COURSESOFSTUDIES

FOR

THREE YEAR DEGREE

COURSEIN

SCIENCE HONOURS

DEPARTMENTOFPHYSICS

Choice Based Credit System(CBCS)

First & Second Semester Examination –2022-23

Third & Fourth Semester Examination –2023-24

Fifth & Sixth Semester Examination–2024-25

GOVERNMENTAUTONOMOUSCOLLEGE,
PHULBANI,KANDHAMAL-762001

DISTRIBUTIONOFMARKS

Paper with Practical	
Mid Sem(15Marks)	
Two questions to be answered carrying 1mark each	2X1mark =2marks
Two questions to be answered carrying1.5marks each	2X1.5 marks= 3marks
Two questions to be answered carrying 2marks each	2X2 marks=4marks
One question to be answered carrying 6 marks each	1X6marks= 6marks
End Sem(60Marks)	
Eight questions to be answered carrying 1 mark each	8X1mark =8marks
Eight questions to be answered carrying 1.5 marks each	8X1.5marks=12marks
Eight questions to be answered carrying 2 marks each	8X2marks=16marks
Four questions to be answered carrying 6 marks each	4X6marks=24marks
Paper without Practical	
Mid Sem(20Marks)	
Three questions to be answered carrying1marks each	3X1 mark =3marks
Two questions to be answered carrying 2 marks each	2X2 marks=4marks
Two questions to be answered carrying 3 marks each	2X3 marks=6marks
One question to be answered carrying 7 marks each	1X7marks= 7marks
End Sem(80Marks)	
Twelve questions to be answered carrying 1 marks each	12X1 mark=12marks
Eight questions to be answered carrying 2 marks each	8X2marks=16marks
Eight questions to be answered carrying 3 marks each	8X3marks=24marks
Four questions to be answered carrying 7 marks each	4X7marks=28marks

SYLLABI FOR CBCS COURSE

Sem	CORE COURSE (14)	Ability Enhancement Compulsory Course (AECC) (2)	Ability Enhancement Elective Course (AEEC) (2) (Skill Based)	Elective: Discipline Specific DSE (4)	Elective: Generic (GE) (4)
I	CORE-I	AECC-I AECC-III (EV-I)			GE-IA
	CORE-II				
II	CORE-III	AECC-II			GE-1B
	CORE -IV	AECC-III (EV-II)			
III	CORE-V	AECC-III (EV-III)	SEC-I		GE-2A
	CORE-VI				
	CORE-VII				
IV	CORE-VIII	AECC-III (EV-IV)	SEC-II		GE-2B
	CORE-IX				
	CORE-X				
V	CORE-XI	AECC-III (EV-V)		DSE-I	
	CORE-XII			DSE-II	
VI	CORE-XIII	AECC-III (EV-VI)		DSE-III	
	CORE-XIV			DSE-IV /Project	

YEAR&SEMESTER-WISEPAPERS&CREDITSATA GLANCE

Three-Year(6-Semester)CBCSProgramme(B.Sc.Hons)(PhysicsDepartment)				
Yr.	Sl.No.	**Course Structure**	**Code**	**Credit Points**
FIRSTYEAR		**SEMESTER-I**		
	1	Mathematical Physics-I	C-1.1	4+2
	2	Mechanics	C-1.2	4+2
	3	Mechanics and Properties of matter, Oscillation and Waves, Thermal Physics, Electricity, Magnetism and Electronics	GE-1.3	4+2
	4			
	5	Ethics &Values (Unit-I)	AECC-1.5	1
		SEMESTER-II		
	6	Electricity and Magnetism	C-2.1	4+2
	7	Waves and Optics	C-2.2	4+2
	8			
	9			
	10	Ethics & Values (Unit-II)	AECC-2.5	1
SECONDYEAR		**SEMESTER-III**		
	11	Mathematical Physics-II	C-3.1	4+2
	12	Thermal Physics	C-3.2	4+2
	13	Analog Systems and Applications	C-3.3	4+2
	14	Optics, Special Theory of Relativity, Atomic Physics, Quantum Mechanics and Nuclear Physics	GE-3.4	4+2
	15			
	16	Ethics & Values (Unit-III)	AECC-3.6	1
		SEMESTER-IV		
	17	Mathematical Physics -III	C-4.1	4+2
	18	Elements of Morden Physics	C-4.2	4+2
	19	Digital System and Application	C-4.3	4+2
	20	Mathematics	GE-4.4	4+2
	21	Communicative English		
	22	Ethics& Values (Unit-IV)	AECC-4.6	1
FINALYEAR		**SEMESTER-V**		
	23	Quantum Mechanics& Applications	C-5.1	4+2
	24	Solid State Physics	C-5.2	4+2
	25	Classical Dynamics	DSE-5.3	6
	26	Nuclear and Particle Physics	DSE-5.4	6
	27	Ethics & Values (Unit-V)	AECC-5.5	1
		SEMESTER-VI		
	28	Electro-magnetic Theory	C-6.1	4+2
	29	Statistical Mechanics	C-6.2	4+2
	30	Nano-Materials and Applications	DSE-6.3	6
	31	Project Work /Basic Instrumentation	DSE-6.4	6 / 4+2
	32	Ethics& Values (Unit-VI)	AECC-6.5	1

Notes:

- CC- Core Course
- GE- Generic Elective Course
- DSE- Discipline Specific Elective Course
- AECC-Ability Enhancement Compulsory Course
- SECC-Skill Enhancement Compulsory Course (Skill Based)
- Fora6 credit course, the total teaching hours are: Minimum-50 Hours, Maximum-65 Hours

Program Outcomes

Students taking admission to this program of B.Sc. in Physics are expected to get equipped with following outcomes:

1. Explaining the basic scientific principles and methods.
2. Inculcating scientific thinking and awareness among the student
3. Ability to handle the situation by critically analyzing the problem.
4. Understanding the natural and environmental issues as well as threats.
5. To contribute to solve various problems faced by our society
6. Build moral and ethical values.

Program Specific Outcome:

After completing BSc Physics course students will be able to:

1. To apply the theories learnt and the skills acquired through laboratory experiment to solve real time problems.
2. Acquire adequate knowledge in Physics to pursue higher studies and build carrier in various scientific fields.
3. Use computers and software for programming skill and numerical analysis.
4. Acquire team spirit for development of the organization through working in groups for scientific projects.
5. Face the challenges of various social as well as global problems.

SEMESTER-I

C-1.1: MATHEMATICAL PHYSICS-I

Full Marks-100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

COURSE OUTCOME

After completion of the course the students will be able to:
1) Plot curves of different functions and expands functions in binomial and Taylor series.
2) Solve differential equations of different nature.
3) Represent differential operators and physical variable in different curvilinear coordinate system.
4) Apply Dirac-delta function in various physical problems.
5) Perform line, surface and volume integrations for scalar and vector fields.
6) Perform basic scientific computing using C and C++programming.

THEORY

UNIT-I

Calculus-I: Plotting of functions, Intuitive ideas of continuous, differentiable functions and plotting of curves, Approximation: Taylor and binomial series (statements only), First Order Differential Equations and Integrating Factor, Second Order Differential equations: Homogeneous Equations with constant coefficients, Wronskian and general solution, Statement of existence and Uniqueness Theorem for Initial Value Problems, Particular Integral.

UNIT-II

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

Vector algebra: 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 a rea and volume respectively, Scalar and Vector fields.

UNIT-III

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems, Comparison of velocity and acceleration in cylindrical and spherical coordinate system

Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular Function, Properties of Dirac delta-function.

UNIT-IV

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

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion 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).

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris (2013,7thEdition., Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India),2008

Reference books:

1. Mathematical Physics C. Harper (Prentice Hall India), 2006
2. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition, Mc-Graw Hill Education)
3. Complex variables and applications, J.W Brown and R.V. Churchill Mathematical Physics, -SatyaPrakash (Sultan Chand)
4. Mathematical Physics, B.D. Gupta (4th edition, Vikas Publication), 2009
5. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Sri Krishna Prakashan),2009
6. Mathematical Physics–H.K. Dass, Dr. Rama Verma (S. Chand Publishing), 2011

PRACTICAL

TheaimofthisLabisnotjusttoteachcomputerprogrammingandnumericalanalysisbuttoemphasizeitsroleinsolving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- The course will consist of lectures (both theory and practical) in the Lab
- Evaluation done not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

Introduction and Overview: Computer architecture and organization, memory and Input / output devices.

Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow and overflow emphasize the importance of making equations in terms of dimension less variables, Iterative methods. Algorithm

Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations. Systematic and Random Errors, Propagation of Errors, Normal Law of Errors, Standard and Probable Error.

Review of C and C++ Programming: Introduction to Programming, constants, variables and Fundamentals datatypes, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If Statement, If else Statement, Nested If structure, Else If Statement, Ternary operator, Go to Statement. Switch Statement. Unconditional and Conditional Looping. While ----------+Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D and 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects

Programs: Sum and average of a list of numbers, larges to forgiven list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search,

Random number generation: Area of circle, area of square, volume of sphere, value of π and applications in physics lab.

Review of C and C++ Programming: Introduction to Programming, constants, variables and Fundamentals datatypes, operators and Expressions, I/O statements, scan f and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If Statement, If else Statement, Nested If structure, Else If Statement, Ternary operator, Go to Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D and 2D) and strings, user defined functions, Structures and Unions, Idea of classes and

objects

Programs: Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search,

Random number generation: Area of circle, area of square, volume of sphere, value of π and applications in physics-lab.

Reference Books*:*

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

C-1.2: MECHANICS

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hr

COURSE OUTCOME

After completion of the course the students will be able to learn and apply:

1) Linear and rotational dynamics of bodies and system of bodies
2) Kinematics of moving fluids and dynamics of oscillatory motion under action of central force field.
3) Planetary motion and concept of special theory of relativistic motion.
4) Experimental methods to measure elastic constants and gravitational constant

THEORY

UNIT-I

Rotational Dynamics: Centre of Mass, Motion of CoM, Centre of Mass and Laboratory frames, Angular Momentum of a particle and system of particles, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Perpendicular and Parallel Axis Theorems, Routh Rule, Calculation of moment of inertia for cylindrical and spherical bodies, Kinetic energy of rotation, Eulers Equations of Rigid Body motion, Motion involving both translation and rotation. Moment of Inertia of a Flywheel.

