

# **COURSES OF STUDIES**

**FOR**

**THREE YEAR DEGREE COURSE**

**IN**

**SCIENCE HONOURS**

**DEPARTMENT OF PHYSICS**

**Choice Based Credit System(CBCS)**

First & Second Semester Examination – 2021-22

Third & Fourth Semester Examination – 2022-23

Fifth & Sixth Semester Examination – 2023-24



**GOVERNMENT AUTONOMOUS COLLEGE,  
PHULBANI, KANDHAMAL**

**DISTRIBUTION OF MARKS**

<b>Paper with Practical</b>	
<b>Mid Sem (15 Marks)</b>	
Two questions to be answered carrying 1 mark each	2X1 mark = 2 marks
Two questions to be answered carrying 1.5 marks each	2X1.5 marks = 3 marks
Two questions to be answered carrying 2 marks each	2X2 marks = 4 marks
One question to be answered carrying 6 marks each	1X6 marks = 6 marks
<b>End Sem (60 Marks)</b>	
Eight questions to be answered carrying 1 mark each	8X1 mark = 8 marks
Eight questions to be answered carrying 1.5 marks each	8X1.5 marks = 12 marks
Eight questions to be answered carrying 2 marks each	8X2 marks = 16 marks
Four questions to be answered carrying 6 marks each	4X6 marks = 24 marks
<b>Paper without Practical</b>	
<b>Mid Sem (20 Marks)</b>	
Three questions to be answered carrying 1 mark each	3X1 mark = 3 marks
Two questions to be answered carrying 2 marks each	2X2 marks = 4 marks
Two questions to be answered carrying 3 marks each	2X3 marks = 6 marks
One question to be answered carrying 7 marks each	1X7 marks = 7 marks
<b>End Sem (80 Marks)</b>	
Twelve questions to be answered carrying 1 mark each	12X1 mark = 12 marks
Eight questions to be answered carrying 2 marks each	8X2 marks = 16 marks
Eight questions to be answered carrying 3 marks each	8X3 marks = 24 marks
Four questions to be answered carrying 7 marks each	4X7 marks = 28 marks

**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 AECC-III(EV-II)			GE-1B
	CORE -IV				
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-WISE PAPERS & CREDITS AT A GLANCE

Three-Year (6-Semester) CBCS Programme (B.Sc. Hons) (Physics Department)				
Yr.	Sl.No.	Course Structure	Code	Credit Points
FIRST YEAR	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 and 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			
SECOND YEAR	9			
	10	Ethics & Values (Unit-II)	AECC-2.5	1
	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	Molecular Biology	C-4.1	4+2
	18	Plant Ecology & Phytogeography	C-4.2	4+2
FINAL YEAR	19	Plant Systematics	C-4.3	4+2
	20	Plant Ecology & Taxonomy	GE-4.4	4+2
	21			
	22	Ethics & Values (Unit-IV)	AECC-4.6	1
	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:**

- C- Core Course
- GE- Generic Elective Course
- DSE- Discipline Specific Elective Course
- AECC- Ability Enhancement Compulsory Course
- SECC- Skill Enhancement Compulsory Course (Skill Based)
- For a 6 credit course, the total teaching hours are: Minimum- 50 Hours, Maximum-65 Hours

## SEMESTER-I

### C-1.1 :MATHEMATICAL PHYSICS-I

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

### THEORY

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

#### 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 inexact 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 area 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 geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities

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

#### Text Books:

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

#### Reference books:

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

### PRACTICAL

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

- Highlights the use of computational methods to solve physical problems
- 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 pointnumbers, 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 data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If Statement, If else Statement, Nested If structure, Else If Statement, Ternary operator, 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  $\pi$  and applications in physics lab.

**Reference Books:**

- ❖ Introduction to Numerical Analysis, S.S. Sastry, 5<sup>th</sup> Edition, 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, 3rd Edition. 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, 3<sup>rd</sup>Edn. , 2007, Wiley India Edition.
- ❖ Numerical Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- ❖ An Introduction to computational Physics,T.Pang, 2<sup>nd</sup>Edn., 2006, Cambridge Univ. Press.

