MTPE4001 SELECTION OF ENGINEERING MATERIALS (3-0-0)

Course Objective:
To develop a systematic, performance-driven approach for the selection of materials and manufacturing processes for engineering components, considering service conditions, cost, processability and sustainability.

Module I (6 Hours)
Role of materials in engineering design; stages of the design process and material selection at each stage; classification of engineering materials – metals, ceramics, polymers, composites; review of mechanical, thermal, electrical and chemical properties relevant to selection; cost basis of material selection.

Module II (6 Hours)
Material selection methodology: translation of design requirements – function, constraints, objectives and free variables; screening and ranking; derivation of material performance indices for ties, beams, shafts, columns and panels; selection with multiple constraints and conflicting objectives; weighted property method, limits on properties method, cost per unit property method.

Module III (6 Hours)
Selection for mechanical service: selection for strength, stiffness, toughness and fracture resistance; selection for fatigue and creep resistance; selection for wear and abrasion resistance; selection for corrosion and oxidation resistance; materials for low temperature and elevated temperature applications; effect of environment on material performance.

Module IV (6 Hours)
Process selection: classification of manufacturing processes – casting, forming, machining, joining, powder and surface treatment processes; process attributes – size, shape, tolerance, surface finish, batch size and cost; matching of materials and processes; influence of processing on microstructure and properties.

Module V (6 Hours)
Case studies and modern trends: materials selection for automotive, aerospace, biomedical, marine and consumer product applications; material substitution – reasons, procedure and case studies; selection for sustainability – recycling, eco-properties and life cycle considerations; failure of components in service and reselection of materials.

Course Outcome:
CO1: To understand the classification of engineering materials and the properties relevant to design and selection.
CO2: To formulate design requirements and derive material indices for screening and ranking of candidate materials.
CO3: To select suitable materials for components subjected to mechanical, thermal and corrosive service conditions.
CO4: To select appropriate manufacturing processes compatible with the chosen material and the design requirements.
CO5: To analyse service failures, recommend material substitution and incorporate cost and sustainability considerations in selection.

Text Books:
1. Ashby M.F., Materials Selection in Mechanical Design; Butterworth-Heinemann.
2. Charles J.A., Crane F.A.A. and Furness J.A.G., Selection and Use of Engineering Materials; Butterworth-Heinemann.

Reference Books:
1. Farag M.M., Materials and Process Selection for Engineering Design; CRC Press.
2. Dieter G.E., Engineering Design: A Materials and Processing Approach; McGraw Hill.