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.

UNIT-II

Elasticity: Relation between Elastic constants, Twisting torque on a Cylinder or Wire, bending of beams, External bending moment, Flexural rigidity, Single and double cantilever Surface Tension: Excess pressure across a curved membrane, Quink's drop

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube, Surface tension, Gravity waves and ripple.

Viscosity: Poiseuille's Equation for Flow of a Liquid with corrections.

UNIT-III

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, Differential Equation of motion with central force and its solution, The first Integrals (two), Concept of power Law Potentials, Kepler's Laws of Planetary motion, Satellites: Geosynchronous orbits, Weightlessness, Basic idea of global positioning system(GPS),Physiological effects on astronauts.

UNIT-IV

Oscillations: Simple Harmonic Oscillations. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Equation of motion and solution (cases of oscillatory, critically damped and overdamped) Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor, Bar Pendulum, Katers Pendulum.

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, Mass less Particles, Mass-energy Equivalence, Relativistic Doppler effect, Relativistic Kinematics, Transformation of Energy and Momentum.

Text Books:

1. Mechanics, D.S. Mathur, PS Hemne (S. Chand Publishing),2012
2. Introduction to Special Relativity, R. Resnick (John Wiley),2007

Reference Books:

- Introduction to Mechanics Daniel Klapnner and Robert Kolenkow, McgrawHill.2007
- MechanicsbyK.RSimon,1971
- Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, etal (Tata McGraw-Hill),2007
- Physics, Resnick, Halliday and Walker (8/e.2010, Wiley)
- Theoretical Mechanics-M.R. Spiegel (Tata McGraw Hill),2017
- Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M. Sands (Pearson),2012
- Mechanics-M. Das, P.K. Jena and R.N. Mishra (Srikrishna Publications),2009

PRACTICAL

(Minimum5 experiments are to be done):

1. To study surface tension by capillary rise method
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate(a) Spring constant, (b) g and (c)Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Modulus of Rigidity of a Wire by Maxwells needle.
7. To determine the value of g using Bar Pendulum.
8. To determine the value of g using Kater's Pendulum

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11thEdn,2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers.

GE-1.3: MECHANICS AND PROPERTIES OF MATTER, OSCILLATION AND WAVES, THERMAL PHYSICS, ELECTRICITY, MAGNETISM AND ELECTRONICS

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical–25/3hrs

THEORY

COURSE OUTCOME

On successful completion of the course the students will able to:

1) Understand the general physical behavior of the matter.

2) Use the principles of oscillations and waves and their application in their respective fields.

3) Apply the fundamental knowledge of Electricity and magnetism in solving their problems.

4) Use the skills of Thermal Physics ans its derivation and importance in the field.

UNIT-I: Mechanics and Properties of Matter

Moment of Inertia Parallel axis and perpendicular axis theorem, M.I. of a Solid sphere and Solid cylinder, Gravitational potential and field due to a thin spherical shell and a solid sphere at external points and internal points, Relation among elastic constants, depression at free end of a light cantilever, Surface tension, pressure, difference across a curved membrane, viscous flow, Poiseuille's formula

UNIT-II: Oscillation and Waves

Simple harmonic motion, damped harmonic motion, under damped, over damped and critically damped motion, Forced vibration, Resonance, Wave equation in a medium, Velocity of Longitudinal waves in an elastic medium and velocity of transverse wave in a stretched string, Composition of SHM, Lissajous figures for super position of two orthogonal simple harmonic vibrations (a) with same frequency, (b) frequency with 2:1.

UNIT-III: Thermal Physics

Entropy, change in entropy in reversible and irreversible process, Carnot engine and its efficiency. Carnot Theorem, Second law of thermodynamics, Kelvin-Planck, Clausius formula. Thermal conductivity, differential equation for heat flow in one dimension, Maxwell thermos dynamic relation (statement only), Clausius Clapeyron equation, Black body radiation, Planck radiation formula (No derivation).

UNIT-IV: Electricity and Magnetism

Gauss law of electrostatics, use of Gauss law to compute electrostatic field due to a linear charge distribution, Magnetic induction B, Lorentz force law, Biot-Savarts law, Magnetic induction due to long straight current

carrying conductor, and in the axis of a current carrying circular coil, Amperes Circuital law, its differential form, The law of electromagnetic equations, its differential and integral form, Maxwell's ectro-magnetic equations and their physical significance, Growth and decay of currents in LR and RC circuits, time constant, alternating currents in RC, RL and LCR circuits, impedance, power factor, resonance. P-type and N-type semiconductors, PN-Junction as rectifier, Half wave and Full wave rectifiers (Bridge type), efficiency, ripple factor, use of RC, LC, and filters, working of PNP and NPN transistors, transistor configurations in CE and CB circuits and relation between α and β. JFET, its operation and characteristics of V -I curve.

PRACTICAL

(Minimum6experimentsaretobedone)

1. To determine the moment of inertia of a fly wheel.
2. To determine the Young's modulus (Y) of a wire by Searl's method.
3. To determine the modulus of rigidity of a wire by Maxwell's needle/Torsion Pendulum (Dynamic method).
4. To determine g by bar pendulum.
5. To determine the value of Y of a rubber by using travelling microscope.
6. To determine the Rigidity of modulus by static method.
7. To determine the frequency of a telescope by using Sonometer.
8. Verification of Laws of Vibration of a string by using Sonometer.
9. To compare capacitances using De Sauty bridge.
10. To determine the Law of resistance by using Foster bridge.
11. Compare the specific heat of two liquids by method of Cooling.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flintand H.T. Worsnop, 1971, Asia Publishing House.
2. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal(1985),Vani Publication.
3. A Text Books of Practical Physics, Indu Prakash and Ramakrishna,11thEdition (2011), Kitab Mahal, New Delhi.

AECC-1.5(EV-I): ETHICS&VALUES

UNIT-I: Issues Relating to Women

Full Mark – 25Mark
End Sem Mark–25 Mark

1.1 Introduction:

General introduction on Ethics and Values, Gender equality as an essential precursor to social progress, the present scenario, Desirable gender related values.

1.2 Women and Family:

Pre-natal sex selection, Gendered practices in the family, Gender based division of labour in the family, Marriage and women, Marriage and women's consent, Child marriage, Practice of dowry, Women and family violence.

1.3 Women and Work:

Women's work: The Invisible hands, Exploitation of women at work, Gender Stereotyping at work, Glass Ceiling, Women and pay gap, Sexual Harassment of women at work, Working women and role conflict.

1.4 Women, Community and Society:

Violence against women in public spaces, Gender sensitive language and communication, Gendered language, Sexist Language, Gender neutral language, Women and property Rights, Women's property Rights in Indian Laws, The functionality of Women's Property Rights.

SEMESTER-II

C-2.1: ELECTRICITY AND MAGNETISM

COURSE OUTCOME

After completion of the course the students will learn;

1) The fundamental laws and concepts of electricity and magnetism.
2) Properties of electric and magnetic field and the energy they carry at different physical situation.
3) To calculate electric and magnetic field for different charge and current distributions.
4) Polarization and magnetization and induction under various conditions.
5) Complex electrical circuit and can compute current, voltage and power transfer using circuit theorems.

6) Practical use of multimeter for measuring various electrical components.
7) Experimental measurement and analysis of magnetic field and electrical circuit response and unknown resistance and capacitance in a network

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory–60/3hrs
End Sem Practical-25/3hrs

THEORY

UNIT-I: Electric Field and Electric Potential

Electric field: Electric field lines, Electric flux, Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Conservative nature of Electrostatic Field. Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole placed in electric field, Potential calculation in different simple cases, Laplace and Poisson's equations, The Uniqueness Theorem, Method of Images and its application on (1) Plane Infinite Sheet and (2) Sphere.
Electrostatic energy of system of charges, Electrostatic energy of a charged sphere, Conductors in an electrostatic Field, Surface charge and force on a conductor.

UNIT-II

Magnetic Field: Magnetic Force, Lorentz Force, Biot Savarts Law, Current Loop as a Magnetic Dipole and its Dipole Moment (analogy with Electric Dipole), Amperes Circuital Law and its application to (1) Solenoid (2)Toroid (3) Helmholtz coil, Properties of B: curl and divergence, Vector Potential, Ballistic Galvanometer: Torque on a current Loop, Current and ChargeSensitivity, Electro-magnetic damping, Logarithmic damping, CDR.

UNIT-III

Dielectric Properties of Matter: Electric Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant, Capacitor (parallel plate, spherical, cylindrical) filled with dielectric, Displacement vector D, Relations between E, P and D, Gauss Law in dielectrics. Magnetic Properties of Matter: Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H, M, Ferromagnetism, B-H curve and hysteresis.
Electromagnetic Induction: Faradays Law, Lenzs Law, Self Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's Equations

UNIT-IV

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit:(1) Resonance (2) Power Dissipation (3) Quality Factor, (4) Band Width, Parallel LCR Circuit.
Network theorems: Ideal Constant-voltage and Constant-current Sources, Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Applications to DC and AC circuits. Transient Currents Growth and decay of current in RC and LR circuits.

Text Books:

1. Introduction to Electrodynamics– D.J. Griffiths (Pearson, 4th edition,2015)
2. Foundations of Electromagnetic Theory-Ritz and Milford (Pearson)4thEdition

Reference Books:

1. Classical Electrodynamics, J.D. Jackson (Wiley), 1998
2. Electricity and Magnetism D. C. Tayal (Himalaya Publishing house),2014
3. Electricity, Magnetism and Electromagnetic Theory- S. Mahajan and Choudhury (Tata Mc Graw Hill)-2012
4. FeynmanLecturesVol.2, R. Feynman, R.B. Leighton, M. Sands (Pearson)-2008
5. Electricity and Magnetism, J.H. Fewkes and J. Yarwood. Vol. I (Oxford Univ. Press)

PRACTICAL

(Minimum of 6experimentsaretobe done)

Use a Multimeter for measuring(a) Resistances, (b)AC and DC Voltages, c) DC Current,(d) Capacitances, and(e)Checking electrical fuses.

1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Fosters Bridge.
4. And compare capacitances using De Sautys bridge.
5. Measurement of field strength B and its variation in a solenoid/artificial coil(determined B/dx)
6. To verify the Thevenin and Norton theorems.
7. To determine self-inductance of a coil by Anderson's bridge.
8. TostudyresponsecurveofaSeriesLCRcircuitanddetermineits(a)Reso-nant frequency, (b)Impedance at resonance,(c) Quality factor Q, and(d)Bandwidth.

