

DEPARTMENT OF MECHANICAL ENGINEERING SYLLABUS OF ENTRANCE TEST FOR Ph.D. (MECHANICAL ENGG.)

SECTIONA: RESEARCH METHODOLOGY (50%)

Introduction to Research Methodology: meaning, objectives, types, significance .Research Process. Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Research Problem: Alternative approaches to the study of the research problem and problem formulation. Formulation of hypotheses, Feasibility, preparation and presentation of research proposal. Research Design: measurement scales, features, types, experimental designs. Types of sample designs. Data Collection: primary and secondary data, validation. Processing and Analysis of data: processing operations and problems, types of analysis, use of statistical measures in analysis (mean, median, mode, standard deviation, variance, degree of freedom). Introduction to statistical analysis: Probability and probability distributions; binomial, Poisson, exponential and normal distributions and their applications. Sampling: fundamentals, types, distributions, sampling theory, sample size determination. Basic Principles of design of experiments, completely randomized, randomized block designs, factorial, Taguchi and RSM designs. Edition, tabulation. Correlation, regression and testing of Hypothesis: procedure, parametric tests-z-test, t-test, chi-square test, F-test. Analysis of variance. Interpretation: meaning, need, technique, precaution. Presentation: Report Writing, Types of reports, Oral presentation. Use of software for statistical analysis: SPSS, Minitab's. Ethical Practices in Research.

SECTIONB: MECHANICAL ENGINEERING (50%)

Materials Technology: Introduction to material science & engineering, classification and properties of materials, crystal geometry and structure determination. Fundamental mechanical properties creep, fatigue and fracture processes .Factors affecting mechanical properties. Destructive and non-destructive testing of materials .Metals & Alloys: Ferrous and non ferrous metals, alloy system, solid solutions, Phase diagram, phase transformation, iron-carbon system, TTT diagram, Heat treatment of plain carbon steels, low alloy steels, stainless steel, Al alloys, Cu alloys. Ceramic Materials, Simple ceramic crystal structure, silicate structure, mechanical properties of ceramics. Polymer Materials, classification, mechanical properties of polymers, reinforced polymers ,manufacturing processes of polymers . Nano Structural Materials: Production methods for Carbon Nano Tubes (CNT), Properties of CNT, Advantages of Nano-materials. Composite Materials: Introduction, Characteristics of particles, reinforced and fibre reinforced composites. Deterioration of Materials: Oxidation and Corrosion, Corrosion control and corrosion resistance of alloys.

Non Traditional Machining Processes: Distinction between traditional and non-traditional machining. An Overview, need, classification, features and applications of non-traditional machining processes .Elements of process, equipment, mechanism of metal removal, process parameters, applications, limitations for following non traditional machining processes: Abrasive jet machining, Ultrasonic machining, Water jet machining, Abrasive Water Jet Machining, Electro chemical machining, Electro chemical grinding ,electro chemical deburring ,Electrochemical honing ,Chemical machining, photo-chemical machining, Electric Discharge Machining, Plasma Arc Machining, Laser Beam machining, Electron Beam Machining. Hybrid Machining Processes: concept, classification, applications and Advantages.

Welding Technology: Classification of welding processes, weldability, metallurgy of fusion welds, solidification mechanism, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of microstructures and properties of

weld metal .Heat affected zone, re-crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals. Welding Power Sources, Arc welding power sources, AC/DC welding power source, DC rectifiers. Manual metal arc welding, GTAW, GMAW, FCAW and CO₂ welding processes, plasma arc, submerged arc welding, electro gas and electro slag welding, analysis of the process. Electrode coatings of electrodes for SMAW, SAW fluxes. Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effect of polarity on metal transfer and melting rate .Theory and mechanism of solid state welding. Techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding .High energy rate welding .Electron beam and laser welding processes.

Metal Forming: Stress-strain relations in elastic and plastic deformation; concept of flow stress, deformation mechanisms; hot and cold working - forging, rolling, extrusion, wire and tube drawing; sheet metal working Processes, analysis of rolling, forging, extrusion and wire /rod drawing; metal working defects.

Metrology and Inspection: Limits, fits, and tolerances, interchangeability, selective assembly; linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry; surface finish measurement; inspection of screw threads and gears; alignment testing of machine tools.