

**Curriculum and syllabus
(Choice Based Credit System)**

For

B.Sc. with Physics

KAZI NAZRUL UNIVERSITY

Under

**Choice Based Credit System
(From Session 2016-2017)**

**Department of Physics
Kazi Nazrul University
Asansol, Burdwan, W.B.**

June 2016

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication. 3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Department of Physics, Kazi Nazrul University, Asansol

Curriculum For B.Sc. with Physics [Choice Based Credit System]

Semester-I

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Mechanics	Core Course (Theory +Lab)		4	0	4	6
2	Discipline 2	Core Course (Theory) OR		5	1	0	6
3	Discipline3	Core Course (Theory +Lab)		4	0	4	6
3	Discipline3	Core Course (Theory) OR		5	1	0	6
3	Discipline3	Core Course (Theory +Lab)		4	0	4	6
4	EVS	AECC					4
				Total Credit =22			

Semester-II

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Electricity and Magnetism	Core Course (Theory +Lab)		4	0	4	6
2	Discipline 2	Core Course (Theory) OR		5	1	0	6
3	Discipline3	Core Course (Theory +Lab)		4	0	4	6
3	Discipline3	Core Course (Theory) OR		5	1	0	6
3	Discipline3	Core Course		4	0	4	6

4	Eng/MIL	(Theory +Lab) AECC					2
							Total Credit =20

Semester-III

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Thermal Physics and Statistical Mechanics	Core Course (Theory +Lab)		4	0	4	6
2	Discipline 2	Core Course (Theory)		5	1	0	6
		OR					
3	Discipline 3	Core Course (Theory +Lab)		4	0	4	6
		Core Course (Theory)		5	1	0	6
3	Discipline 3	OR					
		Core Course (Theory +Lab)		4	0	4	6
4	Electrical Circuit Network Skills	SEC-I					2
							Total Credit =20

Semester-IV

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Waves and Optics	Core Course (Theory +Lab)		4	0	4	6
2	Discipline 2	Core Course (Theory)		5	1	0	6
		OR					
3	Discipline3	Core Course (Theory +Lab)		4	0	4	6
		Core Course (Theory)		5	1	0	6
3	Discipline3	OR					
		Core Course (Theory +Lab)		4	0	4	6

4	Basic Instrumentation Skills	SEC-I				2
						Total Credit =20

Semester-V

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Discipline Specific Elective (Discipline 1: Physics)	Core Course (Theory) OR		5	1	0	6
		Core Course (Theory +Lab)		4	0	4	6
2	Discipline Specific Elective (Discipline 2:)	Core Course (Theory) OR		5	1		6
		Core Course (Theory +Lab)		4	0	4	6
3	Discipline Specific Elective (Discipline-3:)	Core Course (Theory) OR		5	1	0	6
		Core Course (Theory +Lab)		4	0	4	6
4	Technical Drawing Skills	SEC-I				2	
						Total Credit =20	

Semester-VI

Sr. No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			credit
				L	T	P	
1	Discipline Specific Elective (Discipline 1: Physics)	Core Course (Theory) OR		5	1	0	6
		Core Course (Theory +Lab)		4	0	4	6
2	Discipline Specific Elective (Discipline 2:)	Core Course (Theory) OR		5	1	0	6
		Core Course (Theory +Lab)		4	0	4	6
		Core Course (Theory)		5	1	0	6

3	Discipline Specific Elective (Discipline-3:)	OR Core Course (Theory +Lab)	4	0	4	6
4	Computational Physics	SEC-I				2
						Total Credit =20

Discipline Specific Electives (DSE)

[Four papers are to be taken and each paper will be of 6 credits]

For Semester V: (Any one from the following)

1. Nuclear and Particle Physics, 2. Atomic Physics & Spectroscopy, 3. Communication Electronics, 4. Astronomy and Astrophysics

For Semester VI : (Any one from the following)

5. Applied Optics, , 7. Physics of Devices and Instruments, 8. Nano Materials and Applications.

Other Disciplines of choice:

One must be Mathematics
and other may be from the following

1. Chemistry, 2. Computer Science, 3. Electronics, 4. Geology, 5. Economics,6. Biology 7. Any relevant course from B.A./B. Sc. Program.

