

DEPARTMENT OF MECHANICAL ENGINEERING

Punjabi University, Patiala 147002
(Established under Punjab Act No. 35 of 1961)

Syllabus for Ph. D. Entrance Test for Session 2024-25

**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, 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.

Ethical Practices in Research, Plagiarism in research.

**Section-B
(Subject)**

Materials Technology: Classification and properties of engineering materials; Crystal structure and its determination using X-Ray diffraction technique; Fundamental mechanical properties; Creep, Fatigue and Fracture processes; Destructive and non-destructive testing of materials; Iron-carbon equilibrium phase diagram; TTT & CCT diagrams; Heat treatment of steels; Ceramic materials: Classification, properties and structures (chain and sheet structures); Carbon Nanotubes (CNTs): Introduction, classification, synthesis, properties and applications; Composite materials: Introduction, classification, properties and applications; Corrosion and Oxidation; Prevention and control of corrosion.

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 ; Overview, need, classification, features and applications of non-traditional machining processes; Elements of process, equipment, mechanism of metal removal, process parameters, applications, limitations non-traditional machining processes (Abrasive jet machining, Ultrasonic machining, Water jet machining, Abrasive water jet machining,

Electrochemical machining, 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 and survey of welding processes; Weld ability; 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; Welding power sources; Arc welding power sources; Arc welding consumables; Manual metal arc welding, GTAW, GMAW, FCAW; Scope of friction welding; Electron beam, Plasma arc, Submerged arc and Laser welding processes.

Thermodynamics: Basic concepts and definitions; Properties of gas and pure substance; First law for closed system; Application of steady state flow process; Second law of thermodynamics; Thermodynamic system and processes; Irreversibility; Carnot cycle, Otto cycle, Diesel cycle, Rankine cycle, Brayton cycle; Steam Generators; Boiler mountings and accessories; Steam turbines.