



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160923

Semester – VI

Electrical Materials

Type of course: Engineering – Open Elective Course

Prerequisite: Physics (3110018) and Basic Electrical Engineering (3110005).

Rationale:

The course is aimed to provide exposure to the various electrical materials which are used in electrical engineering and their applications in designing electrical equipments and it gives the fundamental knowledge of various material used in electrical engineering. This course provides the essential knowledge in the selection of conducting, dielectric, insulating, magnetic, semiconductor and superconductor materials during design of electrical engineering equipments.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total HRS	% Weightage
01	Conductors Classification: High conductivity, high resistivity materials, fundamental requirements of high conductivity materials and high resistivity materials, mobility of electron in metals, factors affecting conductivity and resistivity of electrical material, thermoelectric Effect: Seeback effect, Peltier effect, commonly used high conducting materials: copper, aluminum, bronze brass properties and characteristics, constantan, platinum and nichrome properties, characteristics and applications, material used for AC and DC machines	09	20
02	Dielectric Materials and Insulators Properties of gaseous, liquid and solid dielectric, dielectric as a field medium, electric conduction in gaseous, liquid and solid dielectric, breakdown in dielectric materials, mechanical and electrical properties of dielectric materials, effect of temperature on dielectric materials, polarization, loss angle and dielectric loss, petroleum based insulating oils, transformer oil, capacitor oils and its properties, classification of insulation (Solid) and application in AC and DC machines, solid electrical insulating materials, fibrous, paper boards, yarns, cloth tapes, sleeving wood, impregnation, plastics, filling and bounding materials, fibrous, film, mica, rubber, mica based materials, ceramic materials.	09	20



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03	Magnetic Materials Basic terms, classification of magnetic material: diamagnetic, paramagnetic, ferromagnetic, anti-ferromagnetic and amorphous material, hysteresis loop, magnetic susceptibility, coercive force, curie temperature, magnetostriction, factors affecting permeability and hysteresis loss, common magnetic materials: soft and hard magnetic materials, electric steel, sheet steel, cold rolled grain-oriented silicon steel, hot rolled grain-oriented silicon steel.	08	20
04	Semi-Conductors and Superconductors General concepts, energy bands, types of semiconductors: intrinsic Semiconductors, extrinsic Semiconductors, compound semiconductor, amorphous semiconductor, hall effect, drift, mobility, diffusion in Semiconductors, semi-conductors and their applications. Superconductors: Superconductivity, properties of superconductors, critical field, Meissner effect, type-I and type-II Superconductors.	08	20
05	Special purpose materials Nickel iron alloys, high frequency materials, permanent magnet materials, feebly magnetic materials, ageing of a permanent magnet, effect of impurities, Losses in Magnetic materials, Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials.	08	20

Text Books:

1. Electrical Engineering Materials: A.J. Dekker, PHI Publication.
2. An Introduction to Electrical Engineering Materials: C. S. Indulkar and S. Thiruvengadam, S. Chand & Co., India.

Reference Books:

1. Material Science for Electrical & Electronics Engineers: Ian P. Hones, Oxford University Press.
2. Electrical Properties of Materials: L. Solymar and D. Walsh, Oxford University Press-New Delhi.
3. A Course in Electrical Engineering Materials: T K Basak, New Age Science Publications.
4. A Course in Electrical Engineering Materials: R K Rajput, Laxmi Publications.
5. A Course in Electrical Engineering Materials: S. P. Seth and P. V. Gupta, Dhanpat Rai & Sons.
6. Electrical and Electronic Engineering Materials: S.K. Bhattacharya, Khanna Publishers, New Delhi.
7. Electrical Engineering Materials: T.T.T.I Chennai, Tata MacGraw Hill.

Suggested Specification table with marks(Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	20	15	10	5

Legends: R: Remembrance; U: Understanding, A: Application, N: Analyze, E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)



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Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome (Theory):

After learning the course the students should be able to:

Sr. No.	CO Statement	Marks % Weightage
01	Recall different material and its properties which are used in electrical equipments as conductor and its properties in electrical equipments.	20
02	Elucidate various types of dielectric materials, special purpose materials and their properties in various conditions.	40
03	Evaluate types of magnetic materials and its behavior.	20
04	Analyze semi-conductor and superconducting material used in electrical engineering and different effect associated with the materials.	20

List of Open Source Software/learning website:

<https://nptel.ac.in/courses/108/108/108108116/>

<https://nptel.ac.in/courses/113/104/113104096/>

<https://nptel.ac.in/courses/108/108/108108112/>

<https://nptel.ac.in/courses/115/103/115103108/>