

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Fluid Mechanics	Subject Code	CL20511CL
Semester	B. Tech. – 5 th 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, Fluid statics, Applications of fluid statics, Manometer, Types of manometer, Dimensional analysis of flow.

Unit-II

Fluid flow phenomena, Newtonian and Non- Newtonian fluid flow, Boundary layer theory, Friction factor for smooth and rough pipes.

Unit-III

Mass, momentum and energy balance, Bernoulli's equation, Euler's equation, Flow of incompressible fluid, Flow past immersed bodies, Packed bed.

Unit-IV

Fluid moving machinery, Pump, Fans, Blowers, Fluidization mechanism and applications.

Unit V

Measurement of fluid flow, Venturimeter, Orifice meter, Rota meter, Pitot tube, Weirs and notches, advanced flow meters.

Name of Text Books:

1. McCabe, W, L., Smith, J ,C., Harriott, Peter., Unit Operations of Chemical Engineering, McGraw Hill Higher Education Publication, New Delhi
2. Messey, B., Fluid Mechanics, Chapman Publication, London

Name of Reference Books:

1. Badger, W, L., Banchero, J, T., Introduction to Chemical Engineering., McGraw Hill Publication, New Delhi
2. Brown, G, G., et al., Unit Operations, John Wiley Sons Publication., New York.
3. Vijay Gupta, Santhosh Kumar Gupta, Fluid Mechanics and its application, New Age International Publication, New Delhi.
4. Rangwala, S, C., Fluid Mechanics, Charotar Publishing House, Anand
5. Radhakrishnan, E., Fluid Mechanics, Prentice Hall of India, New Delhi
6. Vyas R.P., Fluid Mechanics, Dennet and Co. Publications, Nagpur

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Mass Transfer Operations-I	Subject Code	CL20512CL
Semester	B. Tech. – 5 th 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

CRYSTALLIZATION: Equilibrium relationship, principles, Yield of crystals, Super saturation curve, Crystal growth, equipment, application of principles to design.

Unit – II

HUMIDIFICATION: Equilibrium for humidification, Dehumidification, Humidity chart and its use, wet bulb temperature and its theory and use in measurement of humidity and calculation of humidification operation, adiabatic humidification, equipments.

Unit – III

DRYING: Equilibrium relationship in drying Equipment Principles, mechanism and theory of drying, Calculation of drying time.

Unit – IV

LEACHING: Liquid solid equilibrium, Equipment, principles of leaching, Calculation of number of ideal stages, Plate efficiency.

Unit – V

LIQUID: Liquid Extraction, Liquid – Liquid equilibrium, equipment principles of extraction, Penchan-Savarit method, counter-current extraction. Using reflux application of McCabe Tile method, extraction in packed and spray columns.

Name of Text Books:

1. Unit Operation of Chemical Engg. - McCabe & Smith

Name of Reference Books:

1. Chemical Engineering Vol.I - Coulson J.M. & Richardson J.F.
2. Unit Operation - Brown & Associates.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Heat Transfer Operations	Subject Code	CL20513CL
Semester	B. Tech. – 5 th 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 Heat transfer and general concept of heat transfer by conduction, convection and radiation.

Conduction: Basic concepts of conduction in solid liquid and gases. One dimensional heat conduction with out heat generation through plane walls, cylindrical and spherical surfaces, composite layers etc. insulating materials, critical and optimum thickness of insulation. Extended surfaces, fins and their practical applications. Introduction to unsteady state heat transfer.

Unit-II

Convection-Basic concept, natural and forced convection, Hydrodynamic and thermal boundary layers, Laminar and turbulent heat transfer inside and out side of tubes, Dimensional analysis, determination of individual and overall heat transfer coefficient, fouling factors. Heat transfer in molten metals.

Unit-III

Condensation of mixed and pure vapors, film wise and drop wise condensation, loading in condensers and basic calculation on condensers. Heat transfer in boiling liquids, boiling heat transfer coefficient, radiation heat transfer, Black body and gray body concept, Kirchoff's law, radiation between surfaces, combined heat transfer between surfaces.

Unit-IV

Heat exchangers – classification and design criteria, types of exchanges ie Double pipe, shell and tube, plate type etc. mean temperature difference, LMTD correction factor for multiple pass exchangers, NTU and efficiency of heat exchangers, use of efficiency chart.

