement Course-II		SEC	2	0	0	2
6	Discipline Specific Elective-III		DSE	4	0	0	4
6	Discipline Specific Elective-IV		DSE	4	0	0	4
			Total				22

SEC (Skill Enhancement Course)-I (choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	PHY333	Technical Skills	2	0	0	2
2	PHY334	Renewable Energy and Energy harvesting	2	0	0	2
3	PHY340	Space weather	2	0	0	2

DSE (Discipline Specific Elective)-III (Choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	PHY335	Nano Materials and Application	4	0	0	4
2	PHY336	Vacuum Science	4	0	0	4
3	PHY337	Astronomy and Astrophysics	4	0	0	4

DSE (Discipline Specific Elective)-IV (Choose one)

S. No.	Course code	Course Name	L	T	P	Cr.
1	PHY338	Atmospheric Physics	4	0	0	4
2	PHY339	Particle physics	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Course Name: Mechanics
Course Code: PHY101A

L	T	P	Cr.
4	0	0	4

Unit 1: Fundamentals of Dynamics (15)

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

Work and Energy: Work and Kinetic Energy Theorem. Conservative and nonconservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Unit 2: Rotational Dynamics and Elasticity (15)

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Unit III Central forces and non-inertial systems (15)

Central forces and Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Unit 4: Special Theory of Relativity (15)

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

Reference Books:

1. D. Kleppner, R.J. Kolenkow, An introduction to mechanics, New Delhi: McGraw-Hill, 1973.
2. C.Kittel, W.Knight, et.al. Mechanics, Berkeley Physics, vol.1, New Delhi: Tata McGraw-Hill, 2007.
3. Resnick, Halliday and Walker, Physics, 8/e. Wiley, 2008.

4. G.R. Fowles and G.L. Cassiday, Analytical Mechanics, New Delhi: Cengage Learning, 2005.
5. R. P. Feynman, R. B. Leighton, M. Sands, Feynman Lectures, Vol. I, Pearson Education, 2008.
6. R. Resnick, Introduction to Special Relativity, John Wiley and Sons, 2005.
7. R. L. Reese University Physics, Thomson Brooks/Cole, 2003.
8. D.S. Mathur, Mechanics, New Delhi: S. Chand and Company Limited, 2000.
9. F.W Sears, M.W Zemansky, H.D Young, University Physics. 13/e, Addison Wesley, 1986.

Course Name: Electricity and Magnetism
Course Code: PHY102A

L	T	P	Cr.
4	0	0	4

Unit-I **(18)**

Electrostatics

Conservation and quantization of charge, Coulomb's Law, Concept of electric field, Electric flux, Gauss's law and its applications, Electric potential difference and Electric Potential, Conservative nature of Electrostatic Field, Relation between Electric field and Electric potential, Differential form of Gauss's law, Laplace's equation and Poisson's equation, Electric potential and Electric Field of a dipole.

Electrostatic potential energy of system of charges, Potential Energy of charged sphere, Conductors in an electrostatic Field, Method of electric images and its applications

Unit-II **(16)**

Magnetostatics

Magnetic field, Magnetic force on a current carrying wire, Torque acting on a current loop placed in a uniform magnetic field, Biot-Savart's law and its applications, Ampere's Circuital law and its applications, Force on parallel current carrying wires, Curl and Divergence of magnetic field, Magnetic vector potential and its expression.

Electromagnetic Induction

Faraday's law (Differential and integral form), Lenz's law, Self Inductance and Mutual Inductance, Reciprocitytheorem, Energy stored in a Magnetic field, A circuit containing self-inductance, Displacement current and Maxwell's equations.

Unit-III **(14)**

Dielectric Properties of Matter

Dielectric, Electric field in matter, Polarization vector(P), Dielectric constant, Capacitor with a dielectric, Electric Susceptibility, Gauss's law in dielectrics, Displacement Vector(D), Relations between E, P and D, Energy Stored in capacitor, Electromagnetic energy density.

Magnetic Properties of Matter

Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, B-H curve and hysteresis.

Unit-IV **(12)**

Electrical Circuits and Network Theorems

Kirchhoff's laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit, Parallel LCR Circuit, Ideal Constant-voltage and Constant-current Sources, Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem.

Ballistic Galvanometer

Torque on a current Loop, Ballistic Galvanometer: Current and Charge Sensitivity, Electromagnetic damping, Logarithmic damping.

REFERENCE BOOKS:

1. E.M.Purcell, Electricity and Magnetism. New York: McGraw Hill Education, 1986.
2. A. Kip, Fundamentals of Electricity and Magnetism. New York: McGraw Hill, 1968
3. A. S. Mahajan and A. A. Rangwala, Electricity and Magnetism. New Delhi: Tata McGraw Hill, 1988.
4. D. C. Tayal, Electricity and Magnetism. New Delhi: Himalaya Publishing House.
5. J. H. Fewkes, and J. Yarwood, Electricity and Magnetism. UK: Oxford University Press, 1991.
6. D. J. Griffiths, Introduction to Electrodynamics. Benjamin Cummings, 3rd Edn, 1998.

Course Name: Mathematical Physics-I

Course Code: PHY121

L	T	P	Cr.
4	0	0	4

Unit I **(17)**

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

Unit II **(13)**

Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Unit III **(15)**

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.

Unit IV **(15)**

Statistical distributions, second moments and standard deviations, definition of probability, fundamental laws of probability, discrete probability distributions, combinations and permutations, continuous distributions – expectation, moments and standard deviation, Binomial, Poisson and Gaussian distributions, applications to experimental measurement.

Reference books

1. K.F Riley, M.P. Hobson and S. J. Bence,Mathematical Methods for Physics and Engineers, , 3rd ed., Cambridge University Press 2006
2. P. Dennery and A.Krzywicki,Mathematics for Physicists, Dover Publications,1967
3. E.A. Coddington,An introduction to ordinary differential equations, PHI learning, 2009.
4. George F. Simmons, Differential Equations, McGraw Hill,2007.

Course Name: Physics Laboratory-I
Course Code: PHY104A

L	T	P	Cr.
0	0	4	2

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipments.

List of Experiments:

1. Measurements of length (or diameter) using verniercaliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity
5. To determine the Moment of Inertia of a Flywheel.
6. To determine **g** and velocity for a freely falling body using Digital Timing Technique
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.
13. To study the characteristics of a series RC Circuit.
14. To determine an unknown Low Resistance using Potentiometer.
15. To determine an unknown Low Resistance using Carey Foster's Bridge.
16. To compare capacitances using De'Sauty's bridge.
17. Measurement of field strength B and its variation in a solenoid (determine dB/dx).
18. To verify the Thevenin and Norton theorems.
19. To verify the Superposition, and Maximum power transfer theorems.
20. To determine self inductance of a coil by Anderson's bridge.
21. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
22. Determine a high resistance by leakage method using Ballistic Galvanometer.
23. To determine self-inductance of a coil by Rayleigh's method.

L	T	P	Cr.
4	0	0	4

Course Name: Vibrations and Waves
Course Code: PHY111A

Unit I Harmonic Vibrations (15)

Sinusoidal vibrations, Simple harmonic motion, Period, Frequency and Amplitude, Energy of a simple harmonic oscillator, Superposition Principle, Superposition of Two Harmonic Waves, Phase and Group Velocities, Superposition of large number of simple harmonic vibrations, Anharmonic Oscillators, Damped simple harmonic vibrations, Decay of free vibrations due to damping, Types of damping, Methods of finding the damping coefficient of a damped vibrating system.

Unit II Forced and coupled vibrations (15)

Harmonic forced oscillators, Relation between velocity and driving force frequency, Power supplied to the Forced Oscillator by the driving force, Forced oscillations with damping, Quality factor of a forced oscillator, Coupled Oscillations, Stiffness Coupled Oscillators, Normal coordinates, Degrees of freedom, Normal modes of vibrations, Forced vibrations and resonance for two coupled oscillators, Inductance coupling of electrical oscillators, Masses on a string with coupled oscillators.

Unit III Wave Motion (15)

What is wave?, Plane and Spherical Waves, Longitudinal and Transverse Waves, Progressive Waves, Energy in Progressive waves, Wave Equation, Particle and Wave Velocities, Energy Transport, Intensity of Wave, Velocity of Waves, Velocity of Transverse Vibrations of Stretched Strings, Stationary waves on a string, Energy of a vibrating string, Velocity of Longitudinal Waves in a Fluid in a Pipe.

Unit IV Transmission of signals and Electromagnetic Waves (15)

Transmission of a non-monochromatic wave, Frequency range and Signal duration, Bandwidth theorem, Group and phase velocities, Electromagnetic theory of dispersion, Doppler effect, Electromagnetic (EM) waves: Maxwell Equations, Wave equation, EM waves in a medium of finite ε, μ and σ. Energy flow due to a plane EM wave, EM waves in a conducting medium, Skin depth.

Reference Books

1. S P Puri, Vibrations and Waves, Macmillan India Ltd.,2004.
2. H. J. Pain, The Physics of Vibrations and Waves, John Wiley and Sons, 2013.
3. N.K. Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill, 1998

L	T	P	Cr.
4	0	0	4

Course Name: Analog System and Application
Course Code: PHY131

UNIT 1: SEMICONDUCTOR DIODES (15)

Semiconductor materials. doping. Energy Level Diagram. Carrier transport in semiconductors: Conductivity and Mobility, Concept of Drift velocity. Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode and its applications. Special diodes: Zener diode and voltage regulation, Principle and structure of LED, Photodiode and solar cells.

UNIT II: JUNCTION TRANSISTORS (15)

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Current components in transistors, Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions. Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. FET and MOSFET.

UNIT III: AMPLIFIERS AND OSCILLATORS (15)

Amplifiers, Classification of Class A, B & C Amplifiers. Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley &Colpitts oscillators.

UNIT 4: OPERATIONAL AMPLIFIER (15)

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.) Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation).

Reference Books:

1. J. Millman, and C. C. Halkias, Electronic Devices and Circuits. New Delhi: Tata McGraw Hill, 1983
2. J. D. Ryder, Electronic Fundamentals and Applications. New Delhi: Prentice Hall, 2004.
3. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, Singapore: John Wiley & Sons Inc., 1991
4. M. S. ShurIntroduction to Electronic Devices, Singapore: John Wiley & Sons Inc., 2000
5. B. G. Streetman and S. Banerjee, Solid State Electronic Devices, New Delhi: Prentice Hall India, 5th Edn, 2001.
6. S.Salivahananand N.S.Kumar,Electronic Devices & circuits, 3rd Edn.,New Delhi: Tata Mc-GrawHill, 2012.
7. R.A. Gayakwad,OP-Amps and Linear Integrated Circuit, 4th Edn., New Delhi: Prentice Hall, 2000.
8. A.S. Sedra, K.C. Smith, A.N. Chandorkar, Microelectronic circuits, 6th Edn., Oxford: Oxford University Press, 2014.

Course Name:Waves and Analog Electronics Laboratory
Course Code: PHY132

L	T	P	Cr.
0	0	4	2

List of experiments:

1. To determine the frequency of a tuning fork using a sonometer.
2. To verify the laws of transverse vibrations of stretched strings using a sonometer.
3. To determine the frequency of an electrically maintained tuning fork by Melde's experiment.
4. To determine the frequency of AC mains using a sonometer and an electromagnet.
5. To find the velocity of sound in the material of the given rod with a Knudt's tube. 22. To determine the velocity of ultrasonic waves in a given liquid.
6. To measure the logarithmic decrement, coefficient of damping, relaxation time and quality factor of a simple damped pendulum.
7. To find the resistivity of a semiconductor crystal by using the Four Probe technique and hence, determine the band gap of the material.
8. To determine the carrier concentration and mobility of the semiconductor crystal by using the Hall effect measurement technique.
9. To study V-I characteristics of PN junction diode, and Light emitting diode.
10. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
11. To study (a) Half-wave Rectifier and (b) Full-wave Bridge Rectifier and investigate the effect of C, L and π filters.
12. To study the current voltage characteristics of the Tunnel diode.
13. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
14. To study the characteristics of a Bipolar Junction Transistor in CE, CB and CC configurations.
15. To study the various biasing configurations of BJT.
16. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
17. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
18. To design a phase shift oscillator of given specifications using BJT.
19. To study the characteristics of Junction Field Effect Transistor (JFET).
20. To study the characteristic of Metal Oxide Semiconductor Field Effect Transistor (MOSFET).
21. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
22. To design a Wien bridge oscillator for given frequency using an op-amp.
23. To design a phase shift oscillator of given specifications using BJT.
24. To study the Colpitt`s oscillator.
25. To design a digital to analog converter (DAC) of given specifications.
26. To study the analog to digital convertor (ADC) IC.
27. To design an inverting amplifier using Op-amp (741, 351) for dc voltage of given gain
28. To design inverting amplifier using Op-amp (741, 351) and study its frequency response
29. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
30. To study the zero-crossing detector and comparator
31. To add two dc voltages using Op-amp in inverting and non-inverting mode
32. To design a precision Differential amplifier of given I/O specification using Op-amp.
33. To investigate the use of an op-amp as an Integrator.
34. To investigate the use of an op-amp as a Differentiator.

Course Name: Digital Systems and Application
Course Code: PHY221

L	T	P	Cr.
4	0	0	4

Unit I **(12)**

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Integrated Circuits (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.

Unit II (**15)**

Digital Circuits and Boolean algebra: Difference between Analog and Digital Circuits. Binary Numbers, Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal

numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. De Morgan's Theorems. Boolean Laws. Simplification of LogicCircuit using Boolean Algebra. Fundamental Products, Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Unit III **(20)**

Arithmetic and Sequential Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Unit IV **(13)**

Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.

Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram.

Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI.

Introduction to Assembly Language: 1 byte, 2 byte & 3 byte instructions.

Reference Books:

1. A. P. Malvino,and D. P. Leach, Digital Principles and Applications. New Delhi: Tata McGraw Hill, 1986.
2. A. P. Malvino, Digital Computer Electronics. New Delhi: Tata McGraw Hill, 1986.
3. W. H. Gothmann, Digital Electronics. New Delhi: Prentice Hall, 1980.
4. J. Millman,and H. Taub, Pulse, Digital and Switching Waveforms. New Delhi: Tata McGraw Hill, 1992.
5. A. Mottershead, Electronic Devices and Circuits. New Delhi: Prentice Hall, 1977.
6. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085. New Delhi: Prentice Hall, 2002.

