GOUR MAHAVIDYALAYA

REACCREDITED BY NAAC (2nd Cycle) B+

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1.3.1 Institution integrates cross cutting issues relevant to Gender, Environment and Sustainability, Human Values and Professional Ethics into the Curriculum

MECHANICS

Core Course: II
Course Code: DC2T
Hours / Week: 4
Credit: 4

Semester: I
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives

- To know the basics of elasticity and its importance in beams, girders.
- To understand the concepts of viscosity, surface tension and the various methods to determine the parameters experimentally.

Instructor: Dr. Anirban Ray

1. Fundamentals of Dynamics

(a) Review of Newton's Laws: Mechanistic view of the Universe. Concepts of Inertial frames, force and mass. Solution of the equations of motion (E.O.M.) in simple force fields in one, two and three dimensions using Cartesian, cylindrical polar and spherical polar coordinate systems.
(b) Dynamics of systems of particles: Difficulty of solving the E.O.M. for systems of particles. Newton's third Law. External and Internal forces. Momentum and Angular Momentum of a system. Torque acting on a system. Conservation of Linear and Angular Momentum. Centre of mass and its properties. Two-body problem.
(c) Variable- mass system: motion of rocket.

2. Work and Energy

(a) Work - Kinetic Energy Theorem. Conservative Forces: Force as the gradient of a scalar field - concept of Potential Energy. Other equivalent definitions of a Conservative Force. Conservation of Energy.
(b) Qualitative study of one dimensional motion from potential energy curves. Stable and Unstable equilibrium.
(c) Energy of a system of particles.

3. Gravitation and Central Force Motion

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(a) Central Force. Reduction of the two body central force problem to a one-body problem. Setting up the E.O.M. in plane polar coordinates.
(b) Differential equation for the path. Motion under an Inverse-square force. Newton's Law of Gravitation. Inertial and gravitational mass. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).
(c) Gravitational potential energy. Potential and field due to spherical shell and solid sphere.

4. Non-Inertial Systems

(a) Galilean transformations and Galilean invariance.
(b) Non-inertial frames and idea of fictitious forces. E.O.M with respect to a uniformly accelerating frame.
E.O.M with respect to a uniformly rotating frame - Centrifugal and Corioli's forces. Laws of Physics in a laboratory on the surface of the earth.

5. Rotational Dynamics

(a) The Rigid Body: Constraints defining the rigid body. Degrees of freedom for a rigid body;
(b) Relation between Angular momentum and Angular Velocity - Moment of Inertia Tensor. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.
(c) E.O.M for rotation about a fixed axis.
(d) Principal Axes transformation. Transformation to a body fixed frame. E.O.M for the rigid body with one

point fixed (Euler's equations of motion). General motion of a rigid body - translation plus rotation. Kinetic energy of rotation.

6. Elasticity : Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Bending of a beam . Internal bending moment. Elastic potential energy.

7. Fluid Motion

(a) Kinematics of Moving Fluids: Idea of compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Reynold's number. Euler's Equation. The special case of fluid statics $F = \nabla p$: Simple applications (e.g: Pascal's law and Archimedes principle).
(b) Poiseuille's equation for Flow of a viscous Liquid through a Capillary Tube.

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Reference Books

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw- Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley. Analytical Me- chanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole. Additional Books for Reference
- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000 University Physics.
- F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
65	0	0	0	06

Professional Ethics – Green, Gender –Brown, Human Values – Blue, Environment & Sustainability - Pink

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ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM

Core Course: III
Course Code: DC3T
Hours / Week: 6
Credit: 6

Semester: II
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives:

- To study the fundamental ideas of electrostatics and current electricity
- To know about the classification of magnetism depending upon their properties
- To understand the concept of series and parallel resonance circuit

Instructor: Sadhan Biswas

Unit I: Electrostatics and Condensers

Fundamentals of electrostatics – Electric field – Electric potential - Coulomb's law - Lines of forces - Properties – Gauss theorem - Electric intensity due to a charged sphere and cylinder – Mechanical force on unit area of a charged surface - Principle of a capacitor – Capacity of a spherical capacitor – Energy stored in a charged conductor – Loss of energy due to sharing of charges between two charged conductors.