I. MECHANICS (Theory + LAB.) [Credits: 06]

Theory - 45 Lectures [Marks : 50]

1. Mechanics of a Single Particle

Velocity and acceleration of a particle in (i) plane polar coordinates - radial and cross-radial components (ii) spherical polar and (iii) cylindrical polar co-ordinate system; Time and path integral of force; work and energy; Conservative force and concept of potential; Conservation of energy; Dissipative forces; Conservation of linear and angular momentum.
(10)

2. Mechanics of a System of Particles

Linear momentum, angular momentum and energy - centre of mass decomposition; Equations of motion, conservation of linear and angular momenta.
(6)

3. Rotational Motion

Moment of inertia, radius of gyration; Energy and angular momentum of rotating systems of particles; Parallel and perpendicular axes theorems of moment of inertia; Calculation of moment of inertia for simple symmetric systems; Ellipsoid of inertia and inertia tensor; Setting up of principal axes in simple symmetric cases. Rotating frames of reference - Coriolis and centrifugal forces, simple examples. Force free motion of rigid bodies - free spherical top and free symmetric top.
(10)

4. Central force Motion

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts.
(6)

5. Oscillations:

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. Concept of different types of waves (plane, spherical, cylindrical), Group and phase velocity, Growth and decay of sound waves in hall, Sabine's formula, reverberation.
(7)

6) Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. (6 Lectures).

Recommended Books :

1. Classical Mechanics – J. Goldstein (Narosa Publ. House).
2. Principles Of Mechanics - John. L Synge and Byron. A Griffith,
3. Theoretical Mechanics - M. R. Spiegel, (Schaum's Outline Series) (McGraw-Hill).

4. Mechanics - K. R. Symon (Addison-Wesley).
5. Introduction to Classical Mechanics - R. G. Takwale and P. S. Puranik (Tata McGraw-Hill).
6. Classical Mechanics – N. C. Rana and P. S. Joag (Tata McGraw-Hill).
7. The Feynman Lectures on Physics – Vol I (Addison-Wesley).
8. Mechanics – H. S. Hans and S. P. Puri (Tata McGraw-Hill).
9. Introduction to Special Theory of Relativity. R. Resnick
10. S. Banerji and A. Banerjee – The Special Theory of Relativity (Prentice Hall of India, 2002)
9. Berkeley Physics Course, Vol – I (Mechanics) (Mc Graw Hill).

MECHANICS LAB [Marks: 50]

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the elastic Constants of a wire by Searle's method.
8. To determine the value of g using Bar Pendulum.
9. Determination of surface tension of a liquid by Jaeger's method.
10. Determination of Young's modulus by flexure method.

II. ELECTRICITY AND MAGNETISM (Theory + LAB.) [Credits: 06]

Theory - 45 Lectures [Marks : 50]

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. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. mutual potential energy of two dipoles, force and torque between two dipoles, linear and planar quadrupoles – their potentials and fields. (12 hrs)

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. (6 hrs)

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 \mathbf{D} . Relations between \mathbf{E} , \mathbf{P} and \mathbf{D} . Gauss' Law in dielectrics. (4 hrs)

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field \mathbf{B} . Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of \mathbf{B} : curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. (6 hrs)

Magnetic Properties of Matter: Magnetization vector (\mathbf{M}). Magnetic Intensity (\mathbf{H}). Magnetic Susceptibility and permeability. Relation between \mathbf{B} , \mathbf{H} , \mathbf{M} . Ferromagnetism. B-H curve and hysteresis. (2 hrs)

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. (3hrs)

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. (8 Lectures)

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. (4 hrs)

Reference Books:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

ELECTRICITY AND MAGNETISM LABORATORY [Marks: 50]

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. 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.
11. To study the response curve of a parallel LCR circuit and determine its (a) antiresonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleigh's method.
15. To determine temperature co-efficient of resistance by meter-bridge.

III.: THERMAL PHYSICS AND STATISTICAL MECHANICS

(Theory + LAB.) [Credits: 06] Theory - 45 Lectures [Marks : 50]

Laws of Thermodynamics:

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **(15 Lectures)**

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for $(C_P - C_V)$, C_P/C_V , TdS equations. **(7 Lectures)**

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. **(7 Lectures)**

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **(6 Lectures)**

Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics. **(10 Lectures)**

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press

Thermal Physics and Statistical Mechanics Laboratory [Marks: 50]

1. To determine Mechanical Equivalent of Heat, J , by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
4. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer
5. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.

