

Bharati Vidyapeeth University
College of Engineering
Department of Chemical Engineering

Part 1

Structure of Ph. D. Coursework

Bharati Vidyapeeth Deemed University
Faculty of Engineering and Technology
Structure of Ph. D. Coursework
(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 Chemical Engineering	4	-	100	-	100	04
3	i) Literature survey presentation	-	02	-	50	50	02
	ii) Presentation of idea of research*	-	02	-	50	50	02
Total		08	04	200	100	300	12

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.

Part 2

Paper I

Research Methodology

BHARATI VIDYAPEETH DEEMED UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY

Ph.D. Course-work Syllabus

Paper-I

Research Methodology

<u>TEACHING SCHEME</u>	<u>EXAMINATION SCHEME</u>	<u>CREDITS ALLOTTED</u>
Lectures: 4 Hours/Week	Theory Examination: 100 Marks	Total Credits: 04
	Duration : 3Hrs	
Topics Covered		
UNIT-I	<p>Types and Characteristics of Research</p> <p>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>	(6 Hours)
UNIT-II	<p>Review of Literature</p> <p>Importance of literature review in defining a research problem, sources of literature, identifying the gap areas from the literature review</p> <p>Searching for publications: Publication databases, search engines and patent databases etc.</p>	(6 Hours)
UNIT-III	<p>Research Problem Formulation</p> <p>Research problem formulation, determine the scope, objectives, limitations and assumptions of the identified research problem, justify basis for assumption, developing the objectives</p> <p>Developing a research plan: Exploration, description, diagnosis and experimentation</p>	(6 Hours)
UNIT-IV	<p>Methods of Data Collection</p> <p>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 collection using a digital computer system, case studies of data collection.</p>	(6 Hours)

UNIT-V	Inferential Statistics and Hypothesis Testing 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.	(6 Hours)
UNIT-VI	Quantitative Methods and Applied Statistics 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)	(6 Hours)
UNIT-VII	Computer Applications 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.	(6 Hours)
UNIT-VIII	Developing Research Report: Structure and components of scientific reports, types of report, developing research report. Thesis Writing: 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. Oral Presentation: Creating and making effective presentation, use of visual aids, importance of effective communication.	(6 Hours)
UNIT-IX	Research Ethics and IPR Ethics: ethical issues in research, plagiarism tools and its importance. IPR: 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.	(6 Hours)
UNIT-X	Publishing of research work 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.	(6 Hours)

	Importance of publication in standard databases such as Scopus, Web of science etc., understanding of h-index, citation index and impact factor.	
Text Books/References:		
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	

Part 3
Paper- II
Advances in Chemical Engineering

BHARATI VIDYAPEETH DEEMED UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY

Ph.D. Course-work Syllabus

Paper- II

Advances in Chemical Engineering

<u>TEACHING SCHEME</u>	<u>EXAMINATION SCHEME</u>	<u>CREDITS ALLOTTED</u>
Lectures : 4 Hours/Week	Theory Examination : 100 Marks	Total Credits : 04
	Duration : 3Hrs	
Topics Covered		
UNIT-I	Chemical Engineering Mathematics Review of basic concepts of Numerical Methods; Applications of Numerical Methods for transport processes, Numerical differentiation and integration for multidimensional systems; Application of software.	(6 Hours)
UNIT-II	Fluid Flow Operations Review of basics concepts of Fluid flow operations; fluid statics and fluid dynamics, flow through pipe, flow rate and pressure drop calculations; Two phase flow: Gas/liquid, liquid/liquid and gas/solid flow, flow types and regimes in horizontal and vertical flow, behavior of non-Newtonian fluids in two phase flow.	(6 Hours)
UNIT-III	Chemical Engineering Thermodynamics Review of chemical engineering thermodynamics; Classical thermodynamics and statistical thermodynamics, phase equilibria and chemical reaction equilibria; phase non-ideality measurement using advanced models viz. NRTL, activity coefficient model, etc.; Energy calculations.	(6 Hours)
UNIT-IV	Heat Transfer Basic concepts of heat transfer, designing of heat transfer equipment such as heat exchanger, evaporator, boiler, cooling tower, etc. heat transfer equipment design standards.	(6 Hours)
UNIT-V	Mass Transfer Mass transfer models; Advanced separation techniques: Azeotropic and	(6 Hours)

