# Syllabus for Ph.D. Entrance Test in Mechanical Engineering

## SECTION-I: Research Methodology

∗The syllabus of Research Methodology will be common for all the subject except Law

| Syllabus | |
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| **Introduction to Research**: The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research, Meaning and types of Research hypothesis, Importance of Review of Literature, Organizing the Review of Literature. | |
| **Types of Research**: Types of research, pure (basic, fundamental) and applied research, qualitative and quantitative. | |
| **Research Design**: Meaning, need, types of research design – Exploratory, Descriptive, Casual research Design, Components of research design, and Features of good Research design. Experiments, surveys and case study Research design. | |
| **Sampling, Data Collection and analysis**: Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties. Statistical Methods for Data Analysis : Applications of Statistics in Research, measures of central tendency and dispersion | |
| **Research Report**: Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Thesis and dissertations. components of thesis and dissertations. Referencing styles and bibliography. | |
| **Ethics in Research** - Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher. | |
| **ICT Tools for Research**: Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools. **Web search**: Introduction to Internet, use of Internet and WWW, using search engines and advanced search tools. | |

## RECOMMENDED BOOKS

| 1 | Donald Cooper and PS Schindler (2009) | Business Research Methods, 9th edition, Tata McGraw Hill. |
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| 2 | Kothari C. R | Research Methodology |
| 3 | Uma Sekaran (2010) | Research Methods for Business, 4th edition, Wiley. |
| 4 | Ranjit Kumar (2009) | Research Methodology, 2nd edition, Pearson Education |
| 5 | Naresh Malhotra and S Dash (2009) | Marketing Research, 5th edition, Pearson Prentice Hall. |
| 6 | Michael V. P | Research Methodology. |
| 7 | Fred N. Kerlinger : | Foundations of Behavioral Research. |

## SECTION-II: Mechanical Engineering

| | Topics covered |
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| UNIT-I | **Probability & Statistics**<br>Measures of Central Tendency, Mean, Median, Mode, Measures of Variation, Range, Population Variance and Standard Deviation, Sample Variance and Standard Deviation, Variance and Standard Deviation for Grouped Data, Probability Distributions, Variance, Standard Deviation, and Expectation, The Binomial Distribution, Poisson Distribution, Normal Distributions, The Standard Normal Distribution. Practical examples based on these distributions. |
| UNIT-II | **Numerical Methods**<br><u>Roots of Equations</u>: Significant figures, Accuracy and Precision, Error definition, Round-Off errors, Truncation error, Total numerical error. Bracketing methods-Bisection and False position method. Open methods, Newton-Raphson method<br><u>Linear Algebraic Equation</u>: Navie-Gauss elimination, pitfalls of Gauss Elimination, techniques of improving solutions.<br><u>Numerical differentiation and Integration</u>: Trapezoidal rule, Simson's rules, integration with unequal segment, multiple integral, derivatives of unequally spaced data<br><u>Ordinary Differential Equations</u>: Euler's method, improvement of Euler's method, Runge-Kutta method, system of equations. |
| UNIT-III | **Manufacturing Engineering**<br><u>Principles of metal cutting</u>: Mechanics of chip formation; Geometry of cutting tools and tool signatures; Orthogonal and oblique cutting; Metal cutting models: Merchant model, Lee-Shaffer model, Oxley model; Forces in metal cutting; Tribology in metal cutting; Surface roughness in machining; Thermal aspects of machining; Tool wear, tool life, tool materials, tool coatings and coating techniques; Economics of machining; Machinability; Cutting fluids: properties, types, application techniques. |
| UNIT-IV | **Thermal Engineering**<br><u>Fluid Mechanics</u>: The continuity equation, Stream function for uniform stream, two dimensional flow past solid bodies, velocity functions. Limiting cases of small viscosity, exact solution, theory of hydrodynamic lubrication.<br><u>Heat Transfer</u>: Steady and transient Conduction, Principle of Fluid flow and Convective heat transfer. Concept of velocity and thermal boundary layers, Navier-Stokes equations and convection equation, Boundary layer approximations. |
| UNIT-V | **Design Engineering**<br><u>Vibration:</u> Basic concepts, Free vibration of single degree of freedom systems with and without damping, forced vibration of single DOF-systems, Natural frequency., Transient Vibration of single Degree-of freedom systems.<br><u>Failure due to Fatigue:</u> High cycle and low cycle fatigue, Fatigue design models, Fatigue testing, Fatigue mechanisms, General S-N behavior, Factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach, Modes of mechanical failure, Review of failure theories for ductile and brittle materials |
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| **Text Books/References:** | |
| 1. | Allan G. Bluman, Elementary Statistics A Step by Step Approach, McGraw-Hill. |

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| 2. | Numerical methods for engineers / Steven C. Chapra, Raymond P. Canale |
| 3. | Fundamentals of Machining and Machine Tools, G. Boothroyd and W. A. Knight, CRC-Taylor and Francis, 2006 |
| 4. | Fluid Mechanics. FM White. Boston: McGraw-Hill Book Company |
| 5. | Fundamentals of Heat and Mass Transfer-5th Ed. Frank P. Incropera. John Wiley |
| 6. | Heat Transfer. J.P Holman McGraw-Hill Book Company |
| 7. | Mechanical Vibration. G. K. Grover |
| 8 | Design of Machine Elements V. B. Bhandari |