IV. WAVES AND OPTICS (Theory + LAB.) [Credits: 06]

Theory - 45 Lectures [Marks : 50]

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. (5

Lectures)

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. (2

Lectures)

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

(4 Lectures)

Interference of light waves

Young's experiment; spatial and temporal coherence; intensity distribution; Fresnel's biprism, interference in thin film; fringes of equal inclination and equal thickness; Newton's ring. Michelson's interferometer, Multiple beam interference – reflected and transmitted pattern. Fabry-Perot interferometer. (9

Lectures)

Diffraction of light waves

Fresnel and Fraunhofer class, Fresnel's half period zones; explanation of rectilinear propagation of light; zone plate. Fraunhofer diffraction due to a single slit, double slit and circular aperture (qualitative). Planediffraction grating (transmission). Rayleigh criterion of resolution; resolving power of prism, telescope, microscope and transmission grating.

(10 Lectures)

Polarisation

Different states of polarisation; double refraction, Huygen's construction for uniaxial crystals; polaroids and their uses. Production and analysis of plane, circularly and elliptically polarised light by retardation plates and rotatory polarisation and optical activity; Fresnel's explanation of optical activity; Biquartz and half shade polarimeter. (6 Lectures)

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Wave Optics Laboratory [Marks: 50]

1. To investigate the motion of coupled oscillators.
2. To study Lissajous Figures.
3. Familiarization with: Schuster's focusing; determination of angle of prism.
4. To determine refractive index of the Material of a prism using sodium source.

5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine wavelength of sodium light using Newton's Rings.
8. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
9. Feby Perrot Interferrometer.
10. Laser Diffraction.

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 & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani Pub.

DISCIPLINE SPECIFIC ELECTIVES (DSE)

PHYSICS-DSE: Nuclear and Particle Physics

[Credits: Theory-05, Tutorials-01, 60 Lectures]

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

(10)

Nuclear Models : Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi

gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

(12)

Radioactivity decay (a) Alpha decay: basics of α -decay processes, theory of α - emission, Gamow factor, Geiger Nuttall law, α -decay spectroscopy. (b) β -decay: energy kinematics for β -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

(10)

Nuclear Reactions Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

(8)

Interaction of Nuclear Radiation with matter Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. (8)

Detector for Nuclear Radiations Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector. (8)

Particle Accelerators Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

(5)

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, concept of quark model,

color quantum number and gluons.
(14)

Reference Books :

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press.
5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons.
6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi.
7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
9. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
10. Theoretical Nuclear Physics, J.M. Blatt & V. F. Weisskopf (Dover Pub.Inc., 1991).

PHYSICS-DSE: ATOMIC & MOLECULAR PHYSICS
[Credits: Theory-04 (45 Lectures), Practicals-02]

1. Atomic Spectrum

Good quantum numbers and selection rules. Stern-Gerlach experiment and spin as an intrinsic quantum number. Incompatibility of spin with classical ideas. Bohr-Sommerfeld model. Fine structure. Study of fine structure by Michelson interferometer.

(16)

2. Vector atom model

Magnetic moment of the electron, Landé g factor. Vector model – space quantization. Zeeman effect. Explanation from vector atom model.

(12)

3. Many electron model

Pauli exclusion principle, shell structure. Hund's rule, spectroscopic terms of many electron atoms in the ground state.

(4)

4. Molecular spectroscopy

Diatomic molecules – rotational and vibrational energy levels. Basic ideas about molecular spectra. Raman effect and its application to molecular spectroscopy (qualitative discussion only).

(5)

5. Laser Spectroscopy

Population inversion, Einstein's A and B coefficients; feedback of energy on a resonator; 3-level and 4-level systems.

(8)

PRACTICAL - DSE LAB : ATOMIC & MOLECULAR PHYSICS

1. To determine the value of e/m by Bar magnet.
2. Determination of Rydberg constant through Balmer line using hydrogen discharge tube.
3. To determine the absorption lines in the rotational spectrum of Iodine vapour.
4. To determine the thickness of a thin mica sheet using the white light spectrum from Michelson interferometer.
5. Determination of Landé g factor by DPPH-Diphenyl using electron spin resonance.

PHYSICS-DSE: Communication Electronics **[Credits: Theory - 04 (45 Lectures), Practical - 02]**

Electronic communication

Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band

designations and usage. Channels and base-band signals. Concept of Noise, signal-to-noise (S/N) ratio.

Analog Modulation Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Envelope Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver.

Analog Pulse Modulation Channel capacity, Sampling theorem, Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.

Digital Pulse Modulation Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

Introduction to Communication and Navigation systems: Satellite Communication– Introduction, need, Geosynchronous satellite orbits geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink. Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only). GPS navigation system (qualitative idea only).

Reference Books

- ▶ Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.

- ▶ Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- ▶ Electronic Communication systems, G. Kennedy, 3rd Edn, 1999, Tata McGraw Hill.
- ▶ Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
- ▶ Communication Systems, S. Haykin, 2006, Wiley India.
- ▶ Electronic Communication system, Blake, Cengage, 5th edition.
- ▶ Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press.

