

# Bharati Vidyapeeth Deemed University

Faculty of Engineering and Technology

Revised Structure of Ph. D. Coursework

Mechanical Engineering

(With effect from Academic Year 2017-18)

Sr. No.	Subject	Teaching Scheme		Examination Scheme (marks)			Credits
		L	P/D	Theory Examination	Presentations	Total	
1	Paper –I: Research Methodology	4	-	100	-	100	04
2	Paper- II: Advances in Mechanical Engineering	4	-	100	-	100	04
3	i) Literature survey presentation	-	02	--	50	50	02
	ii) Presentation of idea of research*	-	02	--	50	50	02
<b>Total</b>		<b>08</b>	<b>04</b>	<b>200</b>	<b>100</b>	<b>300</b>	<b>12</b>

Note: \*- The student will have to give presentation based on the literature survey and idea of research and shall submit copy of the presentation to the respective Head of the Constituent Unit which is his/her place of research.

**BHARATI VIDYAPEETH DEEMED UNIVERSITY  
FACULTY OF ENGINEERING AND TECHNOLOGY**

**Ph.D. Course-work Syllabus for Mechanical Engineering**

<b>Paper-I: Research Methodology</b>		
<b><u>TEACHING SCHEME:</u></b>	<b><u>EXAMINATION SCHEME:</u></b>	<b><u>CREDITS ALLOTTED:</u></b>
Lectures: 4 Hours/Week	Theory Examination: 100 Marks	Total Credits: 04
	Duration : 3 Hrs	
<p><b>Course Objectives:</b></p> <ul style="list-style-type: none"> <li>• begin to formulate researchable problem in areas of research interest;</li> <li>• write a research proposal or report;</li> <li>• make appropriate choices about research strategies;</li> <li>• review literature judiciously and systematically;</li> <li>• understand and begin to apply the principles of collecting suitable data;</li> <li>• understand and begin to conduct appropriate analyses of data;</li> <li>• make appropriate choices about quantitative methods;</li> <li>• demonstrate sensitivity to ethical issues raised by researchers;</li> </ul>		
<b>Topics Covered</b>		
<b>UNIT-I</b>	<p><b>Types and Characteristics of Research</b>            Definition and objectives of research, Characteristics of research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Overview of research methodology in various areas of engineering, Introduction to problem solving, basic research terminology such as proof, hypothesis, lemma etc., Role of information and communication technology (ICT) in research.</p>	<b>(6 Hours)</b>
<b>UNIT-II</b>	<p><b>Review of Literature</b>            Importance of literature review in defining a research problem, sources of literature, identifying the gap areas from the literature review            Searching for publications: Publication databases, search engines and patent databases etc.</p>	<b>(6 Hours)</b>
<b>UNIT-III</b>	<p><b>Research Problem Formulation</b>            Research problem formulation, determine the scope, objectives, limitations and assumptions of the identified research problem, justify basis for assumption, developing the objectives            Developing a research plan: Exploration, description, diagnosis and experimentation</p>	<b>(6 Hours)</b>
<b>UNIT-IV</b>	<p><b>Methods of Data Collection</b>            Static and dynamic characteristics of instruments used in experimental set up, calibration of various instruments, sampling methods, various methods of data collection, selection of appropriate method for data collection, data</p>	<b>(6 Hours)</b>

	collection using a digital computer system, case studies of data collection.	
<b>UNIT-V</b>	<b>Inferential Statistics and Hypothesis Testing</b> Data processing, data analysis strategies and tools, Basic concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation, Hypothesis testing: Z-test, T-test, Chi Square test, Analysis of variance ( ANOVA) etc.	<b>(6 Hours)</b>
<b>UNIT-VI</b>	<b>Quantitative Methods and Applied Statistics</b> Measurement of central tendency and dispersion, Probability distribution, Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, moments and response curve methods, probable errors in research, error analysis, Hidden Markov Model ( HMM)	<b>(6 Hours)</b>
<b>UNIT-VII</b>	<b>Computer Applications</b> Role of computers in research, maintaining literature data using software tools such as Mendeley, Endnote2 etc., tabulation and graphical presentation of research data, use of statistical software tools such as Excel, R, SPSS, GRETL, MINITAB etc. in research, use of word processing tools such as Latex, software tools for making effective presentation.	<b>(6 Hours)</b>
<b>UNIT-VIII</b>	<b>Developing Research Report:</b> Structure and components of scientific reports, types of report, developing research report. <b>Thesis Writing:</b> Different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes. <b>Oral Presentation:</b> Creating and making effective presentation, use of visual aids, importance of effective communication.	<b>(6 Hours)</b>
<b>UNIT-IX</b>	<b>Research Ethics and IPR</b> <b>Ethics:</b> ethical issues in research, plagiarism tools and its importance. <b>IPR:</b> intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights.	<b>(6 Hours)</b>
<b>UNIT-X</b>	<b>Publishing of research work</b> Design of conference and journal research paper, design of review paper, effective way of writing abstract, introduction, result and discussion and conclusion in research papers, answering the queries of reviewers. Importance of publication in standard databases such as Scopus, Web of science etc., understanding of h-index, citation index and impact factor.	<b>(6 Hours)</b>
<b>Text Books/References:</b>		
1.	Wayne Goddard, Stuart Melville, Research Methodology: An Introduction, Juta and Company Ltd, 2004	
2.	Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, SAGE publications	