## C-1.2 :MECHANICS

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

### 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 Fly wheel.

**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: Poiseuilles Equation for Flow of a Liquid through a Capillary Tube, Surface tension, Gravity waves and ripple

**Viscosity:** Poiseuilles 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, Keplers 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 over damped) 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, Massless 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 Klapanner and Robert Kolenkow, McGraw Hill.2007
- ❖ Mechanics by K.R Simon, 1971
- ❖ Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et al (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

**(Minimum 5 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 (Poiseuilles 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:**

- ❖ 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, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- ❖ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11thEdn, 2011, KitabMahal

## GE-1.3 :MECHANICS AND PROPERTIES OF MATTER, OSCILLATION AND WAVES, THERMALPHYSICS, ELECTRICITY AND MAGNETISM AND ELECTRONICS

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

## THEORY

### 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, Poiseuilles 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 superposition 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 thermodynamic relation (statement only), ClausiusClapeyron 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, BiotSavarts 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, Maxwells electro-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  $\alpha$  and  $\beta$ . JFET, its operation and characteristics of V-I curve.

**Text Books:**

1. Elements of Properties of Matter D.S. Mathur (S. Chand Publication)-2010
2. Heat and Thermodynamics A.B. Gupta and H.B. Ray (New Central Book Agency)-2010
3. A Text Books book of oscillations, waves and acoustics (5th ed.) M. Ghosh and D. Bhattacharya (S. Chand Publication)-2018
4. Electricity and magnetism- R. Murugesan (S. Chand publishing)-2017
5. Fundamentals of Electronics-Raskhit and Chattopadhyay (New age International Publication)-2018

**Reference Books:**

- ❖ Physics of Degree students Vol.I M. Das, P.K. Jena et al (Sri Krishna Prakashan)-2006
- ❖ Physics of Degree students Vol.II M. Das, P.K. Jena et al (Sri Krishna Prakashan)-2006
- ❖ Waves and Oscillations (2nd ed) N. Subramaniam and BrijLal (Vikas Publications)-1994
- ❖ A Text Books book of Sound (2nd ed) - N. Subramaniam and BrijLal (S. Chand Publications)-1999

## PRACTICAL

**(Minimum 6 experiments are to be done)**

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:**

- ❖ Advanced Practical Physics for students, B.L. Flintand H.T. Worsnop, 1971, Asia Publishing House
- ❖ A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal (1985), Vani Publication
- ❖ A Text Books of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition (2011), KitabMahal, New Delhi

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

### UNIT-I : Issues Relating to Women

**End Sem – 25 Marks**  
**Full Marks – 25 Marks**

**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****Full Marks – 100****Mid Sem – 15/1hr****End Sem Theory – 60/3 hrs****End Sem Practical – 25/3 hrs****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 to (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 Charge Sensitivity, Electromagnetic 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) 4th Edition

**Reference Books:**

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

**PRACTICAL****(Minimum of 6 experiments are to be 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 DeSautys bridge.
5. Measurement of field strength B and its variation in a solenoid/artificial coil (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To determine self inductance of a coil by Andersons bridge.
8. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
9. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonance frequency and (b) Quality factor Q.

**Reference Books:**

- ❖ Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- ❖ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
- ❖ Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
- ❖ A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

## C-2.2 : WAVES AND OPTICS

**Full Marks – 100**

**Mid Sem – 15/1hr**

**End Sem Theory – 60/3 hrs**

**End Sem Practical – 25/3 hrs**

### 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 : Electromagnetic nature of light. Definition and properties of wave front 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 (1:1 and 1:2) and their uses, Superposition of N harmonic waves.

#### UNIT- III

**Interference :** Division of amplitude and wave front, Young's double slit experiment, Lloyd's 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 : Michelson's Interferometer-(1) Idea of formation of fringes (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 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, as slit and a wire.