Communication Electronics Lab

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM - Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators

Reference Books

- Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
- Electronic Communication system, Blake, Cengage, 5th edition.

PHYSICS-DSE: Astronomy & Astrophysics

[Credits: Theory-05, Tutorials-01, 60 Lectures]

Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. Basic concepts of positional astronomy: Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Radiant Flux and

Luminosity, Apparent and Absolute magnitude scale, Distance Modulus; Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Stellar Spectral Classification, Hertzsprung-Russell Diagram.

(24 Lectures)

Astronomical techniques: Basic Optical Definitions for Astronomy (Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes). Physical principles: Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.

(9 Lectures)

The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology). The solar family (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets. Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification)

(11 Lectures)

The milky way: Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus. **(14**

Lectures)

Galaxies: Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms. **(7**

Lectures)

Large scale structure & expanding universe: Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).

(10 Lectures)

Reference Books :

- Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
- Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing.
- The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books.
- Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer.
- K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi, 2002.
- Baidyanath Basu, 'An introduction to Astro physics', Second printing, Prentice - 58 Hall of India Private limited, New Delhi, 2001.
- Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.

PHYSICS-DSE: APPLIED OPTICS

[Credits: Theory - 04 (45 Lectures), Practical - 02]

(i) Matrix methods : Introduction, Refraction and Translation matrix, System matrix for thin and thick lens, Cardinal points of optical system.

(08 periods)

(ii) Sources and Detectors : Basic principle of LED, Characteristics and applications of various kinds of LEDs, Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers. Characteristics and applications of various kinds of photo detectors.

(14

Periods)

(iii) Holography : Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.

(8

Periods)

(iv) Fibre Optics : Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.

(15

Periods)

Reference Books :

- Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill. 78
- LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
- Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
- Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
- Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
- Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
- Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
- Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press

PRACTICAL- DSE LAB: Applied Optics

- a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
- b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
- c. To find the polarization angle of laser light using polarizer and analyzer
- d. V-I characteristics of LED
- e. Study the characteristics of LDR.
- f. Photovoltaic Cell.
- g. To measure the numerical aperture of an optical fibre
- h. To study the variation of the bending loss in a multimode fibre.
- i. To determine the power loss at a splice between two multimode fibre.

PHYSICS-DSE: PHYSICS OF DEVICES AND INSTRUMENTS

[Credits: Theory - 04 (45 Lectures), Practical - 02]

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

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection. **(3 Lectures)**

Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. **(3**

Lectures) Multivibrators: Astable and Monostable Multivibrators using transistors.
(3 Lectures)

Phase Locked Loop (PLL): Basic Principles, Phase detector (XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter– Function, Loop Filter Circuits, transient response, lock and capture. Basic idea of PLL IC (565 or 4046).
(5 Lectures)

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

(12

Lectures)

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

Lectures)

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

(15 lectures)**Reference Books:**

- Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley & Sons
- Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt. Ltd.
- Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt. Ltd
- Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd.
- Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
- Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt. Ltd
- Semiconductor Physics and Devices, D.A. Neamen, 2011, 4th Edition, McGraw Hill
- PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

PRACTICAL- DSE LAB: PHYSICS OF DEVICES AND INSTRUMENTS**Experiments from both Section A and Section B:****Section-A**

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters of given specification.
3. To design the active filter (wide band pass and band reject) of given specification.
4. To study the output and transfer characteristics of a JFET.
5. To design a common source JFET Amplifier and study its frequency response.
6. To study the output characteristics of a MOSFET.
7. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
8. To design an Amplitude Modulator using Transistor.

9. To design PWM, PPM, PAM and Pulse code modulation using ICs.
10. To design an Astable multivibrator of given specifications using transistor.
11. To study a PLL IC (Lock and capture range).
12. To study envelope detector for demodulation of AM signal.
13. Study of ASK and FSK modulator. 14. Glow an LED via USB port of PC.
15. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.

Section-B: SPICE/MULTISIM simulations for electrical networks and electronic circuits.

1. To verify the Thevenin and Norton Theorems.
2. Design and analyze the series and parallel LCR circuits.
3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain
4. Design and Verification of op-amp as integrator and differentiator
5. Design the 1st order active low pass and high pass filters of given cutoff frequency
6. Design a Wein`s Bridge oscillator of given frequency.
7. Design clocked SR and JK Flip-Flop`s using NAND Gates
8. Design 4-bit asynchronous counter using Flip-Flop ICs
9. Design the CE amplifier of a given gain and its frequency response.
10. Design an Astable multivibrator using IC555 of given duty cycle.