Unit II: Magnetic properties of materials

Magnetic field – Magnetic induction – Intensity of Magnetization – Magnetic permeability – Susceptibility – Properties of para, dia, and ferromagnetic materials – Curie point - Curie temperature - Hysteresis – Retentivity – Coercivity – Experiment to draw B-H curve by magnetometer method – Loss of energy per cycle.

Unit III: Electric current and electrical measurements

Biot-Savart's law – Magnetic intensity at a point due to a current carrying straight conductor - Axis of a circular coil and solenoid – Moving coil ballistic galvanometer – Damping correction - Ampere's circuital law - Carey Foster's bridge – Specific resistance – Potentiometer – Principle – Ammeter calibration – Calibration of low range and high range voltmeter using potentiometer.

Unit IV: Electromagnetic induction

Laws of electromagnetic induction – Self and mutual induction – Self inductance of a solenoid – Mutual inductance of a pair of solenoids – Coefficient of coupling – Experimental determination of self and mutual inductance (Rayleigh's method) - Growth decay of current in circuit containing Land R – Growth and decay of charge in circuit containing C and R – High resistance by leakage – Charging and discharging of capacitor through Land R.

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Unit V: AC circuits

Alternating EMF – Alternating EMF applied to circuits containing L and R, C and R – Alternating EMF applied to circuits containing L, C and R – Series and Parallel resonance circuits – Sharpness of resonance – Q factor – Power in AC circuits – Power factor – Wattless current – Transformer - Choke.

Books for Study

1. R. Murugesan, Electricity and Magnetism, S.Chand & Co., New Delhi, 2008 (Unit I to V).
2. Brijlal and Subramaniyam, Electricity and Magnetism, S. Chand & Co., New Delhi, 1983 (Unit I to V).

References

1. Edward M. Purcell & David J. Morin, Cambridge University Press, 3rd Edition, 2013.

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
68	0	0	0	08

Professional Ethics – Green, Gender –Brown, Human Values – Blue, Environment & Sustainability - Pink

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WAVES AND OPTICS

Core Course: II
Course Code: DC4T
Hours / Week: 4
Credit: 4

Semester: II
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives

- To know the basics of elastic waves.
- To understand the concepts of electromagnetic wave.
- To study the concept of simple harmonic motion in sound waves.

Instructor: Dr. Anirban Ray

1. Oscillations

(a) 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.

2. Superposition of Harmonic Oscillations

(a) 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.

(b) Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

3. Wave motion

. (a) Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Traveling) Waves. Wave Equation. Particle and Wave Velocities. Di erential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

. (b) Water Waves: Ripple and Gravity Waves

4. Velocity of Waves

(a) (a) Velocity of Transverse Vibrations of Stretched Strings.

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(b) (b) Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's For- mula for Velocity of Sound. Laplace's Correction.

5. Superposition of Harmonic Waves

- (a) Standing (Stationary) Waves in a String: Fixed and Free Ends. An- alytical Treatment. Changes with respect to Position and Time. En- ergy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment.
- (b) Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes.
- (c) Superposition of N Harmonic Waves. Phase and Group Velocities.

6. Wave optics

(a) Electromagnetic nature of light. De nition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

7. Interference

(a) Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reaction: 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.

8. Interferometers

. (a) Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes.

. (b) Fabry-Perot interferometer.

9. Diffraction and Holography

(c) (a) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Re- solving power of grating.

(d) (b) Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

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(e) (c) Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

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.
- Optics, 4th Edn., Eugene Hecht, Pearson Education Limited, 2014.
- 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.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
- A textbook of Optics; N Subramanyam, B. Lal and M.N.Avadhanulu; S.Chand. Publishing.

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
60	0	0	0	12

Professional Ethics – Green, Gender –Brown, Human Values – Blue, Environment & Sustainability - Pink

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THERMODYNAMICS

Core Course: IV
Course Code: DC6T
Hours / Week: 4
Credit: 4

Semester: III
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives:

- To study the fundamental laws of thermodynamics and concept of entropy.
- To brief out the ideas of low temperature Physics and Radiation laws.
- To outline the concept of specific heat of liquids by theories

Instructor: Priyanka Chowdhuri

Unit I: Transmission of heat

Conduction process - Thermal conductivity - Measurement of thermal conductivity by Forbe's method and Lee's disc method for bad conductors - Thermal radiation - Stefan's law - Newton's law from Stefan's law - Experimental determination of Stefan's constant.

