		Category	L	T	P	Credit
22EE220	**MATERIALS SCIENCE FOR ELECTRICAL ENGINEERS**	ESC	3	0	0	3

Preamble

The course work aims in imparting fundamental knowledge of materials science required for electrical engineers. The course work will introduce engineers to different types of conductors, semiconductors and dielectrics. The recent magnetic materials, Solar cell materials, superconductors and smart materials will be discussed

Prerequisite

22PH120-Physics

Course Outcomes

On the successful completion of the course, students will be able to

	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Compute the electrical properties of metals based on classical, quantum and band theory of solids.	TPS3	80%	85%
CO2	Use the basic properties of semiconductor for fabrication of optoelectronic devices	TPS3	80%	85%
CO3	Calculate the various dielectric properties at a given frequency.	TPS 3	80%	85%
CO4	Compute the magnetic properties of different magnetic and magnetostrictive materials	TPS3	80%	85%
CO5	Explain the properties and application of metallic glasses, nano material, smart materials ,superconductors	TPS2	80%	85%
CO6	Explain the importance of solar cell materials Conducting polymers, Two dimensional materials ,Spintronics and QLED	TPS2	80%	85%

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**L**									**L**			
CO2	**S**	**M**	**L**									**L**			
CO3	**S**	**M**	**L**									**L**			
CO4	**S**	**M**	**L**									**L**			
CO5	**M**	**L**	**L**									**L**			
CO6	**M**	**L**	**L**									**L**			

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	**CAT 1**			**CAT 2**			**ASSIGNMENT 1**				**ASSIGNMENT 2**				**TERMINAL**			
TPS SCALE	**1**	**2**	**3**	**1**	**2**	**3**	**3**	**4**	**5**	**6**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1	**8**						50								2		10	
CO2	6	15	20				50								4		10	
CO3	6	15	30								50				4		15	
CO4				**6**		50					50				4		15	
CO5				8	15										2	15		
CO6				6	15										2	15		
	20	30	50	20	30	50									20	30	50	

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Conducting Materials

Conduction in metals- Classical free electron theory of metals- Mobility and Conductivity- Thermal Conductivity of metals, polymers and ceramics-Widemaan Franz Law . Quantum free electron theory –Fermi function, Band theory of Solids Blochs theorem-Kronig-Penny model –Application of low and high resistivity materials.

Semiconducting Materials

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration
and temperature, Carrier generation and recombination, diffusion and drift current , p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices-Laser diode and photodiode.

Dielectric materials

Electric polarization-Different types of polarization- -Internal field-Claussius Mosotti Relation-Dielectric Loss-Dielectric Breakdown-Uses of dielectrics (Capacitors and Transformers) - Frequency and temperature dependence of Polarization - Ferroelectric materials piezoelectric materials.

Magnetic materials

Origin of magnetic moment - Wiess theory- Hysteresis- Hard and soft magnetic materials, Ferrites –properties & applications. Neodymium magnets- Magnetostrictive materials-CMR-GMR.

Advanced Engineering materials

Metallic Glasses-Types of metallic glasses- Properties and applications - Superconductors-Types of superconductor-Properties and Applications , Nano materials- Properties and Applications- Smart materials-Properties and Applications –Solar cell materials-Conducting polymer - Two dimensional materials- -Spintronics-QLED

Text Book

1. M.A.Wahab Solid State Physics - Structure and Properties of Materials, 3rd edition,Reprint, Narosa Publishers, 2020

Reference Books& web resources

1.. William D Callister Materials Science and Engineering – An introduction,10th edition,

Wiley Publications, 2018

2. William F Smith, Javed Hashemi, Ravi Prakash Materials Science and Engineering 4th edition, Tata McGraw Hill, 2006

3. https://nptel.ac.in/courses/115102025/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1.	**Conducting Materials**	
1.1	Conduction in metals - Classical free electron theory of metals - Mobility and Conductivity	2
1.2	Thermal Conductivity of metals, polymers and ceramics - Wiedemaan Franz Law	1
1.3	Quantum free electron theory – Fermi function	1
1.4	Band theory of Solids - Bloch theorem - Kronig - Penny model	2

Module No.	Topic	No. of Periods
1.5	Application of low and high resistivity materials	1
2.	**Semiconducting Materials**	
2.1	Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier concentration and temperature	2
2.2	Carrier generation and recombination.	1
2.3	Diffusion and drift current , p-n junction	2
2.4	Metal-semiconductor junction (Ohmic and Schottky),	2
2.5	Semiconductor materials of interest for optoelectronic devices - Laser diode and photodiode	1
3.	**Dielectric materials**	
3.1	Electric polarisation - Different types of polarisation	2
3.2	Internal field - Claussius Mossotti Relation	1
3.3	Dielectric Loss - Dielectric Breakdown - Uses of dielectrics(Capacitors and Transformers)	2
3.4	Frequency and temperature dependence of Polarization	2
3.5	Ferroelectric materials & Piezoelectric materials	1
4.	**Magnetic materials**	
4.1	Origin of magnetic moment- Wiess theory	2
4.2	Hysteresis - Hard and soft magnetic materials- Ferrites – properties & applications	2
4.3	Neodymium magnets , Magnetostrictive materials- CMR-GMR.	2
5.	**Advanced Engineering materials**	
5.1	Metallic Glasses – Types of metallic glasses – Properties and applications	1
5.2	Superconductors – Types of superconductor- Properties and Applications	1
5.3	Nano materials – Properties and Applications	1

Module No.	Topic	No. of Periods
5.4	Smart materials – Properties and Applications	1
5.5	Solar cell materials, Conducting polymers	2
5.6	Two dimensional materials - Spintronics-QLED	1
	Total number of hours	36

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