**Text Books:**

1. Optics P.K. Chakrabarty, New Central Agency 3<sup>rd</sup> Edition 2012
2. Optics - Ajoy Ghatak (McGraw Hill)- 2017

**Reference Books:**

- ❖ Optics-E. Hecht (Pearson)-2008
- ❖ Fundamentals of Optics- F.A. Jenkins and H.E. White (McGraw-Hill)-2017
- ❖ Geometrical and Physical Optics R.S. Longhurst (Orient Black Swan)-1986
- ❖ A text book of Optics N. Subrahmanyam and Brij Lal (S. Chand Publishing), 2006
- ❖ The Physics of Vibrations and Waves- H.J. Pain (John Wiley)-2013
- ❖ Principles of Optics- Max Born and Emil Wolf (Pergamon Press) 7<sup>th</sup> Edition 1999
- ❖ The Physics of Waves and Oscillations-N.K. Bajaj (McGraw Hill)-1998

### PRACTICAL

**(Minimum 5 experiments are to be done)**

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify 2 T law.
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:**

- ❖ Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- ❖ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal

- ❖ Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
- ❖ 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 – 25 Marks

#### 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

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

#### THEORY

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

#### UNIT-I

**Fourier Series-I:** Periodic functions, Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only), Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients, Complex representation of Fourier series, Expansion of functions with arbitrary period, Expansion of non-periodic functions over an interval, Even and odd functions and their Fourier expansions 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.Arken,H.J.Weber,F.E.Harris (2013, 7<sup>th</sup>Edn., Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India) 9th Edition 2011

**Reference Books:**

- ❖ Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)-2009
- ❖ Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing) -2011
- ❖ Mathematical Physics C. Harper (Prentice Hall India)-1978
- ❖ Schaum's Outlines Series M. Spiegel (2<sup>nd</sup> Edition, McGraw Hill Education)-2004
- ❖ Complex variables and applications J.W.Brown and R.V.Churchill-2017
- ❖ Mathematical Physics, Satya Prakash (Sultan Chand)-2014
- ❖ Mathematical Physics B.D. Gupta (4<sup>th</sup> edition, Vikas Publication-2009

## PRACTICAL

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done on the basis of formulating the problem but not on the programming

**Topics**

**Introduction to Numerical computation software Scilab:** Introduction to Scilab, Advantages and disadvantages, Scilab computation software Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (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, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program(2).

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

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

**Solution of Linear system of equations by Gauss elimination Solution method and Gauss Seidal method.**

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

**Solution of ODE :**

**First order Differential equation Euler, modified Euler, Runge- Kutta methods, Second order differential equation. Fixed difference method:**

**First order differential equations**

- Radioactive decay
- Current in RC and LC circuits with DC source
- Newton's law of cooling
- Classical equations of motion

**Second order Differential Equation**

- Harmonic oscillator (no friction)
- Damped Harmonic oscillator
- Over damped
- Critical damped
- Oscillatory
- Forced Harmonic oscillator
- Transient and Steady state solution
- Apply above to LCR circuits also

**Reference Books:**

- ❖ Mathematical Methods for Physics and Engineers, K.F.Riley, M.P. Hobson and S. J.20 Bence, 3rd ed., 2006, Cambridge University Press
- ❖ Complex Variables, A.S. Fokas and M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- ❖ First course in complex analysis with applications, D.G.Zill and P.D. Shanahan, 1940, Jones and Bartlett
- ❖ Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernandez. 2014 Springer
- ❖ Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
- ❖ Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 201, S.Chand and Company
- ❖ Scilab Image Processing: Lambert M. Surhone. 2010 Beta script Publishing

**C-3.2 : THERMAL PHYSICS**

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

**THEORY****UNIT-I**

**Introduction to Thermodynamics** Recapitulation of Zeroth and First law of thermodynamics,

**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 Intensive Thermodynamic 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  $C_p$  and  $C_v$  (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 Equipartition of Energy (N o 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 CO<sub>2</sub> 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 (Books and allied Ltd)-2010
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman (McGraw- Hill)-1981