Unit II: Specific heat

Specific heat capacity of liquids - Dulong and Petit's law - Variation of specific heat and atomic heat with temperature – Einstein's and Debye's theories - Newton's law of cooling - Specific heat capacity of liquids - Barton's correction.

Unit III: Thermodynamics

Zeroth law of thermodynamics – First law of thermodynamics – Heat engines – Reversible and irreversible process of Carnot's theorem – Second law of thermodynamics - Thermodynamic scale of temperature – Entropy – Change of entropy in reversible and irreversible processes – Temperature – Entropy diagram (T-S) – Law of increase of entropy – Maxwell's thermodynamical relations – Clausius Clapeyron's latent heat equations.

Unit IV: Phase transition

Combined 1st and 2nd law of thermodynamics – Entropy of an ideal gas – Reversible adiabatic process – Temperature – entropy diagrams – Helmholtz and Gibbs functions – Maxwell's equations - Joule-Kelvin inversion curve – Joule- Kelvin coefficient – Phase changes – Ehrenfest's classification of phase transition – Equation of state – Heat transformation – Specific heat capacity of saturated vapours – Experiment for latent heat of vaporization.

Unit V: Statistical Mechanics

Introduction – Phase space - Microstates and macrostates – Thermodynamic probability and entropy – Maxwell Boltzmann

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statistics to a monoatomic ideal gas – Specific heat capacity of a diatomic gas – Planck's quantum theory – Black body radiation – Bose–Einstein statistics – Fermi-Dirac Statistics.

Books for Study

1. Brijlal and Subramaniyam, Heat, Thermodynamics & Statistical Physics, S.Chand & Co., New Delhi, 2008 (Unit I to V).
2. Brijlal and Subramaniyam, Heat and Thermodynamics, S.Chand & Co., New Delhi, 2007 (Unit I to V).

Books for References

2. J.B. Rajam and C.L. Arora, Heat and Thermodynamics, S. Chand & Co., 1981.
3. Sharma J.K., Sarkar K.K., Thermodynamics and Statistical Physics, Himalaya Publishing House, 1991.

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
59	0	0	0	12

Professional Ethics – Green, Gender –Brown, Human Values – Blue, Environment & Sustainability - Pink

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ANALOG ELECTRONICS AND APPLICATION

Core Course: X
Course Code: DC10T
Hours / Week: 4
Credit: 4

Semester: IV
Max. Marks : 50
Internal Marks : 10
External Marks : 40

Objectives:

- To know about the intrinsic and extrinsic semiconductors
- To understand the transistor circuit configuration
- To know about the characteristics of operational amplifiers.

Instructor: Dr. Anirban Ray

Unit I: Semiconductors and diodes

Intrinsic - extrinsic semiconductor – PN junction diode – Biasing of PN junction – V-I Characteristics of diode – Rectifiers – Half wave – Full wave - bridge rectifiers – Break down mechanisms – Zener diode:Characteristics – Zener diode as voltage regulator.

Unit II: Transistors

Introduction – npn - pnp transistors – Transistor action – Transistor configurations – Common base configuration – CB characteristics – CE characteristics – Relation between α and β – Voltage divider biasing - Transistor as an amplifier – Transistor as a two part network – h parameters.

Unit III: Amplifiers and Oscillators

Single stage CE amplifier – Analysis of hybrid equivalent circuit – Power amplifiers – Efficiency of class β power amplifier – Push–pull amplifier - General theory of feedback – Properties of negative feedback – Criterion for oscillations – Hartley oscillator – Colpitt's oscillator.

Unit IV: Special semiconductor devices

Field effect transistors – Characteristics of FET – Parameters - JFET- Working & Characteristics of JFET - Difference between JFET and Bipolar Transistor - Working &V-I characteristics of SCR - UJT - UJT as relaxation oscillator.

Unit V: Operational amplifiers

Differential amplifier - Common mode rejection ratio – Characteristics of an ideal op-amp – Virtual ground – Inverting amplifier – Non inverting amplifier – Applications - Adder – Subtractor – Integrator – Differentiator – Unity gain buffer.