	extractive distillation, reactive distillation, supercritical fluid separation, zone melting; chromatographic separation, Multi-component separation: Mass transfer with chemical reaction.	
UNIT-VI	Chemical Engineering Process Modeling and Optimization Review of Process Modeling and Optimization, modeling of chemical process optimization, advanced simulation approaches using CFD, etc. multi-variable and Multi-objective optimization.	(6 Hours)
UNIT-VII	Biochemical Engineering Review of Biochemical processes, Microbial biochemistry: Fermentation technology, Biofuel Technology, pyrolysis and gasification of biomass, design aspects of bioreactors.	(6 Hours)
UNIT-VIII	Multiphase Reactor Engineering Review of chemical reaction engineering, Types, classification, application of industrial importance; Hydrodynamic characteristics of different reactors: mechanically agitated contactors, bubble columns, slurry reactors, spray columns, loop reactors and modified versions; Design aspects of multiphase reactors: Determination of controlling step, determination of intrinsic kinetics and factors affecting intrinsic kinetics, pressure drop, fractional phase hold- up, mass and heat transfer coefficient, extent of mixing, etc.	(6 Hours)
UNIT-IX	Process Dynamics and Control Introduction to Multivariable systems, Interaction dynamics and its role on control system design, Multivariable control classical approaches, Structure selection- variable pairing, tuning single loop controllers for MIMO systems, IMC controller design, pole placement controller design, Design of observer, Kalman filter design, Model (observer) based predictive controllers, LQR/LQG, various MPC schemes.	(6 Hours)
UNIT-X	Wastewater Treatment Review of waste water treatment, advanced treatment techniques viz. advanced oxidation processes (AOPs), advanced biological treatments, membrane based treatments, etc. analytical techniques.	(6 Hours)

Text Books/References:	
1.	Luyben, W.L. Process Modeling, Simulation and Control for Chemical Engineers, McGraw-Hill
2.	Brenner, C. E. Fundamentals of Multiphase flows, Cambridge University Press
3.	Smith, J. M.; Van Ness, H. C.; Abbott, M. M. Introduction to Chemical Engineering Thermodynamics, McGraw Hill
4.	Bird, R.B.; Stewart,W.E.; Lightfoot, E.N. Transport Phenomena; John Wiley and Sons Publications
5.	Wetly,J.H; Wicks,C.E.;Wilson, R.E. Fundamentals of momentum, heat and Mass transfer, John Wiley and sons
6.	Hines, A.L.; Maddox, R.N. Mass Transfer Fundamentals and Applications, Prentice Hall
7.	King, C. J. Separation Processes, Tata McGraw Hill
8.	Froment, G.F.; Bischoff, K.B. Chemical Reactor Analysis and Design, John Wiley and Sons
9.	Smith J.M. Chemical Engineering Kinetics, McGraw-Hill
10.	Press <u>W.H</u> ;Teukolsky S.A.; <u>Vetterling</u> , W.T.; <u>Flannery</u> , B.P.Numerical Recipes inMulti-Language Code, Cambridge University press
11.	Shuler, M.L.; Fikret, K. Bioprocess Engineering: Basic Concepts, Prentice Hall
12.	Bailey, J.E.; Ollis, D.F. Biochemical Engineering Fundamentals. McGraw-Hill
13.	Chakraborti, A.; Biotechnology and alternative technologies for utilization of biomass or agricultural waste, oxford and IBH publishing Co
14.	Sharma, M. M.; Doraiswamy, L. K. Heterogeneous Reactions, John Wiley and Sons
15.	Levenspiel, O.; Kunni, D. Fluidization Engineering, John Wiley and Sons
16.	Davidson, J. F.; Harrison, D. Fluidization,Academic Press Inc.
17.	Stephanopoulos, G. Chemical Process Control: An introduction to theory and practice, Prentice Hall
18.	Coughanowr, D.R.; Process systems Analysis and Control, McGraw Hill
19.	MetCalf; Eddie. Waste Water Engineering: Treatment and Reuse, Tata McGrawHill
20.	Noel de Nevers, Air Pollution Control Engineering, <u>Waveland Pr. Inc.</u>
21.	Ewing, G.W. Instrumental Methods of Chemical analysis, Tata McGraw Hill
22.	Davis, M.E. Numerical Methods and Modeling for Chemical Engineers, John Wiley and Sons