**Reference Books:**

- ❖ Theory and experiments on thermal Physics, P.K.Chakrabarty (Newcentral book agency limited)-2017
- ❖ Thermodynamics, Kinetic Theory and Statistical Thermodynamics-Sears and Salinger(Narosa)-1988
- ❖ 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
- ❖ Thermal and Statistical Physics M.Das, P.K. Jena, S. Mishra, R.N.Mishra (Shri Krishna Publication)-2009

**PRACTICAL**

**(Minimum 5 experiments are to be 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:**



- ❖ Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- ❖ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
- ❖ Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
- ❖ A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Publications.

### C-3.3 :ANALOG SYSTEMS AND APPLICATIONS

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

#### 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) Photo diode(3) Solar Cell.

##### UNIT II

**Bipolar Junction Transistors:** n-p-n and p-n-p transistors, Characteristics of CB, CE and CC Configurations, Current gains  $\alpha$  and  $\beta$ , Relation between  $\alpha$  and  $\beta$ , Load line analysis of Transistors, DC Load line and Q-point, Physical mechanism of current flow, Active, Cut-off and Saturation Regions.

**Transistors Biasing:** Transistor Biasing and Stabilization circuits, Fixed Bias and Voltage Divider Bias.

**Amplifiers:** Transistors as 2-port network h-parameter Equivalent Circuit, Analysis of a single stage CE amplifier using Hybrid Model, Input and Output impedance, Current, Voltage and Power Gains, Classification of class A, B and C amplifiers, Push-pull amplifier (class B)

##### UNIT-III

**Coupled Amplifier:** RC-coupled amplifier and its 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 Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency, Hartley and Colpitt'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-Rashit and Chattopadhyay (New age International Publication), 15<sup>th</sup> Edition-2018
2. Concept of Electronics- D.C.Tayal (Himalay Publication)-2018

##### Reference Books:

- ❖ Electronic devices and circuits R.L.Boylstad (Pearson India)-2009
- ❖ Electronic Principles- A.P.Malvino (Tata McGraw Hill)-2008
- ❖ Electronic Devices and Circuits- S.Salivahar and NS Kumar -(Tata McGraw Hill)3<sup>rd</sup> Edition-2012
- ❖ OP-Amps and Linear Integrated Circuit-R. A. Gayakwad (Prentice Hall) 4<sup>th</sup> Edition, 2000
- ❖ Physics of Semiconductor devices, Donald A Neamen (Prentice Hall)

#### PRACTICAL

##### (Minimum 5 experiments are to be done)

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:**

- ❖ Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGrawHill.
- ❖ Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- ❖ Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
- ❖ Microprocessor 8085: Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

## GE-3.4 : OPTICS, SPECIAL THEORY OF RELATIVITY, ATOMIC PHYSICS, QUANTUM MECHANICS AND NUCLEAR PHYSICS

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

### 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, Young's double slit experiment, biprism and measurement of wave length of light by it, color of thin films and Newton's rings, Fresnel and Fraunhofer 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, Malus Law, Double refraction, Ordinary and extraordinary 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 its 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 (McGraw Hill)-2017
- ❖ Modern Physics H.S. Mani and G.K. Mehta-2018.

### PRACTICAL

**(Minimum 6 experiments 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 prism
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.

**Reference Books:**

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

## AECC-3.6 (EV-III) : ETHICS & VALUES

### UNIT-III : Issues of Drug, Tobacco and Alcohol Addiction

**End Sem – 25 Marks**

**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 them and how 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 of family ties 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 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-IV

### C-4.1 :MATHEMATICAL PHYSICS-III

**Full Marks – 100**

**Mid Sem – 15/1hr**

**End Sem Theory – 60/3 hrs**

**End Sem Practical – 25/3 hrs**

### THEORY

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems; known or unknown.

