NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Mechanical Operations	Subject Code	CL20411CL
Semester	B. Tech. – 4th 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

Solids, Characteristics of Solid particles, Properties of masses of particles, Particle size, mixed particle size analysis, Average particle size, Specific surface area of mixture, No of particles in mixture, Screen analysis, Standard screens, Standard screens, Capacity and effectiveness of screen, Ideal and actual screens, Screening Equipment – Grizzly screens, Gyrating screens, Trommels, Shaking screens, Oscillating screens.

Unit-II

Size reduction, Mechanism of Size reduction, Crushing Efficiency, Energy and power requirement, Rittinger's, Law, Kick's and Bond's Law, Work index., Size reduction equipments-crushers, grinders, ultrafine grinders and cutting machines.

Unit-III

Mixing, Mixing – liquids with liquids, liquids with solids and solids with solids, power requirements. Mixing equipment-Kneaders, dispersers and masticators, Banbury Mixer, Muller Mixer, Pug mills, Ribbon Blenders, Tumbling Mixers.

Unit-IV

Classification of solid particles, Magnetic Separation, Electrostatic Separator, Floatation, Sedimentation, Thickeners, Cyclone Separator, Filtration, Filter Media, Filter Aid, Equipments for filtration-Pressure filters, Leaf filters, Continuous rotary filters.

Unit-V

Handling of solids, Nature and characteristics of Bulk solids, Conveyers-Belt conveyors, Screw conveyor, Chain and Flight conveyors, Bucket Elevators, Pneumatic conveyors, storage bins & silos.

Name of Text books:

1. W.L. McCabe, J.C. Smith & Peter Harriott, 'Unit Operations of Chemical Engineering' 5th Ed. McGraw Hill Publication.
2. Hiramath, kulkarni, Unit Operation I, Everest Publication, Pune.

Name of Reference Books.

1. Badger & Banchero, 'Introduction to Chemical Engg' McGraw Hill
2. Brown et al., 'Unit operation', John Wiley sons.
3. J.F. Richardson, J.H. Harkar.J.R. Backhurst: Coulson and Richardson's Chemical Engineering Vol 2
4. Dr. CM Narayan and Dr. B.C. Bhattacharya: Mechanical Operation for Chemical Engineers.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Chem. Engg. Thermodynamics	Subject Code	CL20412CL
Semester	B. Tech. – 4th 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

Application of first law of thermodynamics, Batch flow process, Steady and unsteady Flow, Reversibility critical properties corresponding state, Compressibility application of second law of thermodynamics, Entropy of various processes. Pressure volume and temperature relations

Unit II

Thermodynamics equations, Joule Thompson effect. Effect of pressure on specific heat of fluids, 3rd law of thermodynamics, Maxwell's relation

Unit III

Thermodynamics properties, Compression and expansion of fluid, Single and multistage power requirement, Effect of clearance, Compression of real gases.

Unit IV

Carnot and reversed Carnot cycle, Air cycle for refrigeration, Bi-fluid refrigerant cycle, Cascade system refrigeration, Absorption cycle, Application of Brayton cycle or Bell Coleman air cycle, Reversed Brayton Cycle, Vapor compression refrigeration cycle. Multistage refrigeration, Dry ice.

Unit V

Chemical equilibrium, Fugacity, Calculation of free energy, Work function, Free energy relationship, Condition of equilibrium, Variation of energy, Numerical application of Gibbs-Helmotz equation, Temperature dependence of free energy, Chemical potential in ideal gas mixture, Chemical equilibrium and its application.

Name of Text Books:

1. Smith J. M., Chemical Engineering Thermodynamics, McGraw-Hill Publication
2. Rao Y. V. C, Theory and Problems of Thermodynamics, Wiley Eastern Ltd., New Delhi.
3. Nag P. K., Engineering Thermodynamics, Tata McGraw-Hill publication, New Delhi.