9. To study the response curve of a parallel LCR circuit and determine its(a) Anti resonance frequency and(b)Quality factor Q.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop,1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash and Ramakrishna,11thEd., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and JonM.Ogborn,4thEdition, reprinted1985, Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

C-2.2: WAVES AND OPTICS

COURSE OUTCOME

On successful completion of the course the students will able to:

1) Understand reflection, refraction and optical lens system and their applications.

2) Use the principles of wave motion and superposition to explain physics of polarization, interference and diffraction.

3) Solve problems of optics by appropriate equations and can perform numerical and analytical calculation.

4) Perform, analyze and interpret results of laboratory experiment related to reflection, refraction, interference, diffraction and polarization.

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Geometrical Optics: Fermat's principle, reflection and refraction at plane interface, Matrix formulation of geometrical Optics, Cardinal points and Cardinal planes of an optical system, Idea of dispersion, Application to thick Lens and thin Lens, Ramsden and Huygens eyepiece. Wave Optics: Electro-magnetic nature of light. Definition and properties of wavefront Huygens Principle. Temporal and Spatial Coherence.

UNIT-II

Wave Motion : Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Traveling)Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave. Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods, Lissajous Figures(1:1and 1:2)and their uses, N Superposition of N harmonic waves.

UNIT-III

Interference: Division of amplitude and wave front, Young's double slit experiment, Lloyds Mirror and Fresnel's Bi-prism, 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 (Fizeau Fringes), Newton's Rings: Measurement of wavelength and refractive index. Interferometer : Michelsons Interferometer-(1) Idea of form off rings (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5)Visibility of Fringes, Fabry-Perot interferometer.

UNIT-IV

Fraunhofer diffraction: Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions, Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Text Books:

1. Optics P.K. Chakrabarty, New Central Agency 3rdEdition2012
2. Optics-Ajoy Ghatak (Mc Graw Hill)-2017

Reference Books:

1. Optics-E. Hecht (Pearson)-2008
2. Fundamentals of Optics-F.A. Jenkins and H.E. White (McGraw-Hill)-2017

3. Geometrical and Physical Optics R.S. Longhurst (Orient Black swan)-1986
4. A text book of Optics N. Subrahmanyam and Brij Lal (S. Chand Publishing),2006
5. The Physics of Vibrations and Waves-H.J. Pain (John Wiley)-2013
6. Principles of Optics-Max Born and Emil Wolf (Pergamon Press)7th Edition1999
7. The Physics of Waves and Oscillations-N.K. Bajaj (Mc Graw Hill)-1998

PRACTICAL

(Minimum5experimentsaretobedone)

1. To determine the frequency of an electric tuning fork byMeldesexperimentandverify2Tlaw.
2. To plot the I-D curve and to determine the refractive index of a prism
3. To determine refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine wavelength of (1) Na source and(2) spectral lines of Hg source using plane diffraction grating.
7. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop,1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash and Ramakrishna,11thEd., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani

AECC-2.5(EV-II): ETHICS &VALUES

UNIT-II: Values and Good Citizenship

End Sem – 25 Marks
Full Marks–25Marks

2.1 Indian Constitution:

Salient Values of Preamble: Sovereign, Socialist, Secular, Democratic, Republic, Justice, Liberty, Equality and Fraternity.

2.2 Patriotism:

Patriotic value and ingredients of nation building, Concept of Good citizenship, Emotional connection with the country, Duties of citizens and Qualities of good citizens

2.3 Volunteerism:

Concept of facets of Volunteerism and Leadership, Building a better society through Volunteerism, Blood Donation, Social Work, Helping the Aged, Environmental Protection

2.4 Work Ethics:

Punctuality, Cleanliness, Law abidingness, Rational Thinking and Scientific Temper.

SEMESTER-III

C-3.1: MATHEMATICAL PHYSICS-II

COURSE OUTCOME

After completion of the course the students will be able to:

1) Solve problems on Fourier series expansion of periodic and non-periodic functions.
2) Solve different types of 2nd order differential equations of polynomials with variable coefficients using power series technique.
3) Perform special integration using Gamma and Beta functions.
4) Find the solutions of partial differential equations for physical problems like electric field of dielectric sphere and vibrational modes of strings etc.
5) Use Scilab programming for curve fitting and solving differential equations

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs

End Sem Practical–25/3hrs

THEORY

UNIT-I

Fourier Series-I: Periodic functions, Orthogonality of sine and cosine functions, Dirichlet Conditions (Statementonly),ExpansionofperiodicfunctionsinaseriesofsineandcosinefunctionsanddeterminationofFouriercoefficients, Complex representation of Fourier series, Expansion of functions with arbitrary period, Expansion of non-periodic functions over an interval, Even and odd functions and their Fourier expansions and Application, Summing of Infinite Series, Term-by-Term differentiation and integration of Fourier Series, Parseval Identity.

UNIT-II

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance, Singularities of Bessel's and Laguerre Equations, Frobenius method and its applications to differential equations: Legendre and Hermite Differential Equations, Legendre and Hermite Polynomials: Rodrigue's Formula, Generating Function, Orthogonality.

UNIT-III

Polynomials: Simple recurrence relations of Legendre and Hermite Polynomials, Expansion of function in a series of Legendre Polynomials, Associated Legendre Differential Equation, Associated Legendre polynomials, Spherical Harmonics

Some Special Integrals: Beta and Gamma Functions and relation between them, Expression of Integrals in terms of Gamma Functions, Error Function (Probability Integral).

UNIT-IV

Partial Differential Equations: Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string.

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris(2013,7thEdn.,Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India)9thEdition2011

Reference Books:

1. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)-2009
2. Mathematical Physics–H.K. Dass, Dr. Rama Verma (S. Chand Publishing)-2011
3. Mathematical Physics C. Harper (Prentice Hall India)-1978
4. Schaum's Outlines Series M. Spiegel (2ndEdition, Mc Graw Hill Education)-2004
5. Complex variables and applications J.W. Brown and R.V. Churchill-2017
6. Mathematical Physics, Satya Prakash (Sultan Chand)-2014
7. Mathematical Physics B. D . Gupta(4thedition,VikasPublication-2009

PRACTICAL

Topics

Introduction to Numerical computation software Scilab: Introduction to Scilab, Advantages and dis advantages, Scilab computation software Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initializing variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, datafile, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3Dplotting (2), Branching Statements and program design, Relational and logical operators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optionalarguments,preservingdatabetweencallstoafunction,ComplexandCharacterdata,stringfunction,Multidimensionalarrays(2)anintroductionto Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions,Numericalmethodsanddevelopingtheskillsofwritingaprogram(2).

Curve fitting, Least square fit Goodness of fit, standard constant Deviation:

Ohms law to calculate R, Hooke's law to calculate spring constant

SolutionofLinearsystemofequationsbyGausseliminationSolutionmethodandGaussSeidalmethod.Diagonalization matrices, Inverse of a matrix, Eigen vectors, problems: Solution of mesh equations of electric circuits(3meshes),Solution of coupled spring mass systems(3masses)

Solution of ODE:

First order Differential equation Euler, modified Euler, Runge-Kutta methods ,Second order differential equation.

Fixed difference method:

First order differential equations

1. Radioactive decay
2. Current in RC and LC circuits with DC source

3. Newton's law of cooling
4. Classical equations of motion

Second order Differential Equation

1. Harmonic oscillator (no friction)
2. Damped Harmonic oscillator
3. Over damped
4. Critical damped
5. Oscillatory
6. Forced Harmonic oscillator
7. Transient and Steady state solution
8. Apply above to LCR circuits also

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S.J. 20 Bence, 3rded.,2006, Cambridge University Press.
2. Complex Variables, A.S. Fokas and M.J. Ablowitz, 8th Ed.,2011, Cambridge Univ. Press
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones and Bartlett
4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering.
   Applications: A.V. Wouwer, P. Saucez, C.V. Fernndez.2014Springer.
5. Scilab by example: M. Affouf2012, ISBN:978-1479203444
6. Scilab (A free software to Matlab): H. Ramchandran, A.S. Nair.201, S. Chand and Company
7. Scilab Image Processing: Lambert M. Surhone.2010 Beta script Publishing.

C-3.2: THERMAL PHYSICS

COURSE OUTCOME

After completion of the course the students will be able to:

1) State and illustrate laws of thermodynamics and its applications to various systems.
2) Understand energy equation and its applications by using thermodynamic variables.
3) Explain entropy and its applications and determine phase transitions.
4) Quantify the transport behavior of gas using ideal gas and real gas equation of state under different thermodynamic conditions.
5) Understand and apply the concept of reversible and irreversible process and can determine the efficiency of heat engine, refrigerators and heat pumps.
6) Perform experiment on heat exchange, expansion of perfect gas and can determine thermo dynamical constants

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Introduction to Thermodynamics RecapitulationofZerothandFirstlawofthermodynamics,

Second Law of Thermodynamics: Reversible and Irreversible process with examples, Kelvin-Planck and Clausius Statements and their Equivalence, Carnots Theorem, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas, Principle of increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy of the Principle of Increase of Entropy, Temperature Entropy diagrams for Carnot's Cycle, Third Law of Thermodynamics, Unattainability of Absolute Zero.

UNIT-II

Thermodynamic Potentials: Extensive and IntensiveThermodynamic Variables,

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibbs Free Energy, Their Definitions, Properties and Applications, Surface Films and Variation of Surface Tension with Temperature, Magnetic Work, Cooling due to adiabatic demagnetization.

Phase Transitions: First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius Clapeyron equation (2) Relation between *Cp* and *Cv* (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases (5) Energy equations (6) Change of Temperature during Adiabatic Process.

UNIT-III

Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Sterns Experiment, Mean, RMS and Most Probable Speeds, Degrees of Freedom, Law of Equi-partition of Energy (No proof required), Specific heats of Gases.