Unit-V

Evaporation Elementary principle, Types of evaporators, Single and multiple effect operation, material and energy balance in evaporators, boiling point elevation, Duhrings rule, effect of liquid head, thermo compression.

Name of Text books:

- W.L McCabe and J.C. Smith, “Unit Operations In Chemical Engineering”, 4th Edn., McGraw Hill Publishing Co., 1985
- D.Q. Kern, Process Heat Transfer, McGraw Hill Publishing, Co., New York, 1950

Name of Reference Books:

- M. Mikheyev, Fundamentals of Heat Transfer, Mir Publishers, Moscow, 1968.
- A.S. Foust, L.A. Wenzel, C.W. Clump, Louis maus and L.B. Anderson, Principles of Unit Operations, John Wiley, New York, 1959.
- W.H. Mc Adams, Heat transmission, McGraw Hill Publishing co., New York, 1954
- Max Jaboc, Heat Transfer, Vol. I, John Wiley Inc., New York, 1949.
- N. Necati Ozisik, Basic Heat Transfer, McGraw Hill Kogakush, 1977.
- Dawande S.D. Principles of Heat & Mass Transfer, Central Techno Publications.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Numerical Methods	Subject Code	CL20514CL
Semester	B. Tech. – 5 th 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

Treatment and Interpretation of Engineering Data: Graphical representation of empirical equations, Interpolation, extrapolation, Graphical and numerical integration. Propagation of errors, Properties of variance, Confidence limits for small samples. Newton-Raphson method to find root's of algebraic equation.

Unit-II

Solution of simultaneous algebraic equations: Gauss elimination method, Gauss-Jordan method, Factorization method, Jacobi's iteration method, Gauss-Seidal iteration method, Ill conditioned method, Newton Raphson method

Unit-III

Numerical Integration and Numerical Solution of Ordinary Differential Equation: Trapezoidal rule and Simpson's one ^{3rd} rule of numerical integration. Euler's and Runge Kutta-IV method to Solution of ordinary differential equation. Solution of second order differential equation using Runge Kutta-IV method.

Unit-IV

Solution of Partial Differential Equation: Finite difference techniques to solve partial differential equation, Orthogonal collection to solve partial differential equation

Unit-V

Application of Numerical Methods in Chemical Engineering:

All the above method would be practiced to solve chemical engineering problems, solvers for linear and non linear equations

Name of Text Books:

1. Mickley H. S., Sherwood T. K., Reed C. E., Applied Mathematics in Chemical Engineering, McGraw-Hill Publication.
2. Finlayson B. A., Introduction to Chemical Engineering Computing, 7th Ed., Wiley Interscience publication.
3. Rice R.G. and Do D. D., Applied Mathematics for Chemical Engineers, Wiley.
4. Beers K. J., "Numerical Methods for Chemical Engineering: Applications in Matlab", Cambridge University Press.
5. Cutlip M. B. and Shacham M., Problem Solving in Chemical and Biochemical Engineering with POLYMATH, EXCELL and MATLAB, 2nd Ed., Prentice Hall.
6. Constantinides A. and Mostoufi N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall.
7. Chapra S. C., Canale R. P., Numerical Methods for Engineers, McGraw-Hill Publication.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Plant Design & Costing	Subject Code	CL20515CL
Semester	B. Tech. – 5 th 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

Chemical Engineering Plant Design-Introduction, General Design considerations, Process Design Development. Scale up of plants.

Unit-II

Selection of Process Equipment and Materials, Locating the Chemical Plant, Plant Layout.

Unit-III

Process Auxiliaries-Piping Instrumentation, Control and power Systems.

Unit-IV

Factors involved in project cost estimation, methods employed for the estimation of the capital investments and cost estimation in chemical plants Deprecation and methods of its calculations, effects of taxes on depreciations.

Unit-V

Evaluation of profitability, Return on investments, Studies on alternative investments, Replacement cost and asset accounting, Book keeping Factory records and Balance sheet.