Name of Reference Books:

1. Yadav R., Fundamentals of Engineering Thermodynamics, Central Publishing House, Allahabad
2. Dogde B.F, Chemical Engineering Thermodynamics, Mc Graw Hill Publication.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Process Economics & Management	Subject Code	CL20413CL
Semester	B. Tech. – 4th 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

Definition of Economics, Income, Investment, Reserve, Assets & Liability, Utility, Market, Money, Theories of Profit, Cost Control & Cost Reduction, Price-Price Determination, Value, Wealth, Goods, Credits, Stock Exchange, Demand, Supply, Economics Of Size, Laws Of Return, Money Standard, GNP, GDNP, Per Capita Income

Unit - II

Small and Large Scale Industries, Forms of Business Organization (Single Ownership, Partnership, Joint Stock Companies and Public Sector Undertaking, Joint Sector Undertaking) Industrial Finance Institutions.

Unit - III

Industrial Administration – Relationship & Scientific Management, Nature of Management, Functions of Managements, Control, Organizations And Structure, Out Line of Time & Motion Study, Work Study

Unit - IV

Management of production, plant locations & layout, production and cost control, personal management, job evaluations wages & wages payment plans PERT and CPM analysis.

Unit - V

Factory Act, Trade Dispute Act, Boiler Act, ESI Act, Gratuity Act, Minimum Wages Act, Trade Union Act, Workman Compensation

Name of Text Books/ Reference:

1. Industrial organization & Engg. Econiomics - S.C Sharma ,T.R.Banga
2. Tarachand - Engineering Economics
3. Principles of management- O.Dounell
4. Industrial management – W.R.Spriagel

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Fuel Technology	Subject Code	CL20414CL
Semester	B. Tech. – 4th 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

Classification of Fuel- Solid Fuels, Liquid Fuels, Gaseous Fuels. Various Terms Related to the Study of Fuels and Combustion. Coal-Origin, Composition, Petrography. Analysis and Properties of Coal. Classification of coal.

Unit-II

Coal Preparation, Coal Storage, Coal Carbonization and by-product Recovery. Physical and Chemical Properties of Coke. Briquetting of Solid Fuels. Liquefaction of Solid Fuels.

Unit-III

Coal: A Source of Energy- Gasification of Coal. Fixed Bed Gasification, Fluidized Bed Gasification, Entrained Bed Gasification. Integrated Gasification Combined Cycle (IGCC). Underground Gasification of Coal. Indian Scenario related to Coal Gasification. Coal to Liquid (CTL) via Fischer – Tropsch (F-T) Synthesis.

Unit-IV

Gaseous and Liquid Fuels- Natural gas, Producer gas, Water gas, Carburetted Water gas, Coal gas, Gases from biomass, LPG. Gasoline, Kerosene, Diesel. Physico–Chemical Properties and Testing of Liquid Fuels. Coal Tar Fuels (CTF).

Unit-V

Combustion: General Principle of Combustion. Combustion of Solid Fuels – Grate Firing and Pulverized Fuel Firing System. Combustion of Liquid Fuels. Burners for Liquid and Gaseous Fuels Combustion.

Name of Text books:

1. Samir Sarkar, Fuels & Combustion, Oriant Longman Private Limited, Mumbai.
2. Om Prakash Gupta, Elements of Fuels, Furnaces & Refractories, Khanna Publishers, Delhi.
3. Himus, Coals.

Name of Reference Books.

1. Brame and King, Fuels: Solid, Liquid and Gases.
2. B.K. Sharma, Fuels & Petroleum Processing.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	**Instrumentation & Measurement**	Subject Code	CL20415CL
Semester	B. Tech. – 4th 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

PRINCIPAL OF MEASUREMENT: Error analysis, Static & Dynamic characteristics of measurement. Dynamic response of I & II order instruments.

TEMPERATURE MEASUREMENT: Expansion Thermometers, Thermocouples, Resistance Temperature Detectors, Thermistors & Pyrometers and Calibrations.

Unit -II

PRESSURE MEASUREMENT: Manometers, Bourdon tubes, Bellows, Measurement of gage pressure, vacuum. Measurement of absolute Pressure, Mc Leod Gage, Pirani Gage, Ionization Gage. Vacuum sensor, Thermal vacuum sensor, Response of mechanical pressure gages, Strain Gages & LVDT.

Unit -III

BUILDING BLOCKS OF AN INSTRUMENT: Transducer, amplifier, signal conditioner, signal isolation, signal transmitter, display, data acquisition modules, I/O devices, interfaces.

