DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

SCHEME FOR PRE Ph.D. COURSE WORK, CHEMICAL ENGINEERING

S. No.	Subject Code	Subject	Periods / Week L – T – P	ESE Duration	ESE Marks		Credits
					Max.	Min. 50%	
1	CHEPHDT01	Research Methodology in Engineering	3 – 1 – 0	3 Hrs.	100	50	4
2	**	Elective - I	3 – 1 – 0	3 Hrs.	100	50	4
3	**	Elective - II	3 – 1 – 0	3 Hrs.	100	50	4
4	CHEPHDS01	Seminar	-	-	Qualified/ Not qualified		-
Total			**9 – 3 – 0**	**-**	**300**		**12**

Duration of the semester will be 6 months.
*Candidate has to score minimum 60% of the aggregate marks to qualify in ESE.
Two core subjects as Electives (4 credits each) to be decided by the DRC.

List of Electives		** Subject Code	List of Electives		** Subject Code
S. No.	Subject		S. No.	Subject	
1	Advanced Heat Transfer	CHEPHDT 02	6	Advanced Mass Transfer	CHEPHDT 07
2	Chemical Reactor Design	CHEPHDT 03	7	Industrial Pollution Control Technologies	CHEPHDT 08
3	Fluidization Engineering	CHEPHDT 04	8	Design and Development of Catalysts	CHEPHDT 09
4	Process Optimization	CHEPHDT 05	9	Advance Wastewater Treatment	CHEPHDT 10
5	Chemical Process Modeling	CHEPHDT 06	10	Advanced Process Control	CHEPHDT 11

24/04/19 24/04/19 24/04/19 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT01 : Research Methodology in Engineering

Introduction and Design of Research

Meaning, objective, significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of constants and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative v/s quantitative research methodologies, field studies, field experiments v/s laboratory experiments, research design in social and physical sciences.

Data and Methods of Data Collection

Survey, assessment and analysis, data collection, primary and secondary sources of data collection, collection of primary data through questionnaire and schedules, collection of secondary data, processing and analysis of data, sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multi stage sampling, pilot survey, scaling techniques validity and reliability.

Data Analysis

Procedure for testing of hypothesis, null hypothesis, determining level of significance, type-1 and type-2 errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance, one, two way, chi square test and its applications, students 'T' distribution, non-parametric statistical techniques, binomial test, correlation and regression analysis-discriminate analysis-factor analysis, cluster analysis, measures of relationship.

Simulation

Meaning of simulation, need of simulation, appropriateness of simulation, its advantages and disadvantages, its application in Engineering, methods of simulation.

Research Report Preparation and Presentation

Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report, mechanics of writing a research report, writing bibliography and references.

Texts/References:

- Kothari C.K., Research Methodology-Methods and Techniques, New Age International
- Panneerselvem, R., Research Methodology, Prentice Hall of India New Delhi, 2004

24/04/19 24/04/19 24/04/19 24/4/19 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT02 : Advanced Heat Transfer

General equation of heat conduction, transient heat conduction: numerical and analytical methods for the solution of transient heat conduction problems, critical radius and optimum thickness of insulation. Free convective heat transfer under different situation and application of dimensional analysis to estimate the convective heat transfer coefficients. Heat transfer factor Reynolds number plot, analogy equation for heat momentum transfer. Boiling heat transfer with particular reference to nucleate and film boiling and estimation of boiling heat transfer coefficient. Heat transfer from condensing vapors. Nusselt equation for film type condensation of vapors over vertical surfaces and inclined tubes. View factors and emissivity factors for different situation. Radiation shield and radiation error in pyrometry. Combined conduction, convection and radiation heat transfer.

Texts/References:

- Hallman J. P., Heat Transfer Operation, McGraw Hill
- Sachdeva R.C., Fundamentals of Engineering Heat & Mass Transfer
- Bird, R. B., Steward, W.E. and Lightfoot E N., Transport Phenomena, Second edition, John Wiley and sons
- Deen W. M. Analysis of Transport phenomena, Oxford University Press, 1998
- Slattery J. C., Momentum Heat and Mass Transfer, Krieger Publishing, 1981

24/04/19 24/04/19 24/04/19 24/4/19 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT03 : Chemical Reactor Design

Review of design of ideal isothermal homogeneous reactor for single and multiple reactions, RTD of ideal reactor, interpretation of RTD data, Flow models for non-ideal reactors, dispersion model, N tanks in series, multi parameter model, diagnosing the ills of reactor, influence of RTD and micro mixing on conversion. Adiabatic and non-adiabatic operations in batch and flow reactors, optimal temperature in progression. Hot spot in tubular reactor, auto thermal operation and steady state, multiple steady state, introduction to bifurcation theory, catalytic reactors, effectiveness factor, selectivity, catalyst deactivation. Design of heterogeneous catalytic reactors.