Books for Study

1. V.K. Mehtha, Principle of Electronics, S.Chand Publictions, NewDelhi, 3rd Edition , 2008 (Unit I to V).

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Books for References

1. B.L.Theraja, Basic Electronics solid state physics, S.Chand and company Ltd., 2002 (Unit I to V).

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
59	21	0	0	0

Professional Ethics – Green, Gender –Brown, Human Values – Blue, Environment & Sustainability - Pink

QUANTUM MECHANICS AND APPLICATION

Core Course: XI
Course Code: DC11T
Hours / Week: 4
Credit: 4

Semester: V
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives:

- To learn the approximation methods to study perturbation theory
- To study the concepts of Angular momentum
- To understand the basic idea of Dirac formalism in Quantum mechanics

Instructor: Dr. Anirban Ray

Quantum Mechanics and Applications (Theory):

1. Schrodinger Equation

(a) Description of a particle using wave packets. Spread of the Gaussian wave-packet for a free particle in one dimension. Fourier transforms and momentum space wave function. Position-Momentum un-certainty.

2. General discussion of bound states in an arbitrary potential

(a) Continuity of wave function, boundary condition and emergence of discrete energy levels. Application to one-dimensional problem - square well potential.

3. Quantum mechanics of simple harmonic oscillator.

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(a) Setting up the eigenvalue equation for the Hamiltonian. Energy levels and energy eigenfunctions in terms of Hermite polynomials (Solution to Hermite di erential equation may be assumed). Ground state, zero point energy & uncertainty principle.

4. Quantum theory of hydrogen-like atoms

Reduction of a two body problem to a one body problem. The time independent Schrodinger equation for a particle moving under a central force - the Schrodinger equation in spherical polar coordinates. Separation of variables. Angular equation and orbital angular momentum. Spherical Harmonics (Solution to Legendre differential equation may be assumed). Radial equation for attractive coulomb interaction - Hydrogen atom. Solution for the radial wavefunctions (Solution to Laguerre differential equation may be assumed). Shapes of the probability densities for ground & first excited states. Orbital angular momentum quantum numbers l and m; s, p, d,shells.

5. Generalized Angular Momenta and Spin.

(a) Generalized angular momentum. Electron's magnetic Moment and Spin Angular Momentum. Gyromagnetic Ratio and Bohr Magneton and the g - factor. Energy associated with a magnetic dipole placed in magnetic field. Larmor's Theorem. Stern-Gerlach Experiment.

(b) Addition of angular momenta - statement only. Restriction of eigen- values from $|j1 - j2|$ to $|j1 + j2|$.

Spectra of Hydrogen atom and its structure

(a) Formula for first order nondegenerate perturbative correction to the eigenvalue - statement only.

(b) Spin-orbit interaction and relativistic correction to the kinetic energy and Darwin term.

(c) Fine structure of the hydrogen atom spectrum

6. Atoms in Electric & Magnetic Fields

(a) Zeeman Effect: Normal and Anomalous Zeeman Effect (Formula for first order perturbative correction to the eigenvalue to be assumed).

(b) Paschen Back effect & Stark effects (Qualitative Discussion only).

7. Many electron atoms

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(a) Identical particles. Symmetric & Antisymmetric Wave Functions. Pauli's Exclusion Principle. Hund's Rule. Periodic table.

(b) Fine structure splitting. L-S and J-J coupling scheme. Spectral Notations for Atomic States and Term symbols. Spectra of Alkali Atoms (Na etc.).

Books for study

1. Gupta, Kumar & Sharma, Quantum Mechanics, 23rd Edition, 2004
2. P.M. Mathews & K.Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill, New Delhi, 2005L.
3. Ghatak, Ajoy, Lokanathan, S.Quantum Mechanics: Theory and Applications, 2004

References

1. I. Schiff, Quantum Mechanics, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2010.
2. Satyaprakash, Quantum Mechanics, Pragati Prakashan.
3. Merzbacher E, Quantum Mechanics, Wiley and Sons, USA, 3rd Edition, 1998.

