Centre of Excellence in Product Design and Smart Manufacturing

Syllabus For Recruitment 23-24

Section 1: Additive Manufacturing (AM)

Definition and concepts of additive manufacturing (AM), Design for Additive Manufacturing, Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Electron Beam Melting (EBM), Direct Metal Laser Sintering (DMLS), Binder Jetting, Material Jetting, Laminated Object Manufacturing (LOM), Hybrid Additive Manufacturing, Polymers, metals, ceramics, and composites used in additive manufacturing, Material properties and considerations for AM, Powder characteristics and requirements, Design principles for AM, Topology optimization, Support structures and build orientation, Design constraints and guidelines, Surface finishing techniques, Heat treatment and stress relief, Machining and polishing, Metal additive Manufacturing, Bio Printing.

Section 2: Micro-Electromechanical Systems (MEMS)

Basic concepts of MEMS technology and MEMS devices. Silicon as a MEMS material – mechanical properties of silicon. Mechanical components in MEMS. Design concepts of mechanical components. Working Principles of Microsystems. Engineering Science for Microsystems design and Fabrication. Scaling laws – Scaling in geometry, rigid body dynamics, electrostatic forces, electromagnetic forces, electricity-fluid mechanics and heat transfer. Materials for MEMS and Microsystems. Fabrication technologies – Photolithography – Ion implantation – diffusion – oxidation – CVD – Physical Vapor Deposition – Etching, Micro manufacturing – Bulk and surface micro machining – LIGA, Microsystems Design – Design considerations – Process design – Mechanical Design – CAD – Micro system packaging – Levels – Bonding – Interfaces – Assembly – Selection of Packaging Materials.

Section 3: Robotics & Automation

Basics of robotics and its applications**,** Classification of robots based on kinematics and control**,** Robot components and subsystems, Forward and inverse kinematics, Jacobian matrix and velocity analysis, Robot dynamics and control, Robot programming languages: teach pendant, high-level languages,

Offline programming and simulation, Robot control using programming, Types of sensors used in robotics: position, proximity, vision, tactile, etc. Actuator types: electric motors, pneumatics, hydraulics, etc. Feedback and closed-loop control, Programmable Logic Controllers (PLCs) and their programming, Control modes: position, velocity, force control, Trajectory planning and interpolation, PID control and other control strategies, Types of manipulators: serial, parallel, and SCARA, Grippers and end-effectors, Machine learning techniques, Artificial Intelligence in Robotics.

Section 4: Micro Manufacturing

Introduction to Micro-manufacturing, Introduction classification, requirement, Methods and processes, µ-manufacturing systems & equipment, Challenges in µ-manufacturing, µ-machining and other challenges, Fundamentals of the micro-/nano-cutting process; Specific energy and cutting force, Minimum chip thickness and chip formation, Ductile mode cutting, Effect of work piece material micro-structure. Introduction to µ-Turning, application, machines, mechanism of material removal, forces in µ-Turning, surface finish, materials for µ-Turning. µ-Grinding, laser micro-bending, micro-deep drawing and micro-extrusion. Micro welding and joining techniques. Micro-fabrication using deposition techniques such as epitaxial, sputtering, chemical vapor deposition (CVD) techniques and Lithography (LIGA) based techniques, Micro-EDM, ECM, Laser processing, Micro-Joining and Assembly Additive Processes, Micro-Metrology, Miniaturized machines and robots, Design for Micro-Manufacturing, Micro-factories, Computer integrated Manufacturing.