Text/References:

- Carberry James J, Chemical and catalytic reaction engineering, McGraw Hill
- Smith J. M., "Chemical Engineering Kinetics", McGraw Hill
- Levenspiel O., "Chemical Reaction Engineering", Wiley Eastern, 2nd ed. 1972
- Frinebt G. F., Bischoff K.B; " Chemical Reactor Analyzer and design" John Wiley & Sons
- Foggler H. S., Elements of Chemical Reaction Engineering

Chandraka 24/04/19 Gaul 24/04/19 24/04/19. Saha 24/4/19
Amrita 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT04 : Fluidization Engineering

Phenomenon of Fluidization, Industrial applications of fluidized beds, Gross behavior of fluidized beds-Minimum fluidizing velocity and pressure drops; Voidage, Transport disengaging height; Bubbles in dense beds-Davidson Model, stream of bubbles, Bubbling bed models, Emulsion phase, Turn-over rate of solids, Residence Time Distribution of Solids, Diffusion model of solids movement, Interchange coefficient of solid into and out of wake; Flow Pattern of Gas through fluidized beds, diffusion model for gas flow; two region models, evaluation of interchange coefficients, Mass and heat transfer between fluids and solid- from bubbling bed models; Catalytic conversion from bubbling bed model; contacting efficiency; application to successive reactions; Theories and bed wall heat transfer; comparison of theories; Entrainment and elutriation, Circulation rates of solids, flow of high and low bulk density mixtures; Design for catalytic reactors; Design for non-catalytic gas-solid reactors.

Text/References:

- Kuinl D. and Levenpiel O., Fluidization Engineering, John Wiley, 1969
- Davidson J. F. and Harrison D., Fluidization, Academic Press 1971
- Zenz F.A. and Othmer D. F., Fluidization and Fluid Particles Systems, Reinhold Publishing,1960

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT05 : Process Optimization

Introduction to optimization; Formulation of objective function; Basic concepts-functions, regions, necessary and sufficient conditions for an extreme of an unconstrained function.

One dimensional Search: Scanning and bracketing; Newton, quasi-Newton and secant methods; Region elimination method; Polynomial approximation methods.

Unconstrained multivariable optimization: Direct methods-random search, grid search, univariate search, simplex method, conjugate search direction and Powell's method; indirect method-gradient and conjugate gradient methods, Newton's method, movement in search direction, secant method.

Linear programming: Basic concepts in linear programming; Graphical solution; Simplex method; Standard LP from; Obtaining first feasible solution; Sensitivity analysis.

Non-linear programming: Lagrange multiplier method; Quadratic programming; Penalty function and augmented Lagrangian methods.

Texts/References:

- Edgar T.F. and Himmelblau D.M., Lasdon, Optimization of Chemical Processes, McGraw Hill, 2001
- Urbaniec K. and McDermott C., Optimal Design of Process Equipment, John Wiley, 1986

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT06 : CHEMICAL PROCESS MODELING

Introduction to process modeling, types of models, the basic modeling approaches, the transport phenomena models, population balance models, parameter estimation.

Texts/References:

- Denn M. M., Process Modelling, John Wiley, 1987
- Baughman R.D. and Liu Y.A., Neural Networks in Bioprocessing and Chemical Engineering, Academic Press, 1996
- Rutherford Aris, Mathematical Modeling, Vol.1, A Chemical Engineer's Perspective (Process Systems Engineering), Academic Press, 1999

Chandrakar 24/04/19 Gaur 24/04/19 24/04/19. Sudeha 24/4/19

Amitjain 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT07 : Advanced Mass Transfer

Qualitative behavior of the vapour-liquid equilibria (VLE). Simple models for vapour- liquid equilibria: Raoult's and Henry's laws. Dew point and bubble point calculations. VLE by modified Raoult's law and K-value correlations. Flash calculations.

Ternary and multicomponent system, fractionation. Theories and design, number of plates, Lewis Sorel's method, minimum reflux ratio, Underwood's equation, Colburn's equation.

Unsteady state mass transfer, multicomponent Gas-Phase systems, effective diffusivity, Maxwell's law, Regular and Random surface renewal, Harriot Model, Danckwerts model.

Mass Transfer across a phase boundary – the film-penetration theory, other theories of mass transfer. Interfacial turbulence, Mass Transfer coefficient, Applications of theories of interphase transfer. Mass Transfer and chemical reaction – steady state and unsteady state

Universal velocity profile – The laminar sub-layer, the buffer layer, Reynolds analogy, Taylor – Prandtl Modifications.

Text / References :

- Seader J.D., Henley E. J., Chemical Engineering Principles.
- Coulson J.M. and Richardson J.F., Chemical Engineering

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT08 : Industrial Pollution Control Technologies

Brief review of industrial, municipal and natural pollution sources, dynamics of pollutants from point, non-point, line and area sources; generation, transport and decay of air pollutants; sampling and monitoring methods.

Strategies and methods for removal of gaseous pollutants and particulates from process exhaust streams; air pollution abatement technology; detail design of particulates and gaseous emission control equipment; air pollution indices; air pollution survey; costs of air pollution control, air pollution legislation and regulations.

