# Advanced Materials Technology

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| **Semester II**  **Subject code - 6PC5204ME** | **L**  **3** | **T**  **1** | **P**  **0** | **Credits**  **4** |

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| **Course Objectives**: | **Course Outcomes**: |
| 1. Gives knowledge for material selection based on its properties 2. Provides the knowledge and practice regarding different Material & their behavior. 3. Gives hands on practice regarding Elastic, Plastic & Failure behavior. | **After completion of the course, the student will be able to**   1. Select suitable material for different industrial applications 2. Understand the elastic and plastic behaviour of the material for which it is utilized in industry. 3. Understand the fatigue and fracture behaviour of engineering materials 4. Identify applications of all kinds of smart materials. 5. Analyze the mechanical and metallurgical properties of non metallic Materials |

**UNIT-I**

**Selection of Materials:**

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability, corrosion and wear resistance – Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

**UNIT-II**

**Elastic and Plastic Behavior:**

Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solution hardening, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors - Super plasticity - Deformation of non-crystalline material.

**UNIT-III**

**Fracture Behavior:**

Griffith's theory, stress intensity factor and fracture toughness mechanisms – Ductile to brittle transition in steel - High temperature fracture, creep. - Larson-Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms. Paris law - Effect of surface and metallurgical parameters on fatigue - Fracture of non-metallic materials – Failure Analysis, sources of failure, procedure of failure analysis.

**UNIT-IV**

**Smart Materials:**

Dual phase steels, Micro alloyed, High strength low alloy (HSLA), steel, Transformation

induced plasticity (TRIP) steel, Maraging steel - Intermetallics, Ni and Ti - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials, bio materials.

**UNIT-V**

**Non metallic Materials:**

Polymerization, Structure and properties of thermoplastics and thermosets, Engineering applications, Property modifications, Mechanical, thermal behaviour of composites with polymer matrix. Advanced structural ceramics: WC, TiC, TaC, AI2O3, SiC, Si3N4, CBN and diamond - properties, processing and applications. Adhesives: Properties and applications

**References :**

1. Thomas H. Courtney, " Mechanical Behavior of Materials ", McGraw-Hill, 2000.
2. Charles J.A., Crane, F.A.A and Furness, J.A.G., “Selection and use of Engineering Materials", 3rd Edition, Butterworth-Heinemann, 1977.
3. Flinn, R.A. and Trojan, P.K., “Engineering Materials and their Applications ", (4th Edition), Jaico Publishing, 1999.
4. George E. Dieter, “Mechanical Metallurgy ", McGraw Hill, 1988.
5. Metals Hand Book, Vol.10, “Failure Analysis and Prevention ", (10th Edition), 1994.
6. Willam D. Callister, Jr., “Material Science and Engineering: An introduction”, John Wiley & Sons, Inc, 2003.
7. Willam F. Smith, “Principles of Materials Science and Engineering”, 3rd edition, McGraw Hill,