Course Code	Course Name	Credits
26PH604	PHYSICAL-TECHNICAL IN MATERIAL SCIENCE	04

Course Objectives

- To impart knowledge on various materials, smart materials, optical composite, ceramic and superconductors' techniques.
- To learn the structural, ceramic and glass making, properties of materials, and surface characterization techniques.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Gain information about atomic structure, atomic bonds, crystal structure, crystal geometry and crystal defects

Unit 1 – Phase Transition In Materials (13 Hrs.)

Definition and basic concepts – solubility limit – phases – microstructure –phase equilibria – unary phase diagrams – Binary phase diagrams – Binary isomorphous systems – Interpretation of phase diagrams – Development of microstructure in isomorphous alloys – mechanical properties of isomorphous alloys – Binary eutectic systems – Development of microstructure in eutectic alloys – Equilibrium diagrams having intermediate phases or components – Eutectoid and peritectic reactions – Concurrent phase transformations – ceramics and ternary phase diagrams – The Gibbs phase rule – The iron – iron carbide phase diagrams.

Unit 2 – Nonlinear Optical Materials (11 Hrs.)

Introduction-Harmonic Generation-Second Harmonic Generation-Phase Matching-Third Harmonic Generation-Optical Mixing-Parametric Generation of Light-Self focusing of Light– nonlinear optical materials.

Unit 3 - Ceramics (12 Hrs.)

Introduction – Glasses – Glass Ceramics – clay products – refractory's -abrasives – cements – advanced ceramics – ceramic phase diagrams – brittle fracture of ceramics – stress – strain behavior – mechanism of plasticde formation – miscellaneous mechanical consideration.

Unit 4 – Polymers (12 Hrs.)

Introduction – Hydrocarbon molecules – polymer molecules – chemistry of polymer molecules – molecular weight – molecular shape – molecular structure – molecular configuration – thermo plastic and thermos setting polymers – copolymers – mechanical behaviour of polymers – polymer types– miscellaneous applications – advanced polymer materials – polymerization– polymer additives.

Unit 5 - Alloys And Composites (12 Hrs.)

Introduction – Ferrous alloys: Steels – Heat treatment – Formation of peartile – Formation of lamite – Formation of manterisite – Terryzering of mechanical steels. Non-ferrous alloys: copper and its alloys – aluminum and its alloys – Titanium and its alloys – Nickel and its alloys. Large particle composite – dispersion strengthened composites – influence of fiber length – influence of fiber orientation and concentration – The fiber phase – The matrix phase – polymer – matrix composites – Metal – Matrix composites – ceramic – matrix composites – carbon – carbon composites –hybrid composites – Laminar composites – sandwich panels.

Reference Books:

1. Material Science, OP, Khanna, Dhanpat RAI, Publications, 2013.
2. Materials Science and Engineering, WilliamD, Callister, JR, John wiley&son,1996.
3. Material Science and Engineering V. Raghavan, Prentice Hall
4. Balasubramanian. R., Callister's Material Science and Engineering,Wiley, India, 2010.
5. M. Arumugam - Materials Science, Anuradha Publications, Chennai
6. V. Pokropivny, R. Lohmus, I. Hussainova, A. Pokropivny, S. Vlassov.Introduction in nanomaterials and nanotechnology. University of Tartu.2007
7. A Text book of Materials Science, P, Mani, G.Ranganath, Jayaprakash, RN, Dhanam age.

Websites and eLearning Sources:

1. https://onlinecourses.nptel.ac.in/noc25_mm19/preview
2. https://youtu.be/JxQXidQmU84?si=U6qhEP2kdcVUif9b
3. https://youtu.be/pOEWAN00qdE?si=bnvczr5R4QzByWo5

COs and Bloom's Taxonomy Mapping – 26PH604		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain phase transitions, phase diagrams, Gibbs phase rule, and microstructural evolution in materials.	K1, K2
CO2	Apply principles of phase equilibria and alloy systems to interpret binary and ternary phase diagrams.	K3
CO3	Analyze nonlinear optical materials and ceramic materials including their structure, properties, and applications.	K4
CO4	Analyze polymer materials including molecular structure, polymerization mechanisms, and mechanical behavior.	K5
CO5	Evaluate and design advanced materials such as alloys and composites for engineering and technological applications.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH604													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	1	3	2	1	1	1	1	1.58
CO2	3	3	2	2	1	1	2	3	2	2	2	1	2.00
CO3	3	3	3	2	1	1	2	3	3	2	2	2	2.25
CO4	3	3	3	2	2	1	2	3	3	2	2	2	2.33
CO5	3	3	3	3	2	2	3	3	3	3	2	2	2.58
												Total	2.15

Mean Score: 3- High, 2- Medium/Moderate, 1-Low