Molecular Collisions: Mean Free Path, Collision Probability, Estimates of Mean Free Path,

Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

UNIT-IV

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation, The Virial Equation, Andrews Experiments on CO2 Gas. Critical Constants, Continuity of Liquid and Gaseous State. Vapour and Gas, Boyle Temperature, Van der Waals Equation of State for Real Gases, Values of Critical Constants, Law of Corresponding States, Comparison with Experimental Curves, P-V Diagrams, Joules Experiment, Free Adiabatic Expansion of a Perfect Gas, Joule- Thomson Porous Plug Experiment, Joule- Thomson Effect for Real and Van der Waal Gases, Temperature of Inversion, Joule-Thomson Cooling

Text Books:

1. Thermal Physics, A.B. Gupta (Book sand allied Ltd)-2010
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman (McGraw- Hill)-1981

Reference Books:

1. Theory and experiments on thermal Physics, P.K. Chakrabarty (New central book agency imited)-2017
2. Thermodynamics, Kinetic Theory and Statistical Thermodynamics-Sears and Salinger (Narosa)-1988
3. A Treatise on Heat-Meghnad Saha and B.N. Srivastava (The Indian Press) Heat, Thermodynamics and Statistical Physics, N. Subrahmanyam and Brij Lal (S. Chand Publishing)-2008
4. Thermal and Statistical Physics M. Das, P.K. Jena, S. Mishra, R.N. Mishra (Shri Krishna Publication)-2009

PRACTICAL

(Minimum5experimentsaretobe done):

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barnes constant flow method.
2. To determine the Coefficient of Thermal Conductivity of a bad-conductor by Lee and Charltons disc-method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To determine the specific heat of liquid by the method of cooling
6. To determine the specific heat of solid by applying radiation correction.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop,1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11thEd., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and J on M. Ogborn, 4thEdition, reprinted1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for under graduate classes, D.P. Khandelwal, 1985, Vani Publications.

C-3.3: ANALOG SYSTEMS AND APPLICATIONS

COURSE OUTCOME

At the end of the course the students will gain knowledge on:

1) Semiconductor and PN junction technology and their applications in two terminal devices like diode, rectifier, voltage regulator, LED and Solar Cells etc.

2) Physics of Bipolar junction transistors and its various applications like amplifier and oscillator.

3) Feedback amplifier, and RC-coupled amplifier and its response for different input signal at different frequency range.

4) Complete theory of OP-Amps and its applications for various applications like adder, subtractor, integrator, differentiator, and timer etc.

5) Experimental study and analysis of Diode, Solar cell, BJT, OP-AMP and Oscillators.

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Semiconductor Diodes: P and N type semiconductors, energy level diagram, conductivity and Mobility, Concept of Drift velocity, PN-junction fabrication (simple idea), Barrier formation in PN Junction Diode, Static and Dynamic Resistance, Current flow mechanism in Forward and Reverse Biased Diode, Drift velocity, derivation for Barrier Potential, Barrier Width and current Step Junction.
Two terminal device and their applications: (1) Rectifier Diode: Half-wave Rectifiers. center-tapped and bridge type Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, L and C Filters (2) Zener Diode and Voltage Regulation, Principle and structure of LEDS, (2) Photodiode (3) Solar Cell.
UNITII
Bipolar Junction Transistors: n-p-n and p-n-p transistors, Characteristics of CB, CE and CC Configurations, Current gains a and b, Relation between a and b, Load line analysis of Transistors, DC Load line and Q-point, Physical mechanism of current flow, Active, Cut-off and Saturation Regions.
Transistors Biasing: Transist or Biasing and Stabilization circuits, Fixed Bias and Voltage Divider Bias.
Amplifiers: Transistorsas2-portnetworkh-parameter Equivalent Circuit, Analysis of a single stage CE amplifier using Hybrid Model, Input and Output impedance, Current, Voltage and Power Gains, Classification of class A, B and C amplifiers, Push-pull amplifier (class B)
UNIT-III
Coupled Amplifier: RC-coupled amplifier and it's frequency response.
Feedback in Amplifiers: Effect of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain Stability, Distortion and Noise. Sinusoidal Oscillations: Barkhausen's Gaterian for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency, Hartley and Colpitts's oscillators.
UNIT-IV
Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical OP-AMP (IC741). Open-loop and Closed loop Gain. Frequency Response. CMRR, Slew Rate and concept of virtual ground.
Application 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.

Text Books:

1. Foundations of Electronics- Raskhit and Chattopadhyay (New age International Publication),15th Edition-2018
2. Concept of Electronics- D.C. Tayal (Himalay Publication)-2018

Reference Books:

1. Electronic devices and circuits R.L. Boylstad (Pearson India)-2009
2. Electronic Principles- A.P. Malvino (Tata Mc Graw Hill)-2008
3. Electronic Devices and Circuits- S. Salivahar and NS Kumar- (Tata Mc Graw Hill)3rdEdition2012
4. OP- Amps and Linear Integrated Circuit-R. A. Gayakwad (Prentice Hall)4thEdition,2000
5. Physics of Semiconductor devices, DonaldA Neamen (Prentice Hall)

PRACTICAL

(Minimum5experimentsaretobedone)

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I and power curves of solar cells, and find maximum power point and efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration and draw load line
4. To study the various biasing configurations of BJT for normal class A operation.
5. To study the frequency response of voltage gain of a RC- coupled transistor amplifier.
6. To design and study OP Amp-IC (741/351) as inverting and non-inverting amplifier
7. To design and study OP Amp-IC (741/351) as integrator and differentiation and study frequency response.
8. To design and study OP Amp-IC (741/351) as adder and subtractor.
9. To design a Wien-bridge oscillator for given frequency using an op-amp.
10. To design a phase shift oscillator of given specifications using BJT.
11. To study the Colpitt's oscillator.

Reference Books

1. Modern Digital Electronics, R.P. Jain, 4thEdition,2010, Tata Mc Graw Hill.

2. Basic Electronics: A text lab manual, P.B.Zbar, A.P. Malvino, M.A.Miller,1994,Mc-GrawHill.
3. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar,2002, Prentice Hall.
4. Microprocessor 8085: Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning

GE-3.4 :OPTICS, SPECIAL THEORY OF RELATIVITY, ATOMIC PHYSICS,QUANTUM MECHANICSANDNUCLEARPHYSICS

Full Marks – 100
MidSem–15/1hr
End Sem Theory – 60/3 hrs
EndSem Practical – 25/3hrs

COURSE OUTCOMES

At the end of the course the students will be able to :

1) Understand the elementary knowledge of Geometrical as well as wave Optics in terms of behavior of light.
2) Gain knowledge of physics in Atomic level and Spectroscopy.
3) Describe the concepts of Quantum and fundamental knowledge of relativistic physics.
4) Understand the concept of Nuclear Physics

THEORY

UNIT-I

Optics-I: Elementary ideas of monochromatic aberrations and their minimization, chromatic aberration, achromatic combination, Theory of formation of primary and secondary rainbow, condition of interference, coherent sources, Youngs double slit experiment, biprism and measurement of wave length of light of by it, color of thin films and Newton's rings, Fresnel and Fraunhoffer diffraction, diffraction by single slit plane transmission grating.

Optics-II: Electromagnetic nature of light, polarized and unpolarized light, polarization by reflection and refraction, Brewster's Law, Mauls Law, Double refraction, Ordinary and extra ordinary rays.

UNIT-II Atomic Physics

Inadequacy of classical physics, brief outline of Rayleigh Jeans theory and Planck's quantum theory of radiation, particle nature of electromagnetic radiation photoelectric effect, Compton effect, dual nature of radiation, wave nature of particles, de-Broglie hypothesis, matter wave, wave-particle duality, Davisson-Germer experiment. Bohr's theory of Hydrogen atom, explanation of Hydrogen Spectra, correction for finite mass of the nucleus, Bohr's correspondence principle, limitations of Bohr's theory, Discrete energy, exchange by atom Frank Hertz experiment.

UNIT-III

Quantum Mechanics: Heisenberg's Uncertainty relation, Time dependent Schrodinger's wave equation in one dimension and three dimensions, The physical interpretation of the wave function, Probability density and probability current density, Equation of continuity, Normalization of the Wave function, Expectation value of an observable, Ehrenfest's theorem. Time-independent Schrodinger's wave equation in one dimension particle in a box, energy eigen values and eigen functions.

UNIT-IV

Nuclear Physics: Properties of the nucleus Charge, Size, Spin, Magnetic Moment, Mass, Mass defect, Binding-energy, packing fraction, Nuclear force and its characteristics features, Radioactive decay laws, average life, half-life, nuclear fission, nuclear fusion, Linear accelerators, and cyclotron.

Relativity: Galilean transformation, Newtonian relativity and its limitation, Michelson Morley experiment and it's consequence, postulates of special theory of relativity. Lorentz transformation, length contraction, time dilation, relativistic mass and momentum, mass energy relation.

Text Books:

1. University Physics, H. D. Young, R.A. Freedman (Person)-2017
2. Fundamentals of Physics, Resnick, Halliday, Walker (Wiley) -2015

Reference Books:

❖ A Text Books book of Optics N. Subrahmanyam and Brij Lal (S. Chand Publishing)-2006
❖ Introduction to Special Relativity-R. Resnick (John Wiley)-2007
❖ Concepts of Modern Physics Arthur Beiser (Mc Graw Hill)-2017
❖ Modern Physics H.S. Mani and G.K. Mehta-2018

PRACTICAL

(Minimum 6experiments are to be done):

1. Determination of E.C.E. of a Copper by taking 3 readings.
2. Determination of Refractive index of the material of a prism using Sodium light.
3. To determine the wave length of light using plane diffraction grating.
4. To determine the wave length of light using Newton's ring.
5. Determination of refractive index of (a) glass and (b) liquid by using travelling microscope.
6. To plot the I- D curve and to determine the refractive index of a prim

7. Determination of radius of curvature of a convex/ concave mirror by using Kohlrausch's method.
8. To determine the magnifying power of a given telescope.
9. To Obtain the static characteristics of a P-N-P/N-P-N transistor/Triode Valve.
10. To determine the reduction factor of a tangent Galvanometer.
11. To study the Variation of magnetic field along the axis of a circular coil carrying current.

AECC-3.6(EV-III): ETHICS & VALUES
UNIT-III: Issues of Drug, Tobacco and Alcohol Addiction

End Sem – 25Marks
Full Marks–25 Marks

3.1-Extent of the Problem
Extent of Drug and Tobacco addiction and alcoholism in India, Myths associated with them, Health hazards associated with the man dhow they have become silent killers

3.2- Socio-economic impact:
Socio-economic impact of Drug and Tobacco addiction and alcoholism:
Loss of physical and mental strength, Loss of character, Loss off amilyties and relationship, Loss of earning and livelihood potentials, Loss of societal respect and dignity etc.

