

**TAMIL NADU PUBLIC SERVICE COMMISSION**

**POST OF PRINCIPAL / ASSISTANT DIRECTOR (TRAINING)**

**INCLUDED IN THE TAMIL NADU EMPLOYMENT AND TRAINING SERVICE**

**MANUFACTURING ENGINEERING (DEGREE STANDARD)**

**UNIT 1. ENGINEERING MATERIALS AND METALLURGY**

Constitution of alloys - phase diagrams - Heat treatment : Full annealing-stress relief, Recrystallisation- Spheroidizing, Normalising, Hardening and tempering of steel. Isothermal transformation diagrams- TTT– CCT cooling curves - Hardenability– Austempering, martempering – case hardening, carburizing, nitriding, cyaniding, carbonitriding –flame and induction hardening –vacuum and plasma hardening – thermo-mechanical treatments - properties and applications of ferrous, non ferrous and non metallic materials - nanomaterials and their properties - mechanical properties and testing: Crystal imperfections- Dislocations- Strengthening mechanisms- Elastic, anelastic and viscoelastic behaviour – modulus of elasticity- plastic deformation- Mechanical tests tension, compression, impact, hardness- effect of temperature, grain size , solutes and precipitates on dislocation dynamics – Mechanism of Fracture - mechanism of creep - creep resistant materials- creep tests- fracture toughness- ductile-brittle transition – fatigue fracture-fatigue test.

**UNIT 2. CASTING AND JOINING PROCESSES**

Pattern – core – mould- Melting and pouring - melting practice-fluxing- Degasification and inoculation- types of furnaces –Melting practice – casting processes – sand casting, die casting, centrifugal casting, casting design - special casting processes - Evaporative pattern casting-ceramic mould casting –electro magnetic moulding - squeeze casting –investment casting-shell moulding - Cleaning and inspection of castings – Casting defect and remedies

Welding – Classification of welding – Electric Arc Welding- Equipment – Consumables – processes – Gas Welding – Equipment – Processes – Resistance welding — special welding processes –Plasma arc welding -electron beam welding-laser beam welding-friction welding-ultrasonic welding – diffusion welding-high velocity oxy fuel processes, Soldering and Brazing – Adhesive bonding – Weld design-Welding Inspection – Defects, Causes and Remedies.

### **UNIT 3. FORMING AND SHAPING PROCESSES**

Classification of Forming Processes - Temperature in Metal working - Hot and Cold working - Plastic Deformation - bulk forming processes – Forging, Rolling, Extrusion and rod/wire drawing processes - Effect of friction, calculation of forces, work done - Defects – applications. special forming processes - Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - Rubber pad forming - Water hammer forming- sheet metal forming- cutting, bending, drawing- Fine blanking. H.E.R.F. techniques - Superplastic forming techniques Advantages, limitations and applications. Overview of Powder metallurgy technique - Advantages - applications - Powder preform forging - powder rolling - Tooling and process parameters.

Processing of Plastics and Composites: Types of plastics – Processing of thermo plastics – extrusion moulding, injection moulding, blow moulding, calendaring, film blowing, thermoforming- Bonding of thermoplastics- Processing of thermosets – compression moulding, transfer moulding, injection moulding, – Laminated plastics — Composites- types- Plastic Matrix Composite, Metal Matrix Composite, Ceramic Matrix Composite - Fabrication Methods

### **UNIT 4. MATERIAL REMOVAL PROCESSES AND MACHINES**

Fundamentals of Metal Cutting-Tool geometry- Mechanics of orthogonal and oblique cutting - mechanism of chip formation- Types of chips produced in cutting -Cutting forces - Merchant's circle diagram - Calculations -Cutting temperature – Tool life – cutting fluid- Tool failure modes-wear mechanisms- machinability, Vibration and chatters in machining, cutting tool materials - Machining operations and machine tools

– Lathe- Drilling – Boring- Jig Boring – Shaper – Planer – Broaching - Grinding - Finishing operations - deburring - lapping, honing, burnishing - super finishing operations- Gear cutting methods –Gear finishing methods