#### 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, Cauchys Inequality, Cauchys Integral formula, Simply and multiply connected region, Laurentand 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 Transforms (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.Arken, H.J.Weber, F.E.Harris (2013, 7<sup>th</sup>Edn., Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India) 10<sup>th</sup> Edition 2014

**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 (2<sup>nd</sup> Edition, Mc- GrawHill Education)-2004
- ❖ Complex variables and applications J.W.Brown and R.V.Churchill 7<sup>th</sup> Edition 2003
- ❖ Mathematical Physics, Satya Prakash (Sultan Chand)-2014
- ❖ Mathematical Physics B.D.Gupta (4<sup>th</sup> edition, Vikas Publication)-2009

**PRACTICAL****20 classes (2 hrs. duration each)**

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

- Solve simple Differential Equations like

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

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

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

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

- 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  $\sigma = 0.1, 0.01, 0.001$  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 :

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

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 Bessels 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, 3rd ed., 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. Fernandez. 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

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

### THEORY

#### UNIT- I

**Atomic Spectra and Models:** Inadequacy 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 hydrogenatom, Ritz Rydberg combination principle, Alpha Particle Scattering, Rutherford Scattering Formula, Rutherford Model of atom and its limitations. **Atomic Model:** Bohrs 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, Sommerfelds 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, WaveParticle Duality, Complementarity.

**Wave Particle Duality:** de Broglie hypothesis, Experimental confirmation of matter wave, Davisson Germer Experiment, velocity of deBroglie wave, waveparticle 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 consequence of the uncertainty principle, Nature of the nuclear force, NZ graph, Liquid Drop model: semi empirical 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 Arthur Beiser (McGraw Hill)-2002
2. Modern Physics Murugesan and Sivaprasad (S.Chand) 18th Edition 2016

#### 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) 2nd Edition
- ❖ 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. Weisskopf (Springer)-2003

## PRACTICAL

(Minimum 4 experiments are to be done):

1. To show the tunneling effect in tunnel diode using I-V characteristics.
2. To determine the wavelength 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 Planck's constant using LEDs of at least 4 different colours.
6. To determine the value of  $e/m$  by (a) Magnetic focusing or (b) Barmagnet.
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, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
- ❖ A Text Books Book of Practical Physics, I. Prakash and Ramakrishna, 11<sup>th</sup> Edn, 2011, Kitab Mahal

## C-4.3 :DIGITAL SYSTEMS AND APPLICATIONS

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

### 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 Conversion, BCD, Octal and Hexadecimal numbers, AND, OR and NOT. Gates (realization using Diode and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers.

#### UNIT-II

**Boolean algebra:** De Morgan's 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 2's complement. Half and Full Adders. Half and Full Subtractors, 4 bit binary Adder/Subtractor.

**Timers: IC 555:** block diagram and application is Astable multivibrator and Monostable 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 (only up to 4 bits)

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

**Text Books:**

1. Foundation of Electronics-Rakshit Chattopadhyaya (New Age) -2015
2. Digital Circuits and Logic design: Samuel C. Lee (Prentice Hall) -1976
3. Digital Principles and Applications - A.P. Malvino, D.P. Leach and Saha (Tata McGraw) - 7th Edition 2011

**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 6 experiments are to be done):**

1. Student should 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-bit binary 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 555 Timer.
8. To design a monostable multivibrator of given specifications using 555 Timer.

**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 Marks – 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 them and how 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 family ties and relationship, Loss of earning and livelihood 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

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

#### 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 Eigen functions of Hermitian Operator, Energy Eigen Spectrum, Degeneracy, Orthonormality of Eigen functions, Linear Dependence. 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, groundstate, zero point energy and uncertainty principle, One dimensional infinitely rigidbox 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.Aruldas (Printice Hall of India)-2008
- ❖ Quantum Physics-S. Gasiorowicz (Wiley)-2007
- ❖ Quantum Mechanics -J.L. Powell and B. Craseman (Narosa)-1998
- ❖ Introduction to Quantum Mechanics M.Das and P.K.Jena (Shri KrishnaPublication)-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  $\sim -13.6 \text{ eV}$ . Take  $e = 3.795\sqrt{(eV^\circ A)}$ ,  $\hbar c = 1973(eV^\circ A)$  and  $m = 0.511 \times 10^6 eV/c^2$