3.3-Laws to Address this Problem:
Silent features of social legislation such as NDPS Act, 1985 and COTPA Act, 2003, Mechanism and Government Schemes for prevention, deaddiction and rehabilitation

3.4-Roleof Stake -holders:
Provision of Tobacco free campus and role of students, Role of students in their family and immediate surroundings, Role of NGOs and other agencies.

SEMESTER-IV

C-4.1: MATHEMATICAL PHYSICS-III

COURSE OUTCOME

After completion of the course the students will be able to:
1) Understand complex numbers and variables and can solve problems on it.
2) Solve definite integrals using complex theorems.
3) Perform Fourier transform and inverse transform of different types of functions and their derivatives.
4) Solve Laplace transform and inverse transform of different types of functions and their derivatives.
5) Find solutions of differential equations and related physical problems using Fourier and Laplace transforms.
6) Use Scilab programming for solving integration and problems related to matrix method.

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation Eulers formula, De-Moivre's theorem, Roots of complex Numbers, Functions of Complex Variables, Analyticity and Cauchy-Riemann Conditions, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts, Integration of a function of a complex variable, Cauchy's Inequality, Cauchy's Integral formula, Simply and multiply connected region, Laurent and Taylors expansion, Residues and Residue Theorem,

Application in solving simple Definite Integrals.

UNIT-II

Integral Transforms-I: Fourier Transforms: Fourier Integral theorem, Fourier Transform, Examples, Fourier Transform of trigonometric, Gaussian, finite wave train and other functions, Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Inverse Fourier Transform.

UNIT-III

Integral Transforms-II: Convolution theorem, Properties of Fourier Trans- forms (translation, change of scale, complex conjugation), Three dimensional Fourier transforms with examples, Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/ Heat flow Equations.

UNIT-IV

Laplace Transforms: Laplace Transforms (LT) of Elementary functions,

Properties of Laplace Transforms: Change of Scale Theorem, Shifting Theorem, LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions, Inverse LT, Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris (2013,7thEdn., Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (WileyIndia) 10thEdition2014

Reference Books:

- Mathematical Physics and Special Relativity–M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)-2009
- Mathematical Physics– H.K. Das, Dr. Rama Verma (S. Chand Publishing) 2011
- Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition, Mc- Graw Hill Education)-2004
- Complex variables and applications J.W. Brown and R.V. Churchill 7th Edition2003
- Mathematical Physics, Satya Prakash (Sultan Chand)-2014
- Mathematical Physics B.D. Gupta (4th edition, Vikas Publication)-2009

PRACTICAL

20 classes (2hrs. duration each)

Scilab based simulations (X Cos) experiments based on Mathematical Physics problems like
Solve simple Differential Equations lik

Scilab based simulations (XCos) experiments based on Mathematical Physics problems like

- Solve simple Differential Equations like

$\frac{dy}{dx} = e^x$, with y (x = 0) = 0

$\frac{dy}{dx} + e^x = x^2$, $with\ y\ (x = 0) = 0$

$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = -y$, $with\ y\ (x = 0) = 0$, $y\ (x = 0) = 1$

$\frac{d^2y}{dx^2} + e^{-x}\frac{dy}{dx} = -y$, $with\ y\ (x = 0) = 0$, $y\ (x = 0) = 1$

- Direct Delta Function

Evaluate $\int_{-3}^{3} dx\ \frac{(x+3)}{\sqrt{2\pi}\sigma^2}\ e^{\frac{-(x-2)^2}{2\sigma^2}}$, for σ = 0.1, 0.01, 0.001 and show that it tends to 5.

- Fourier Series:
  Program to sum
  Evaluate the Fourier coefficients of a given periodic function (square wave)
- Frobenius method and Special functions:

  $\int_{-1}^{1} d\mu\ P_n(\mu)\ P_{nm}(\mu) = \frac{2}{2n+1}\ \delta_{m,n}$,

  Plot $P_n(x)$, Legendre polynomial of degree n, and $J_n(x)$, Bessel function of first kind.
  Show recursion relation
- Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
- Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.
- Evaluation of trigonometric functions e.g., sin, Given Bessel's function at N points find its value at an intermediate point.

  Complex analysis: Calculate $\int \frac{dx}{(x^2+2)}$ and check it with computer integration.
- Integral transform: FFT of e^{-x^2}

Reference Books:

❖ Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S.J. Bence, 3rded.,2006, Cambridge University Press
❖ Mathematics for Physicists, P. Dennery and Krzywicki, 1967, Dover Publications
❖ Simulation of ODE/ PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernndez. 2014 Springer ISBN:978-3319067896
❖ Scilab by example: M. Affouf,2012. ISBN:978-1479203444
❖ Scilab (A free software to math lab): H. Ramchandran, A. S. Nair.2011 S. Chand and Company
❖ Scilab Image Processing: Lambert M. Surhone.2010 Beta script Publishing

C-4.2: ELEMENTS OF MODERN PHYSICS

COURSE OUTCOME

After completion of the course the students will be able to:
1) Understand the transition of Classical mechanics to Quantum mechanics.
2) Explain the particle properties of wave and wave nature of particle through photo electric effect and Compton Effect.
3) Explain the reason behind Hydrogen atomic spectra.
4) Understand the principle of uncertainty and its consequences.
5) Describe the Nuclear structure, nuclear force, stability of nucleus and radioactive decay.

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Atomic Spectra and Models: In adequacy of classical physics, Brief Review of Black body Radiation, Photoelectric effect, Compton Effect, dual nature of radiation wave nature of particles, Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle, Alpha Particle Scattering, Rutherford Scattering Formula, Rutherford Model of atom and its limitations.

Atomic Model: Bohr's Model of Hydrogen atom, explanation of atomic spectra, correction for finite mass of the nucleus, Bohr correspondence principle, limitations of Bohr model, discrete energy exchange by atom, Frank Hertz Experiment, Sommer Felds modification of Bohr's Theory.

UNIT-II

Wave Packet: superposition of two waves, phase velocity and group velocity, wave packets, Gaussian Wave Packet, spatial distribution of wave packet, Localization of wave packet in time, Time development of a wave packet, Wave Particle Duality, Complementarity.

Wave Particle Duality: de-Broglie hypothesis, Experimental confirmation of matter-wave, Davisson Germer Experiment, velocity of de-Broglie wave, wave particle duality, Complementarity.

Uncertainty Principle: Heisenberg Uncertainty Principle, Illustration of the Principle through thought Experiments of Gamma ray microscope and electron diffraction through a slit, Estimation of ground state energy of harmonic oscillator and hydrogen atom, non-existence of electron in the nucleus, Uncertainty and complementarities.

UNIT-III

Nuclear Physics- I: Size and structure of atomic nucleus and its relation with atomic weight, Impossibility of an electron being in the nucleus as a con- sequence of the uncertainty principle, Nature of the nuclear force, NZ graph, Liquid Drop model: semiempirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

UNIT-IV

Nuclear Physics-II: Radioactivity, stability of the nucleus, Law of radioactive decay, Mean life and Half-life Alpha decay, Beta decay-energy released, spectrum and Paulis prediction of neutrino, Gamma ray emission energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus, Fission and fusion mass deficit, relativity and generation of energy, Fission- nature of fragments and emission of neutrons, Nuclear reactor: slow neutron interacting with Uranium 235, Fusion and thermo nuclear reactions driving stellar energy (brief qualitative discussion).

Text Books:

1. Concepts of Modern Physics ArthurBeiser (Mc Graw Hill)-2002
2. Modern Physics Murugeshan and Siva prasad (S. Chand)18thEdition2016

Reference Books:

❖ Quantum Mechanics: Theory and Applications, A.K. Ghatak and S. Lokanathan, (Macmillan)-2004
❖ Introduction to Quantum Theory, David Park (Dover Publications)-1974
❖ Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin- (Tata McGraw-

Hill)2ndEdition
- Physics for scientists and engineer with Modern Physics-Jewell and Serway- (CENGAGE Learnings) 2010.
- Modern Physics of Atoms and Molecules Bransden and Joachim (Pearson India) -2003
- Atomic and Nuclear Physics-A.B. Gupta (New Central)-2009
- Theoretical Nuclear Physics, J.M. Blatt and V.F. Weisskof (Springer)-2003

PRACTICAL

(Minimum4experimentsaretobedone):

1. To show the tunneling effect in tunnel diode using I-V characteristics.
2. To determine the wave length of laser source using diffraction of single slit.
3. To determine the wavelength of laser source using diffraction of double slits.
4. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.
5. To determine the Plancks constant using LEDs of at least 4 different colours.
6. To determine the value of e/m by (a) Magnetic focusing or(b) Bar-magnet.
7. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
- A Text Books Book of Practical Physics, I. PrakashandRamakrishna,11thEdn,2011, Kitab Mahal

C-4.3: DIGITAL SYSTEMS AND APPLICATIONS

COURSE OUTCOME

At the end of the course students will be able to:

1) Understand the components of Integrated Circuits (IC) and its use.
2) Differentiate between Analog and Digital circuit and can design different types of logic circuits.
3) Simplify logic circuits using Boolean algebra.
4) Understand the design and working of cathode ray oscilloscope (CRO) and can use it for measuring and analyzing various electrical circuit and signals.
5) Use different data processing circuits, arithmetic circuits and timer IC 555.
6) Understand the basics of data storage in computer and its working.

Full Marks – 100
MidSem–15/1hr
End Sem Theory – 60/3 hrs
EndSem Practical – 25/3hrs

THEORY

UNIT-I

Integrated Circuits (Qualitative treatment only): Active and 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 ICs.

Digital Circuits: Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversation, BCD, Octal and Hexadecimal numbers, AND, OR and NOT. Gates (realization using Diode sand Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers.

UNIT-II

Boolean algebra: De Morgans Theorems: Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Idea of Minterms and Maxterms, Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

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

UNIT-III

Data Processing Circuits: Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2s complement. Half and Full Adders. Half and Full Subtractors, 4bit binary Adder/ Subtractor.

Timers: IC 555: block diagram and application is Astable multivibrator and Mono stable multivibrator.

