NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Process Equipment Design-II**	Subject Code	**CL20711CL**
Semester	B. Tech. – 7th Semester	Board of Studies	Chemical Engg.
Maximum Marks	70	Minimum marks	25
Lecture period works	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

Details of Course:

Note : 1. Use of relevant design data book, steam tables, and Chemical Engineer's Hand book- by J.H.Perry is permitted in the examination.

Unit-I

Design of - Double pipe and, Shell- Tube heat exchanger: Basic design procedure of heat transfer equipment, mean temperature, LMTD, Calorific temperature, Individual side heat transfer coefficient, Overall heat transfer coefficient, Dirt factors, Surface area for heat transfer, Construction details, Selection algorithm, Pressure drop, Design stability. CAD of shell and tube heat exchangers.

Unit-II

Design of Condenser: Design of condensers for single vapor, Correlations of heat transfer coefficient for condensation inside and outside of tubes, Area of heat transfer, Vertical and horizontal condensers, Design of desuperheater cum-condenser and condenser-cum-sub-cooler, Condensation of mixtures, Pressure drop in condensers, CAD of condenser.

Unit-III

Design of Evaporators: Convective boiling, Selection of reboilers, and vaporizers, Design of reboilers, vaporizers and evaporators, Single and Multiple effect evaporators with and without BPR.

Unit-IV

Design of Driers: Tray, Tunnel, Rotary: Heat and mass balance, Humidity, Hot gas flow rate, Drying time, Detail inside design of these driers

Name of Text Book:

1. Kern D.Q.- Process Heat Transfer, McGraw Hill Publication.
2. Richardson & Coulson - Chemical Engineering Plant Design Vol. VI, Butterworth Heinemann Publication, New Delhi
3. Perry J.H.- Chemical Engineers Hand Book , McGraw Hill Publication, New York

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Chemical Reaction Engineering-II**	Subject Code	**CL20712CL**
Semester	B. Tech. – 7th Semester	Board of Studies	Chemical Engg.
Maximum Marks	70	Minimum marks	25
Lecture period works	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

Details of Course:

Unit-I
Basics of Non-Ideal Flow: E**,** the age distribution of fluid, the RTD, Conversion in non-ideal flow reactors, models for non ideal flow- dispersion model, Chemical reaction and dispersion, tank in series model.

Unit-II
Mixing of fluids: Self mixing of single fluid- degree of segregation, early and late mixing, mixing of two miscible fluids.

Unit-III
Fluid particle reactions: Un-reacted core model: diffusion through gas film control, diffusion through ash layer control, chemical reaction control. Rate of reaction for shrinking spherical particles, determination of rate controlling step.

Unit-IV
Fluid – Fluid reactions: Kinetic regimes for mass transfer and reaction, rate equations for various regimes, film conversion parameter, application to design, reactive and extractive reactions.

Unit–V
Solid catalyzed reactions: film resistance, surface phenomenon and pore diffusion controls, heat effects, combination of resistances, experimental method for finding rate, determining controlling resistances and rate equations, application to design, catalyst deactivation: mechanism, rate equation and design.

Name of Text Books:
1. Chemical Engineering Kinetics. J.M. Smith.
2. Chemical Reaction Engineering. Octave Levenspiel.

Name of Reference Books:
1. Chemical Reaction Engineering. H.Scott Fogler.
2. Principles of Reaction Engineering, Central Techno Publications. S.D.Dawande,
3. Chemical Engineering, Volume IV. Coulson and Richardson

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Process Dynamics & Control**	Subject Code	**CL20713CL**
Semester	B. Tech. – 7th Semester	Board of Studies	Chemical Engg.
Maximum Marks	70	Minimum marks	25
Lecture period works	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

Details of Course:

Unit – I

Laplace transform, Linear open loop system. The first and second order systems and their transient response Interacting and non inter – acting systems. Linearisation. Transportation lag.

Unit – II

Linear closed loop system-control system, block diagram, closed loop transfer function. Controllers, Transient response of closed loop systems.

Unit – III

Pneumatic controller mechanism, bafflenozzle, proportional controller. Mechanism, proportional controller, mechanism. Proportional integral control. Proportional derivative control value. PID control. Final control element. Control valve. advance process control valves. Feed forward control.

Unit – IV

Stability concept, Routh stability criterion, Nyquists stability criterion.

Unit – V

Root locus technique, introduction to frequency response, Bode diagram, Bode stability criterion, Gain and phase margins, Fuzzy Logic Control.

TEXT :

Process Systems Analysis and Control – Coughanowr and Koppel.

REFERENCE :

1. Automatic Process Contorl - Eckman.
2. Process Contorl - Harriot.
3. Control systems Engineering - I.J. Nagrath & M. Gopal.
4. Process Dynamics & Control - Dale E. Seborg, Thomas F. Edgar & Dun can A. Mellichamp. Joln wiley & sons Inc Pt. Ltd.
5. Chemical Process Control - Stephanoplulos G.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Petroleum Refining Processes (Elective-II)**	Subject Code	**CL20714CL**
Semester	B. Tech. – 7th Semester	Board of Studies	Chemical Engg.
Maximum Marks	70	Minimum marks	25
Lecture period works	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

Details of Course:

Unit-I

Petroleum refining in India: - Various petroleum products, secondary processing, quality improvement, production and consumption position, world reserves of fuel. Composition of petroleum crude, Refining-Introduction, Classification - according to type, gravity. Types of refineries.

