MINIMUM CORE SUBJECT AREAS: MATERIALS ENGINEERING

AREA	SUBJECTS / DESCRIPTION	RECOMMENDED CONTACT HOURS
All areas in Group 1 are considered core with recommended hours specified (160 hours total), and 60 hours total from at least 2 out of 9 areas in Group 2.		
Group 1: all areas are considered core with recommended hours specified (160 hours total)		
1. Introduction to Materials Engineering	- atomic structure, crystalline solids structure, imperfection in solids, mechanical properties, introduction to materials degradation, phase diagrams, electrical and magnetic properties, introduction to structure and properties of metals, polymer and ceramics	40
2. Mechanics of solids	- forces and stresses, axial loading, torsion, shear and bending moment diagrams, pure bending, transverse loading, stress and failure criteria	30
3. Deformation and fracture	- dislocation theory, strengthening mechanisms, yield criteria, brittle fracture, fatigue, time-dependent behaviour	30
4. Materials testing	- the role of materials testing, optical microscopy, thermal analysis, x-ray diffraction, molecular spectroscopy, non-destructive testing	30
5. Materials characterization	- scanning electron microscopy, crystallography and diffraction, transmission electron spectroscopy and analytical techniques, Auger electron spectroscopy, mass spectrometry, Rutherford backscattering spectroscopy, surface analysis methods	30
Group 2: 60 hours total from at least 2 out of 9 areas below:		
1. Electronic properties of materials	- crystal structure and diffraction, lattice dynamics, fundamentals of electron theory, free electron gas, semiconductivity, dielectric properties	30
2. Thermodynamics and kinetics of materials	- systems and states, first and second laws of thermodynamics, thermodynamic variables and property relationships, equilibrium, phase rule and phase diagrams	30
3. Polymers	- basic concepts of polymer science, melt rheology, processing, rubber elasticity, viscoelasticity, yield and fracture, polymers and their properties	30
4. Composite materials	- natural and synthetic composites, thermosetting and thermoplastic matrices, fibre-matrix interface, micromechanics, laminae mechanics, failure criteria, processing, short fibre composites, ceramic and metal matrix composites	30
5. Environmental degradation	- overview of electrode potential, Nernst equation, Pourbaix diagram, anodic and cathodic protection, electrode kinetics and corrosion rate, passivation, forms of corrosion	30
6. Building materials	- types of applications, concrete ingredients, steel frame construction, cement, aggregates, concrete mix design, concrete testing, durability, admixtures, glass, cladding	30
7. Biomaterials	- properties of polymeric materials, ceramics and metals for biomedical applications, surface properties and characterization, strength, wear and sterilization, biological response to foreign materials, biocompatibility, degradable materials	30
8. Ceramics	- structure of ceramics, synthesis of powders, sol-gel processing, forming science, sintering and microstructure development, powder characterization, microstructure characterization, processing-structure-property relationship	30
9. Nanomaterials	- nano-size effects, quantum effects, size effects, synthesis and preparation of nanomaterials, characterization techniques, properties of one-dimensional materials	30