UNIT-IV

Introduction to Computer Organization: Input/output Devices, Data storage (idea of RAM and ROM), Computer memory, Memory organization and addressing, Memory Interfacing, Memory Map.

Shift registers: Serial-in-serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out. Shift Registers (onlyupto4bits)
Counters(4bits): Ring Counter, Asynchronous counters, Decade Counter. Synchronous Counter.
Text Books:

1. Foundation of Electronics-Rakshit Chattopadhaya (New Age)-2015
2. Digital Circuits and Logic design: Samuel C. Lee (Printice Hall)-1976
3. Digital Principles and Applications- A.P. Malvino, D.P. Leach and Saha(Tata McGraw)- 7th Edition2011

Reference Books:

- The Art of Electronics by Paul Horowitz and Wilfield Hill, Cambridge University -2006
- Electronics by Allan R. Hambley, Prentice Hall -1994
- Digital Logic and Computer design M. Morris Mano (Pearson) -2016
- Concepts of Electronics D.C. Tayal (Himalaya Publishing house)-2018

PRACTICAL

(Minimum 6experiments are to be done):
1. Students hould know how to measure (a) Voltage, and (b)Time period of a periodic wave form using CRO and to test a Diode and Transistor using a Millimeter.
2. To design a switch (NOT gate) using a transistor.
3. To verify and design AND, OR, NOT and XOR gates using NAND gates.
4. Half Adder, Full Adder and 4-bitbinary Adder.
5. Half Subtractor, Full Subtractor, Adder- Subtractor using Full Adder I.C.
6. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
7. To design a stable multivibrator of given specifications using 555Timer.
8. To design a mono stable multivibrator of given specification susing555Timer.

Reference Books

- Basic Electronics: A Text Books lab manual, P.B. Zbar, A.P. Malvino,
- M.A. Miller,1994, Mc-Graw Hill.
- OP- Amps and Linear Integrated Circuit, R. A. Gayakwad,4th edition,2000, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008,Tata Mc-Graw Hill. Electronic Devices and circuit Theory, R.L. Boylestad and L.D. Nashelsky, 2009, Pearson

AECC-4.6 (EV-IV): ETHICS & VALUES

UNIT-IV: Ethical Values for Student Life

End Sem – 25 Marks
Full Mark – 25 Marks

4.1 Extent of the Problem: Extent of Drug and Tobacco addiction and alcoholism in India, Myths associated with them, Health hazards associated with the man dhow they have become silent killers

4.2 Socio-economic impact:

Socio-economic impact of Drug and Tobacco addiction and alcoholism:
Loss of physical and mental strength, Loss of character, Loss of familyties and relationship, Loss of earning and live lihood potentials, Loss of societal respect and dignity etc.

4.3 Laws to Address this Problem:

Silent features of social legislation such as NDPS Act, 1985 and COTPA Act, 2003, Mechanism and Government Schemes for prevention, deaddiction and rehabilitation

4.4 Role of Stake -holders:

Provision of Tobacco free campus and role of students, Role of students in their family and immediate surroundings, Role of NGOs and other agencies

SEMESTER-V

C-5.1: QUANTUM MECHANICS AND APPLICATIONS

COURSE OUTCOME

After completion of the course students will be able to:

1) Understand the fundamental principles and pre mathematical requisites of quantum mechanics.
2) Solve Schrodinger equation for standard systems.
3) Identify the problems on Hermitian operators, expectation value, and eigen value and eigen functions.
4) Apply the principles of quantum mechanics to explain space quantization, Zeeman effect, Stark effect.
5) Work independently with key questions and problems in quantum mechanics

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Schrodinger equation: Time dependent Schrodinger equation, Properties of Wave Function, Interpretation of wave function, Probability and probability current densities in three dimensions, Conditions for Physical Acceptability of Wave Function, Normalization, Linearity and Superposition Principles. Wave function of a free particle, Wave Packet, Fourier Transform and momentum space Wave function, Spread of Gaussian Wave packet, Evolution with time, Position and Momentum Uncertainty.

UNIT-II

Operators: Operators, Commutator Algebra, Position, Momentum Angular Momentum and Energy operators, Hermitian Operators, Expectation values of position and momentum, Ehrenfest Theorem, Eigen values and Eigenfunctions of Hermitian Operator, Energy Eigen Spectrum, Degeneracy, Orthonormality of Eigen functions, Linear Dependance. Orthogonalisation.

UNIT-III

Time-Independent Schrodinger equation in one dimension (1d), 2d and 3d, Hamiltonian, stationary states and energy eigen values, expansion of an arbitrary wave function as a linear combination of energy eigen functions, General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states. General Discussion of Bound states in an arbitrary potential: Continuity of wave function, Boundary condition and emergence of discrete energy levels, Application to one dimensional problem-Square well potential, Quantum mechanics of simple Harmonic Oscillator-Energy Levels and energy eigen functions, ground state, zero point energy and uncertainty principle, Onedimensional infinitely rigid box energy eigen values and eigen functions, normalization, quantum dot as example, Quantum mechanical scattering and tunnelling in one dimension across a step-potential and rectangular potential barrier.

UNIT-IV

Atoms in Electric and Magnetic Fields: Electron angular momentum. Space quantization, Electron Spin and Spin Angular Momentum, Larmors Theorem, Spin Magnetic Moment, Stern Gerlach Experiment, Vector Atom Model, L-S and J-J coupling, Zeeman Effect, Electron Magnetic Moment and Magnetic Energy, Gyro magnetic Ratio and Bohr Magnet on Atoms in External Magnetic Fields: - Normal and Anomalous Zeeman Effect, Paschenback and Stark Effect (qualitative Discussion only)

Text Books

1. Introduction to Quantum Theory, D.J. Griffiths (Pearson)-2015
2. Introduction to Quantum Theory David Park (Dover Publications)-1974

Reference Books:

- Quantum Mechanics, Theory and applications A. Ghatak and S. Lokanathan (McMillan India)-2004
- Quantum Mechanics- G. Aruldhas (Printice Hallof India)-2008
- Quantum Physics–S. Gasiorowicz (Wiley)-2007
- Quantum Mechanics-J.L. PowellandB. Craseman (Narosa)-1998
- Introduction to Quantum Mechanics M. Das and P.K. Jena (Shri Krishna Publication)-2006.

PRACTICAL

Use C/ C++/ Scilab for solving the following problems based on Quantum Mechanics like (Use finite difference method, matrix method, ODE solver method in all cases)

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}$[V(r)-E], V(r) = -$\frac{e^2}{r}$,
where m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is $\sim -13.6\ eV$. Take
e =3.795$\sqrt{(\text{eV°A})}$, $\hbar c$ = 1973$(eV°A)$ and $m = 0.511 \times 10^6 eV/c^2$

2. Solve the s-wave radial Schrodinger equation for an atom:
$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}$[V(r)-E], V(r) = -$\frac{e^2}{r}$, where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential: $V(r)$ =-$\frac{e^2}{r}e^{\frac{-r}{a}}$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wave function. Take e =3.795$\sqrt{(\text{eV°A})}$, $\hbar c$ = 1973($eV°A$) and m = 0.511 × $10^6 eV/c^2$ and a = 3°A, 5°A, 7°A. The ground state energy is expected to be above – 12eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}$[V(r)-E], for the anharmonic oscillator potential: V(r)= $-\frac{kr^2}{2} + \frac{br^2}{3}$,
Find the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 0940MeV/c^2, k = 100MeV/fm^2, b = 0,10,30 MeV/fm^3. In these Units, c = 197.3 $MeV\ fm$. [The ground state energy is expected to lie between 90 and 110 MeV for all three cases.]

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}$[V(r)-E], where m is the reduced mass of the two-atom system for the Morse potential$V(r)$ = D($e^{-2\alpha r}$-$e^{\alpha r}$), where $r = r - r_0$. Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave functions for the choices give below:
a. m = 940$x10^6 eV/c^2$, D = 0.755501eV, α = 1.44, r_0 = 0.131349 °A
b. m = 940$x10^6 eV/c^2$, D = 0.755501eV, α = 1.44, r_0 = 0.131349 °A

Laboratory Based Experiments: (to be taken-up depending on availability of equipment)
1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
2. Study of Zeeman effect: with external magnetic field; Hyper fine splitting
3. To show the tunneling effect in tunnel diode using I-V characteristics.
4. Quantum efficiency of CCDs

Reference Books

- Schaum's outline of Programming with C++. J. Hubbard, 2000, McGraw– Hill Publication
- Numerical Recipesin C: TheArt of Scientific Computing, W.H. Pressetal., 3rdEdition, 2007, Cambridge University Press.
- An introduction to computational Physics, T. Pang, 2ndEdn., 2006, Cam-bridge Univ. Press
- Simulation of ODE/ PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C.V. Fernndez.2014Springer.
- Scilab (A Free Software to Mathlab): H. Ramchandran, A.S. Nair.2011, S. Chand and Co.
- Scilab Image Processing: L.M. Surhone. 2010 Betascript Publishing ISBN:9786133459274

C-5.2: SOLIDSTATE PHYSICS

COURSE OUTCOME

After completion of the course students will be able to:
1) Understand the crystal structure and elementary ideas on X-ray diffraction to obtain lattice structure.
2) Grasp the ideas and concepts on lattice dynamics in solids in understanding the specific heat of solids.
3) Distinguish various magnetic materials and quantify their properties using B-H curve.
4) Understand the dielectric properties of matter.
5) Understand the band theory of solids and apply it in explaining the concepts of Laser and Hall effect.
6) Know the concept of superconductivity and its theory of development.

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Crystal Structure: Solids, Amorphous and Crystalline Materials, Lattice translation Vectors, Lattice with a Basis. Central and Non-Central Elements. Unit Cell, Miller Indices, Types of Lattices, Reciprocal Lattice, Brillouin zones, Diffraction of X-rays by crystals, Bragg Law, Atomic and Geometrical Factor

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear, Monoatomic and Diatomic Chains, Acoustical and Optical Phonons, Qualitative Description of the phonon spectrum in solids, Dulong and Petits Law, Einstein and Debye theories of specific heat of solids, *T* 3Law

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevin theory of dia and Paramagnetic Domains, Curieslaw, Weiss Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss.