SENSOR AND TRANSDUCERS: Classification, principals and applications, interpretation of performance specification of transducers.

Unit -IV

LIQUID LEVEL MEASUREMENT: Direct level measurement, interface measurement, Hydrostatic head level measurement in pressure vessels, Ultrasonic level devices, Point & Continuous level measurement using radioactive devices, Capacitance type devices, resistance sensors, Nuclear radiation type level gages & level switches.

Unit -V

ANALYTICAL INSTRUMENTATION: Gas Chromatography, operating principles, type, components & applications, High performance liquid chromatography; Refractive index, pH, viscosity, density & conductivity measurement; Gas Analyzers.

Name of Text Books:

1. Johnson C., "Process Control Instrumntation Technology", 8th Ed. Prentice-Hall. (2005)
2. Eckman D.P., Industrial Instrumentation, McGraw Hill Publications (1975)
3. Nakra B.C. and Chaudhary K.K., "Instrumentation, Measurement and Analysis, 2nd Ed. Tata-McGraw Hill. (2004)
4. Andrew W. G. "Applied Instrumentation in the Process Industries" Vol. I, II & III Ed. Gulf Publication. (1993)

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR
CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Applied Physical & Organic Chemistry	Subject Code	CH20416CL
Semester	B. Tech. – 4th 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

OSMOSIS AND OSMOTIC PRESSURE: Determination of Osmotic Pressure by Berkley & Hartley's Method and Moss and Frazer's Method. Semi permeable Membrane and its Mechanism, Ideal and Non Ideal Solution, Osmotic Pressure and Pressure Relationship, Abonrmal Osmotic Pressure, Activity and activity Coefficient, Vapor Distillations of Liquid Mixtures. Henry's Law, Raoult's Law, Lowering of Vapor Pressure and Elevation of Boiling Points.

Unit-II

PHASE RULE: One Component System, Water system, Sulfur System, Two Component System, Salt Hydrates (Fe C_{l3}- water & $NaSO_4$), Distribution Law, ΔG minimization

ADSORPTION: Adsorption of Gases, Types of Adsorption, Langmuir's Adsorption isotherm, physical Adsorption isotherms. Gibb's Equation, Applications of Adsorption.

Unit-III

ELECTROCHEMISTRY: Conductance of Electrolytes, Laws of Electrolysis & its Significances, Migration of ions, Transference Numbers and its determination, Equivalent Conductance and its Measurement, E.m.f. and its Measurements, Reversible Electrode, reaction in reversible Cells, Free energy changes in cells, Reversible electrode potential, Proton transfer theory, ionization constant, ionic product of water, pH – Scale and Buffer solution, Theory of Indicator.

Unit-IV

Electronic theory and its application to organic reactions (general treatment). Various types of isomerism. Some common organic compounds:

1. Malonic ester & acetoacetic ester-preprations & their synthetic uses.
2. Organometallic compounds – Grignard reagent
3. Hydroxy acids – Oxalic acid, lactic acid & citric acid.

Unit-V

1. Carbohydrates – nomenclature & classification Glucose, fructose, sucrose cellulose & starch
2. Aromatic compounds – properties & uses of Benzene.
3. Aniline, Phenol, Diazocompounds, benzoic acid, Pthalic acid, Benzaldehyde.

Name of Text Books:

1. Puri and Sharma, Advanced Physical Chemistry.
2. Bahl & Bahl, Essentials of Physical Chemistry.
3. Bahal Arun, Bahal B.S. A Text Book of Organic Chemistry S. Chand & Co
4. Soni P.L.A Text Book of Organic Chemistry S. Chand & Comp.