Unit-II

Distillation and Equilibrium: -Dehydration and desalting of crude Reflux ratios, types of trays, trays efficiencies, and types of distillation used in petroleum industries, various Units with distillation column, various products properties and applications, treatments of important products

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Unit III Cracking and Coking: -Types of cracking, thermal cracking: visbreaking hydro-cracking., effect of operating variables on cracking, catalytic cracking – reactions, various processes, catalysts for catalytic cracking, fixed bed, moving bed and fluidized bed catalytic cracking, Deep catalytic cracking, super oil cracking technology, deep catalytic cracking. Coking – delayed coking, fluidized bed coking. flexi coking, fluidized bed coking

Unit-IV

Reforming -Thermal reforming, catalytic reforming – reactions, catalyst used, operating variables, various processes. IFPS New technologies for reformulated gasoline. Gasification of heavy petroleum feed stock.

Unit-V

Rebuilding of Hydrocarbons & Pollution by Refineries: -Alkylation, Isomerisation, Polymerisation, Gas to liquid technology.Gas to liquid technology(GTL) Automation in petroleum refinery- Distributed control system. Pollution by Refineries.

Name of Text books:

1. W.L.Nelson , Petroleum Refining Engineering
2. G.D Hobson, Modern petroleum Technology
3. SarkarG.N. , Advanced Petroleum Refining.

Name of Reference books:

1. Bhaskara Rao B.K.,Modern Petroleum Refining Processes.
2. Sharma B.K. Fuels and Petroleum processing.
3. Petroleum refining: Technology & Economics by Gary

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Polymer Technology (Elective-II)**	Subject Code	**CL20715CL**
Semester	B. Tech. – 7th Semester	Board of Studies	Chemical Engg.
Maximum Marks	70	Minimum marks	25
Lecture period works	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

Details of Course:

Unit-I
Introduction to polymer science Classification of polymer structure Molecular weight. Chemical structure & Thermal transition.

Unit-II
The synthesis of high polymers Step-growth polymerization. Chain growth polymerization. Polymerization techniques, Reactions of synthetic polymers, special topics in polymer, synthesis, Chemical structure determination.

Unit-III
Solution & solid-state properties, Viscosity & Rubber elasticity.

Unit-IV
Degradation, stability & environmental issues, polymer additives, blends & composites.

Unit-V
Commodity thermoplastics & fithers elastolmers & thermosets engineering & speciality polymers.

Name of Text / Reference books:
Polymer Sc. & Tech – Joelr Fried

Introduction to Polymer Chemistry – D.S. Mishra

Polymer Science & Tech. of plastic and – Premamoy Ghosh.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Biochemical Engineering (Elective-II)**	Subject Code	**CL20716CL**
Semester	B. Tech. – 7th Semester	Board of Studies	Chemical Engg.
Maximum Marks	70	Minimum marks	25
Lecture period works	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	0	4

Details of Course:

Unit-I
Introduction to biochemical engineering, homogeneous and heterogeneous reactions, factors affecting rate of reactions, various definitions of rate of reactions, elementary and non-elementary reactions.

Unit–II
Enzymes and enzymatic reactions, kinetics of enzyme-catalyzed reactions, enzyme substrate complex and enzyme action, simple enzyme kinetics with one or two substrates, determination of elementary-step rate constants, factors affecting enzyme activity, hydrolytic enzymes and its application, enzyme immobilization and its applications.

Unit–III
Kinetics of substrate utilization, product formation, and biomass production in cell, kinetics of balanced growth, growth-cycle phase for batch cultivation, sterilization-thermal death kinetics of micro-organisms.

Unit–IV
Reactors for carrying our biochemical reactions, bioreactor for plant and animal cells, down-stream process recovery of particulate, product isolation, filtration, sedimentation, centrifugation, crystallization, purification and drying.

Unit–V
Application of biochemical methods for treatment of contaminated soils and ground water: Basics of microbial metabolism, biodegradation of synthetic organics, growth kinetics.

Name of Text Books:

1. Bailey, J.E. and Ollis, D. F. Biochemical Engineering Fundaments, McGraw Hill International Edition.
2. Rao, D.G. Introduction to Biochemical Engineering, Tata McGraw-Hill Publication.
3. Singh, B.D. Bio-Technology, Kalyani Publication

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Process Dynamics & Control Laboratory**	Subject Code	**CL20722CL**
Semester	B. Tech. – 7^{th} Semester	Board of Studies	Chemical Engg.
Maximum Marks	20	Minimum marks	10
		Practical Periods/Week	Credits
		3	2

Details of Course:

List of experiments to be performed:

1. To calculate the time constant of thermometer.
2. To determine phase lag and amplitude ratio of thermo well.
3. To determine damping coefficient, decay ratio, overshoot and characteristics time for step response of mercury manometer.
4. To study the dynamic response of liquid level in two tank interacting liquid level system and to compare experimental and theoretical responses.
5. To study the characteristic of PID controller by estimating time required to reach PV and to estimate the offset.
6. To study the steady state and transient response to a P control.
7. To study the steady state and transient response to a P +D control.
8. To study the steady state and transient response to a P+I control.
9. To study the steady state and transient response to a P+I+D control.
10. To study the stability of the system by plotting the Bode plots.
11. To determine the flow coefficient C_v of the control valves.
12. To determine the % hysteresis of the control valve.
13. To determine the rangeability of the equal % control valve.
14. To determine the time constant of mercury in glass thermometer.
15. To determine the time constant of mercury in glass thermometer.
16. To determine the time constant of RTD (PT100) sensor.
17. To determine the time constant of thermocouple sensor.
18. To determine the time constant of thermister sensor.
19. To determine the time constant of mercury in glass thermometer.
20. To study the tuning of PID controller by open loop method, using Zeigler-Nichols tuning rule.