# NITTTR Bhopal

# Department of Mechanical Engineering Education

## Syllabus for Ph.D. Entrance Test

## Total marks: 50

### UNIT-1: Engineering Materials

Structure and properties of engineering materials, phase diagrams, heat treatment, and stress-strain diagrams for engineering materials. Modern methods of transportation, structural systems, and manufacturing all rely on innovative alloys and advanced production processes. Mechanical properties of materials include testing both existing and theoretical materials for qualities such as strength, plasticity, and hardness. Current programs range from simulating and modeling a variety of forming operations for metals to studying the wear behavior of composites. Mechanics of Composites, Stress analysis, Theories of failure.

### UNIT-2: Manufacturing Technology

Principles of manufacturing such as casting, forming, welding, welding metallurgy of ferrous and non-ferrous alloys, fundamental principles of industrial welding processes including Solid-State, Laser, Resistance, Electron Beam, and Arc Welding, computational modelling, heat flow, residual stress and distortion, weld design for various loading conditions, and Non-Destructive Testing methods. Friction stir welding and processing, Wire Arc Additive Manufacturing (WAAM), Industry 4.0 & IoT in Welding.

### UNIT-3: Machine Tools and Metrology

Machining and Machine Tool Operations: Mechanics of machining; machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.
**Metrology and Inspection:** Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators and gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM).

### UNIT-4: CAD/CAM and Optimization

CAD/CAM and their integration tools; Geometric modeling; Product lifecycle management; Standardization, simplification, diversification; Additive manufacturing; Production Planning and Control: Forecasting models, aggregate production planning.
**Design Optimization:** Single variable Minimization, Multivariable Unconstrained Optimization, Constrained Optimization, Non-traditional Methods of Optimization.

### UNIT-5: Robotics and Automation

Industrial Robots – configurations, drives and controls; Sensors, actuators, drives and control systems (PID, PLC, SCADA), Microprocessors and embedded systems.