Semester II

GENERIC ELECTIVES (GE-3): Engineering Physics II

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre- requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Engineering Physics II, GE-3	**4**	**2**	**0**	**2**	**Class XII pass**	**Engineering Physics I**	**Physics Faculty of CIC**

Learning Objectives

This module intends to provide an understanding of the basics of electrostatics and electrodynamics. It emphasizes on learning of concepts of electric circuits, electromagnets and induction mechanism. Further it gives a day-to-day knowledge of transformers, motors and generators. Also, it provides learning of solar energy usage and its technology. The lab activities provide a hand on experiments on electricity and solar energy. It provides understanding of working of utility devices. It intends to promote projects on robotics and solar energy.

Learning outcomes

- Understanding of physics principles in devices.
- Ability to conceptualize and build electrical devices for real life use.
- Reverse engineering of electrical devices and redesigning of such objects.
- Practical hands-on skills and understanding of simple engineering concepts derived from Electricity & Magnetism.

SYLLABUS OF GE-3

Unit I: (16 Hour) Electricity

Basics of Electrostatics and Electrodynamics - Electric Circuit elements and function - Current, voltage, capacitance, resistance - Power and efficiency in

electrical appliances
Unit II: (16 Hour) Electromagnetism basics
Joule heating - Electrical safety devices - Basics of Electromagnetism - Electromagnets and induction - Transformers. DC motors and generators
Unit III: (16 Hour) Electromagnetism applications
AC motors - Using electromagnetic spectrum - Information transfer and broadcasting
Unit IV: (16 Hour) Alternate Energy
Use of Radiation energy and appliances - Photovoltaic cells and conversion of solar energy to electricity - Advantages, limitations and challenges of different solar cell technologies - Different forms of renewable energy and technology.

Practical component –
Engineering Kitchen Activities [Laboratory]

- Electric circuit, power requirement, cost of electricity, energy efficiency of sample appliances
- Potential divider, measurement of resistances of different scales
- Build a buzzer
- Conversion of solar power to electricity using photovoltaic cells: design, working principle, performance, application
- Build an autonomous robot
- Build a remote-controlled robot
- Understanding physics of devices – one implementation of "Tod-Phod-Jod" concept.
- Innovation project – designing instruments, devices, model & prototyping

Essential/recommended readings

1. *Introduction to Electrodynamics.* David. J. Griffiths, PHI Learning, 2012
2. *Textbook of Electrical Technology* – Volume I & II. B. L. Thareja, and A. K. Thareja, S. Chand Publishing, 2006

GENERIC ELECTIVES (GE-4): Engineering Chemistry II

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			

Engineering Chemistry II, GE-4	**4**	**2**	**0**	**2**	**Class XII pass**	**Engineering Chemistry I**	**Chemistry Faculty of CIC**

Learning Objectives

This course has an aim of making students aware of the structure and properties of engineering materials, polymers and composites, which are most commonly used around us for various applications daily. Also, an elaborative discussion will be done, on one of the most important constituents of life i.e. water, it's properties, types, analysis etc., so that aspects related to water impurities and its different types of treatment methods become clear to them and they can further contribute towards the cause of providing this basic amenity to our society, as and when they get a chance, either by indulging themselves in research with academia or industry. At the end, students will be exposed to various characterization instrumentation techniques, through which they shouldbe able to get a better understanding about various kinds of materials (biomolecules, drugs, nanomaterials etc.)

Learning outcomes

- Students will develop a good understanding about the engineering materials, polymers and composites which are used in our daily life.
- Knowledge about one of the basic amenities of life i.e. water will be enhanced, so that students can further contribute towards solving various related problems in due course of life.
- Further, through learning characterization techniques, students will be able to understand better about various kinds of materials like nanomaterials, drugs and biomolecules.

SYLLABUS OF GE-4

Unit-I. (16 Hour)
Engineering Materials, Polymers and composites

Glass, Ceramics, Magnetic materials, Classification, functionality, general properties and types of polymers; (addition polymerization, step polymerization, copolymerization) Different types of polymers; natural and synthetic polymers; Linear, branched and cross-linked polymers; Thermoplastic and thermosetting polymers, their applications; Plastics: Properties of Polyethylene Plastics; Vinyl Plastics, Nylons, Phenol-formaldehyde resins (Bakelite) and Glyptal; Speciality Polymers: Engineering thermoplastics, Conducting polymers, Electroluminescent polymers, liquid crystalline polymers and biodegradable polymers.

Unit-II. (16 Hour)

Analysis of Water

Analytical aspects of water: Sources, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Water quality standards, physical, chemical and biological characteristics; hardness of water, disadvantages of hardness, determination of hardness (EDTA method). Alkalinity and its determination; Boiler problems with hard water and their prevention: Municipal water supply – its treatment and disinfection using break -point chlorination. Desalination, Reverse Osmosis, Electrodialysis and defluoridation of water.

Unit-III. (16 Hour)

Material characterization Techniques

Spectroscopy, General features of spectroscopy, Discussion on various kinds of spectra obtained using various spectroscopic techniques like UV-Visible spectroscopy, Fourier-Transform Infra- red spectroscopy, Fluorescence spectroscopy, Circular Dichroism spectroscopy etc.

Unit-IV. (16 Hour)

Nanomaterials and their Characterization

Characterization of Nanomaterials using UV-Visible Absorption spectroscopy, Fourier Transform Infra-red spectroscopy, Transmission electron microscopy (TEM), Scanning Electron Microscopy and FESEM etc.

Practical component –

1. Experimental demonstration of the synthesis of various types of polymers (like nylon, rayon fibre/ artificial silk etc.)
2. Molecular dynamics simulation of small molecules like water using softwares like LAAMPS
3. Demonstration of different experiments for determination of hardness of water

4. Interpretation and analysis of experimental data/ figures of various structures (biomolecules, and nano-structures) from some already published research papers/ reviews for understanding various spectroscopic and physicochemical techniques

Essential/recommended readings

1. Engineering Materials: Polymers, Ceramics and Composites, 2nd ed. Kindle Edition by A.K. Bhargava
2. Engineering Chemistry by O.G. Palanna, McGraw Hill, 2017.
3. Water Treatment (Hardness of Water) by Subodh Bhandarkar
4. Materials Science and Engineering: An Introduction, by Callister, 8th Edition, John Wiley and sons inc., Jan 2010.
5. Plastics Materials, Newness, Butterworths and Brydson, J.A., London, 1975
6. Spectroscopy and Characterization of Nanomaterials and Novel Materials: Experiments, Modelling, Simulations, and Applications, by Prabhakar Misra
7. Optical Properties and Spectroscopy of Nanomaterials, 2009 by Jin Zhong Zhang