

DEPARTMENT OF MECHANICAL ENGINEERING
SYLLABUS OF ENTRANCE TEST FOR Ph.D. (MECHANICAL ENGG.)
(Session- 2020-2021)

SECTION-A
(RESEARCH METHODOLOGY)

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, Minitabs. Ethical Practices in Research, Plagiarism in research.

SECTION-B
(MECHANICAL ENGINEERING)

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.

Computer Aided Design & Manufacturing: Introduction to conventional and computer aided design / manufacturing environments. Need for networking and introduction to different types of computer

networks. Direct NC, CNC and Distributed NC, NC part programming for 2D motion. Group Technology - methods of part family formation. Computer Aided Process Planning. Automatic data collection systems for shop floor control. Operating principles of some commonly used sensors and actuators.

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 nontraditional machining processes: Abrasive jet machining, Ultrasonic machining, Water jet machining, Abrasive Water Jet Machining, Electrochemical machining, Electrochemical grinding, electrochemical 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.

Industrial Automation And Robotics: Concept of automation in industry, mechanization and automation, classification of automation systems. Difference between hard automation and robotic automation. Air cylinders –their design and mounting; pneumatic and hydraulic valves- flow control valves, metering valves, direction control valves, hydraulic servo systems; pneumatic safety and remote control circuits. Basis of automated work piece handling- working principles and techniques, job orienting and feeding devices. Transfer mechanisms- automated feed cut of components, performance analysis. Assembly automation, automated packaging and automatic inspection. Introduction to robot technology- robot physical configuration and basic robot motions. Types of manipulators- constructional features, servo and non servo manipulators. Feedback systems and sensors- encoders and other feedback systems, vision, ranging systems, tactile sensors. Concept of spatial desecrations and transformations, manipulator kinematics, Inverse manipulator, Kinematics Jacobians, Velocity and static forces, manipulator dynamics

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, thyristor controlled rectifiers, transistorized units, and inverter systems. 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. Under water welding.