L	T	P	Cr.
4	0	0	4

Course Name: Mathematical Physics-II
Course Code: PHY222

Unit-I **(15)**

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Error on the slope and intercept of a fitted line.

Solution of Algebraic and Transcendental Equations

Fixed-point Iteration Method, Bisection Method, Secant Method, Newton Raphson Method, and Generalized Newton's Method, Comparison and Error Estimation.

Matrices and Linear System of Equations

Solution of Linear Equations: Gauss Elimination Method, Gauss Seidel Iterative Method, Computation of Eigen values and Eigenvectors of Matrices by using Iterative Methods.

Unit-II **(15)**

Interpolation and Curve Fitting

Interpolation: Forward and Backward Differences. Symbolic Relation, Differences of a polynomial, Newton' Forward and Backward Interpolation Formulas, Divided Differences, Newton's General Interpolation Formula, Curve Fitting, Polynomial least squares and cubic spline fitting.

Unit-III **(15)**

Numerical Differentiation and integration:

Numerical Differentiation using Newton's Interpolation Formulas and Cubic Spline method, Errors inNumeric differentiation, Numerical integration General Quadrature Formula, Trapezoidal Rule, Simpson's 1/3 and 3/8 Rules, Weddle's Rule.

Unit-IV **(15)**

Solution of Ordinary Differential Equations

Euler's Method, Modified Eulers's Method, RungeKutta Method of Second Order with Error Estimation, Solution of 2Point Boundary Value Problems. Finite Difference approximation of Derivatives, Finite difference method.

Reference books

1. S. S. SastryIntroductory Methods of Numerical Analysis. New Delhi: PHI Learning Pvt. Ltd., 4th Ed, 2006.
2. J. D. Scarborough, Numerical Mathematical Analysis. Oxford & IBH Publishing, sixth Edition, 1966
3. K. E. Atkinson,Elementary Numerical Analysis New York: Wiley, 1985
4. R. W. Hamming, Numerical Methods for Scientists and Engineers . Courier Dover Publications, 1986
5. William H Schaum,Schaum's Outline of Programming with C++, New York: McGrawHill; 2nd Edition, 2000.
6. J. Hubbard, Numerical Recipes in C++: The Art of Scientific Computing , Cambridge University Press; 2nd Edition. 2000

L	T	P	Cr.
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Course Name: Mathematical Laboratory
Course Code: PHY223

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying experimental problems using FORTRAN 77 and C.

Note:

1. Students are expected to perform at least eight-ten experiments out of following list. The experiments performed in first semester cannot be repeated in second Semester.
2. The examination for both the courses will be of 3 hours duration

List of Experiments:

Experimental skills:

General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results.

1. Determination of Roots of algebraic equations:

a) Biseciton Method
b) Newton Raphson Method
c) Secant Method

2. Roots of linear equations:

a) Gauss Elimination Method.
b) Gauss Seidal Iterative Method.

3. Eigen Value problem:

a) Eigen value and Eigenvector of a Matrix by Iterative Method.

4. Integration:

a) Trapezoidal Rule
b) Simpson 1/3 and Simpson 3/8 rules
c) Gauss quadrature formula

5. Differential Equations:

a) Euler's method
b) Modified Euler's method
c) Range KuttaMethod(2nd order and 4th order)

6. Interpolation:

a) Newton's Forward interpolation,
b) Newton's Backward interpolation
c) Lagrange's interpolation

Course Name: Digital Electronics Laboratory
Course Code: PHY224

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1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. To minimize a given logic circuit.
8. Half Adder, Full Adder and 4-bit binary Adder.
9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
10. Parity generator and checker.
11. To study D/A and A/D convertors
12. To build Flip-flop Circuits using elementary gates (RS, Clocked RS, D type, and JK Flip-Flop).
13. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
14. To build JK Master-slave flip-flop using Flip-Flop ICs
15. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
16. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
17. Write the following programs using 8085 Microprocessor

a) Addition and subtraction of numbers using direct addressing mode
b) Addition and subtraction of numbers using indirect addressing mode
c) Multiplication by repeated addition.
d) Division by repeated subtraction.
e) Handling of 16-bit Numbers.
f) Use of CALL and RETURN Instruction.
g) Block data handling.
h) Other programs (e.g. Parity Check, using interrupts, etc.).

Course Name: Weather Forecasting
Course Code: PHY225

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Unit I **(9)**

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.

Unit II **(4)**

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.

Unit III **(9)**

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

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.

Unit IV **(8)**

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.

Reference books:

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

Course Name: Radiation Safety
Course Code: PHY226

L	T	P	Cr.
2	0	0	2

Unit I **(6)**

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

Unit II **(7)**

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, Interaction of Photons – Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and Moderation.

Unit III **(7)**

Radiation detection and monitoring devices: Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). Radiation detection**:** Basic concept and working principle of *gas detectors* (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), *Scintillation Detectors* **(**Inorganic and Organic Scintillators), *Solid States Detectors* and *Neutron Detectors, Thermoluminescent Dosimetry.*

Unit IV

(10)Radiation safety management: *Biological effects of ionizing radiation*, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management.

Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification, Sterization, Food preservation.

Reference Books:

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman, 1995
2. G.F.Knoll, Radiation detection and measurements
3. Thermoluninescense Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.

Course Name: Optics
Course Code: PHY231

L	T	P	Cr.
4	0	0	4

Unit I **(15)**

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

Interference: Interference: Division of amplitude and division of wave-front, Young's Double Slit experiment, Lloyd's Mirror and Fresnel's Biprism, Phase change on reflection: Stokes' treatment, Interference in Thin Films, parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (FizeauFringes), Newton's Rings: measurement of wavelength and refractive index, Michelson's Interferometer: Idea of form of fringes, Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.

Unit II **(15)**

Diffraction: Difference between Fresnel and Franunhoffer diffraction, Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating, Diffraction of N slits and its discussion, Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, Fresnel Diffraction: Half-period zones, Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Unit III **(15)**

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization, Polarization by transmission and reflection, Malus Law, Brewster's Law, Polarization by refraction, anisotropic crystals, Theory ofdouble refraction, Elliptically and circularly polarized light, Quarter wave and half wave plates, Production and detection of polarized light.

Unit IV **(15)**

LASERs: Attenuation of light in an optical medium; thermal equilibrium; interaction of light with matter: Induced, Spontaneous and Stimulated Emissions, Einstein relations; laser beam characteristics and applications, light amplification; populationinversion; active medium, pumping; metastable states; principle pumping schemes; Laser Action, Components of Lasers, Types of lasers; Ruby Laser, Semiconductor Laser, He- Ne Laser and Semiconductor Laser.

Reference Books:

1. F. A. Jenkins and H. E. White Fundamentals of Optics, McGraw-Hill , 1976
2. H. R. Gulati and D. R. Khanna Fundamentals of Optics, R. Chand Publications, 1991
3. N. Subramanayam, B. Lal, & M. N. Avadhamulu, Textbook of Optics. New Delhi: S. Chand & Company, 2006.
4. A. Ghatak,Optics. New Delhi: Tata McGraw Hill Publication, 2008

Course Name: Elements of Modern Physics
Course Code: PHY232

L	T	P	Cr.
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Unit I **(15)**

Drawbacks of classical mechanics, foundations of quantum mechanics: Planck's quantum, Blackbody Radiation, Quantum theory of Light; Photo-electric effect and Compton scattering; de - Broglie wavelength and matter waves; Davisson-Germer experiment; Wave description of particles by wave packets. Group and Phase velocities and relation between them; Two-Slit experiment with electrons; Probability; Wave amplitude and wave functions.
Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Energy-time uncertainty principle

Unit II **(15)**

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles - time dependent and independent, Operators and wavefunction : Momentum, Energy, Hamiltonian operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Eigen values and eigen functions, Postulates of quantum mechanics, Probability and probability current densities in one dimension. One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

Unit III **(15)**

X-rays Spectra: Origin of X-rays from electromagnetic theory, X-ray diffraction, Bragg's law, Laue Spots, Continuous X-ray spectrum, Characteristics absorption and emission Spectra, Moseley's law, Applications of Moseley's law

Atoms in Electric & Magnetic Fields: Electron angular momentum; Space quantization. Electron Spin and Spin Angular Momentum.Larmor's Theorem; Spin Magnetic Moment.Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magnetron

Unit IV **(15)**

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

Many electron atoms: Pauli's Exclusion Principle; Symmetric & Antisymmetric Wave Functions;Fine structure; Spin orbit coupling; Spectral Notations for Atomic States; Total angular momentum; Spin-orbit coupling in atoms- L-S and J-J couplings; Hund's Rule; Spectra of Hydrogen

Reference Books:

1. H. E. White, Introduction to Atomic Spectra. London: McGraw Hill, 1934.
2. C. B. Banwell, Fundamentals of molecular spectroscopy, New Delhi: Tata McGraw Hill, 1986.
3. G. M. Barrow, Introduction to Molecular spectroscopy. New York: McGraw Hill, 1962.
4. G. Herzberg, Spectra of diatomic molecules.New York: Van Nostr and Reinhold, 1950.
5. J. L. McHale,Molecular spectroscopy. New Jersey: Prentice Hall, 1999.
6. Arthur Beiser,Concepts of Modern Physics, McGraw-Hill, 2002.
7. Rich Meyer, Coop Kennard, Introduction to Modern Physics, Tata McGraw Hill, 2002
8. David J. Griffith,Introduction to Quantum Mechanics, Pearson Education. 28, 2005.
9. A.K.Ghatak&S.Lokanathan,Quantum Mechanics: Theory & Applications, Macmillan, 2004.

Course Name: Optics and Modern Physics Laboratory
Course Code: PHY233

L	T	P	Cr.
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List of experiments

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Study of Solar Cell characteristics
3. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
4. To determine work function of material of filament of directly heated vacuum diode.
5. To determine the Planck's constant using LEDs of at least 4 different colours.
6. To determine the wavelength of H-alpha emission line of Hydrogen atom.
7. To determine the ionization potential of mercury.
8. To determine the absorption lines in the rotational spectrum of Iodine vapour.
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.
11. To show the tunneling effect in tunnel diode using I-V characteristics.
12. To determine the wavelength of laser source using diffraction of single slit.
13. To determine the wavelength of laser source using diffraction of double slits.
14. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
15. Study of C.R.O. as display and measuring device, Study of Sinewave, square wave signals (half wave and full wave rectification)
16. Study of excitations of a given atom by Franck Hertz set up.
17. To determine charge to mass ratio (e/m) of an electron by Thomson method.
18. To determine the thermionic work function of tungsten
19. To determine the speed of light in air.
20. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
21. To determine the Resolving Power of a Prism.
22. To determine wavelength of sodium light using Fresnel Biprism.
23. To determine wavelength of sodium light using Newton's Rings.
24. To determine the wavelength of Laser light using Diffraction of Single Slit.
25. To study the wavelength of spectral lines of sodiumlight using plane transmission grating.
26. To study the specific rotation of sugar solution Laurent's half shade polarimeter method
27. To compare the focal length of two lenses by Nodal slide method.

Course Name: Thermal and Statistical Physics
Course Code: PHY234

L	T	P	Cr.
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UNIT-I Basic Thermodynamics (15)

Laws of Thermodynamics, The zeroth law, indicator or PV diagrams, work done, internal energy, Carnot cycle, Carnot's engine. Entropy as a thermodynamic variable; reversible and irreversible processes, Principle of increase of entropy, Statistical basis of entropy, Thermodynamic scale of temperature; its identity with perfect gas scale, impossibility of attaining absolute zero.

UNIT-II Maxwell Relations (15)

Thermodynamic potentials and equilibrium of thermodynamic systems, Maxwell's equations, ClausiusClapeyron equation, Joule Thomson effect, Use of Joule Thomson effect in liquefaction of gasses, Low temperatures: Production and measurement of very low temperatures, adiabatic demagnetization, Phase transitions of first and second orders, phase diagrams of Helium, Gibbs phase rule and its applications.

UNIT-III Statistical Physics (17)

Scope of statistical physics, micro and macrostates, thermodynamic probability distribution of n particles in two compartments, deviation from the state of maximum probability; equilibrium state of dynamic system, distribution of distinguishable particles in compartments and cells, phase space and its division into cells, Boltzmann statistics for ideal gas, Bose Einstein statistics and its applications to photon gas, Fermi Dirac statistics and its application to electron gas, comparison of the three statistics.

UNIT-IV Theory of Thermal Radiation (13)

Properties of Thermal Radiation, Blackbody Radiation, Spectral distribution of Blackbody radiation, Kirchhoff's Law and applications, Radiation Pressure, Stefan Boltzmann Law Thermodynamical proof, Planck's Quantum Postulates, Planck's Law of Blackbody Radiation, Rayleigh Jeans Law, Stefan Boltzmann Law, Wien's displacement Law from Planck's Law.

Reference Books:

1. R.H. Swendsen, An Introduction to Statistical Mechanics & Thermodynamics. Oxford: Oxford University Press, 2012.
2. C. S Helrich,. Modern Thermodynamics with Statistical Mechanics. Berlin: Springer, 2009.
3. V.S. Bhatia, Statistical Physics and Thermodynamics. New Delhi: Vishal Publication, 1986.
4. M.W. Zemansky, and R.H. Dittman, Heat and Thermodynamics. New York: McGraw-Hill, 1996.
5. S Lokanathan.andR. S. Gambhir, Statistical and Thermal Physics. New Delhi:rentice Hall, 1991.

Course Name: Thermal and Statistical Physics Laboratory
Course Code: PHY235

L	T	P	Cr.
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Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitiveequipments.

Note:

• Students are expected to perform at least eight-ten experiments out of following list. The experiments performed in first semester cannot be repeated in second Semester.

• The examination for both the courses will be of 2hours duration

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne'sconstant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.
8. To measure the thermal conductivity and thermal diffusivity of a conductor.
9. To determine the value of Stefan's Constant of radiation.
10. To find the thermal conductivity of copper
11. Measurement of Planck's constant using black body radiation.

Course Name: Solid State Physics
Course Code: PHY303A

L	T	P	Cr.
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Unit I Solids (12)

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

Unit II Elementary Lattice Dynamics (12)

Lattice Vibrations and Phonons, Linear Monoatomic and Diatomic Chains, Acoustical and Optical Phonons, Qualitative Description of the Phonon Spectrum in Solids, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids,

Unit III Elementary Band theory (16)

Kronig Penny model. Band Gaps. Conductors, Semiconductors and Insulators, P and N type Semiconductors. Conductivity of Semiconductors, Mobility, Hall Effect, Hall coefficient, Superconductivity: Experimental Results, Critical Temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect.