UNIT-III

Dielectric Properties of Materials: Polarization Local Electrical Field at an Atom, Depolarization Field, Electric Susceptibility, Polarizability, Clausius Mosotti Equation, Classical theory of Electronic Polarizability.

Lasers: Einsteins A and B coefficients, Metastable States, Spontaneous and Stimulated emissions, Optical Pumping and population Inversion, Three Level and Four Level Lasers, Ruby Laser and He-Ne Laser.

UNIT-IV

Elementary band theory: Kronig-Penny model of band Gap, Conductor, Semiconductor (P and N type) and insulator, Conductivity of Semiconductor, mobility, Hall Effect, Measurement of conductivity (04 problem method)and Hall-Coefficient.

Superconductivity: Experimental Results, Critical Temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors, Londons Equation and Penetration Depth, Isotope effect, Idea of BCS theory (No derivation).

Text Books:

1. Introduction to Solid State Physics- Charles Kittel (Wiley India)8th Edition2012
2. LASERS: Fundamentals and Applications-Thyagarajan and Ghatak (Mc Millan India)-2011

Reference Books

- Solid State Physics-N. W. Ashcroft and N.D. Mermin (Cengage)-2003
- Solid State Physics- R.K. Puri and V.K. Babbar (S.Ch and Publication)-2010
- Solid State Physics S. O. Pillai (New Age Publication)-2008
- Lasers and Nonlinear Optics B.B. Laud (Wiley Eastern)-2011
- Elements of SolidState Physics-J.P. Srivastava (Prentice Hall of India)-2014
- Elementary SolidState Physics-Ali Omar (Addison Wiley)-2002

PRACTICAL

(Minimum4experimentsaretobedone)

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube-Method)
2. To measure the Magnetic susceptibility of Solids.
3. To measure the Dielectric Constant of a dielectric Materials and variation with frequency
4. To determine the Hall coefficient of a semiconductor sample.
5. To draw the BH curve of Fe using solenoid and to determine the energy loss from Hysteresis
6. To measure the resistivity and band gap of a given semiconductor by four problem method.
7. To study PE hysteresis loop of a ferroelectric crystal

Reference Book;

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop,1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted1985, Heinemann Educational Publishers.
- A Text Books Book of Practical Physics, I. Prakash and Ramakrishna,11Ed.,2011, Kitab Mahal
- Elements of SolidState Physics, J.P. Srivastava,2ndEd., 2006, Prentice- Hallof India.

DSE-5.3: CLASSICAL DYNAMICS

COURSE OUTCOME

After completion of the course students will be able to:

1) Understand the requirement and advantages of Lagrangian over Newtonian and write Lagrane's equation for specific systems.

2) Know about the Hamilton's Principle and apply it to obtain the result of some extremum problems.

3) Have a qualitative analysis of motion of particles in central field and electromagnetic fields.

4) Grasp the fundamental knowledge of special theory of relativity and its potential application fundamental dimensions.

5) Distinguish between the Euclidean space and four dimensional Minkowski space through the developents..

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Generalised co-ordinates and Velocities, Generalised Force, Principle of virtual work Derivation of Lagranges equation of motion from D Alemberts Principles, Lagrangian and its Application to Simple, Compound and Double Pendulums, Single Particle in Space, At woods Machine, Dumbbell, Linear harmonic oscillator.

UNIT-II

Hamiltons Principle, Calculus of Variation and derivation of Euler- Lagranges equation, Langranges Equations derived from Hamiltons Principles, Hamiltoian and its applications to Shortest Distance between two points in a plane, Geodesic

Problem, minimum surface of revolution, Brachistochrone problem, The Equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, canonical momenta, Hamiltions equations of motion, Motion of charged particles in external electric and magnetic fields, Applications to central force motion and coupled oscillators.

UNIT-III

Special theory of Relativity (Postulates of special theory of relativity), Lorentz transformations, Minkowski space, The invariant interval, light cone and worldlines, space time diagrams, Times-dilation, length contraction and Twin-paradox, Variation of mass with velocity mass energy relation

UNIT-IV

Four Vectors: Space Like, Time-like and light-like. Four velocity and acceleration, Four momentum and energy-momentum relation. Doppler effects from a four vector perspective, Concept of four-force, Conservation of four momentum, Application to two-body decay of an unstable particle

Text Books;

1. Classical Mechanics, H. Goldstein,C.P.Poole,J.L.Safko(Pearson)-20112.ClassicalMechanicsNCRanaandP SJoag.-2017

Reference Books;

1. Mechanics-D.S. Mathur (Sultan Chand)-2000
2. Solved problems in Classical Mechanics, O.L. Delange and J. Pierrus (Oxford Press) (2010)
3. Classical Mechanics-M. Das, P.K. Jena, M. Bhuyan, R.N. Mishra (Srikrishna Prakashan)-2009
4. Mathematical Physics with Classical Mechanics-SatyaPrakash (Sultan Chand and sons)-2014
5. Introduction to classical dynamics R.K. Takwale and S. Puranik (Tata Mc Graw Hill)-2017
6. Classical Mechanics J.C. Upadhyay (Himalayan Publisher)-2017
7. Classical Dynamics of particles and systems -S.T. Thorton and Marion (Cengage Publication)-2012.

DSE-5.4: NUCLEAR AND PARTICLE PHYSICS

COURSE OUTCOME

After completion of the course students will be able to:

1) Rewind the elementary knowledge of Nuclear physics and decay processes.
2) Understand the idea of diferent proposed models of Nuclei.
3) Have some practical knowledge of different counters and detectors to study different Nuclear phenomenon.
4) Understand the fundamental principles and types of of accelerators.
5) Know the elementary knowledge of particle physics and symmetry and conservation laws.

Full Marks – 100
Mid Sem –15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

UNIT-I

General properties of Nuclei: Constituents of nucleus and their intrinsic properties, Quantitative facts about mass, radius, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment electric moments, nuclear excites states.

Radioactivity decays: (a) Alpha decay: basics of alpha- decay processes, theory of alpha-emission, Gamow factor, Geiger Nuttall law (b) beta-decay: energy kinematics for beta-decay, positron emission, electron capture, neutrino hypothesis. (c) Elementary idea of Gamma decay.

UNIT-II

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, conditions of nuclear stability, two nucleon separation energies, evidence for nuclear shell structure, nuclear magic number, basic assumption of shell models.

UNIT-III

Detector for nuclear radiations: Detector for nuclear radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic Principle of Scintillation Detectors and Construction of photo multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge Particle and photodetection (Concept of charge carrier and mobility), neutron detector.

Particle Accelerators: Van-de Graff generator (Tandem Accelerator), Linear accelerator, Cyclotron, Synchrotrons

UNIT-IV

Particle Physics: Particle interactions, basic features, types of particles and its families,

Symmetries and conservation laws: Energy and momentum, angular momentum, parity, baryon number, Lepton

number, Isospin, strangeness and charm, Elementary ideas of quarks and gluons.

Text Books

1. Introduction to Nuclear Physics by Roy andNigam-2014
2. Atomic and Nuclear Physics- N. Subramanyam, Brij Lal and Jivan Seshan (S. Chand Publishing)-2007

Reference Books;

- Introduction to Modern Physics-H.S. Mani and G.K. Mehta (Affilated east and west) -2018
- Introductory nuclear Physics- Kenneth S. Krane (Wiley India Pvt. Ltd)-1987
- Introduction to Elementary Particles-D. Griffith (John Wiley and Sons)-2008
- Concepts of Nuclear Physics-Bernard L. Cohen. (Tata Mc graw Hill)-2017
- Concepts of Modern Physics-Arthur Beiser (Mc Graw Hill)-2017

AECC-5.5 (EV-V): ETHICS&VALUES

UNIT-V: Vulnerable Sections of Society: Understanding their Issues

5.1 Extent of the Problem:

Extent of Drug and Tobacco addiction and alcoholism in India, Myths associated with them, Health hazards associated with them and how they have become silent killers

5.2 Socio-economic impact:

Socio-economic impact of Drug and Tobacco addiction and alcoholism:

Loss of physical and mental strength, Loss of character, Loss of familyties and relationship, Loss of earning and live lihood potentials, Loss of societal respect and dignity etc.

5.3 Laws to Address this Problem:

Silent features of social legislation such as NDPS Act, 1985 and COTPA Act, 2003, Mechanism and Government Schemes for prevention, deaddiction and rehabilitation

5.4 Role of Stake -holders:

Provision of Tobacco free campus and role of students, Role of students in their family and immediate surroundings, Role of NGO sand other agencies.

SEMESTER-VI

C-6.1: ELECTRO MAGNETIC THEORY

COURSE OUTCOME

After successful completion of the course students will be able to:

1) Understand writing Maxwell's equation in different media.
2) Understand the concept of electromagnetic wave and its propagation through different medium.
3) Know the polarization process of electromagnetic wave using various crystals.
4) Use wave-plates for the analysis of different polarized light.
5) Understand theory of Optical rotation and principle of polarimeter.
6) Perform experimental measurement and analysis of polarized light, Stefan's constant.

Full Marks – 100
Mid Sem–15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Maxwell Equations: 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 Poynting Vector, Electro- magnetic (EM) Energy Density, Physical Concept of Electromagnetic Field Energy Density.

UNIT-II

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, Electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

UNIT-III

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media, Reflection and Refraction of plane waves at plane interface between two dielectric media, Laws of Reflection and Refraction, Fresnel's Formulae for perpendicular and parallel polarization cases, Brewster's law, Reflection and Transmission coefficients, Totalinternal reflection, evanescent waves, Metallic reflection (normal Incidence)

UNITIV

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization, Uniaxial and Biaxial Crystals, Light Propagation in Uniaxial Crystal, Double Refraction, Polarization by Double Refraction, Nicol Prism, Ordinary and extraordinary refractive indices, Production and detection of Plane, Circularly and Elliptically Polarized Light, **Phase Retardation Plates:** Quarter-Wave and Half-Wave Plates. Babinets Compensator and its uses, Analysis of Polarized Light.

Rotatory Polarization: Optical Rotation, Biots Laws for Rotatory Polarization, Fresnels Theory of optical rotation, Calculation of angle of rotation, Experimental verification of Fresnels theory, Specific rotation, Laurents half-shade polari-meter.

