SEMESTER 7

ADVANCED MATERIALS

Course Code	OECHT722	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2Hrs 30Min
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To impart knowledge of properties and applications of various types of advanced materials

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Classification and structure property relations of materials:** Importance of Engineering materials, classification of materials, classification of materials- basic categories (metals, ceramics, and polymers), Composite materials and advanced materials: semiconductors, biomaterials, smart materials, and nanoengineered materials. Amorphous and semi-crystalline materials, mechanical, thermal and electrical properties of materials and their dependence on the microstructure, elastic and plastic behaviour of metals, ceramics and polymers, changes in the microstructure of materials due to mechanical and thermal load, length scales relevant for materials and their characterization.	**8**
2	**Metal alloys:** Types of metal alloys, processing and applications of metal alloys. **Ceramics:** types processing and applications of ceramics advanced ceramics, mechanical properties, processing and applications. **Polymers:** Classification, properties, processing and applications. **Composites:** particle-reinforced composites, Fiber-reinforced composites- Characteristics, synthesis and applications of composites.	**10**

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	Biomaterials: Types of Biomaterials: Natural and Synthetic, Properties and Biocompatibility, Applications in Medical Devices, Implants, and Tissue Engineering.	
3	**Nanomaterials and nanocomposites:** advanced nano-materials - synthesis, properties and applications – fullerenes, graphene, graphite, carbon nano-tubes, nano wires, nano rods, nanofluids, nanoclusters. Nanocomposites - Matrix materials- Basics of Metal matrix, Ceramic Matrix and Polymer Matrix nanocomposites - Nano-reinforcements, nanofillers. Introduction to bionanotechnology (fundamental concepts only) - Nanomedicine, Drug delivery, Therapeutic applications. Applications of biosensors,	**9**
4	**Smart materials:** Types of smart materials, thermochromic and photochromic materials, Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, , piezoelectric ceramics: Principles of Piezoelectricity, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, properties and applications, magnetostrictive materials: Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto-resistance Effect, properties and applications, Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC)	**9**

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Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Summarize the important factors that affect the behaviour of materials under different conditions.	**K2**
CO2	Compare the physical properties of metals, alloys, polymers, ceramics, and composites significant in various engineering applications.	**K2**
CO3	Explain different types of advanced nanomaterials, nanocomposites , their methods of synthesis and applications.	**K2**
CO4	Explain the key theory and operation principles of smart materials, their synthesis, properties and applications.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**										**2**
CO2	**3**											
CO3	**3**											
CO4	**3**	**2**										

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Materials Science and Engineering An Introduction	William D. Callister, Jr.	Wiley	Tenth, 2018
2	The science of Engineering of Materials	Donald. R Askeland	Cengage learning	Sixth, 2010
3	Nanostructures & Nanomaterials: Synthesis, Properties & Applications	Joel I. Gersten	Wiley	2001
4	Nanocomposite science and technology	Pulikel M. Ajayan	Wiley	2005
5	Engineering analysis of smart material systems.	Donald J. Leo	John Wiley & Sons	2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Bionanotechnology	David S Goodsell	John Wiley & Sons,	2004

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/113/104/113104009/
2	https://onlinecourses.nptel.ac.in/noc19_mm21/preview
3	https://nptel.ac.in/courses/112104173