Unit IV Magnetic and Dielectric Properties of Matter (20)

Magnetic properties: Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevin Theory of dia – and Paramagnetic Domains, Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss.

Dielectric Properties of Materials: Polarization, Local Electric Field at an Atom, Depolarization Field. Electric Susceptibility, Polarizability, ClausiusMosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion.

Reference Books:

1. Charles Kittel, Introduction to Solid State Physics, 8th Ed., Wiley India Pvt. Ltd. 2004.
2. J.P. Srivastava, Elements of Solid State Physics, 2nd Ed., Prentice-Hall of India, 2006.
3. Leonid V. Azaroff, Introduction to Solids, Tata Mc-Graw Hill, 2004.
4. N.W. Ashcroft and N.D. Mermin, Solid State Physics, Cengage Learning, 1976.
5. Rita John, Solid State Physics, McGraw Hill, 2014
6. H. Ibach and H. Luth, Solid-state Physics, Springer, 2009.
7. M. Ali Omar, Elementary Solid State Physics, Pearson India, 1999
8. M.A. Wahab , Solid State Physics, Narosa Publications, 2011.

Course Name: Quantum Physics
Course Code: PHY322

L	T	P	Cr.
4	0	0	4

UNIT-I **(17)**

Time dependent and Independent Schrodinger Equation

Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum, space wavefunction; Position-momentum uncertainty principle.

UNIT-II

Problems in ID and Quantum theory of hydrogen-like atoms **(13)**

Problems in one dimension: Potential step, potential barrier,rectangular potential well, degeneracy, linear dependence, Sturm's theorem, bound states, orthogonality, linear harmonic oscillator, oscillator wave function, parity.

Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wave functions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,. shells.

UNIT-III

Atoms in Electric & Magnetic Fields: **(15)**

Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

UNIT IV

Many Electron atom **(15)**

Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms- L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Suggested Books:

1. J.L. Powell, and B. Crasemann, Quantum Mechanics.NewDelhi: Narosa. 1995.
2. D.J. Griffiths, Introduction to Quantum Mechanics.UK:Pearson, 2005.

3. E. Merzbache, rQuantum Mechanics. New York:Wiley.1970.
4. S. Gasiorowicz, Quantum Physics. New York:Wiley. 2000
5. F. Schwabl, Quantum Mechanics NewDelhi: Narosa. 1992
6. P.M.Mathews and K.Venkatesan, A Text book of Quantum Mechanics, 2 Ed., 2010, McGraw Hill

Course Name: Quantum and Solid State Laboratory
Course Code: PHY323

L	T	P	Cr.
0	0	4	2

AIM

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitiveequipments.

Note:

• Students are expected to perform at least eight-ten experiments out of following list. The experiments performed in first semester cannot be repeated in second Semester.

The examination for both the courses will be of 3 hours duration

1. To measure the Magnetic susceptibility of Solids.
2. To determine the Coupling Coefficient of a Piezoelectric crystal.
3. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
4. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150^{o}C) and to determine its band gap.
5. To determine the Hall coefficient of a semiconductor sample.
6. To study temperature coefficient of resistance of Cu.
7. To measure the thermal conductivity and thermal diffusivity of a conductor.
8. To determine the value of Stefan's Constant of radiation.
9. To measure magnetic volume susceptibility of liquid FeCl2/MnSO solution by Quincke's method.
10. To measure dielectric constant of a non-polar liquid and its applications.
11. To study the reverse saturation current to a PN junction diode at various temperatures and to find out the approximate value of the energy gap.
12. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
13. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
14. To show the tunneling effect in tunnel diode using I-V characteristics.
15. Measurement of Planck's constant using black body radiation and photo-detector
16. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
17. To determine the Planck's constant using LEDs of at least 4 different colours.
18. To determine the ionization potential of mercury.
19. To determine the absorption lines in the rotational spectrum of Iodine vapour.
20. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books

1.B.L. Flint and H.T. Worsnop, Advanced Practical Physics for students, , Asia Publishing House,1971.

2. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, 4 Edition,reprinted Heinemann Educational Publishers, 1985.
3. I.Prakash& Ramakrishna, A Text Book of Practical Physics, 11thEd., Kitab Maha,2011.
4. J.P. Srivastava, Elements of Solid State Physics, 2nd Ed., Prentice-Hall of India,2006

Course Name: Physics of the Earth
Course Code: PHY324

L	T	P	Cr.
4	0	0	4

Unit IThe Earth and the Universe (15)

(a) Origin of universe, creation of elements and earth. A Holistic understanding of our dynamic planet through Astronomy, Geology, Meteorology and Oceanography. Introduction to various branches of Earth Sciences. (b) General characteristics and origin of the Universe. The Milky Way galaxy, solar system, Earth's orbit and spin, the Moon's orbit and spin. The terrestrial and Jovian planets. Meteorites & Asteroids. Earth in the Solar system, origin,size, shape, mass, density, rotational and revolution parameters and its age.(c) Energy and particle fluxes incident on the Earth.

Unit IIStructure (15)

(a) The Solid Earth: Mass, dimensions, shape and topography, internal structure, magnetic field, geothermal energy. How do we learn about Earth's interior? (b) The Hydrosphere: The oceans, their extent, depth, volume, chemical composition. River systems. (c) The Atmosphere: variation of temperature, density and composition with altitude, clouds. (d) The Cryosphere: Polar caps and ice sheets. Mountain glaciers. (e) The Biosphere: Plants and animals. Chemical composition, mass. Marine and land organisms.

Unit IIIDynamical Processes (15)

(a) The Solid Earth: Origin of the magnetic field. Source of geothermal energy. Convection in Earth's core and production of its magnetic field. Mechanical layering of the Earth. Introduction to geophysical methods of earth investigations. Concept of plate tectonics; sea-floor spreading and continental drift. Geodynamic elements of Earth: Mid Oceanic Ridges, trenches, transform faults and island arcs. Origin of oceans, continents, mountains and rift valleys. Earthquake and earthquake belts. Volcanoes: types products and distribution. (b) The Hydrosphere: Ocean circulations. Oceanic current system and effect of coriolis forces. Concepts of eustasy, tend – air-sea interaction; wave erosion and beach processes. Tides. Tsunamis. (c) The Atmosphere: Atmospheric circulation. Weather and climatic changes. Earth's heat budget. Cyclones. Climate:
i. Earth's temperature and greenhouse effect. ii. Paleoclimate and recent climate changes. iii. The Indian monsoon system. (d) Biosphere:

Unit IVEvolution (15)

Nature of stratigraphic records, Standard stratigraphic time scale and introduction to the concept of time in geological studies. Introduction to geochronological methods in their application in geological studies. History of development in concepts of uniformitarianism, catastrophism and neptunism. Law of superposition and faunal succession. Introduction to the geology and geomorphology of Indian subcontinent. 1. Time line of major geological and biological events. 2. Origin of life on Earth. 3. Role of the biosphere in shaping the environment. 4. Future of evolution of the Earth and solar system: Death of the Earth.

Reference Books:

1. H. Jay Melosh, Planetary Surface Processes, Cambridge University Press, 2011.
2. John Harte, Consider a Spherical Cow: A course in environmental problem solving, University Science Books,
3. Holme's Principles of Physical Geology Chapman & Hall, 1992
4. C. Emiliani, Planet Earth, Cosmology, Geology and the Evolution of Life and Environment Cambridge University Press 1992

Course Name Laser Physics
Course Code: PHY325

L	T	P	Cr.
4	0	0	4

UNIT I
QUANTUM THEORY OF RADIATIO (15)
Light waves and photons, optical directionality, interactivity, monochromaticity and coherence, quantum transitions in absorption and Emission of light, The active medium, creating population inversion, Laser gain curve, Einstein's quantum theory of Radiation, Einstein coefficients and their relationship momentum transfer and possibility of amplification, kinetics of optical absorption, shape and width of spectral lines, line broadening mechanism, natural, collision and Doppler broadening.

UNIT II
DYNAMICS OF LASER PROCESSES (15)
Optical resonators of various kinds and their role in confinement of laser beam. Control of laser output: Interactivity, control of spectral characteristics, method of Q switching, Pulsed Lasing, mode locking for ultra-short pulses, modifying the spatial structure of laser output, Frequency transformations in nonlinear media, wave front correction of laser output, Light beam manipulation.

UNIT III
TYPES OF LASERS (15)
Type of Lasers on the basis of pumping methods: solid state laser, organic dye laser, photo dissociation lasers, Ion and Atomic lasers, Molecular Lasers , Electro ionization Lasers, Gas Dynamic Lasers, Chemical Lasers, Plasma Lasers, Semiconductor Lasers.

UNIT IV
APPLICATIONS OF LASERS (15)
Nonlinear optics: harmonic generation, second harmonic generation, phase matching and optical mixing, brief qualitative description of some experiments of fundamental importance, Lasers in optical communications, ranging and measurement, thermonuclear fusion, basics of holography its applications.

Reference Books:

1.B. B. Laud Lasers and Nonlinear optics (2^{nd}Edn.). New Delhi: New Age International (P) Limited, 2005.
2. K. Thyagarajan, A. K. Ghatak, Lasers: Theory and Applications. New Delhi: Macmillan India Ltd, 1981.
3. L. V. Tarasov, Laser Physics. Moscow: Mir Publishers, 1983.
4. L. V. Tarasov, Laser Age in Optics. Moscow: Mir Publishers, 1981.
5.L. Allen, Essentials of Lasers. Oxford: Pergamon Press, 1969.
6.L. Tarasov Laser Physics and Applications. Moscow: Mir Publishers, 1986.
7. W. E. Kock Lasers and Holography. New York: Dover Publications, 1981

Course Name: Biological Physics
Course Code: PHY326

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Unit I Overview (15)

The boundary, interior and exterior environment of living cells. Processes: exchange of matter and energy with environment, metabolism, maintenance, reproduction, Self-replication as a distinct property of biological systems. Time scales and spatial scales, Universality of microscopic processes and diversity of macroscopic form, Types of cells, Multicellularity, Allometric scaling laws.

Unit II Molecules of life (15)

Metabolites, proteins and nucleic acids, Their sizes, types and roles in structures and processes, Transport, energy storage, membrane formation, catalysis, replication, transcription, translation, signaling, Typical populations of molecules of various types present in cells, their rates of production and turnover, Energy required to make a bacterial cell, Simplified mathematical models of transcription and translation, small genetic circuits and signaling pathways, Random walks and applications to biology, Mathematical models to be studied analytically and computationally.

Unit III The complexity of life (15)

The numbers of distinct metabolites, genes and proteins in a cell. Complex networks of molecular interactions: metabolic, regulatory and signaling networks. Dynamics of metabolic networks; the stoichiometric matrix. Living systems as complex organizations; systems biology. Models of cellular dynamics. The implausibility of life based on a simplified probability estimate, and the origin of life problem. Numbers and types of cells in multicellular organisms, Cell types as distinct attractors of a dynamical system, Stem cells and cellular differentiation, Pattern formation and development.

Unit IV Brain structure and Evolution (15)

Brain structure: neurons and neural networks. Brain as an information processing system. Associative memory models. Memories as attractors of the neural network dynamics. At the level of an ecosystem and the biosphere: Foodwebs. Feedback cycles and self- sustaining ecosystems. The mechanism of evolution: variation at the molecular level, selection at the level of the organism. Models of evolution. The concept of genotype-phenotype map. Examples.

Reference Books:

1. Kim Sneppen& Giovanni Zocchi, Physics in Molecular Biology; CUP 2005.
2. Philip Nelson, Biological Physics: Energy, Information, Life; W H Freeman & Co, NY, 2004
3. Rob Phillips et al, Physical Biology of the Cell (2nd Edition), Garland Science, Taylor
4. & Francis Group, London & NY, 2013
5. Uri Alon, An Introduction to Systems Biology; Chapman and Hall/CRC, Special Indian
6. Edition, 2013
7. M. Ridley, Evolution; Blackwell Publishers, 3rd edition 2009.

Course Name: Experimental Techniques
Course Code: PHY327

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Unit I Measurements (15)

Accuracy and precision, Significant figures, Error and uncertainty analysis, Types of errors: Gross error, systematic error, random error, Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting, Guassian distribution, Fluctuations and Noise in measurement system, S/N ratio and Noise figure, Noise in frequency domain, Sources of Noise: Inherent fluctuations, Thermal noise, 1/f noise.

Unit II Shielding, Grounding and Vacuum Systems (15)

Methods of safety grounding, Energy coupling, Grounding, Shielding: Electrostatic shielding, Electromagnetic Interference, Vacuum Systems: Characteristics of vacuum, Gas law, Mean free path, Application of vacuum, Vacuum system- Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization).

Unit III Transducers & industrial instrumentation (15)

Static and dynamic characteristics of measurement Systems, Zero order first order, second order and higher order systems, Electrical, Transducers and sensors, Characteristics of Transducers, Transducers as electrical element and their signal conditioning, Temperature transducers: Thermistor, Thermocouples, Semiconductor type temperature sensors, Strain gauge, Inductance change transducer: Linear variable differential transformer, Capacitance change transducers.

Unit IV Digital Multimeter and Impedence Bridges (15)

Comparison of analog and digital instruments, Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement, Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge, Q-meter and its working operation, Digital LCR bridge.

Reference Books:

1. M. Sayer and A. Mansingh, Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI Learning Pvt. Ltd.
2. J.P. Holman, Experimental Methods for Engineers, McGraw Hill
3. A.K. Ghosh, Introduction to Measurements and Instrumentation, 3rd Edition, PHI
4. Learning Pvt. Ltd.
5. D.V.S. Murty, Transducers and Instrumentation, 2nd Edition, PHI Learning Pvt. Ltd.
6. C.S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices and Systems, Tata
7. McGraw Hill
8. D. Patranabis, Principles of Electronic Instrumentation, PHI Learning Pvt. Ltd.
9. U.Tietze, Ch.Schenk, Electronic circuits: Handbook of design & applications, Springer

Course Name: Physics of Devices and Communication
Course Code: PHY328

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Unit –I (14)

Devices:Characteristic and small signal equivalent circuits of UJT and JFET. Metal semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode.