	Ltd., 2011.
3.	C. R. Kothari ,Research Methodology: Methods and Trends, New Age International, 2004
4.	S.D. Sharma , Operational Research, Kedar Nath Ram Nath & Co.,1972
5.	B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.
6.	Donald Cooper, Pamela Schindler, Business Research Methods, McGraw-Hill publication, 2005.
7.	T. W. Anderson, An introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt. Ltd. New Delhi.
8.	A. Fink, Conducting Research Literature Reviews: from the internet to paper, Sage Publications, 2009
9.	R. A. Day, How to write and publish a scientific paper, Cambridge University Press, 1992

**Paper-II Specific Subject: Advances in Mechanical Engineering**

<b><u>TEACHING SCHEME:</u></b>	<b><u>EXAMINATION SCHEME:</u></b>	<b><u>CREDITS ALLOTTED:</u></b>
Lectures: 4 Hours/Week	Theory Examination: 100 Marks	Total credits: 04
	Duration : 3Hrs.	

<b>Topics covered</b>		
<b>UNIT-I</b>	<p><b>Optimization Methods</b>                      Basic Concepts of Optimization- Convex and Concave Functions, Necessary and sufficient conditions for Stationary Points.                      Single Variable Optimization: Optimum problem formulation, Optimality Criteria, Bracketing methods, region-Elimination method,                      Multivariable optimization: Optimality criteria, Unidirectional search, Direct search method- Evolutionary optimization, Simplex search.</p>	<b>(06 Hours)</b>
<b>UNIT-II</b>	<p><b>Measurement Techniques</b>                      Strain measurement: Theory &amp; classification of strain gauges, Load cell and there types, Gauge factor, Temperature compensation, Wheatstone bridge circuit.                      Temperature measurement: Resistance Temperature Detector (RTD), Thermocouples &amp; Laws of thermocouples, Resistance thermometers &amp; Thermistors, Optical pyrometers.                      Pressure measurement: Diaphragm pressure gauge, Bourdon tube, Bellows, McLeod Gauge, Piezoelectric sensor, Tactile sensor.                      Flow measurement: Hot wire anemometer, Thermal flow meters, Electromagnetic flow meter, Ultrasonic flow meter, Turbine meter.                      Data Acquisition System (DAS) and FFT analyzer.</p>	<b>(06 Hours)</b>
<b>UNIT-III</b>	<p><b>Design of Experiments</b>                      One factor at a time model, Fixed effects model, Estimation of the model parameters, Model adequacy checking, The normality assumption, Two-Factor factorial design, The general factorial design. Fractional factorial design. Response surface methodology. Taguchi method.</p>	<b>(06 Hours)</b>
<b>UNIT-IV</b>	<p><b>Uncertainty Analysis in Experiments</b>                      Errors in instruments, Analysis of experimental data and determination of overall uncertainties in experimental investigation, Uncertainties in measurement of parameters like pressure, temperature, flow etc. under various conditions. Estimation of uncertainty by Partial Differentiation Method (PDM), Combining uncertainty components. Student's t-test method.</p>	<b>(06 Hours)</b>
<b>UNIT-V</b>	<p><b>Computer Aided Design</b>                      Geometric transformations-2D and 3D translation, Scaling, Rotation, Shear and reflection, Homogeneous transformations. Types of mathematical representation of curves, Wire frame models, Wire frame entities. Parametric representation of synthetic curves, Hermit cubic splines, Bezier curves.                      Surface Modeling: Mathematical representation surfaces, Surface model, Surface entities surface representation Parametric representation of surfaces, Plane surface, Rule surface, Surface of</p>	<b>(06 Hours)</b>