## **UNIT 5. CNC MACHINE TOOLS AND NON TRADITIONAL MACHINING PROCESSES**

Introduction to CNC machine tools - Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection - structure of CNC machine tool - guide ways – Friction, Anti friction guide ways, recirculating ball screw, spindle assembly, torque transmission elements, bearings - spindle drives –feed drives – axis measuring system - CNC programming - G & M Codes, manual and CAPP methods- tooling and work holding devices

Need for nontraditional machining processes- classification- Electro discharge machining, Chemical machining, Electro chemical machining, Laser beam machining, Electron beam machining, Plasma arc machining, Abrasive jet machining, Water jet cutting, Ultrasonic machining

## **UNIT 6. METROLOGY AND SURFACE TECHNOLOGY**

Basic concept of measurement – Need, dimensional and form tolerances, Precision and Accuracy - Errors in Measurements – linear and angular measurements – form measurements – straightness, flatness, roundness, surface finish - optical measurements – Coordinate Measuring Machine (CMM), CNC CMM, Computer Aided Inspection (CAI)- machine vision – nano metrology

Surface structure and properties – surface integrity- surface texture – surface roughness – tribology – friction wear and lubrication – surface treatment, coating and cleaning – mechanical surface treatment and coating – case hardening and hard facing, thermal spraying, vapour deposition, ion implantation, diffusion coating- electro plating and electroless plating and electro forming- anodizing- ceramic and organic coating

## **UNIT 7. HYDRAULICS AND PNEUMATICS**

Fluid power systems – Types of fluids- Properties of fluids- Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque - Sources of Hydraulic power: Pumping Theory – Pump Classification - Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves. Hydraulic Circuits: Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control- Pneumatic System: Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Sequential circuit design for simple application using cascade method, Electro pneumatic circuits. Selection criteria of pneumatic components - Hydraulic and Pneumatic power packs.

## **UNIT 8. MECHATRONICS**

8085 Microprocessor- Architecture -Pin Configuration- Timing Diagram and programming- Peripherals and interfacing - Basic interfacing concepts-8255 Programmable Peripheral Interface- interfacing input keyboards- interfacing output display-interfacing memory-A/D and D/A Converters – Interfacing - 8051 Microcontroller - Architecture of 8051- Pin configuration- Ports- External Memory- counters and Timers- Serial and Parallel Data I/O- Interrupts – Assembly language programming - Applications using Intel 8085 and 8051- Temperature Control- Stepper Motor Control- Traffic Light Controller. Measurement and speed control of DC motor - sensors and transducers - Potentiometers-LVDT-Capacitance sensors- Strain gauges- Eddy current sensor-Hall effect sensor- Temperature sensors- Light sensors- Selection of sensors- Signal processing - motion control and measurement system - Control system- Open Loop and Feedback Control-Measurement system-Drives and actuators-Control devices- Servo systems- Motion converters - Programmable Logic Controllers - Basic structure- Input and output processing- Programming- Mnemonics- Timers, counters and internal relays- Data handling-Selection of PLC

## **UNIT 9. PRODUCTION MANAGEMENT**

Types of production System -Production Planning and Control - Functions of production planning and control –Forecasting – methods of forecasting –aggregate planning-material requirement planning - Concepts –Master production Schedule – Bill of Materials, Inventory Record File – MRP Logic – Capacity requirement Planning – Manufacturing Resource Planning (MRP II) – Computer Aided Process Planning - Need for process planning – Functions of process planning – approaches to CAPP – variant, generative and automatic- Expert process planning system - Shop Floor Control - Functions of shop floor control – order scheduling – order progress – Data logging and acquisition – Automated data collection – Control types – Sensor Technology.

## **UNIT 10. MANUFACTURING SYSTEMS**

Group Technology – classification and coding of parts- Production Flow Analysis- Cellular manufacturing - Flexible manufacturing system – elements – workstations, material handling system, computer control system- Enterprise Resource Planning (ERP)- Just in Time (JIT) – Lean manufacturing – TQM principles – continues process improvement – 5s, kaizen – TQM tools and techniques – six sigma, FEMA, quality circles, quality circle deployment, Taguchi technique, TPM – concepts, improvement need, cost of quality, performance measure- Quality systems – need, elements, documentation, quality auditing - concepts, requirements and benefits.