SYLLABUS
PH.D. ENTRANCE EXAM 2018-19
MECHANICAL ENGINEERING DEPARTMENT

SECTION-I
APPLIED MECHANICS AND DESIGN

Engineering Mechanics: Free body diagrams and equilibrium, trusses and frames, virtual work, kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations, impact.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms, dynamic analysis of slider-crank mechanism, gear trains, flywheels, bearings, governors, static & dynamic balancing of rotors.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping, vibration isolation, resonance, critical speeds of shafts.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders, shear force and bending moment diagrams, bending and shear stresses, deflection of beams, torsion of circular shafts, Euler's theory of columns, strain energy methods, thermal stresses. Strain gauges and rosettes, testing of materials with universal testing machine, testing of hardness and impact strength.

Design: Design for static and dynamic loading, failure theories, principles of the design of machine elements such as shafts, spur gears, rolling and sliding contact bearings, brakes, clutches and various joints.

SECTION-II
FLUID MECHANICS AND THERMAL SCIENCES

Fluid Mechanics: Fluid properties, fluid statics, manometry, buoyancy, control-volume analysis of mass, momentum and energy, fluid acceleration, 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.

Heat-Transfer : Modes of heat transfer, one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins, dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes, thermal boundary layer, effect of turbulence, radiative heat transfer, black and grey surfaces, shape factors, network analysis, heat exchanger performance, LMTD and NTU methods.

Thermodynamics: Zeroth, First and Second laws of thermodynamics, thermodynamic system and processes, Carnot cycle, irreversibility and availability, 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.

SECTION - III
PRODUCTION ENGINEERING AND MANUFACTURING TECHNOLOGY

Metal Casting: Design of patterns, moulds and cores, solidification and cooling, riser and gating design, design considerations.

Forming: Plastic deformation and yield criteria, fundamentals of hot and cold working processes, load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes, principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering, adhesive bonding, design considerations in welding.

Machining and Machine Tool Operations: Mechanics of machining, 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, principles of design of jigs and fixtures, Non-conventional machining.

SECTION - IV
INDUSTRIAL ENGINEERING

Operation Management: Forecasting models, aggregate production planning, scheduling, materials requirement planning. Inventory Control: Deterministic and probabilistic models, safety stock inventory control systems.

Operations Research: Linear programming, simplex and graphical method, transportation model, assignment model, network flow models, simple queuing models, PERT and CPM.

Basic concepts of CAD, CAM and CNC programming.

SECTION -V
REFRIGERATION AND ENERGY SYSTEM

Refrigeration and air-conditioning: Refrigeration system, expansion devices, condensers and evaporators, Psychrometric chart, Vapor Absorption system, Humidefication, Dehumedification, Adiabatic mixing, Multistage multi evaporation system, Three fluid absorption system, Solar refrigeration system.

Energy Conversion System: Basic cycles related to energy conversion systems, Combined cycle, Cogeneration system, Steam generator, Steam turbine, Gas turbines, Nuclear power plant, Hydroelectric plant.

Non-Conventional Energy Sources: Solar energy system, Solar power plant, Wind, Tidal, Wave and Geothermal energy, Energy from Biomass and Biofuels.