Name of Text books:

1. Peters Max. S., Timmerhaus Kalus. D., West Ronald E. – Plant Design and Economics for Chemical Engineers, Fifth edition McGraw Hill Co., New York, 1991.
2. Vilbrandt Frank C, Dryden Charles E: Chemical Engineering Plant Design, Fourth edition, McGraw Hill book Co., New York.

Name of Reference Books.

1. Smith Robin- Chemical Process Design, McGraw Hill Book Co., New York, 1995.
2. Kharbanda O.P. Process Plant and Equipment Cost Estimation, Sevak Publication, Bombay.
3. Towler G. and Sinnott R.K. : Chemical Engineering Design: Principles, practice and economics of plant and process design”. Butterworth-Heinemann. 2008

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Process Safety & Hazard Management	Subject Code	CL20516CL
Semester	B. Tech. – 5 th 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: Safety programs, engineering ethics, Accident and loss statistics, Acceptable risk, Public perceptions, Nature of accidents, Three significant disasters.

Unit-II

Toxicology: Effect of toxicants, Toxicological studies, Relative toxicity, Threshold limit values, Industrial hygiene: Government regulations, Identification, evaluation and control, Source models: Flow of liquids and vapors through pipes, flashing liquids, Liquid pool evaporation or boiling.

Unit-III

Fires and explosions, Flammability characteristics of liquids and vapors, Minimum Oxygen Concentration (MOC) and Inerting, Ignition energy, Designs to prevent fires and explosions: controlling static electricity, explosion proof equipments and instruments, Reliefs and rupture disks.

Unit-IV

Hazards identification: Process hazards checklists, Hazard surveys, Hazard and Operability studies (HAZOP), Safety reviews, other methods

Unit-V

Accident investigations, Learning from accidents, Investigation process, Case studies: static electricity, Chemical reactivity, System designs, procedures.

Name of Text Books:

1. D.A.Crowl and J.F.Louvar, Chemical Process Safety: Fundamentals with Applications, Prentice Hall PTR.
2. R.E.Sanders, Chemical Process Safety: Learning from Case Histories, Butterworth Heinemann.

Name of Reference Books:

1. Ralph King and Ronald Hirst, King's Safety in the Process Industries, Wuerz Publishing Ltd., Canada.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Heat Transfer Operation Laboratory	Subject Code	CL20521CL
Semester	B. Tech. – 5 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

1. To find out the thermal conductivity of an insulating slab.
1. To find out the thermal conductivity of an liquids.
2. To find heat transfer in forced convection.
3. To find heat transfer in agitated vessel.
4. To find thermal conductivity of insulating powder.
5. To find out heat transfer coefficient of vertical cylinder in natural convection.
6. To determine internal thermal resistance of the body by calculating Biot number for the solid cylinders.
7. To find out the Stefan Boltzman constant.
8. To find out the emissivity of a test plate.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
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Name of Subject	Numerical Methods Lab	Subject Code	CL20522CL
Semester	B. Tech. – 5 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

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Name of Subject	Fluid Mechanics Lab	Subject Code	CL20523CL
Semester	B. Tech. – 5 th Semester	Board of Studies	Chemical Engg.
Maximum Marks	20	Minimum marks	10
		Practical Periods/Week	Credits
		3	2

Details of Course:

Experiments to be performed

1. Determination of the discharge coefficient of given venturi meter.
2. Determination of discharge coefficient of given orifice meter.
3. Determination of friction factor and head loss in given pipe assembly.
4. Determination of the discharge coefficient of given rectangular notch.
5. Determination of the discharge coefficient of given V- notch.
6. To verify Bernoulli's theorem experimentally.
7. To determine the pressure drop across packed column.
8. To determine the friction factor/ pressure drop across contraction in a given pipe assembly.
9. To determine equivalent length of double pipe assembly.
10. To determine the time required to empty an open hemispherical tank and coefficient
11. To calibrate the given Rota meter.

List of Equipments/Machines required:

1. Bernoulli's apparatus
2. Packed column apparatus
3. Venturi meter
4. Orifice meter
5. Rectangular notch & V - notch apparatus
6. Rota meter
7. Hemispherical tank
8. Pipe assembly.

Recommended Book:

1. W. L. McCabe and J. C. Smith, "Unit Operations In Chemical Engineering", 4th Edn., McGraw Hill Publishing Co., 1985.