CHE 486 : ENERGY ENGINEERING

Theory : 100 marks. L-T-P
Sessional : 50 marks. 3-1-3
Practical : 50 marks.

1. **INTRODUCTION:** Energy crisis, present position in India and the world. Remedial measures. energy resources, Survey, classification and scope of utilization

2. **SOLID FUELS:** Types of solid fuels, classification of coal, origin of coal, Coal composition : Proximate & Ultimate analysis of coal., calorific value of solid fuel : Gross and net calorific value and their determination by Bomb calorimeter, processing of coal, cleaning of coal, coal carbonization, recovery of by-products from coal carbonization, pulverized coal, coal Gasification & Liquefaction.

3. **LIQUID FUELS:** Types of Liquid Fuels- Basic Introduction, Petroleum, Coal tar fuel, liquid fuel from coal, (F-T process and Bergius process), Alcohols, Shale oil etc.

4. **GASEOUS FUELS** : Types of gaseous fuels, manufacture of producer gas, water gas, coal gas, carbureted water gas from coal, LPG, SNG, CNG etc., oil gasification. Gross and net calorific value of gaseous fuel and their experimental determination, Junker's gas calorimeter, Boy's gas calorimeter.

5. **INTRODUCTION TO VARIOUS COMBUSTION EQUIPMENTS**

6. **ALTERNATIVE ENERGY RESOURCES**: Overview of various renewable resources: Hydroelectricity, solar energy, Energy from Biomass, Geothermal Energy, Wind, Tidal energy.
7. **CALCULATIONS**.: for combustion of solid, liquid & gaseous fuels, for calorific value of solid, liquid & gaseous fuels.

PRACTICALS :
Proximate analysis of coal.
Determination of calorific value of solid & liquid fuel by Bomb calorimeter.
Determination of flash point by Abel's apparatus.
Determination of flash point by Pensky-Marten apparatus.
Determination of flash point & fire point by Cleveland apparatus.
Determination of viscosity by Redwood – I & II Viscometers.

BOOKS
Fuel & Combustion by S. Sarkar.
Combustion Engineering & Fuel Technology by A.K. Saha.
Solid, liquid & gaseous fuels by Brame & King.
Fuel Combustion energy Technology, S N Saha, Dhanpat Rai Publication

CH 487 FLUID FLOW OPERATION

Theory : 100 marks L-T-P
Sessional : 50 marks 3-1-3
Practicals 50 Marks

1. **INTRODUCTION** :Properties of fluids, compressible and incompressible fluids, Normal forces on fluids, Dimensional analysis.

2. FLUID STATICS : Principle of hydrostatic equilibrium, barometric equation, pressure management manometer.

3. FLUID FLOW PHENOMENA : Velocity field, laminar flow, velocity gradient and rate of shear, Eddie viscosity, viscosity and momentum flux, shear stress field, Newtonian and non- Newtonian fluids, Binghham model, Ostwald-de Waele model of non-Newtonian fluid, turbulent flow, Reynold's experiments, flow in boundary layer, laminar and turbulent flow in boundary layer, transition from laminar to turbulent flow – Reynold's number, boundary layer separation and wake formation.

4. BASIC EQUATION OF FLUID FLOW :Stream lines and stream tubes, average velocity, mass velocity, integral equation of flow – Euler's equation of motion, momentum equation for one dimensional flow under steady state condition, the Bernoulli's equation, its application to pumps, blowers, turbines etc.

5. FLOW OF INCOMPRESSIBLE FLUID IN CONDUITS :Flow of incompressible fluids in pipes, boundary layer formation in straight tube, laminar flow of Newtonian fluids, Hagen- Poisseuille equation, laminar flow of non-Newtonian fluids, velocity distribution for turbulent flow, average velocity, relation between maximum and average velocity, application of dimensional analysis to fluid flow problems – friction factor, pipe roughness, loss of head due to friction, bends, fittings etc.

6. FLOW PAST IMMERSED BODIES : Drag, Drag-co-efficient , turbulence, friction in flow through bed of solids – Kozeny-Carman equation, Blake-Plummer equation, motion of particles through fluids, equation for one dimensional motion of particle through fluid.

7. FLUIDIZATION : Mechanism of fluidization, batch fluidization, minimum porosity, maximum bed density, bed height, pressure drop in fluidized bed, uses of fluidization.

8. TRANSPORTATION AND METERING OF FLUIDS : Orifice meter, Venturimeter, Pitot tube, Rotameter and Weir-its principle, theory and application. Classification and performance of pump, compressor, blower, selection and specification.

9. COMPRESSIBLE FLUIDS : Continuity equation, total energy balance, mechanical energy balance, ideal gas equation, process compressible fluids.

Practicals:

1. Experiment on Reynold's apparatus
2. Experiment on turbulent flow apparatus
3. Flow characteristics through venture meter, orifice meter
4. Verification of Bernoulle's equation.
5. Determination of friction factor at different floe rates for SS aluminum, copper pipe
6. Frictions losses in pipes, bends, fittings etc.

BOOKS:

Unit Operation of Chemical Engg. by – Mccabe and Smith.
Chemical Engg. Vol-I by – Coulson and Richardson.
Introduction to Chemical Engg. by – Badger and Banchero.

CH 485: PROCESS CALCULATIONS

Theory : 100 marks	L – T – P
Sessional: 50 marks	3 – 1 – 0

Basic material balance Principles, material balance with and without Chemical reaction. Bypass, recycle, purging

Law of conservation of Energy, Application of general energy balance without Reactions occurring, , components of energy balance equations, Prediction of heat capacities of solids and liquids, Heat Capacity, Enthalpy Change of Phase Changes, steam tables, Heat of mixing, energy balance in cyclic Processes, energy Balance in Non-flow

Energy balance that accounts for chemical reactions, effect of temperature on standard Heat of reaction, Temperature of reaction

Degrees of Freedom, Use of Spreadsheets, Tearing and Iterative Techniques in Flow sheeting

Texts

1. K V Narayanan and B Lakshmikutty, Stoichiometry and Process Calculations, , PHI
2. David M. Himmelblau, James B. Riggs, Basic Principles and Calculations in Chemical Engineering, 8th Ed., Prentice Hall of India,

References

3. O.A.Hougen, K. M. Watson and R. A. Ragatz,"Chemical Process Principles", Vol-I,CBS Publishers and Distributors, New Delhi,
4. R. M. Felder and R. W.Rousseau, Elementary principles of chemical processes, 3rd Ed., Wiley,