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
50	0	0	0	10

Professional Ethics – Green, Gender –Brown, Human Values – Blue, Environment & Sustainability - Pink

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SOLID STATE PHYSICS

Core Course: XII
Course Code: DC12T
Hours / Week: 4
Credit: 4

Semester: V
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives:

- To know how to interpret the results obtained from the X-ray diffraction
- To understand the energy bands in metals, semiconductors and insulators
- To know the recent developments in high temperature superconductivity

Instructor: Dr Arka Chowdhuri

Unit I: **States of matter**

Crystalline and amorphous - Unit cell - Bravais lattices - Symmetry point groups – Space groups – Reciprocal lattice (definition and properties) - Reciprocal lattice of SC, BCC, FCC and HCP lattices - Miller indices - atomic scattering factor – Diffraction – Structure factor - X-ray diffraction - Laue equations - Interpretation of Bragg's equation - Ewald construction.

Unit II: **Lattice Vibrations and Thermal Properties**

Vibration of monatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons – Lattice heat capacity – Einstein model – Density of modes in one-dimension and three-dimension – Debye model of the lattice heat capacity – Free electron Fermi gas: Drude model – Electrical conductivity, electronic heat capacity - Hall effect & thermionic power – Electron motion in periodic potential: energy bands in solids, metals, semiconductors and insulators.

Unit III: Dielectrics

Defects and dislocations – Dielectrics: Internal electric field – Polarizability – Clausiusmosotti equation -Ferroelectric crystals and their types – Polarization catastrophe – Landau theory of phase transition: First and second order – Antiferro, pyro and piezoelectric crystals.

Unit IV: Magnetism

Langevin theory of para magnetism - Quantum theory of para magnetism - Curie law – Ferromagnetism - Weiss molecular field theory - Domain theory - Anti ferromagnetism - Neel theory – Ferrimagnetism - Ferrites-spin waves - Experimental techniques to study magnetic properties.

Unit V: Superconductivity

Occurrence of Superconductivity – Meissner effect – Thermodynamics of superconducting transition – London equation – Coherence length – BCS theory – Flux quantization – Type I and Type II

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Superconductors – Josephson superconductor tunneling – DC and AC Josephson effect – SQUID – Recent developments in high temperature superconductivity – Application of superconductors.

Books for Study:

1. C. Kittel, Introduction to Solid State Physics, Wiley India Edition, New Delhi, 7th Edition, Reprint 2008.
2. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2006.

References:

1. B.S. Saxena, R.C. Gupta & P.N. Saxena, Solid State Physics, PragatiPrakashan, Meerut.
2. J.P. Srivastava, Elements of Solid state physics, Prentice-Hall of India Pvt Ltd, New Delhi, Second Edition, 2006.
3. S.L. Kupta and V. Kumar, Solid State Physics, K. Naths Educational Publishers, Meerut, 2006.

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
66	0	0	0	17

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RENEWABLE ENERGY AND ENERGY HARVESTING

Elective Course: SEC2A
Course Code: SEC2A
Hours / Week: 6
Credit: 6

Semester: VI
Max. Marks 50
Internal Marks : 10
External Marks : 40

Objectives:

- To understand the different energy sources
- To know about the different techniques of harnessing solar energy
- To know the characterization techniques relating to the structural, molecular and optical phenomenon

Instructor: Sadhan Biswas

1. Fossil fuels and Alternate Sources of energy

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

2. Solar energy

Solar energy, its importance, storage of solar energy, solar pond, non- convective solar pond, applications of solar pond and solar energy, solar water heater, at plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

3. Wind Energy harvesting

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

4. Ocean Energy

Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

5. Geothermal Energy

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Geothermal Resources, Geothermal Technologies.

6. Hydro Energy
Hydropower resources, hydropower technologies, environmental impact of hydropower sources.

7. Piezoelectric Energy harvesting

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

8. Electromagnetic Energy Harvesting

(a) Linear generators, physics mathematical models, recent applications (b) Carbon captured technologies, cell, batteries, power consumption.
(b) Environmental issues and Renewable sources of energy, sustainability.

Reference Books

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

Cross Cutting Issues

Total Number of Topics	No. of topics relevant to Professional Ethics	No. of topics relevant to Gender	No. of topics relevant to Human Values	No. of topics relevant to Environment & Sustainability
79	0	0	0	79

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