2. Solve the s-wave radial Schrodinger equation for an atom :

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



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  $e = 3.795\sqrt{eV^\circ A}$ ,  $\hbar c = 1973 (eV^\circ A)$  and  $m = 0.511 \times 10^6 eV/c^2$ , and  $a = 3^\circ A, 5^\circ A, 7^\circ A$ . 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:  $V(r) = \frac{kr^2}{2} + \frac{br^3}{3}$ .

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:
- $m = 940 \times 10^6 eV/c^2$ ,  $D = 0.755501 eV$ ,  $\alpha = 1.44$ ,  $r_0 = 0.131349^\circ A$
  - $m = 940 \times 10^6 eV/c^2$ ,  $D = 0.755501 eV$ ,  $\alpha = 1.44$ ,  $r_0 = 0.131349^\circ A$

#### Laboratory Based Experiments : (to be taken up depending on availability of equipment)

- Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
- Study of Zeeman effect: with external magnetic field; Hyper fine splitting
- To show the tunneling effect in tunnel diode using I-V characteristics.
- Quantum efficiency of CCDs

#### Reference Books:

- ❖ Schaum's outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Publication
- ❖ Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al., 3<sup>rd</sup> Edition, 2007, Cambridge University Press.
- ❖ An introduction to computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press
- ❖ Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C.V. Fernandez. 2014 Springer.
- ❖ Scilab (A Free Software to Math lab): H. Ramchandran, A.S. Nair. 2011, S. Chand and Co.
- ❖ Scilab Image Processing: L.M. Surhone. 2010 Beta script Publishing ISBN: 9786133459274

## C-5.2 :SOLID STATE PHYSICS

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

### 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, Monatomic 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,  $T^3$  Law

**Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevins theory of dia and Paramagnetic Domains, Curies law, Weiss Theory of Ferro magnetism and Ferro magnetic 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, Meta stable 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, London's 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 Edition 2012
2. LASERS: Fundamentals and Applications- Thyagarajan and Ghatak (McMillan 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. Chand Publication)-2010
- ❖ Solid State Physics S. O. Pillai (New Age Publication)-2008
- ❖ Lasers and Non linear Optics B. B. Laud (Wiley Eastern)-2011
- ❖ Elements of Solid State Physics- J. P. Srivastava (Prentice Hall of India)-2014
- ❖ Elementary Solid State Physics- Ali Omar (Addison Wiley)-2002

## PRACTICAL

(Minimum 4 experiments are to be done)

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 probe method.
7. To study PE hysteresis loop of a ferroelectric crystal

**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, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- ❖ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11 Ed., 2011, Kitab Mahal
- ❖ Elements of Solid State Physics, J. P. Srivastava, 2nd Ed., 2006, Prentice- Hall of India.

## DSE-5.3 : CLASSICAL DYNAMICS

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

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

### UNIT-I

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

### UNIT-II

Hamilton's Principle, Calculus of Variation and derivation of Euler-Lagrange's equation, Lagrange's Equations derived from Hamilton's Principles, Hamiltonian 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, Hamilton's 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, Time-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 a non stable particle

**Text Books:**

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko (Pearson) -2012. Classical Mechanics N C Rana and P S Joag.-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-Satya Prakash (Sultan Chand and sons)-2014
5. Introduction to classical dynamics R.K.Takwale and S.Puranik (Tata McGraw 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

Full Marks – 100

Mid Sem – 20/1hr

End Sem– 80/3 hrs

### 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 excited 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 photomultiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge Particle and photo detection (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 and Nigam-2014
2. Atomic and Nuclear Physics- N.Subramanyam, BrijLal and JivanSeshan (S. Chand Publishing)-2007