	revolution, Tabulated cylinder.	
<b>UNIT-VI</b>	<b>Fatigue Failure</b> 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 including Mohr's theory and modified Mohr's theory, Yield surface for Isotropic materials	<b>(06 Hours)</b>
<b>UNIT-VII</b>	<b>Composites</b> Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Inter-phases, Distribution of constituents, Composites Fabrication, Fracture & Safety of Composite and Introduction to Nanotechnology, Manufacturing and Characterization of Nano-composites.	<b>(06 Hours)</b>
<b>UNIT-VIII</b>	<b>Advanced Machining Processes</b> Theory and Numerical analysis of abrasive jet machine, Abrasive flow machining, Ultrasonic machining, Electrical Discharge Machining(EDM), Electro Chemical Machining, Electro Chemical Discharge Machining (ECDM) , Vibro ECDM, Dry and Near dry EDM, thermal Energy Methods material pressing, LASER machining, Electron Beam Machining, Plasma arc machining, Physical vapour deposition and chemical vapour deposition, high energy rate forming and Electroforming.	<b>(06 Hours)</b>
<b>UNIT-IX</b>	<b>Advanced Thermodynamics</b> Equation of State, Equation of state for real gases, generalized Compressibility chart, Law of corresponding states, Properties of Pure Substances, Phase change process of pure substances, PVT surface, P-V&P-T diagrams, Laws of thermodynamics, Increase of entropy principle, T-ds relations and entropy generation.	<b>(06 Hours)</b>
<b>UNIT-X</b>	<b>Advanced Heat Transfer &amp; Introduction to CFD</b> Analytical solutions for temperature distribution, Problems related to anisotropic materials, Transient conduction, Principle of fluid flow and Convective heat transfer. Concept of velocity and thermal boundary layers, Boundary layer approximations and special conditions. Introduction to CFD: Governing equations, Hyperbolic, Parabolic & Elliptic systems; Numerical methods such as Finite difference, Finite volume, upwind and down-wind schemes. Implicit and explicit methods. Properties of numerical solutions (Consistency, Stability, Conservation, Convergence and Accuracy).	<b>(06 Hours)</b>

**Text Books/References:**

1	Kumar D. S., Mechanical Measurement & Control, Metropolitan Book Co. Pvt. Ltd. New Delhi, 2007
2	Deb Kalyanmoy, Optimization for Engineering Design: Algorithms and Examples, PHI Learning Pvt. Ltd., 2004
3	Hume K. J., Engineering Metrology, Macdonald, 1950
4	Beckwith T. G., Marangoni R. D., Lienhard J. H., Mechanical Engineering Measurements,

	Pearson Prentice Hall, 2007
5	Montgomery Douglas C., Design and analysis of experiments, Wiley, 2008
6	Zeid Ibrahim & Siva subramanian R., CAD/CAM Theory and Practice by, Tata Mc Graw Hill international.
7	Chandrupatla Tirupathi K. and Belegundu Ashok D., Introduction to finite elements in engineering
8	Gokhale Nitin S., Deshpande Sanjay S., Bedekar Sanjeev V and Thite Anand N., Practical Finite Element Analysis. Finite to Infinite, Pune.
9	Boothroyd G. and Knight W. A., Fundamentals of Machining and Machine Tools, CRC-Taylor and Francis, 2006
10	K. S. Fu, R. C. Gonzalez and Lee C.S.G., ROBOTICS: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
11	B. K. P. Horn, Robot Vision, MIT Press, Cambridge, 1986.
12	Koren Y., Robotics for Engineers, McGraw Hill, 1985.
13	Mechatronics, HMT, Tata McGraw-Hill, New Delhi, 1988.
14	Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, New Delhi, 1994.
15	Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 1999.
16	John D. Anderson., Jr., Computational Fluid Dynamics-The Basics with applications, McGraw-Hill, Inc. New York.
17	Frank P. Incropera., <u>David P. DeWitt.</u> , Fundamentals of Heat and Mass Transfer-5 <sup>th</sup> Ed.. John Wiley
18	Holman J. P., Heat Transfer. McGraw-Hill Book Company
19	Thermodynamics. Sonntag & Van Wylen. John Wiley & Sons
20	Thermodynamics for Engineers/Doolittle-Messe / John Wiley & Sons
21	Murty, B. S., et al. Textbook of nanoscience and nanotechnology. Springer Science & Business Media, 2013.
22	Kaw, Autar K. Mechanics of composite materials. CRC press, 2005.

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-5 <sup>th</sup> 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