Unit –II (14)

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection. Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. Multivibrators: Astable and Monostable Multivibrators using transistors. Phase Locked Loop(PLL): Basic Principles, Phase detector(XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter– Function, Loop Filter Circuits, transient response, lock and capture. Basic idea of PLL IC (565 or 4046).

Unit –III (17)

Processing of Devices: Basic process flow for IC fabrication, Electronic grade silicon. Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Feature size control and wet anisotropic etching. Lift off Technique. Diffusion and implantation.

Digital Data Communication Standards:

Serial Communications: RS232, Handshaking, Implementation of RS232 on PC.
Universal Serial Bus (USB): USB standards, Types and elements of USB transfers. Devices (Basic idea of UART).
Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.

Unit –IV (15)

Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK.

Reference Books:

1. S. M. Sze & K. K. Ng, Physics of Semiconductor Devices, 3rd Ed., John Wiley & Sons (2008).
2. A. K. Singh, Electronic devices and integrated circuits, PHI Learning Pvt. Ltd. (2011).
3. R. A. Gayakwad, Op-Amps & Linear Integrated Circuits, ,4 Ed.,PHI Learning Pvt. Ltd (2000)
4. A. Mottershead, Electronic Devices and Circuits, PHI Learning Pvt. Ltd. (1998).
5. G. Kennedy, Electronic Communication systems, Tata McGraw Hill (1999).
6. A.K. Ghosh, Introduction to Measurements & Instrumentation, , 3rd Ed., PHI Learning Pvt. Ltd. (2009)

Course Name: Embedded System: Introduction to Microcontrollers
Course Code: PHY329

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Theory: 60 Lectures

Unit I **(10)**

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

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

Unit II **(12)**

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.

UNIT III **(16)**

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of8051 microcontroller, I/O port pins description and their functions, I/O port programming in 8051, (Using Assembly Language), I/O programming: Bit manipulation.

Programming of 8051: 8051addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic & logic instructions, 8051 programming in C:- for time delay and I/O operations and manipulation, for arithmetic & logic operations, for ASCII and BCD conversions.

Unit IV **(22)**

Timer & counter programming: Programming 8051 timers, counter programming.

Serial port programming with and without interrupt: Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority in the 8051.

Interfacing 8051 microcontroller to peripherals: Parallel and serial ADC, DAC interfacing, LCD interfacing.

Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging.

Embedded system design and development: Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.

Reference Books:

1. R. Kamal,Embedded Systems: Architecture, Programming & Design, Tata McGraw Hill, 2008
2. M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay,The 8051 Microcontroller and Embedded Systems Using Assembly and C, , 2nd Ed., Pearson Education India, 2007.

3. J.W.Valvano,Embedded microcomputor system: Real time interfacing, Brooks/Cole,2000
4. SubrataGhoshalEmbedded Systems and Robots, Cengage Learning, 2009
5. K.V. Shibu,Introduction to embedded system, , 1st Edition, McGraw Hill, 2009
6. I. Susnea and M. Mitescu,Microcontrollers in practice, Springer, 2005.
7. S.F. BarrettEmbedded Systems: Design & applications, Pearson Education, 2008.
8. J.W. ValvanoEmbedded Microcomputer systems: Real time interfacing, Cengage Learning, 2011

Course Name: Electromagnetic Theory

Course Code: PHY330

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4	0	0	4

UNIT-I

Maxwell Equations **(13)**

Review of Maxwell's equations, Displacement Current, Vector and Scalar Potentials, Gauge Transformations, Lorentz and Coulomb Gauge, Boundary Conditions at Interface between Different Media, Wave Equations, Plane Waves in Dielectric Media, Poynting Theorem and PoyntingVector, Electromagnetic (EM) Energy Density, Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

UNIT-II **(13)**

EM Wave Propagation in Unbounded Media

Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance, Propagation through conducting media, relaxation time, skin depth, Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

UNIT-III **(13)**

EM Wave in Bounded Media

Boundary conditions at a plane interface between two media, Reflection & Refraction of plane waves at plane interface between two dielectric media, Laws of Reflection & Refraction, Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law, Reflection & Transmission coefficients, Total internal reflection, evanescent waves, Metallic reflection (normal Incidence).

UNIT-IV **(21)**

Polarization of Electromagnetic Waves

Description of Linear, Circular and Elliptical Polarization, Propagation of E.M. Waves in Anisotropic Media, Symmetric Nature of Dielectric Tensor, Fresnel's Formula, Uniaxial and Biaxial Crystals, Light Propagation in Uniaxial Crystal, Double Refraction, Polarization by Double Refraction, Nicol Prism, Ordinary & extraordinary refractive indices, Production & detection of Plane, Circularly and Elliptically Polarized Light, Phase Retardation Plates: Quarter-Wave and Half-Wave Plates.

Rotatory Polarization

Optical Rotation, Biot'sLaws for Rotatory Polarization, Fresnel's Theory of optical rotation, Calculation of angle of rotation, Experimental verification of Fresnel's theory, Specific rotation.

Wave Guides

Planar optical wave guides, Planar dielectric wave guide, Condition of continuity at interface, Phase shift on total reflection.

Suggested Books:

1.D. Griffiths, Introduction to Electrodynamics, NewDelhi: Prentice Hall, India Pvt. Ltd.
2. M Reitz, & Christy Foundations of electromagnetic theory, New Delhi:Narosa.
3. A. Z. Capriand, P.V. Panat, Introduction to Electrodynamics, New Delhi:Narosa Publishing Company.
4. J. A. Edminister,Electromagnetics. New Delhi: Tata McGraw Hill .
5. M A. W Miah Fundamentals of electromagnetics. New Delhi:Tata McGraw Hill.
6. J. D Jackson, Classical Electrodynamics. New York: John Wiley, 3rd edition 1998.

Course Name: Nuclear Physics
Course Code: PHY331

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Unit I Nuclear Properties (15)

Historical overview of nuclear physics, Constituents of nucleus, non-existence of electrons in nucleus, Nuclear charge and mass, nuclear radius, spin, parity, angular momentum, magnetic moment, electric quadrupole moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus, explanation of the binding energy curve, qualitative discussion of two-body nuclear forces.

Unit II Radioactive decays (18)

Radioactive decay law, decay constant and half life; methods of measurement of half life, Type of decays, Natural radioactivity, chart of nuclides and domain of instabilities, radioactive dating, units for measuring radiations, constituents of Cosmic rays. Beta decays : β-, β+ and electron capture decays, Fermi's theory, angular momentum and parity selection rules, neutrino and antineutrino, parity violation in β-decay and its experimental verification. Alpha decay: Stability of heavy nuclei against break up, Geiger-Nuttal law, Gamow's explanation, angular momentum and parity in a decay, energy release in alpha decay. Gamma transitions : Excited levels, isomeric levels, gamma transitions, multipole moments, selection rules, transition probabilities, internal conversion.

Unit III Nuclear reactions and Nuclear Models (13)

Rutherford's experiment of nuclear transmutation, Types of nuclear reactions, reactions cross section, conservation laws, Kinematics of nuclear reaction, Q-value and its physical significance. Nuclear fission, neutron reactions, Fermi and transuranic elements, chain reactions, Nuclear reactor, reactor criticality, moderators. Liquid drop model, semi-empirical mass formula, condition of stability, evidence for nuclear magic numbers.

Unit IV Interaction and Detection of radiation (14)

Energy loss of electrons and positrons, Positron annihilation in condensed media, Stopping power and range of heavier charged particles, interaction of gamma rays with matter: Basis of detection of nuclear radiations, Gas-filled detectors, proportional and Geiger-Muller counters, Scintillation detectors, solid-state detectors, solid state nuclear track detectors.

Books:

1. W. E. Burcham, and M. Jobes, Nuclear and Particle Physics, United Kingdom : Pearson 1995.
2. V. K. Mittal, R. C. Verma, and S.C. Gupta, Introduction to Nuclear and Particle Physics. New Delhi: Prentice Hall of India, 2013.
2. K. S. Krane Introductory Nuclear Physics, John Wiley & Sons, 1988.
3. K. Hyde, Basic Ideas and Concepts in Nuclear Physics United Kingdom: Institute of Physics 2004.
4. H. Enge, .Introduction to Nuclear Physics, London: Addison-Wesley 1971.
5.I. Kaplan Nuclear Physics, New Delhi: Narosa 2002.

Course Name: EMT and Nuclear Physics Laboratory
Course Code: PHY332

L	T	P	Cr.
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List of Experiments:

Electromagnetic Theory Lab

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene,
etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a
Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass
interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Nuclear Physics Lab

1. Study the background radiation levels using Radiation meter

Characteristics of Geiger Muller (GM) Counter:

2. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
3. Study of counting statistics using background radiation using GM counter.
4. Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in
different routine materials by operating GM at operating voltage.
5.Study of absorption of beta particles in Aluminum using GM counter.
6. Detection of α particles using reference source & determining its half-life using spark counter
7. Gamma spectrum of Gas Light mantle (Source of Thorium)

Course Title: MATLAB
Paper Code: MTH 310

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Course Objectives

The objective of this course is to teach the basics of computer and computer programming so thatone can develop the computer program in MATLAB at their own. For the purpose of learningprogramming skill, some Numerical methods which are extremely useful in scientific research areincluded. This is all Laboratory work.

UNIT A **(14)**

Starting and Quitting MATLAB, Basic Operations of MATLAB: Input/output data, The ColonOperator ,Graphics, Types of files, mathematical functions, operations on vectors and matrices,random number generators. Error computation: absolute/relative, avoiding large errors.

UNIT B **(14)**

Expressions **,** Variables, Numbers, Operators, Functions, Examples of Expressions, AboutMatrices, Entering Matrices, sum, transpose, the magic Function Types of matrices, Eigen valuesand Eigen vectors, computing inverse of matrices

UNIT C **(13)**

Looping statements: if, else, and elseif, for, while, switch and case, break , return, Developing algorithms using nested loops, Sorting and Searching, Tracing a program/algorithm step-by-step, Commands forParsing Input and Output, User Input and Screen Output, Evaluation, Debugging

UNIT D **(15)**

Plotting Process, Graph Components, Figure Tools, Arranging Graphs within a Figure, SelectingPlot Types. Plotting Two Variables, Changing the Appearance, Adding More Data to the Graph,Changing the Type of Graph, Modifying the Graph Data Source, Working with Images.

Suggested Books:

1. S. Chapman, *MATLAB Programming for Engineers*, *4th Edition*, Cengage Learning, Engineering, 1120 Birchmount Rd, Toronto, ON, M1K5G4, Canada. 2008.
2. D. G. Duffy, *Advanced engineering mathematics with MATLAB*, Boca Raton, FL: CRC Press, 2003.
3.A. H. Register, *A guide to MATALB object-oriented programming*, Boca Raton, FL: CRCPress, 2007.
4. M. Kalechman, *Practical MATALB applications for engineers*, Boca Raton, FL: CRC Press, 2009.
5. A. D. Poularikis, *Discrete random signal processing and filtering primer with MATLAB*, Boca Raton, FL: CRC Press, 2009.

Course Name: Technical Skills
Course Code: PHY333

L	T	P	Cr.
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UNIT-I **(9)**

Preparation and presentation of scientific reports, need, method and approaches for formatting and writing of science reports, case studies of science reports, examples to be taken from pure science, applied science and technical reports, use of computer for word processing, Oral presentation skill.

UNIT-II **(5)**

Machine practice, carpentry, welding and electrical skill

UNIT-III **(8)**

Glass Blowing, vacuum system and their use in industry and research, practical knowledge of measurement of temperature, pressure, electrical electronic optical and magnetic parameters. Use of sensors/transducers, gauges and gadgets needed for the above measurements.

UNIT-IV **(8)**

Electronic skill. Designing of electrical circuits, selection of electronic components, testing of components, making of printed circuit board, relevant practical information on technical specification and selection of different board materials, techniques of designing and layout of complex PCBs, Soldering skills, modern approaches for automation of design and making of electronic circuits, testing of circuits for appropriate and predefined functioning, fault finding and repair

Course Name: Renewable Energy and Energy harvesting
Course Code: PHY334

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UNIT-I **(20)**

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, PV models and equivalent circuits, and sun tracking systems.

UNIT-II

Wind Energy harvesting: **(15)**

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 and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy Osmotic Power, Ocean Bio-mass.

UNIT-III **(8)**

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

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

UNIT IV Piezoelectric Energy harvesting: **(17)**

Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energyharvesting 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.

Suggested Books:

1. G.D Rai , Non-conventional energy sources, Khanna Publishers, New Delhi
2. M P Agarwal, Solar energy - S Chand and Co. Ltd.
3. Suhas P Sukhative, Solar energy, Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, Renewable Energy, Power for a sustainable future, Oxford University Press, in association with the Open University, 2004,
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

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Course Name: Nano Materials and Applications
Course Code: PHY335

UNIT I: NANOSCALE SYSTEMS (15)

Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation-Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences. Electron transport: Carrier transport in nanostrcutures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

UNIT II: SYNTHESIS AND CHARACTERIZATION (15)

Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots. Characterization techniques: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.

UNIT III: OPTICAL PROPERTIES (15)

OPTICAL PROPERTIES: Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

UNIT IV: APPLICATION OF NANOMATERIALS (15)

Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (without derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

Reference books:

1. C.P. Poole Jr. and F.J. Owens, Introduction to Nanotechnology. New Jersey: John Wiley & Sons, 2006.
2. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology, New Delhi: PHI Learning Private Limited, 2009.
3. K. P. Jain Physics of Semiconductor Nanostructures. New Delhi: Narosa Publishing House, 1997.
4. R. Booker, E. Boysen, Nanotechnology for Dummies, Indiana: John Wiley and Sons, 2005.

5. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook, Oxford: Elsevier, 2007.
6. V.V. Mitin, V.A. Kochelap and M.A. Stroscio, Introduction to Nanoelectronics, Cambridge: Cambridge University Press, 2011.
7. B. Bhushan, Springer Handbook of Nanotechnology, Berlin: Springer-Verlag, 2004.
8. C.N.R. Rao and A. Govindaraj, Nanotubes and Nanowires, London: Royal Society of Chemistry, 2005.