Case studies of a few industrial pollution control system

Waste water characteristics. Wastewater treatment objectives, methods and implementation considerations liquid hazardous waste treatment such as chemical, biological, and thermal oxidation, carbon adsorption, ion exchange.

Design of facilities for physical and chemical treatment; design of facilities for treatment and disposal of sludge; effluent disposal

Water pollution legislation and regulation

Text / References :

- Schnelle K.B. and Brown C.A., Air Pollution Control Technology Handbook, CRC Press
- Peavy H.S., Rowe D. R. and Tchobanoglous George, Environment Engineering, McGraw-Hill
- Triwedi R.K. and Goel P.K., An Introduction to Air Pollution, Technoscience Pub.
- Sengar D.S., Environmental Law, PHI
- Jain A.K. and Jain A.K., Waste Water Engineering

24/04/19 24/04/19 24/04/19 24/4/19 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT09 : Design and Development of Catalysts

Structure of solid surfaces; chemisorption and physiosorption; thermodynamics and kinetics of surface processes; principles of heterogeneous catalysis; preparation, characterization and classification; structure and activity; lattice imperfection; geometric and electronic factors preparation and characterization of catalysts.

Kinetics of heterogeneous reactions.

Physical, chemical and mathematical description of catalyst deactivation; deactivation by fouling, poisoning and sintering.

Deactivation and regeneration of catalyst pellets.

Deactivation and regeneration of fixed beds.

Dynamics of poly-functional catalysts.

Electro-catalysis and photocatalyis.

Mechanism and kinetics of some typical heterogeneous catalytic reactions.

Applications in fertilizer, petroleum, petrochemical industries and pollution control.

Text / References :

- Poncelet G., Martens J. and Delmon B., Preparation of Catalyst VI : Scientific bases for the preparation of Haterogeneous Catalysts, Elsevier
- Regalbuto J., Catalyst Preparation : Science and Engineering, CRC Press

Chandrakar 24/04/19 Gaurav 24/04/19 24/04/19. Salaha 24/4/19 Amitjain 24/4/19

CHEPHDT10: Advance Wastewater Treatment

Introduction, health and environment concern in wastewater management.

Water quality: definitions, characteristics and perspectives. The hydraulic cycle, water quality, physical, chemical and biological water quality parameters.

Measurement of organic concentration, BOD, COD and TOC test, reaction between BOD, COD, & TOC, Most probable number (MPN), measurement of biological characteristics, toxicity test.

Reactor used for transient of wastewater mass balance analysis, modeling of ideal flow in reactor, modeling of treatment process, kinetics of processes, process selection.

Physical unit operations: screening, mixing, gravity separation, primary sedimentation, coagulation, secondary treatment of waste water, adsorption.

Biological waste water treatment, micro-organism growth kinetics, modeling of suspended froth treatment process, aerobic biological oxidation, anaerobic process, heavy metal pollution remedies

Texts/References:

- Metcalf and Eddy, Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill publication, India
- Peavy H.S. and Rowe D.R., Environment Engineering, McGraw Hill Book Company, New Delhi
- Levenspiel O., Chemical Reaction Engineering, John Wiley and Sons publication
- Treybal R.E., Mass Transfer Operations, McGraw-Hill publication
- Coulson and Richardson Vol.-II, Butterworth Heinemann Publication, New Delhi

Chandrika 24/04/19   24/04/19   24/04/19,   S. Saha 24/4/19

Amit Jain 24/4/19

DEPARTMENT OF CHEMICAL ENGINEERING
School of Studies, Engineering and Technology
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009
(A Central University Established by Central University Ordinance 2009, No 3 of 2009)
Pre Ph.D. COURSE WORK (Effective from session 2018-19)

CHEPHDT11: Advanced Process Control

A brief review on the preliminary concepts of process control, modeling of few complicated system understanding of first and second order system and PID controls, state space and transfer function matrix models, stability criterion of transfer function matrix models, development of empirical model for process data, identifying discrete-time models from experimental data, design of feed forward and ration control, study of cascade control system, digital sampling, filtering, and control: sampling period, along and digital filters, Z-transforms use of SIMULINK design of digital control, multi loop control: calculation of extent of interaction and pairing of control and manipulated variable implementation of real time optimization in computer control. Study of model predictive control (MPC), concepts of statistical process control, Study of Kalman filter.

Texts/References:

- Seborg Dale E., Edgon Thomas F. and Mellichamp D.C.A., Process Dynamics and Control, WILEY Publication
- Harriet, Process Control
- Stephanopoulos George, Chemical Process Control, Prentice Hall(PTR)
- Luyben M. L. and Luyben W.L., Essential of Process Control, McGraw-Hill
- Ogunnaike B.A. and Ray W.H., Process Dynamics, Modeling and Control Oxford University Press
- Coughnowr D.R. and Kopple L.B., Process System Analysis and Control, McGraw-Hill
- Stephanopolous G., Chemical Process Control- An Introduction Theory and Practice, Prentice Hall of India