**Reference Books:**

- ❖ Introduction to Modern Physics- H.S.Mani and G.K. Mehta(Affiliated 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 McGraw Hill). -2017
- ❖ Concepts of Modern Physics-Arthur Beiser ( McGraw Hill)-2017

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

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

End Sem – 25 Marks

Full Marks – 25 Marks

#### 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 family ties and relationship, Loss of earning and livelihood 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 NGOs and other agencies

# SEMESTER-VI

## C-6.1 : ELECTROMAGNETIC THEORY

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

## 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, Total internal reflection, evanescent waves, Metallic reflection (normal Incidence)

### UNIT IV

**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-shadepolarimeter.

### Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths ( Pearson)-2015
2. Principles of Optics- Max Born and E. Wolf- Cambridge University Press-1999

### Reference Books:

- ❖ Classical Electrodynamics by J.D. Jackson (Willey)-2007
- ❖ Foundation of electromagnetic theory: Ritz and Milford (Pearson)-2008
- ❖ Electricity and Magnetism : D C Tayal (Himalaya Publication)-2014
- ❖ Optics : A.K.Ghatak (McGraw Hill Education)- 2017
- ❖ Electricity and Magnetism: Chattopadhyaya, Rakhit (New Central)-2018

## PRACTICAL

(Minimum 4 experiments 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 Babinet's compensator.
4. To determine the refractive index of liquid by total internal reflection using Wollaston's film.
5. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eye piece.
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 wavelength 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, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- ❖ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
- ❖ Electromagnetic Field Theory for Engineers and Physicists, G. Lehner, 2010, Springer

## C-6.2 : STATISTICAL MECHANICS

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

## THEORY

### UNIT- I

**Classical Statistics-I:** Macrostate 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 equipartition 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, macrostates and microstates, Fermions and Bosons, Bose Einstein distribution function and Fermi-Dirac distribution function. Bose-Einstein Condensation, Bose deviation from Planck's 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, Wien's Displacement law, Wien's distribution Law, Saha Ionization Formula, Rayleigh Jeans Law, Ultra Violet catastrophe.

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

### Text Books:

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

Use C/C++/ Sci lab for solving the problems based on Statistical Mechanics like

1. Plot Planck's law for Black Body radiation and compare it with Wien's law and find Wien'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, 3rd Edn. 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. Fernandez. 2014 Springer ISBN: 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 : NANO MATERIALS AND APPLICATIONS

**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 carriers in 3D, 2D, 1D nanostructure and its consequences.

### UNIT-II

**Synthesis of Nanostructure Materials:** Top down and bottom up approach, Photo lithography Ball milling. Gas phase condensation, Vacuum deposition, Physical vapour deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition, Chemical vapour deposition (CVD), Sol-Gel Electrodeposition, Spray pyrolysis, Hydrothermal 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, solar cells). Single electron devices (no derivation). CNT based transistors. Nonmaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS)

**Text Books:**

1. S.K. Kulkarni, Nanotechnology: Principles and Practices (Capital Publishing Company)-3rd Edition 2014
2. Nano science and nano technology, 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. Chattopadhyaya 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

Full Marks – 100

Mid Sem – 15/1hr

End Sem Theory – 60/3 hrs

End Sem Practical – 25/3 hrs

### 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, 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 mill voltmeter, 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. Front panel 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 McGraw 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 test items:

- 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,
- Winding a coil /transformer.
- Study the layout of receiver circuit.
- Trouble shooting 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.
3. To measure Q of a coil and its dependence on frequency, using a Q-meter.

4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/universal bridge.

**Open Ended Experiments:**

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

**Reference Books:**

- ❖ An advanced course in Practical Physics- Chattopadhyay, Rakshit Central-2013
- ❖ Practical Physics-B.B.Swain (KitabMahal)-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 – 25 Marks*

#### 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:** Reduce recycling, **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

**Ethics and Use of Digital Technology:** Cyber ethics- Crimes and Ethical hacking,

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

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