Course Name: Vacuum Science
Course Code: PHY336

L	T	P	Cr.
4	0	0	4

Unit-I Behaviour of Gasses (15)

Kinetic theory of gases, mean free path, particle flux, monolayer formation, Gas's law; Elementary Gas Transport Phenomenon: Viscosity, diffusion, and thermal transpiration. Gas flow: Viscous, molecular and Transition flow regimes, gas throughput, conductance, mass flow, pumping speed; Gas release from Solids: Vaporization, thermal desorption, virtual leaks, permeation, vacuum baking

Unit-II Measurement of Vacuum (15)

Basics of Vacuum measurement, low, High and ultrahigh vacuums, Gauges and its types, McLeod gauge, thermal conductivity gauges, spin rotor gauge, diaphragm/capacitance gauges manometer, Ionization gauges, hot cathode, cold cathode gauges; Flow Meters and Residual Gas Analyzer, Leak Detection.

Unit-III Production of Vacuum (15)

Mechanical pumps (Rotary, Lobe and Turbomolecular pumps), Diffusion pump, Getter and Ion pumps, Cryopumps, Pump Fluids; Materials in Vacuum: Vaporization, out-gassing, glasses and Ceramics. Joints, Seals and Components, Gaskets and Motion feed through.

Unit -IVApplications of Vacuum Technology (15)

Need for vacuum in material science, vacuum sealing, thin films and epitaxial layers, evaporation based techniques; Sputtering based techniques, Molecular beam epitaxy, Atomic beam deposition,Reactive ion etching, Vacuum furnace, applications of vacuum in low temperature physics and cryogenics.

Reference Books

1. M. H. Hablanian, High Vacuum Technology – A Practical Guide, , Marcel Dekker, Inc., New York, 1990.
2. J. F. O'Hanlon, A User's Guide to Vacuum Technology, John Wiley & Sons, New York 1989.
3. A. Roth, Vacuum Technology, Elsevier Science Publishers, Amsterdam 1990
4. R.K. Fitch and B.S. Halliday, Basic Vacuum Technology, A Chambers, Intitute of Physics Publishing, Bristol &Philedelphia, 1998.
5. L.I. Maissel and R. Glang, Hand Book of Thin Film Technology, McGraw Hill Inc., New Delhi, 1970.
6. K. L. Chopra, Thin Film Phenomena, McGraw Hill Inc., New Delhi, 1969.
7. Paul A Redhead, Vacuum Science and Technology, American Institute of Physics, California, 1997
8. James M. Lafferty, Foundations of Vacuum Science and Technology, John Wiley & Sons, New York, 1998.

Course Name: Astronomy and Astrophysics
Course Code: PHY337

L	T	P	Cr.
4	0	0	4

UNIT-I **(20)**

Astronomical Scales

Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature.

Basic concepts ofpositional astronomy

Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars, Determination of Distance by Parallax Method.

UNIT-II **(12)**

Astronomical techniques: Basic Optical Definitions for Astronomy (Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes).

Physical principles: Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.

UNIT-III **(13)**

The sun and Solar Familty

Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere,Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology.

Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.

Stellar spectra and classification Structure

Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification.

UNIT-IV **(15)**

The milky way

Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way.

Galaxies

Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies, Spiral and Lenticular Galaxies, The Milky Way Galaxy.

Reference Books:

1) B. W. Carroll, and D A. Ostlie, Modern Astrophysics. Addison-Wesley Publishing Co.
2)M.Zeilik, and S. A. Gregory, Introductory Astronomy and Astrophysics. Saunders College Publishing, 4th Edition.
3) B. Basu, An introduction to Astrophysics, Prentice -Hall of India Private limited, New Delhi, 2001.
4) T. Arny, And S.Schneider, Introduction to Astronomy. Tata McGraw Hill 7th edition, 2014
5) V. B. Bhatia, Textbook of Astronomy and Astrophysics with elements of cosmology, Narosa Publication

Course Name: Atmospheric Physics
Course Code: PHY338

L	T	P	Cr.
4	0	0	4

UNIT-I **(13)**

General features of Earth's atmosphere

Thermal structure of the Earth's Atmosphere, Composition of atmosphere, Hydrostatic equation, Potential temperature, Atmospheric Thermodynamics, Greenhouse effect, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze, Instruments for meteorological observations including RS/RW, meteorological processes and convective systems, fronts, Cyclones and anticyclones, thunderstorms.

UNIT-II **(20)**

Atmospheric Dynamics

Scale analysis, Fundamental forces, Basic conservationlaws, The Vectorial form of the momentum equation in rotating coordinate system,scale analysis of equation of motion, Applications of the basic equations, Circulationsand vorticity, Atmospheric oscillations, Quasi biennial oscillation, annual and semi-annualoscillations, Mesoscale circulations, The general circulations, Tropicaldynamics.

Atmospheric Waves

Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a non-homogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption.

UNIT-III **(12)**

Atmospheric Radar and Lidar

Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications, Application of Lidar to study atmospheric phenomenon. Data analysis tools and techniques.

UNIT-IV **(15)**

Atmospheric Aerosols

Spectral distribution of the solar radiation, Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Observational techniques for aerosols, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere, Aerosol studies using Lidars.

Reference Books:

1) M. L.Salby, Fundamental of Atmospheric Physics. Academic Press, Vol 61, 1996
2) J. T. Houghton, The Physics of Atmosphere. Cambridge University press, 3rd edn. 2002.
3) J. R. Holton, An Introduction to dynamic meteorology. Academic Press, 2004
4) S. Fukao, And K. Hamazu, Radar for meteorological and atmospheric observations. Springer Japan, 2014

Course Name: Particle physics
Course Code: PHY339

L	T	P	Cr.
4	0	0	4

Unit I Accelerators (15)

Need of accelerators, Cockroft, Walton, Van de Graff, cyclic accelerators, cyclotron, High energy Cyclotrons, synchrocyclotron, variable energy cyclotron, phase stability, superconducting magnets, and colliding beam machines. Calorimetry and multilayer detection.

Unit II Cosmic rays (15)

Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life time determination for muon and pion. Primary Cosmic Rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories.

Unit III Elementary particles-I (15)

Historical introduction to elementary particles, fermions and bosons, particles and antiparticles, Classification of particles, leptons, hadrons, gauge quanta, types of interactions, electromagnetic, weak, strong interactions, gravitational interactions, isospin, Strangeness, conservation of strangeness in particle interactions, introduction to quarks and qualitative idea of quark model.

Unit IV Elementary particles-II (15)

High energy physics units, high energy electron scattering from protons, basic interactions of quark and leptons, quantum numbers of elementary paticles, determination of properties of leptons, conservation laws governing particle decay, interrelation between particle physics and cosmology

Reference Books:

1. W. E. Burcham, and M. Jobes, Nuclear and Particle Physics, United Kingdom : Pearson 1995.
2. V. K. Mittal,R. C. Verma, and S.C. Gupta, Introduction to Nuclear and Particle Physics. New Delhi:
Prentice Hall of India, 2013
3. H. Enge, Introduction to Nuclear Physics, London: Addison-Wesley 1971
4. D. H. Perkins, Introduction to High Energy Physics United Kingdom: Cambridge University Press, 4th ed. 2001.
5. K. Hyde, Basic Ideas and Concepts in Nuclear Physics United Kingdom: Institute of Physics 2004.
6. I. S. Hughes Elementary Particles. Cambridge University, 3rd ed. 1991.

COURSE TITLE: Organic Chemistry

L	T	P	Cr.
4	0	0	4

COURSE CODE: CHE153

Unit I Compounds of Carbon (15)

Differences in chemical and physical behavior as consequences of structure. Discussion (with mechanism) of reactions of hydrocarbons' ranging from saturated acyclic and alicyclic, unsaturated dienes and aromatic systems. Huckel rule; as applied to 4n+2 systems. Industrial sources and utility of such compounds in daily life for medicine clothing and shelter.

Unit II Stereochemistry (15)

Structure, reactivity and stereochemistry. Configuration and conformation. Optical activity due to chirality; d, l, meso and diasteroisomerism, sequence rules. Reactions involving stereoisomerism. Geometrical isomerism – determination of configuration of geometric isomers. E & Z system of nomenclature. Conformational isomerism – conformational analysis of ethane and n-butane; conformations cyclohexane, axial and equatorial bonds, conformations of monosubstituted cyclohexane derivatives. Newman projection and Sawhorse formula, Fischer and flying wedge formulae.

Unit III Alkyl Halides (15)

Structure of alkyl halides and their physical properties. Preparation from alcohols, hydrocarbons, alkenes and by halide exchange method.

Reactions : (i) Nucleophilic substitution (SN2 and SN1) kinetics, mechanism, stereochemistry, steric and electronic factors, reactivity of alkyl halides, rearrangement, dependence on nucleophile, role of solvent (ii) Elimination E2 and E1 mechanism, stereochemistry, kinetics, rearrangement.

Alcohols

Structure, physical properties (Hydrogen bonding), Methods of preparation: Grignard synthesis (scope and limitations), Reactions: Reactions with hydrogen halides. Mechanism and rearrangement, Reaction with Phosphorous trihalides, mechanism of Dehydration rearrangement.

Unit IV Ethers

Structure, Physical properties, preparation (Williamson synthesis). Reactions: Cleavage, by acids, Electrophilic substitution in ethers.

Aldehydes and Ketones (15)

Structure, Physical Properties; Methods of Preparation: Oxidation of Primary and secondary alcohols, Oxidation of methylbenzenes, Reduction of acid chlorides, Friedel- Crafts Acylation,

Reactions; Nucleophilic addition, Addition of Grignard reagents, Addition of cyanide. Addition of Bisulphite, Addition of derivatives of ammonia. Acetal Formation, Cannizzaro reaction, Aldol Condensation.

Reference Books:

1. R. N. Morrison and R. N. Boyd,Organic Chemistry,PearsonEducation,Dorling Kindersley (India) Pvt. Ltd.
2. I. L. Finar, Organic Chemistry(Volume 1), Pearson Education, Dorling Kindersley (India) Pvt. Ltd.
3. E. L. Eliel,.And S. H. Wilen,Stereochemistry of Organic Compounds, London: Wiley, 1994.
4. J, March, Advanced Organic Chemistry: Reactions, Mechanism and Structure, John Wiley, 6th edition, 2007.

COURSE TITLE: ORGANIC CHEMISTRY LAB

L	T	P	Credits
0	0	4	2

COURSE CODE: CHE154

Course Objectives:

This course is intended to learn the basic concepts of Organic Chemistry Laboratory. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in organic chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

1. Calibration of Thermometer

80-82^o (Naphthalene), 113-114^o (acetanilide).

132.5-133^o (Urea), 100^o (distilled Water)

2. Determination of melting point

Naphthalene 80-82^o, Benzoic acid 121.5-122^o

Urea, 132.5-133^o, Succinic acid 184-185^o

Cinnamic acid 132.5-133^o, Salicylic acid 157-5-158^o

Acetanilide 113-5-114^o, m-Dinitrobenzene 90^o

P-Dichlorobenzene 52^o. Aspirin 135^o.

3. Determination of boiling points

Ethanol 78^o, Cyclohexane 81.4^o, Toluene 110.6^o, Benzene 80^o.

4. Mixed melting point determination

Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

5. Distillation

Simple distillation of ethanol-water mixture using water condenser,

Distillation of nitrobenzene and aniline using air condenser.

6. Crystallization

Concept of induction of crystallization

Phthalic acid from hot water (using fluted filter paper and stemless funnel), Acetanilide from boiling water,

Naphthalene from ethanol,

Benzoic acid from water.

7. Decolorisation and crystallization using charcoal

Decolorisation of brown sugar (sucrose) with animal charcoal using gravity filtration.

Crystallization and Decolorisation of impure naphthalene (100g of naphthalene mixed with 0.3g of Congo Red using 1g decolorising carbon) from ethanol.

8. Sublimation (Simple and Vacuum)

Camphor, Naphthalene, Phthalic acid and Succinic acid.

9. Extraction: the separatory funnel, drying agent:

Isolation of caffeine from tea leaves

10. Steam distillation

Purification of aniline/nitrobenzene by steam distillation.

Reference Books:

1. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford, andP. W. G. Smith, Vogel's Text Book of Practical Organic Chemistry,5th edition, ELBS, 1989.

2. D. L. Pavia, G. M. Lampanana, and G. S. Kriz,. Jr. Introduction to Organic Laboratory Techniques, Thomson Brooks/Cole, 3rd edition,2005.

3. F. G. Mann, and P. C. Saunders. Practical Organic Chemistry, London: Green & Co. Ltd., 1978.

4. G.Svehla, Vogel's Qualitative Inorganic Analysis (revised), Orient Longman, 7th edition, 1996.

5.J. Bassett, R. C. Denney, G. H. Jeffery, and J. Mendham, Vogel's Textbook of Quantitative Inorganic Analysis (revised),Orient Longman, 4th edition, 1978.

COURSE TITLE: Spectroscopy

COURSE CODE: CHE155

L	T	P	Cr
4	0	0	4

Unit I Pure Rotational Spectra (15)

Classification of molecules according to their moment of inertia. Rotational energy levels of hydrogen chloride. Determination of molecular geometry by rotational spectrum, isotopic substitution effects. Stark effect, Estimation of molecular dipole moments, Selection rules, Rotational Raman Spectra, anisotropic polarizabilty, specific selection rule in Raman Spectra, Stokes and anti – Stokes lines.

Unit II Vibrational Spectra (13)

Diatomic molecules, Force constants, Fundamental vibration frequencies, anharmonicity of molecular vibrations and its effect on vibrational frequencies, second and higher harmonies. Frequencies of the vibrational transitions of HCl. Vibrational rotation spectra of CO. P, Q and R branches.

Unit III Infrared and Raman Spectra (15)

Vibrations of polyatomic molecules. Examples of CO_2, H_2O.Mechanics of measurement of infrared and Raman spectra absorption of common functional groups. Their dependence on chemical environment (bond order, conjugation, hydrogen bonding), the number of active infrared and Raman active lines. Fermi resonance, combination bands and overtones, complications due to interactions of vibrations of similar frequency. Application of IR in structure elucidation of organic compounds.

Unit IV UV and Visible Spectroscopy (17)

Measurement technique, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra. Chromophores, auxochromes, electronic spectra of polyatomic molecules. Woodward rules for conjugated dienes, unsaturated carbonyl groups, extended conjugation. Red shift, blue shift, hypo and hyperchromic effects.