Reference Books :

- Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994, Mc-Graw Hill.
- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronics : Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., 2000, Prentice Hall.
- Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHI Learning.
- PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India.

PHYSICS-DSE: Nano Materials and Applications
[Credits: Theory - 04 (45 Lectures), Practical - 02]

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 nanostructures and its consequences.
(10 Lectures)

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots.
(8 Lectures)

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.
(8 Lectures)

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

absorption, emission and luminescence. Optical properties of heterostructures and nanostructures.

(14

Lectures)

ELECTRON TRANSPORT: Carrier transport in nanostructures. Coulomb blockade effect, thermionic emission, tunneling and hopping conductivity. Defects and impurities: Deep level and surface defects. (6

Lectures)

APPLICATIONS: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS). (14 Lectures)

Reference books :

- C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
- S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)
- K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).
- Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
- M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).

- Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011, Cambridge University Press.
- Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

PRACTICAL-DSE LAB: Nano Materials and Applications

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.
7. Growth of quantum dots by thermal evaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.

Reference Books:

- C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).

- S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
- K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
- Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

SKILL ENANFANCEMENT COURSE (SEC) : (any two) (Credit : 02 each)

I. ELECTRICAL CIRCUITS AND NETWORK SKILLS (Theory: 30 Lectures)

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

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law, Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity, Familiarization with multimeter, voltmeter and ammeter. **(3**

Lectures)

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

(4 Lectures)

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

(4 Lectures)

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. (3

Lectures)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. (4

Lectures)

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources. (3

Lectures)

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) (4

Lectures)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. (5

Lectures)

Reference Books:

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

II. TECHNICAL DRAWING SKILLS

Theory: 30

Lectures

Introduction: Drafting Instruments and their uses. lettering: construction and uses of various scales: dimensioning as per I.S.I. 696-1972. Engineering Curves: Parabola: hyperbola: ellipse: cycloids, involute: spiral: helix and loci of points of simple moving mechanism. 2D geometrical construction. Representation of 3D objects. Principles of projections.

(4 Lectures)

Projections: Straight lines, planes and solids. Development of surfaces of right and oblique solids. Section of solids. (6

Lectures)

Object Projections: Orthographic projection. Interpenetration and intersection of solids. Isometric and oblique parallel projection of solids. (4

Lectures)

CAD Drawing: Introduction to CAD and Auto CAD, precision drawing and drawing aids, Geometric shapes, Demonstrating CAD- specific skills (graphical user interface. Create, retrieve, edit, and use symbol libraries. Use inquiry commands to extract drawing data). Control entity properties. Demonstrating basic skills to produce 2-D and 3-D drawings. 3D modelling with Auto CAD (surfaces and solids), 3D modelling with sketch up, annotating in Auto CAD with text and hatching, layers, templates & design centre, advanced plotting (layouts, viewports), office standards, dimensioning, internet and collaboration, Blocks, Drafting symbols, attributes, extracting data. basic printing, editing tools, Plot/Print drawing to appropriate scale.

(16

Lectures)

Reference Books:

- K. Venugopal, and V. Raja Prabhu. Engineering Graphic, New Age International
- AutoCAD 2014 & AutoCAD 2014/Donnie Gladfelter/Sybex/ISBN:978-1-118-57510-9
- Architectural Design with Sketchup/Alexander Schreyer/John Wiley & Sons/ISBN:978-1-118-12309-6

III. BASIC INSTRUMENTATION SKILLS

Theory: 30

Lectures

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

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter

and their significance.

(4 Lectures)

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance.

AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance. (4

Lectures)

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

(6

Lectures)

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.

(3 Lectures)

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

(4 Lectures)

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

(3 Lectures)

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

(3

Lectures)

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.

(3 Lectures)

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

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

Laboratory Exercises:

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

Open Ended Experiments:

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

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.

- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer.
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.

IV. COMPUTATIONAL PHYSICS Lectures

Theory: 30

The aim of this course 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*
- *Use of computer language as a tool in solving physics problems (applications)*
- *Course will consist of hands on training on the Problem solving on Computers.*

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of $\sin(x)$ as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

(4 Lectures)

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. **(5 Lectures)**

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO,

Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

1. Exercises on syntax on usage of FORTRAN.
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using $\exp(x)$ series evaluated at $x = 1$. (6

Lectures)

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from otherlanguages.

Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors. (6 Lectures)

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.

6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

(9

Lectures)

Reference Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi (1999)
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
Elementary Numerical Analysis, K.E. Atkinson, 3 r d Ed