Name of Reference Books:

1. Finar I.L. Organic Chemistry Vol. I & II Elbs (Longman)
2. Morrison R.T., Boyd R.N. Organic Chemistry Prentice Hall Publ.
3. Leidler, Text Book of Physical Chemistry.
4. Samuel Glasstone, Text Book of Physical Chemistry.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Mechanical Operations Laboratory	Subject Code	CL20421CL
Semester	B. Tech. – 4th Semester	Board of Studies	Chemical Engg.
Maximum Marks	20	Minimum marks	10
		Practical Periods/Week	Credits
		3	2

1. Determination of Rittinger's & Kick's constant in respect of the laboratory ball mill.
2. Batch settling study of a given slurry.
3. Determination of effectiveness of screen.
4. Determination of size distribution of a sample of particulate solid by sieve analysis and to evaluate the average particle diameter.
5. Determination of Rittinger's of kick's constant in respect of the laboratory hammer mill.
6. Determination of Rittinger's of kick's constant in respect of the laboratory jaw crusher.
7. Determination of Rittinger's of kick's constant in respect of the laboratory roll crusher.
8. Determination of Bond's constant in respect of the laboratory ball mill.
9. Determination of volume surface mean diameter of given sample by screen analysis.
10. Determination of specific surface area of sand sample mixture.
11. Determination of arithmetic mean, surface mean and volumetric mean diameter of given sample.

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Fuel Technology Lab	Subject Code	CL20422CL
Semester	B. Tech. – 4th Semester	Board of Studies	Chemical Engg.
Maximum Marks	20	Minimum marks	10
		Practical Periods/Week	Credits
		3	2

1. Determination of Viscosity of the Given Oil sample by RedWood Viscometer No. 1
2. Determination of Viscosity of the Given Oil sample by RedWood Viscometer No. 2
3. Determination of Flash & Fire Point of Given Oil Sample by Pensky-Marten's Apparatus
4. Determination of Cloud & pour point Of Given Oil Sample
5. Determination of Moisture Content in the Given Coal Sample by Dean & Stark's Method
6. Determination of Carbon Residue of a Sample of Fuel by Conradson's Apparatus
7. Determination of calorific value of the given fuel sample by Bomb Calorimeter
8. Study of Distillation Characteristics of the Sample of Petroleum Products
9. Determination of Flash & Fire Point of Given Oil Sample by Cleveland Open Cup Apparatus
10. Determination of Smoke Point of Given Kerosene Sample

NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

CHEMICAL ENGINEERING DEPARTMENT

Name of Subject	Physical and Organic Chemistry Lab	Subject Code	CH20423CL
Semester	B. Tech. – 4th Semester	Board of Studies	Chemical Engg.
Maximum Marks	20	Minimum marks	10
		Practical Periods/Week	Credits
		3	2

Experiments to be performed (Minimum 10 experiments)

1. To Determine the relative of the given liquid at room temperature.
2. To determine the surface tension of the given liquid at definite temperature.
3. To determine the solubility of Benzoic Acid at different temperature and to draw the solubility curve.
4. To investigate the adsorption of Oxalic Acid by activated charcoal.
5. To determine the partition coefficient of Solute (lodine) between Solvent (water) and Organic Solvent CCl_4 at room temperature.
6. Study of hydrolysis of Ester such as Ethyl Acetate catalyzed by an acid.
7. Preparation of Oxalic acid from Sucrose (Cane Sugar) by oxidation with Conc. HNO_3
8. Preparation of acetylsalicylic acid from salicylic acid (Acetylation).
9. Preparation of Phenyl azo B-Naptyl from aniline. (Diazotization)
10. Preparation of p- Bromoacetanilide from Acetanilide. (Bromination)
11. Preparation of the given organic (Picric acid) from Phenol (Nitration)
12. Identification of the given organic compounds.

List of Equipments/Machines Required

1. Viscometer
2. Thermostat
3. Calorimeter
4. Separation Funnel
5. Electronic Balance
6. Water bulk with temperature controller
7. PH meter and conductivity meter
8. Weighing Balance
9. Hot plate
10. Water bath
11. Oven

Recommended Books:

1. Samuel Glasstone, Text Book of Physical Chemistry
2. Laidler, Text Book of Physical Chemistry.
3. Puri and Sharma, Advanced Physical Chemistry
4. Bahl & Bahl, Essentials of Physical Chemistry.
5. Finar I.L., Organic Chemistry Vol. I & II, Elbs (Longman)
6. Morrison R.T., Boyd R.N., Organic Chemistry. Prentice Hall Publ.
7. Soni P.L., A Text Book of Organic Chemistry, S. Chand & Comp.