Reference Books:

1.R. M. Silverstein, and F. X. Webster, Spectrometric Identification of Organic Compounds, Wiley, 6th edition, 2007.

2. W. Kemp, Organic Spectroscopy, ELBS, 1996.

3. C. N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 4th edition, 1995.

4. Y. R. Sharma, Elementary Organic Spectroscopy; Principle and Chemical Applications, S. Chand & Company Ltd., 2005.

COURSE TITLE: Spectroscopy Lab

L	T	P	Credits
0	0	4	2

COURSE CODE: CHE156

Course Objectives:

This course is intended to learn the basic concepts of Chemistry Laboratory. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

1. Determine the strength of HCl solution by titrating against NaOH solution conductometerically.
2. Determination of total hardness of water (tap) using standard EDTA solution and Eriochrome black T indicator.
3. Determination of alkalinity of water.
4. Determination of surface tension of given liquid by using Stalagmometer.
5. Determination of residual chlorine in a water sample.
6. To determine the specific and molecular rotations of an optically active substance by using polarimeter.
7. To determine the composition of an unknown solution with a polarimeter.
8. Determination of the viscosity of given lubricating oil by using Redwood Viscometer.
9. Determination of distribution coefficient of I_2 between CCl_4 and Water.
10. To study the kinetics of hydrolysis of methyl acetate in the presence of hydrochloric acid.

Reference Books:

1. B. P. Levitt,Findlays Practical Physical Chemistry, London & New York: Longman Group Ltd.8th edition, 1978.

2.B. D Khosla, V. C. Garg, and A. Gulati, Senior Practical Physical Chemistry, New Delhi: R. Chand & Co., 11thedition, 2002.

3.R. C. Das, and B. Behra, Experimental Physical Chemistry, Tata McGraw Hill Publishing Co. Ltd., 1983.

4.Vogel's Textbook of Quantitative Chemical Analysis (revised by Jeffery, Bassett, Mendham and Denney), 5th edition, ELBS, 1989.

5.G. Svehla, Vogel's Qualitative Inorganic Analysis (revised), 6thedition,NewDelhi:Orient Longman, 1987.

6.G. D. Christian Analytical Chemistry, John Wiley & Sons Inc.

COURSE TITLE: Inorganic Chemistry

COURSE CODE: CHE253

L	T	P	Credits
4	0	0	4

Unit I Atomic Structure and periodic properties (15)

Wave mechanical model of Hydrogen atom, The de Broglie relationship, The uncertainty principle, Schrodinger wave equation and its derivation, Significance of Ψ and Ψ^2, Quantum numbers, Normal and orthogonal wave functions, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations. Concept of extra stability of half and completely filled electronic configuration, Electronic configuration of elements, Penetration and shielding (The Slater's rules). The origin and distribution of the elements, The structure of the periodic table, Atomic parameters and their variation in periodic table, Electronegativity and various scales.

Unit II Ionic Compounds (Bonding and structures) (15)

Properties of ionic substances, Occurrence of ionic bonding, The radius ratio rules, Efficiency of packing, Hexagonal close packing, Cubic close packing, Structures of different crystal lattices, Sodium chloride, Cesium chloride, Wurtzite, Zinc blende, Fluorite, Rutile, Cristobalite, Nickel arsenide, Calcium carbide, Lattice energy, Born-Haber cycle, The calculations of the lattice energy on the basis of Born-Lande equation, Covalent character in predominantly ionic compounds, Imperfections of crystals, Polarizing power and polarizabilty of ions, Fajan's rule.

Unit III Covalent Bond (15)

The Lewis theory, Valence bond theory - A mathematical approach, Resonance, Valence Shell Electron Pair Repulsion Model (VSEPR theory), Prediction of structures and variation of bond angles on the basis of VSEPR theory, Shortcomings of VSEPR theory. Concept of hybridization, Rules for obtaining hybrid orbitals, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3), Molecular orbital theory (LCAO method), Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules, Molecular orbital energy level diagrams (Be_2, N_2, O_2, F_2, NO, CO, HCl, NO_2, BeH_2).

Unit IV Coordination chemistry (15)

Werner's theory, nomenclature of coordination complexes, isomerism in coordination complexes, chelating agents, metal chelates and chelate effects, names and abbreviations of important ligands, polydenate ligands, polypyarzolyborates, macrocylic ligands, macrocylic effect, ketoenolates, troplonates, tripod ligands, conformation of chelate rings, factors determining kinetic and thermodynamic stability.

Reference Books:

1. D. F.C. Shriver, P. W. Atkins,and C. H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.

2. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry, 4th edition, Singapore: Pearson Education, 1999.

3. J. D. Lee, Concise Inorganic Chemistry, ELBS, Oxford, 1994.

COURSE TITLE: Inorganic Chemistry Lab

COURSE CODE: CHE254

L	T	P	Credits
0	0	4	2

Course Objectives:

This course is intended to learn the basic concepts of Inorganic Chemistry Laboratory. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in inorganic chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

Qualitative Analysis

Identification of cations and anions in a mixture which may contain combinations of acid ions.These must contain interfering acid anions and one, the insoluble.

a) Special Tests for Mixture of anions
I. Carbonate in the presence of sulphate.
II. Nitrate in the presence of nitrite
III. Nitrate in the presence of bromide and iodide.
IV. Nitrate in the presence of chlorate.
V. Chloride in the presence of bromide and iodide.
VI. Chloride in the presence of bromide.
VII. Chloride in the presence of iodide.
VIII. Bromide and iodide in the presence of each other and of chloride.
IX. Iodate and iodide in the presence of each other.
X. Phosphate, arsenate and arsenite in the presence of each other.
XI. Sulphide, sulphite, thiosulphate and sulphate in the presence of each other.
XII. Borate in the presence of copper and barium salts.
XIII. Oxalate in the presence of fluoride.
XIV. Oxalate, tartrate, acetate, citrate in the presence of each other.
b) Separation and identification of cations in mixtures
i) Separation of cations in groups.

ii) Separation and identification of Group I, Group II (Group IIA and IIB), Group III, Group IV, Group V and Group VI cations.

Reference Books:

1. G. Svehla, and B. Sivasankar,Vogel's Qualitative Inorganic Analysis (revised),Pearson, 7th edition, 1996.
2. R. C. Bassett, G. H. Denney,and J. Jeffery, Mendham, Vogel's Textbook of Quantitative Inorganic Analysis (revised), 4th edition, Orient Longman, 1978.

COURSE TITLE: PHYSICAL CHEMISTRY

COURSE CODE: CHE353

L	T	P	Credits
4	0	0	4

Unit I Chemical Thermodynamics (20)

Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy.

First Law of Thermodynamics: First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion, .Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchhoff's equation.

Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot's cycle), Entropy, Entropy changes of an ideal gas with changes in P,V, and T, Free energy and work functions, Gibbs-Helmholtz Equation., Criteria of spontaneity in terms of changes in free energy, Third law of thermodynamics, Absolute entropies.

Unit II Chemical Equilibrium

(10) General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant-Van't Hoff equation, homogeneous & heterogeneous equilibrium, Le Chetalier's principle.

Unit III Chemical Kinetics (15)

Rates of reactions, rate constant, order and molecularity of reactions. Chemical Kinetics: Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-lifetime of a reaction, Methods for determining order of reaction, Effect of temperature on reaction rate and the concept of activation energy, Reaction mechanism, Steady state hypothesis

Catalysis

Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis, Unimolecular surface reactions.

Unit IV Electro-Chemistry (15)

Specific conductance, molar conductance and their dependence on electrolyte concentration, Ionic Equilibria and conductance, Essential postulates of the Debye-Huckel theory of strong electrolytes, Mean ionic activity coefficient and ionic strength, Transport number and its relation to ionic conductance and ionic mobility, Conductometry titrations, pH scale, Buffer solutions, salt hydrolysis, Acid-base indicators.

Electrochemical cells

Distinction between electrolytic and electrochemical cells, Standard EMF and electrode potential, Types of electrodes, Reference electrode, Calculation of NG, NH, NS and equilibrium constant from EMF data, Potentiometric determination of pH, Potentiometric titrations.

Reference Books:

1. P. W. Atkins, Physical Chemistry, Oxford University Press, 8th edition, 2006 (Indian Print).
2. . T. Engel,.andP. Reid,. Physical Chemistry, Pearson Education, 1st edition, 2006.
3 G.W. Castellan, Physical Chemistry, Wisley/ Narosa, 3rd edition, 1985 (Indian Print).
4. G. M. Barrow, Physical Chemistry, New York: McGraw Hill, 6th edition, 1996.
5. R. J. Silbey, R. A. Albert, and M. G. Bawendi, Physical Chemistry, 4th edition, New York: John Wiley, 2005.

COURSE TITLE: PHYSICAL CHEMISTRY LAB

COURSE CODE: CHE354

L	T	P	Credits
0	0	4	2

Course Objectives:

To teach the fundamental concepts of Physical Chemistry and their applications. The syllabus pertaining to B.Sc. (Other branches.) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Expected Prospective:

The students will be able to understand the basic objective of experiments in organic chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals and solvents.

1. Treatment of experimental data

Recording of experimental data. Significant number, accuracy and precision, error analysis.

2. Liquids and Solutions

(i) To determine relative viscosities of aqueous solutions of glycerol at different concentrations. (ii) Calculate partial molar volume of glycerol at infinite dilution from density measurement.

(ii) To determine viscosity-average molecular weight, number-average molecular weight and mean diameter of polyvinyl alcohol molecule from intrinsic viscosity data.

3. Thermochemistry

(i) To determine heat capacity of a calorimeter and heat of solution of a given solid compound.

(ii) To determine heat of solution of Solid calcium chloride and calculate lattice energy of calcium chloride using Born-Haber cycle.

(iii) To determine heat of hydration of copper sulphate.

4. Distribution Law

(i) To determine distribution (i.e. partition) coefficient of a solute between water and a non-aqueous solvent.

5. Surface Phenomena

To study the adsorption of acetic acid/oxalic acid from aqueous solution on charcoal. Verify Freundlich and Langmuir adsorption isotherms.

6. Colorimetery

(i) To verify Lambert-Beer law.

7. pH-metry

(i) To titrate a strong acid against a strong base pH-metrically.

(ii) To titrate a weak acid against a strong base and determine the ionization constant of the weak acid.

Reference Books

1. B. P. Levitt, Findlays Practical Physical Chemistry,London& New York:Longman

Group Ltd., 8th edition,1978.

2. B. D. Khosla, V. C. Garg, andA. Gulati, Senior Practical Physical Chemistry, New Delhi: R. Chand & Co., 11thedition, 2002.

3R. C. .Das, and B. Behra, Experimental Physical Chemistry, Tata McGraw Hill Publishing Co. Ltd. 1983.

4.Vogel's Textbook of Quantitative Chemical Analysis (revised by Jeffery, Bassett, Mendham and Denney), ELBS, 5th edition,1989.

5. G.vehla, Vogel's Qualitative Inorganic Analysis (revised), 6th edition, New Delhi: Orient Longman, 1987.

6. G. D. Christian, Analytical Chemistry, Wiley, 6th edition.

Course Title: Spectroscopy and Natural Molecules
Course Code: CHE403

L	T	P	Credits
4	0	0	4

Unit I Spectroscopy (15)

General principles Introduction to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, Chromophores and Auxochromes,Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of WoodwardRules for calculation of λmax for the following systems: α, ß unsaturated aldehydes, ketones,carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular;Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis andtransisomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorptionpositions of O, N and S containing functional groups; Effect of H-bonding, conjugation,resonance and ring size on IR absorptions; Fingerprint region and its significance; applicationin functional group analysis.

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift andfactors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects inalkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

Unit II Carbohydrates (15)

Occurrence, classification and their biological importance.

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimersandanomers, mutarotation, determination of ring size of glucose and fructose, Haworthprojections and conformational structures; Interconversions of aldoses and ketoses; KillianiFischersynthesis

AndRuff degradation.

Disaccharides – Structure elucidation of maltose, lactose and sucrose.

Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

Unit III Dyes (15)

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing;Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism ofDiazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet;Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation andsynthesis of Alizarin and Indigotin; Edible Dyes with examples.

Unit IV Polymers (15)

Introduction and classification including di-block, tri-block and amphiphilicpolymers;Number average molecular weight, Weight average molecular weight, Degree ofpolymerization,Polydispersity Index.

Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic andfree radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation ofalkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde,Polyurethanes) and thermosoftening (PVC, polythene);

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural andsynthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives;Introduction to liquid crystal polymers; Biodegradable and conducting polymers withexamples.

Reference Books:

1. P S. Kalsi, Textbook of Organic Chemistry 1st Ed., New Age International (P)Ltd. Pub.
2. R. T. Morrison, &R. N. Boyd, Organic Chemistry, Dorling Kindersley (India)Pvt. Ltd. (Pearson Education).
3. F. W. Billmeyer, Textbook of Polymer Science, John Wiley & Sons, Inc.
4. V. R. Gowariker,N. V. Viswanathan, &J. Sreedhar, Polymer Science, New Age
5. International (P) Ltd. Pub.
6. I. L. Finar, Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. T. W. S. Graham Organic Chemistry, John Wiley & Sons, Inc.
8. J. Singh, S. M. Ali, &J. Singh, Natural Product Chemistry, PrajatiPrakashan 2010.
9. W. Kemp, Organic Spectroscopy, Palgrave

Course Title: Matrices and Infinite series
Paper Code: MTH 155 A

L	T	P	Credits
4	0	0	4

Objective:
This Course is a requirement for majors in other sciences because study of matrices and infinite series provides a basis for advanced studies not only in Mathematics but also in other branches like engineering, physics and computers etc.

UNIT-A **(12)**
Determinants and their properties, special matrices-hermitian, skew hermitian, orthogonal, unitary, rank of matrix, elementary transformations, vector spaces, linear span, linear dependence and independence, bases and dimension.

UNIT-B **(15)**
Linear transformations, properties of linear transformations, Rank and Nullity of a linear transformation, Rank-Nullity theorem (without proof), matrix of a linear transformation with respect to a given basis.

UNIT-C **(13)**
Eigen values and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, diagonalization, Eigen values of special type of matrices.

UNIT-D **(14)**
Infinite Series: Sequence, Infinite series, convergence , divergence and oscillation of a series, Geometric series, Convergence tests (Comparison test, integral test, D'Alembert's ratio test, Logarithmic test, Cauchy's root test), Alternating series, Absolute convergence of a series, convergence of exponential series.

