SYMBIOSIS INTERNAITONAL (DEEMED UNIVERSITY)
Ph D ENTRANCE TEST

The Syllabus of Mechanical Engineering

DESIGN

1. Types of simple stresses, principal stresses, compound stresses in machine parts, stress-strain relationship**, stress concentration factor**
2. Static loading, theories of failures, allowable stress, factor of safety, Fluctuating stresses, fatigue failure, endurance limit, fatigue strength, modified Goodman diagram, Gerber line, Soderberg line, **design for combined fatigue loading**
3. **Shafts: s**tatic loading: stresses, design principle, types and uses of key, design of keys.
4. Couplings: Types and uses, design of rigid and flexible couplings, Introduction to design of helical springs, design of helical springs for variable load, design of leaf springs
5. Multi disk clutches, cone clutches, centrifugal clutches, block brake, internal expanding brake, band brake, disc brake ,solid disk flywheel, rimmed flywheel, Analysis of belt tension, condition of maximum power, flat belts, v-belts, chain drives, Helical spring design
6. Spur, Helical, Bevel gear design, Force analysis, Beam strength of gears, Cylinders and pressure vessels design, Thin cylinders, thick cylinders, cylindrical and spherical shells

MANUFACTURING TECHNOLOGY

1. METAL CUTTING THEORY AND PRACTICE

   Geometry of single-point cutting tool: Tool-in hand system, ASA system, Significance of various angles of single point cutting tools, Orthogonal Rake System (ORS), Conversions between ASA and ORS systems, Normal Rake System (NRS) & relation with ORS. Orthogonal and Oblique cutting, Mechanics of Chip formation: Types of chips, chip-breakers, Chip reduction coefficient, shear angle, shear strain, Built-Up-Edge and its effect in metal cutting.
2. ADVANCED MANUFACTURING PROCESSES

   Introduction to solid state welding processes, Advantages and applications and imitations, Classification of solid state welding processes and describe each processes ,friction welding processes, advantages ,limitations and applications, processes parameters, Friction welding of similar and dissimilar metals, Friction stir welding process. Introduction forming processes, advantages ,limitations and applications, Vacuum forming and hydro forming, advantages and applications.
3. MICRO AND NANO MANUFACTURING

   Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nanotechnology. Methods for creating Nanostructures; Processes

for producing ultrafine powders- Mechanical grinding; Wet Chemical Synthesis of nanomaterials- sol-gel process.

4. MANUFACTURING MANAGEMENT

   Introduction, Historical perspective of manufacturing management, Competitive priorities and operational strategy, Functional area strategy and Capability, Case Study. Quantitative Methods introduction, Time series and moving averages method, Exponential Smoothing method, Regression Analysis Method, Qualitative Methods. Introduction and History, Product design and process selection, Capacity planning, Plant location and Plant layout.

5. PRODUCT DESIGN FOR MANUFACTURING AND ASSEMBLY

   How Does DFMA Work?, Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry. General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency.

6. FLEXIBLE MANUFACTURING SYSTEMS

   Evolution of Manufacturing Systems, FMS: Definition, objective and Need, FMS: components, Merits, Demerits and Applications, Flexibility in Pull and Push type. FMS: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc. Processing stations- Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station. Material Handling System Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS).

   Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, FMS: Configuration planning and routing, FMS: Production Planning and Control.

THERMAL ENGINEERING SYLLABUS

1. Thermodynamics- Laws of thermodynamics, thermodynamic system and processes, behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.
2. Heat Transfer- Modes of heat transfer, steady & unsteady heat conduction, dimensionless parameters in free and forced convective heat transfer, thermal boundary layer; effect of turbulence; radiative heat transfer, heat exchanger performance, LMTD and NTU methods.
3. Fluid mechanics- Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy, differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

4. Power Plant Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat.
5. I.C. Engines: air-standard Otto, Diesel and dual cycles.
6. Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes.
7. Turbo machinery: Pelton-wheel, Francis and Kaplan turbines - impulse and reaction principles, velocity diagrams. Centrifugal, Reciprocating pumps and compressor.

OPTIMIZATION TECHNIQUES SYLLABUS

Need of Optimization, problem formulation, feasibility and infeasibility, continuous, discrete, combinatorial optimization problem concepts, convexity, unimodal and multimodal functions, Single Variable optimization: Bracketing Methods, Region-elimination methods, Gradient based methods for Single variable and Multi-variable optimization, constraint handling using penalty function method and feasibility-based methods.