Text Books;

1. Introduction to Electro dynamics, D.J. Griffiths (Pearson)-2015
2. Principles of Optics- Max Born and E. Wolf- CambridgeUniversityPress-1999

Reference Books;

- Classical Electro dynamics by J.D. Jackson (Willey)-2007
- Foundation of electro magnetic theory: Ritz and Milford (Pearson)-2008
- Electricity and Magnetism: DC Tayal (Himalaya Publication)-2014
- Optics: A.K. Ghatak (Mc Graw Hill Education)-2017
- Electricity and Magnetism: Chattopadhyaya, Rakhit (New Central)-2018

PRACTICAL

(Minimum 4experiments are to be done):

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 Babinets compensator.
4. To determine the refractive index of liquid by total internal reflection using Wollastonsair-film.
5. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
6. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
7. To verify the Stefan's law of radiation and to determine Stefan's constant.
8. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
9. To determine wave-length and velocity of ultrasonic wave in liquid

Reference Books;

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted1985, Heinemann Educational Publishers
- A Text Books Book of Practical Physics, I. Prakash and Ramakrishna, 11thEd., 2011, Kitab Mahal Electromagnetic Field Theory for Engineers and Physicists, G. Lehner, 2010, Springer

C-6.2: STATISTICAL MECHANICS

COURSE OUTCOME

After successful completion of the course students will be able to:

1) Understand the elementary concepts and applications of classical statistics like micro- and macro- states and the distribution laws.
2) Know the Gibb's paradox and its solution.
3) Understand the concept of quantum statistical distribution functions: Bose and Fermi-Dirac distribution.
4) Understand the thermodynamics of black body radiation and its theoretical explanation using both classical and quantum approach.
5) Use Sci-lab programming for plotting the distribution functions.

Full Marks – 100
Mid Sem –15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3hrs

THEORY

UNIT-I

Classical Statistics-I: Macro-state and Microstate, Elementary Concept of Ensemble, Micro canonical, Canonical and Grand Canonical ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell- Boltzmann Distribution Law, Partition Function.

UNIT-II

Classical Statistics-II: Thermodynamic Functions of an Ideal Gas, classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of equi-partition of Energy (with proof)- Applications to Specific Heat and its Limitations, Thermodynamic Functions of a two energy levels system, Negative Temperature.

UNIT-III

Quantum Statistics: Identical particles, macro-states and micro-states, Fermions and Bosons, Bose Einstein distribution function and Fermi- Dirac distribution function. Bose- Einstein Condensation, Bose deviation from Plancks law, Effect of temperature on Fermi-Dirac distribution function, degenerate Fermi gas, Density of States Fermi energy.

UNIT-IV

Radiation: Properties of Thermal Radiation, Blackbody Radiation, Pure Temperature dependence, Kirchhoff's law, Stefan Boltzmann law: Thermodynamic proof, Radiation Pressure, Weins Displacement law, Wiens distribution Law, Sahas Ionization Formula, Rayleigh Jeans Law, Ultra Violet catastrophe.

Planck's Law of Black body Radiation: Experimental verification, Deduction of (1) Wiens Distribution Law, (2)Rayleigh Jeans Law,(3)Stefan Boltzmann Law,(4) Weins Displacement Law from Plancks Law.

Text Books:

1. Introduction to Statistical Physics by Kerson Huang (Wiley). -2008
2. Statistical Physics, Berkeley Physics Course, F. Reif (Tata Mc Graw-Hill)-2017.

Reference Books;

- Statistical Mechanics, B.K. Agarwal and Melvin Eisner (New Age International)-2013
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics: Francis W. Sears and Gerhard L. Salinger (Narosa)1998
- Statistical Mechanics: R.K. Pathria and Paul D. Beale (Academic Press)-2011.

PRACTICAL

UseC/C++/ Scilab for solving the problems based on Statistical Mechanics like

1. Plot Plancks law for Black Body radiation and compare it with Weins law and find Wein's constant and Stefan constant
2. Plot Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
3. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b)Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
4. Plot Maxwell-Boltzmann distribution function
5. Plot Fermi-Dirac distribution function
6. Plot Bose-Einstein distribution function

Reference Books;

- Elementary Numerical Analysis, K.E. Atkinson, 3rdEdn. 2007, Wiley India Edition
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Edition, 1996, Oxford University Press.
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer

❖ Simulation of ODE/ PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C.V. Fernndez. 2014 SpringerISBN:978-3319067896
❖ Scilab by example: M. Affouf,2012. ISBN:978-1479203444
❖ Scilab Image Processing: L.M. Surhone. 2010, Betascript Pub., ISBN:978-6133459274

DSE-6.3: NANOMATERIALS AND APPLICATIONS

COURSE OUTCOME

After successful completion of the course students will be able to:

1) Explain the fundamental properties and categories of nano materials.
2) Understand the techniques of synthesis of nano materials and types of synthesis ethods.
3) Understand the characterization techniques of nano materials through XRD and microscopy.
4) Use wave-plates for the analysis of different polarized light.
5) Learn the application techniques of nano materials and some important areas of application.

Full Marks – 100
Mid Sem–20/1hr
End Sem – 80/3 hrs

UNIT-I

Nanoscale Systems: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, size effects in nano systems, Quantum confinement Applications of Schrodinger equation-infinite potential well, potential step, potential box, quantum confinement of carriersin3D, 2D, 1D nanostructure and its consequences.

UNIT-II

Synthesis of Nanostructure Materials: Top down and bottoms up approach, Photo lithography Ball milling. Gas phase condensation, Vacuum deposition, Physical vapors deposition (PVT): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition, Chemical vapour deposition (CVD),Sol-Gel Electro deposition, Spraypyrolysis, Hydro thermal synthesis, Preparation through colloidal methods, MBE growth of quantum dots.

UNIT-III

Characterization: X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy

UNIT-IV

Applications: Applications of nano particles, quantum dots, nanowires and thin films for photonic devices (LED, solarcells). Single electron devices (no derivation). CNT based transistors. Nonmaterial Devices: Quantum dots hetero structure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS)

Text Books;

1. S.K. Kulkarni, Nanotechnology: Principles and Practices (Capital Publishing Company)-3rd Edition2014
2. Nano science and nanotechnology, K.K. Choudhary (Narosa)-2016.

Reference Books;

❖ Nano Science and nano technology, Sundar Singh (Pragati Prakashan)-2017
❖ C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.)-2007
❖ Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons)-2005
❖ M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier,2007)
❖ K.K. Chattopadhya and A.N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited)-2009

DSE-6.4: DISSERTATION/ PROJECT WORK

Full Marks – 100
End Sem Project – 100

Topics to be announced by the HOD.

OR

DSE-6.4: BASIC INSTRUMENTATION

COURSE OUTCOME

After successful completion of the course students will be able to:

1) Understand the basic requirements and fundamentals of measurements, accuracy and precision of electronic devices.
2) Have the knowledge of principles behind the working of oscilloscopes and CRT and their use.
3) Specify the electronic devices such as different types of signal generators.
4) To explain and draw the outline of working of digital multieters
5) Draw the block diagram of digital multimeters and know the importance of their accuracy.

Full Marks – 100

Mid Sem–15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical–25/3hrs

THEORY

UNIT-I

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

UNIT-II

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron-gun, electrostatic focusing and acceleration (Explanation only no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Frontpanel controls. Specifications of a CRO and their significance.
Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

UNIT-III

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

UNIT-IV

Digital Instruments: Principle and working of digital meters, Comparison of analog and digital instruments, Characteristics of a digital meter, Working principles of digital voltmeter.
Digital Multimeter: Block diagram and working of a digital multimeter, Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time-base stability, accuracy and resolution.

Text Books;

1. A Text Books book of electrical technology- B.L. Theraja and A.K. Theraja (S. Chand Publishing)-2014.
2. Digital circuits and systems Venugopal (Tata Mc Graw Hill)-2011.

Reference Books;

- Digital Electronics-Subrata Ghoshal (Cengage Learning)-2017

❖ Electronic Devices and circuits- S. Salivahanan and N.S. Kumar (Tata Mc-Graw Hill)-2012
❖ Electronic Devices-Thomas L. Floyd (Pearson)-2015

PRACTICAL

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

- Use of an oscilloscope.
- CRO as a versatile measuring device.
- Circuit tracing of Laboratory electronic equipment,
- Use of Digital multimeter/ VTVM for measuring voltages
- Circuit tracing of Laboratory electronic equipment,
- Windinga coil /transformer.
- Study the layout of receiver circuit.
- Troubles hooting a circuit
- Balancing of bridges

Laboratory Exercises;

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

Open Ended Experiments

1. Using a Dual Trace Oscilloscope

2. Converting the range of a given measuring instrument (voltmeter, ammeter) More emphasis should be given on hands-on experiments

Reference Books;

❖ An advanced course in Practical Physics- Chattopadhaya, RakshitCentral-2013
❖ Practical Physics-B.B. Swain (Kitab Mahal)-2014
❖ Advanced practical Physics- B. Ghosh and KG Majumdar (Vol. I and II)-Shreedhar Publication-2004
❖ A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal(Vani Publication)-1985
❖ B. Sc. Practical Physics- C. L. Arora (S. Chand Publishing)-2010
❖ B.Sc. Practical Physics H. Singh and P.S. Hemne (S. Chand Publishing)-2002

AECC-6.5(EV-VI): ETHICS&VALUES

UNIT-VI: Environmental & Techno Ethics

End Sem – 25 Marks

Full Marks–25Marks

6.1 Environmental Ethics

Types of Ecological Values, Environmental Values & Valuing Nature, Equitable use of Resources, Role of Individual in the conservation of resources for future generation, Bio-Ethics-Genetic manipulation in plants and animals for benefits of society and cruelty against animal.

6.2 Promotion of Green Technology:

Goal of Green Technology: Reducer cycling, **Renew** (removal of chemicals),
Refuse and **Responsibility**.

Green Technology in relation to: - Energy and Construction.

6.3 Ethics and Technology:

Ethics and Technology with reference to science, gadget, machine etc. and interaction with each other,
Agricultural, Industrial, Digital, Globalized Age etc.

6.4 Judicious Use of Technology:

Judicious use of Mobile Phones, Electrical machines, Plastics, Television, Computers and their harmful effects

EthicsandUse of Digital Technology: Cyber ethics- Crimes and Ethical hacking,

Ethics of social media: WhatsApp, Facebook, Twitter and others