Reference Books:

1. S. Narayan, and P. K. Mittal A textbook of Matrices. New Delhi: S. Chand & Co., 2010.
2. B. S. Grewal, Higher Engineering Mathematics. New Delhi: Khanna Publication, 2009.
3. S. Lipschutz, and M. Lipson, Schaum's Outline of Linear Algebra(4^{th}edition).Delhi: Tata McGraw-Hill, 2008.
4. K. Hoffman,andR. Kunze, Linear Algebra(2^{nd} edition) Noida: Pearson, 1971.

Course Title: Calculus
Paper Code: MTH 121

L	T	P	Credits
4	0	0	4

Course Objective:

UNIT-A **(15)**

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications, concavity and inflection points, asymptotes.

UNIT-B **(15)**

Curve tracing in cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule. Reduction formulae, derivations and illustrations of reduction formulae

UNIT-C **(15)**

Volumes by slicing; disks and washers methods, Volumes by cylindrical shells, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.

UNIT-D **(15)**

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

Reference Books:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.

2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.

3. H. Anton, I. Bivens and S. Davis, *Calculus*, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

4. R. Courant and F. John, *Introduction to Calculus and Analysis* (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

Course Title: Calculus & Geometry
Paper Code: MTH-156 A

L	T	P	Credits
4	0	0	4

Objective:
The objective of the course is to equip the students with the knowledge of basic concepts of partial derivatives, multiple integration and their applications in geometry.

UNIT-A **(12)**

Equations of parabola, ellipse, hyperbola and their properties, Cartesian equation and vector equation of a line, shortest distance between two lines, Cartesian and vector equation of a plane, Angle between (i) two lines, (ii) two planes, (iii) a line and a plane, Distance of a point from a plane.

UNIT-B **(14)**
Solid Geometry: Sphere, Cone, Cylinder, Equation of Paraboloid, ellipsoid and hyperboloid in standard forms. Simple properties of these surfaces. Equation of tangent planes to the above surfaces.

UNIT-C **(13)**
Functions of two and more variables: Vector-valued function and space curves. Arc length and unit tangent vector. Limit and continuity of multivariable function. Partial derivatives. Directional derivatives, gradient vectors and tangent planes.

UNIT-D **(14)**
Multiple Integrals and Integral in vector fields: Double and triple integrals. Fubini's Theorem Without proof, Change of order of integration in double integrals, volume of a region in space, Triple integrals in spherical and cylindrical coordinates, substitution in multiple integrals. Line integrals vector fields. Path independence and surface integrals. Divergence and Stoke's theorem (Applications only).

Reference Books:

1. G. B. Thomas, and R. L. Finney, Calculus and Analytic Geometry. New Delhi Addison Wesley, 1995.
2. J.P.Mohindru, and U.Gupta, and A. S.Dogra,New Pattern Vector Algebra and Geometry. International Publishers, New Edition, 2004.
3. B.S. Grewal, B.S. Higher Engineering Mathematics. New Delhi: Khanna Publication, 2009

Course Title: Linear Algebra
Paper Code: MTH 181

L	T	P	Credits
4	0	0	4

Objective:

The concepts and techniques from linear algebra are of fundamental importance in many scientific disciplines. The main objective is to introduce basic notions in linear algebra that are often used in mathematics and other sciences. The emphasis will be to combine the abstract concepts with examples in order to intensify the understanding of the subject.

UNIT-A **(14)**

Systems of linear equations, Matrices, Rank, Determinants and their properties, Vector spaces, subspaces, linear spans, linear dependence and independence, bases and dimension.

UNIT-B **(12)**

The null space and the column space of a matrix and their dimension.Linear transformations, representation of linear transformations by matrices, change of basis, Rank-nullity theorem.

UNIT-C **(13)**

Eigen values and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonalization,Diagonalization of symmetric matrices and quadratic forms.

UNIT-D **(13)**

Inner product, length, orthogonally, orthogonal projections,Cauchy-Schwartz inequality Gram-Schmidt orthonormalization process least square problems, inner product spaces and their applications.

Reference Books:

1. S. Lipschutz, and M. Lipson, Schaum's Outline of Linear Algebra(4^{th}edition).Delhi: Tata McGraw-Hill, 2008.
2. K. Hoffman andR.Kunze, Linear Algebra(2^{nd} edition).Noida: Pearson, 1971.
3. K. B. Dutta, Matrix and Linear Algebra. New Delhi: Prentice Hall of India Pvt. Ltd, 2000.
4. I. S. Luther, and I. B. S Passi, Algebra Vol. I – Groups.New Delhi: Narosa Publishing House, 2004.

Course Title: Differential Equations and Fourier series
Paper Code: MTH-255 A

L	T	P	Credits
4	0	0	4

Objective:
The objective of the course is to enable the students to understand the basic concepts related to ordinary differential, partial differential equations and Fourier series and their applications.

UNIT-A **(14)**
Ordinary Differential Equations: Exact Differential Equations of First Order, Homogeneous and Non-homogeneous Linear Differential equations of Second Order with constant coefficients. Method of variation of parameters. Simultaneous linear equations.

UNIT-B **(14)**
Solution in series of second order linear differential equations with variable coefficients (in particular, solutions of Legendre's and Bessel's equations.) Bessel functions, Legendre functions, their recurrence and orthogonal relations, Gamma and Beta functions.

UNIT-C **(15)**
Periodic functions, Euler's formula. Dirichlet's conditions. Fourier series of discontinuous functions. Fourier series of Even and Odd functions, half range expansions, Fourier series of different wave forms, Complex form of Fourier series

UNIT-D **(13)**
Formulation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients.
Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation and their applications, solution by the method of separation of variables.

Reference Books:

1. B. S. Grewal, Higher Engineering Mathematics. New Delhi: Khanna Publication, 2009
2. E. Kreyszig,.Advanced Engineering Mathematics. New Delhi: Wiley Eastern Ltd., 2003.
3. R K Jain, and S. R. Iyengar ,Advanced Engineering Mathematics, New Delhi: Narosa Publishing House, 2003.
4. G. B. Thomas,and R. L. Finney Calculus and Analytic Geometry. New Delhi Addison Wesley, 1995

Course Title: Number Theory
Paper Code: MTH 206A

L	T	P	Credits
4	0	0	4

Objective:
The aim of this course is to teach the students about the basics of Elementary Number Theory starting with primes, congruence's, quadratic residues, primitive roots, arithmetic functions.

Unit-A (**14)**
Divisibility: Definition, properties, division algorithm, greatest integer function The Euclidean Algorithm, Primes and their properties, Infinitude of primes, The Fundamental Theorem of Arithmetic, The Prime Number Theorem (statement only).

Unit-B **(14)**
Congruences: Definition and properties, Linear congruence's in one variable, Simultaneous linear congruences Euler's phi function, Fermat's Theorem, Euler's Theorem, Wilson's Theorem, Solutions of Congruences, The Chinese Remainder Theorem, Multiplicative property of Euler's phi function, Primitive Roots.

Unit-C **(14)**
Quadratic residues: Quadratic residues and non-residues, The Legendre symbol: Definition and basic properties, Euler's Criterion, Gauss' Lemma The law of quadratic reciprocity.

Unit-D **(14)**
Linear Diophantine equation, The order of an integer. Continued fractions Groups and Arithmetic. What is a group? Numbers modulo n. The group of unit's moduli p. Primitive roots: Definition and properties.

Reference Books:

1. Burton, David M.,*Elementary Number Theory* (6th edition). New Delhi: Tata McGraw Hill, 2006.
2. Niven, I. and Zuckeman, H.S., *Introduction to Number Theory* (5^{th} edition). Delhi: Wiley Eastern, 1991.
3. Apostal, T.N., *Introduction to Analytic Number Theory* (5^{th} edition).New York: Springer Verlag, 1998.
4. Hardy,and Wright, *An Introduction to the theory of Numbers* (6th edition). New York: Oxford Univ. Press, 2008

Course Title: ANALYTICAL GEOMETRY
Paper Code: MTH 325

L	T	P	Credits
5	1	0	6

Objective:

The course is an introductory course on Analytical Solid Geometry so as to enable the reader to understand further deeper topics in Differential Geometry etc.

Unit –I **(14)**

Equations of parabola, ellipse, hyperbola and their properties, Cartesian equation and vector equation of a line, shortest distance between two lines, Cartesian and vector equation of a plane, Angle between (i) two lines, (ii) two planes, (iii) a line and a plane, Distance of a point from a plane.

Unit –II **(14)**

Equation of a sphere and its properties, Equation of a cone, Intersection of cone with a plane and a line, Enveloping cone, Right circular cone, Cylinder: Definition, Equation of cylinder, Enveloping and right circular cylinders.

Unit –III **(14)**

Equations of central conicoids, Tangent plane, Normal, Plane of contact and polar plane, Enveloping cone and enveloping cylinder, Conjugate diameters and diametral planes, Equations of paraboloids and its simple properties.

Unit –IV **(14)**

Plane sectionof central conicoid, Axes of non-central plane sections, Circular sections, Sections of paraboloids, Circular sections of paraboloids, Condition for a line to be a generator of the conicoid.

Reference Books

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005
2. P. K. Jain, and A, Khalil, A text book of Analytical Geometry of three dimensions, Wiley Eastern Ltd, 1999.
3. S. Narayan and P.K. Mittal, Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., 2008.
4. DipakChatterjee, Analytical Solid Geometry, PHI Learning, 2003.
5. S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company, London.

Course Title: Discrete Mathematics
Course Code: MTH 327

L	T	P	Credits
5	1	0	6

Objective:
The objective of this course is to acquaint the students with the basic concepts in Discrete Mathematics and Graph Theory. It also includes the topic like Mathematical Logic, Recursive relations and Boolean algebra.

Unit-A **(12)**
Set Theory, Relations and Functions: Natural Numbers- Well Ordering Principle, Principle of Mathematical Induction, Sets, Algebra of Sets, Ordered Sets, Subsets, Relations, Equivalence Relations and Partitions, Hasse diagram, Lattices, Functions, Special functions, Composition of Functions, one-one, onto and Inverse of a function, Number of one-one functions.

Unit-B **(14)**
Basic Counting Principles and Recurrance Relations: Permutation, Combinations, Pigeonhole Principle, Inclusion-exclusion Principle, Number of onto functions, Partitions and Stirling Numbers of Second kind, Recurrence Relations, Characteristic Equation, Homogeneous and non-homogeneous linear recurrence relations with constant coefficients, Generating Functions for some standard sequences.

Unit-C **(14)**
Graphs and Trees: Basic Terminology, Special Graphs, Handshaking Theorem, Isomorphism of Graphs, Walks, Paths, Circuits, Eulerian and Hamiltonion Paths, Planar and Non Planar Graphs, Coloring of Graph, Directed graphs, Travelling Salesman Problem, Binary Trees, Tree Traversing: Preorder, Postorder and Inorder Traversals, Minimum Spanning Trees, Shortest path problem, Prim's and Kruskal'sAlogrithm.

Unit –D (**12)**
Logic and Boolean algebra: Propositions, Basic logic operators, Logic equivalence involving Tautologies and Contradiction, Conditional Propositions, Quantifiers, Introduction to Boolean algebra, laws of Boolean algebra, Boolean function, Sum of product form, K-map, logic gates and circuits.

Reference Books:

1. K. H. Rosen, Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.
2. D. S. Malik, and M. K. Sen, Discrete Mathematical Structures: Theory and Applications, Thomson Cengagae Learning, New Delhi, 2004.
3. S. Lipschutz, and M. Lipson,Schaum's Outline of Discrete Mathematics,Schaum's Outlines, New Delhi, 2007
4. M. Ram, Discrete Mathematics, Pearson Publications, 2011.
5. C.Liu,L.,Elements of Discrete Mathematics**,** McGraw Hill, International Edition, Computer Science Series, 1986.
6. J.P.Trembley, and R. P. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill.

Course Title: Probability and Statistics
Paper Code: MTH 328

L	T	P	Credits
5	1	0	6

Objective: The course is designed to develop greater skill and understanding of statistics and probability and to explore properties of probability distributions.

UNIT-A **(12)**

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function.

UNIT-B **(13)**

Discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

UNIT-C **(13)**

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf).

UNIT-D **(12)**

Linear regression for two variables, Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Reference Books:

1. Gupta, S.C.,andKapoor, V.K., *Fundamentals of Mathematical Statistics*. New Delhi: S. Chand & Sons, 2002.
2. Mood, A.M.,Graybill, F.A., and Boes, D.C., *Introduction to the theory of Statistics*. Delhi: McGraw Hill, 1974.
3. Baisnab, and Jas M., *Elements of Probability and statistics*. Delhi: Tata McGraw Hill, 2004.
4. Meyer, P.L., *Introductory Probability and Statistical Applications.* Delhi: Addison-WesleyPublishing Company, 1970.
5. Sheldon Ross, *Introduction to Probability Models,* 9th Ed., Academic Press, Indian Reprint, 2007.
6. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, *Introduction to the Theory ofStatistics*, 3rd Ed., Tata McGraw- Hill, Reprint 2007.

Course Title: Linear Programming
Paper Code: MTH 333

L	T	P	Credits
5	1	0	6

Unit-A **(12)**

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit-B **(13)**

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of dual.

Unit-C **(13)**

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit-D **(12)**

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, and linear programming solution of games.

Reference Books:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and NetworkFlows*, 2nd Ed., John Wiley and Sons, India, 2004.

2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.

3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

4. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.

Course Title: Integral Transforms and Complex Analysis
Paper Code: MTH-351A

L	T	P	Credits
4	0	0	4

Objective:
To acquaint the students with the application of Laplace transforms to solve ordinary differential equations. Moreover, basics of Complex Analysis are also included in this course.

UNIT-A **(12)**
Laplace Transforms: Laplace transforms: definition, elementary transforms. Transforms of derivatives and integrals. Transforms of periodic functions. Convolution theorem. Inverse Laplace transforms. Application to ordinary differential equations.

UNIT-B **(15)**
Complex Analysis: Complex numbers, absolute value, argument. Functions e^z, sin z, cos z, log z and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Harmonic functions and their conjugates.

UNIT-C **(13)**
Integration of complex functions, Cauchy's theorem (statement only), Cauchy's theorem for multiply connected domains (statement only). Cauchy's integral formula (statement only) and simple consequences.

UNIT-D **(14)**
Expansion into Laurent series, singularities, Residues, Cauchy residue theorem (statem*ent only).* Evaluation of definite integrals using contour integration

Reference Books:

1. B. S. Grewal, Higher Engineering Mathematics. New Delhi: Khanna Publication, 2009
2. E. Kreyszig, .Advanced Engineering Mathematics. New Delhi: Wiley Eastern Ltd., 2003.
3. R. K. Jain, and K Iyengar S R.Advanced Engineering Mathematics, New Delhi: Narosa Publishing House, 2003.
4. G. B. Thomas, and R. L. Finney Calculus and Analytic Geometry. New Delhi Addison Wesley, 1995
5. R. V. Churchill, and J. W. Brown Complex Variables and Application. New Delhi: McGraw-Hill, 2008.

Course Title: Special Functions & Integral Transforms
Paper Code: MTH 309A

Course Objective: The objective of this course is to introduce the special function as a solution of specific differential equations and acquaint the students with their properties, Integral Transforms and their inverse have been introduced which help in solving the various initial and boundary value problems.

UNIT-A **(13)**

Legendre Polynomials – Orthogonal property of Legendre polynomials, Recurrence relations, Rodrigue's formula, generating function, Orthogonal and Orthonormal functions, Fourier-Legendre series.

UNIT-B **(14)**

Chebyshev Differential Equation, Chebyshev polynomials of first and second kind and relation between them, Generating function, orthogonal property, Recurrence formulae, Fourier Chebyshev Series. Bessel's functions. Strum-Liouville Problem – Orthogonality of Bessel functions, Reccurence formulae, Generating function, Fourier-Bessel Series.

UNIT-C **(15)**

Laplace Transforms, Inverse Laplace transform, Solution of initial value problems using Laplace transforms, Translation theorems, Laplace transform of Dirac-Delta function, Differentiation and Integration of Laplace transform, Convolution theorems, Laplace transform of periodic functions, Laplace transform method to solve some ordinary differential equations.

UNIT-D **(15)**

Review of Fourier series, Fourier integrals, Applications of Fourier series, Fourier transforms. Fourier transforms: Linearity property, Shifting, Modulation, Convolution Theorem, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms, solution of differential Equations using Fourier Transforms.

Reference Books:

1. Jain, R. K. and Iyengar. S.R.K.*Advanced Engineering Mathematics.*Narosa Publishing House, 2004.
2. Rainville,E. D. *Special Functions.* New York: Macmillan, 1960.

Course Title: Human Values and General Studies

L	T	P	Cr.
4	0	0	4

Course Code: SGS107

Course Objectives

- To sensitize students about the role and importance of human values and ethics in personal, social and professional life.
- To enable students to understand and appreciate ethical concerns relevant to modern lives.
- To prepare a foundation for appearing in various competitive examinations
- To sensitize the students about the current issues and events of national and international importance
- To provide opportunity to the students to study inter disciplinary subjects like Geography, Science, Economy, Polity, History, International Relations etc.

Part - A

Human Values

1. Concept of Human Values: Meaning, Types and Importance of Values. **2 Hrs**

2. Value Education : Basic guidelines for value education **2 Hrs**

3. Value crisis and its redressal **1 Hrs**

Being Good and Responsible

1. Self Exploration and Self Evaluation **2 Hrs**
2. Acquiring Core Values for Self Development **2 Hrs**
3. Living in Harmony with Self, Family and Society **3 Hrs**
4. Values enshrined in the Constitution: Liberty, Equality Fraternity and Fundamental Duties. **3 Hrs**

Part - B

Value – based living

1. Vedic values of life **2 Hrs**
2. *Karma Yoga* and *Jnana Yoga* **2 Hrs**
3. *AshtaMarga* and *Tri-Ratna* **2 Hrs**

Ethical Living:

1. Personal Ethics **2 Hrs**
2. Professional Ethics **3 Hrs**
3. Ethics in Education **2 Hrs**

Part-C

General Geography

World Geography **3 Hrs**

The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest.

Indian Geography **3 Hrs**

Location, Area and Dimensions, Physical Presence, Indian States and Union Territories, Important sites and Monuments, Largest-Longest and Highest in India.

General History **3 Hrs**

Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus

Glimpses of World History **3 Hrs**

Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc.

Indian Polity: Constitution of India **3 Hrs**

Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panachayati Raj System, RTI etc.

General Economy **3 Hrs**

The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.

Part-D

General Science **3 Hrs**

General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries

Sports and Recreation **3 Hrs**

The World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours. Famous personalities, Festivals, Arts and Artists

Current Affairs **3 Hrs**

National and International Issues and Events in News, Governments Schemes and Policy Decisions

Miscellaneous Information

Who is who **2 Hrs**

Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports

References Books:

1. A N Tripathi, Human Values, New Age International Publishers, New Delhi, Third Edition, 2009
2. R. Surbiramanian, Professional Ethics, Oxford University Press, New Delhi, 2013.
3. RishabhAnand, Human Values and Professional Ethics, Satya Prakashan, New Delhi, 2012
4. Sanjeev Bhalla, Human Values and Professional Ethics, Satya Prakashan, New Delhi, 2012.
5. RituSoryan,Human Values and Professional Ethics, Dhanpat Rai & Co. Pvt. Ltd., First Edition, 2010.
6. Suresh Jayshree, B. S. Raghavan, Human Values and Professional Ethics by, S Chand & Co. Ltd. , 2007.

7. Yogendra Singh, Ankur Garg,Human Values and Professional Ethics, ,Aitbs publishers, 2011.
8. VrinderKumar,,Human Values and Professional Ethics, Kalyani Publishers, Ludhiana, 2013.
9. R R Gaur, R. Sangal, GP Bagaria,Human Values and Professional Ethics, Excel Books, New Delhi 2010.
10. Dr.BramwellOsula, Dr.SarojUpadhyay,Values and Ethics, Asian Books Pvt. Ltd., 2011.
11. S. Radhakrishnan, George Allen,Indian Philosophy, & Unwin Ltd., New York: Humanities Press INC, 1929.
12. A N Dwivedi,Essentials of Hinduism, Jainism and Buddhism, , Books Today, New Delhi – 1979
13. Dayanand : His life and work, SurajBhan, DAVCMC, New Delhi – 2001.
14. Kapil Dev Dwivedi,Esence of Vedas, ,Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.
15. Prof. B BChaubey, Vedic Concepts, KatyayanVedic SahityaPrakashan, Hoshiarpur, 1990.
16. R. S. Aggarwal,Advance Objective General Knowledge, S. Chand Publisher 2013
17. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers,2013
18. R P Verma, Encyclopedia of General Knowledge and General Awareness by, Penguin Books Ltd 2010
19. Edgar Thorpe and Showick Thorpe,General Knowledge Manual 2013-14, , The Pearson, Delhi.
20. MuktikantaMohantyGeneral Knowledge Manual, Macmillan Publishers India Ltd., Delhi, 2013-14
21. India 2013, Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
22. M.MethewManorama Year Book 2013-14, , Malayalam Manorama Publishers, Kottayam, 2013.
23. Spectrum's Handbook of General Studies – 2013-14, Spectrum Books (P) Ltd., New Delhi

CURRENT AFFAIRS

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum.

Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs, World Atlas Book

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune

Course Title: Programming in C
Course Code: CSA350

L	T	P	Cr.
3	0	0	3

Course Objective: The objective of this course is to help the students in finding solutions to various real lifeproblems and converting the solutions into computer program using C language(structured programming). Students will learn to write algorithm for solutions to variousreal-life problems. Converting the algorithms into computer programs using C language.

UNIT-A

Logic Development and Program Development Tools

- Data Representation, Flowcharts, Problem Analysis
- Decision Trees/Tables, Pseudo Code and Algorithms,
- Program Debugging, Compilation and Execution.

Fundamentals

- Character Set, Identifiers and Key Words, Data Types
- Constants, Variables, Expressions, Statements, Symbolic Constants.

Operations and Expressions

- Arithmetic Operators, Unary Operators, Relational Operators,
- Logical Operators, Assignment and Conditional Operators, Library functions.

UNIT-B

Data Input and Output

- Single Character Input, Single Character Output, Entering Input Data
- More About Scan Functions, Writing Output Data, More About Print Functions
- Gets and Puts Functions, Interactive Programming.

Control Structures

- Introduction, Decision Making with If – Statement, If Else and Nested If,
- While And Do-While, For Loop.
- Jump Statements: Break, Continue, Goto, Switch Statement.

Functions

- Introduction To Functions, Function Declaration, Function Categories
- Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference
- Recursion, Global and Local Variables, Storage Classes.

UNIT-C

Arrays

- Introduction to Arrays, Array Declaration, Single and Multidimensional

Array, Memory Representation, Matrices, Strings, String Handling Functions.

Structure and Union

- Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions.

UNIT-D

Pointers

- Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers,
- Assignment through Pointers, Pointers and Arrays.

Files

- Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File.

Reference Books

1. P KanetkarYashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
2. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.
3. Byron S. Gottfried, Programming in C, McGraw Hills, Second Edition.
4. Kernighan &Richie,The C Programming Language, PHI Publication, Second Edition.
5. Balaguruswamy, Programming in ANSI C.
6. Schaum Outline Series,Programming in C.

Course Title: C Programming Laboratory
Course Code: CSA351

L	T	P	Cr.
0	0	2	1

Implementation of C programming concepts:

- Control Structures, Loops, Arrays, Strings Functions, Structures, Union, Files, etc

Course Title: Basic Communication Skills

L	T	P	Credits
3	0	0	3

Course Code: ENG151A

No. Of Lectures: 60

Course Objective:

- To enhance students' vocabulary and comprehensive skills through prescribed texts.
- To hone students' writing skills.

Learning Outcomes: Students will be able to improve their writing skills as well as will enrich their word power.

Unit – A Applied Grammar (Socio-Cultural Context)

1. Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, Interjection 5 hours
2. Tenses (Rules and Usages in Socio-cultural contexts) 6 hour
3. Modals: Can, Could, May, Might, Will, Would, Shall, Should, Must, Ought to 5hours
4. Passives 5 hours
5. Reported/Reporting Speech 5 hour

Unit – B Reading (Communicative Approach to be Followed)

1. J M Synge: Riders to the Sea (One Act Play) 7 hours
2. Anton Chekhov : Joy (Short Story) 5 hours
3. Swami Vivekanand : The Secret of Work (Prose) 7 hours

Unit – C Writing

1. Paragraph and Essay Writing 5Hours
2. *Letter Writing: Formal and Informal* 5 hours
3. Notice and Email 5hours

References:

a. Books

1. Kumar, Sanjay and PushpLata. *Communication Skills*. India: OUP, 2012. Print.
2. Vandana, R. Singh. *The Written Word* by. New Delhi: Oxford University Press, 2008. Print.

b. Websites

1. www.youtube.com (to download videos for panel discussions). Web.
2. www.letterwritingguide.com. Web.
3. www.teach-nology.com.Web.
4. www.englishforeveryone.org.Web.
5. www.dailywritingtips.com.Web.
6. www.englishwsheets.com.Web.
7. www.mindtools.com.Web.

Course Title: Basic Communication Skills

L	T	P	Credits
0	0	2	1

Course Code: ENG 152

No. Of Lectures: 30

Course Objective:

- To improve fluency in speaking English.
- To promote interactive skills through Group Discussions and role plays.

Learning Outcome: Students will get exposure to speaking through the above mentioned interactive exercises. In addition, they will develop a technical understanding of language learning software, which will further improve their communicative skills.

***Unit* – A Speaking/Listening**

1. Movie-Clippings 10 hours
2. Role Plays 10 hours
3. Group Discussions 10 hours

References:

Books

1. J. KGangal,.*A Practical Course In Spoken English.* India: Phi Private Limited, 2012. Print.
2. SanjayKumar, and PushpLata. *Communication Skills*. India: OUP, 2012. Print.

Websites

1. www.youtube.com (to download videos for panel discussions).Web.
2. www.englishforeveryone.org.Web.
3. www.talkenglish.com.Web.
4. www.mindtools.com.Web.

Course Title: Environmental Studies

Paper Code: EVS100

L	T	P	Credits
4	0	0	4

Course Objective: This course aims at understanding the students in aspects of environmental problems, its potential impacts on global ecosystem and its inhabitants, solutions for these problems as well as environmental ethics which they should adopt to attain sustainable development.

Unit 1

The multidisciplinary nature of environmental studies (2 Hours)

Definition, scope and importance, Need for public awareness

Natural Resources: Renewable and non-renewable resources: (8 Hours)

Natural resources and associated problems.

(a) **Forest resources:** Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) **Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

(f) **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

Ecosystem: (4 Hours)

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

Unit II

Biodiversity and its conservation **4 Hours**

- Introduction – Definition: Genetic, Species and Ecosystem Diversity
- Bio-geographical classification of India
- Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity, global and national efforts.

Environmental Pollution **8Hours**

- Definition, causes, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear pollution

- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

Unit III

Social Issues and the Environment **7 Hours**

- Population growth, variation among nations, Population explosion – Family Welfare Programmes.
- Environment and human health,
- From unsustainable to sustainable development
- Urban problems and related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions

- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environmental Laws: The Environment Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and control of Pollution) Act 1974; The Wildlife Protection Act, 1972; Forest Conservation Act, 1980.
- Issues involved in enforcement of environmental legislation
- Public Awareness

Unit IV

Human Population and Environment5 Hours

- Population Growth and Variations among Nations
- Population Explosion
- Human Rights
- Value Education
- HIV / AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and Human Health
- Case Studies

Field Work **5 Hours**

- Visit to a local area to document environmental assets river/ forest/ grassland/hill/mountain
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems-Pond, river, hill slopes, etc (Field work equal to 5 lecture hours)

Suggested Readings:

1. E, P, Odum, Basic Ecology. Japan: Halt Saundurs, 1983.
2. D. B. Botkin, and E. A. Kodler Environmental Studies: The Earth as a living planet. New York: John Wiley and Sons Inc., 2000.
3. J. S. Singh, S. P. Singh, andS. R. Gupta , Ecology, Environment and Resource Conservation. New Delhi: Anamaya Publishers, 2006.
4. A. K. De, Environmental Chemistry. New Delhi: Wiley Eastern Ltd., 1990.
5. P. D. Sharma, Ecology and Environment. Meerut Rastogi Publications, 2004