Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Branch- Common to All Discipline

ES401	**Energy & Environmental Engineering**	**3L-1T-0P**	**4 Credits**

The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.*

Module 1: Introduction to Energy Science:

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment; Overview of energy systems, sources, transformations, efficiency, and storage; Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

***Module2*: Ecosystems**

- Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem (a.)Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

***Module 3*: Biodiversity and its conservation**

- Introduction – Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

***Module 4:* Environmental Pollution**

- Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides.

Module 5: **Social Issues and the Environment**

- From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns. Case Studies
  Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

Module 6: Field work

- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCE

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai,
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)
6. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.
7. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Chemical Engineering, IV-Semester

CM-402 Fluid Particle Mechanics

COURSE OBJECTIVE

The objective of this course is to understand basic principles of various mechanical operations, construction and working of the equipments.

COURSE CONTENT

Unit-I : Particulate Solid: Properties of particulate solids, evaluation of size & shape, shape factor, surface and population of particles, standard screens and screen analysis of solids, screen efficiency, standard screen series.

Unit-II : Size Reduction: Principles of communication, size reduction; crushing, grinding, pulverizing and ultra fining size reduction equipments, introduction to nano particles, power requirement in comminution.

Unit-III : Mixing and Separation: Mixing of solids, mixing equipment's, design & power requirement of mixers, mixer effectiveness and mixing index. Principles of separation techniques for system involving solids, liquids & gases, classification, sedimentation and filtration, separation equipments, colloidal particles, flocculation and stabilization .

Unit-IV : Transportation and Handling: Selection of conveying devices for solids: Belt, Chain, Screw – conveyors, Elevators and pneumatic conveying devices; elementary design aspects of the devices. visit to chemical engineering, industry engaged mainly with mechanical operation.

Unit-V : Fluidization: Particulate & aggregative fluidization, characteristic of fluidized bed due to particle size, size distribution, shape and density, pressure drop through a fluidized bed and packed bed, character of dense phase fluidization as revealed by pressure drop fluctuations, up flow and down flow fluidization, fluid catalytic process, bed drying, mass transfer in fluidized beds.

COURSE OUTCOMES

1. Ability to evaluate size, surface and population of particles, & screen analysis of solids.
2. Ability to understand principle of size reduction, crushing, grinding, pulverizing and ultra fining.
3. Ability to design mixing equipment and calculate power requirements.
4. Ability to understand principle of separation techniques for system involving solids, liquids and gases, sedimentation and filtration.
5. Ability to understand particulate and aggregative fluidization, pressure drop through fluidized bed.

Topics for the Laboratory

1. To analyses the given sample by differential, cumulative methods using standard screen.
2. Determination of size & surface area of irregular particles using a measuring gauge.
3. To study crushing behavior & to determine the Rittinger's & Bond's constant of the given solid in a jaw crusher.
4. To determine the efficiency of a ball mill for grinding a material of known.
5. To determine the power consumption of the hammer mill.
6. To determine the specific cake resistance for the given slurry by leaf filter.
7. To determine the efficiency of a given cyclone separator.
8. To determine the efficiency of fluidized characteristic bed.
9. To study the Dorr type of thickener.
10. To study the plate & frame filter press.

EVALUATION

Evaluation will be based on continuous an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and interview of each candidate.

References:

1. Perry RH & Don WG; Perry's Chemical Engineering Hand Book; Mc Graw Hill.
2. Nevers De; Fluid Mechanics for Chemical Engineers; TMH
3. Banchero Badker; Introduction to chemical engg; TMH
4. McCabe S, Harriot ; Unit Operations of Chemical Engg; TMH
5. Narayan CM, Bhattacharya BC; Mechanical operations for chemical eng.; PHI
6. Swain A.K., Hemlata Patra, G.K. Roy , Mechanical operation; TMH

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New Scheme Based On AICTE Flexible Curricula

Chemical Engineering, IV-Semester

CM-403 Fluid Mechanics

COURSE OBJECTIVE

The objective of this course is to understand basic concepts of fluid flow and its application to chemical process industries including pipe flow and fluid machinery.

COURSE CONTENT

Unit-I : Review of Fluid Properties: Engineering units of measurement, mass density, specific weight, specific volume, specific gravity, surface tension, capillarity viscosity, bulk modulus of elasticity, pressure & vapor pressure, fluid statics: pressure at a point, pressure variation in static fluid absolute & gauge pressure, manometers, dimensional analysis & dynamic similitude dimensional homogeneity, use of Buckingham pi-theorem, calculation of dimensionless numbers.

Unit-II : Kinematics of Flow: Fluid flow phenomena, types of flow-ideal & real, steady & unsteady, uniform & nonuniform, one, two and three dimensional flow, path lines, streak lines, stream lines, stream tubes, continuity equation for one and three dimensional flow, rotational & irrotational flow, boundary layer theory, flow in boundary layer, flow past immersed bodies, packed bed, fluidized bed.

Unit-III : Dynamics of Flow: Euler's equation of motion along with a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow, momentum correction factor. The moment of momentum equation, forces on fixed and moving vanes and other applications.

Unit-IV : Fluid Measurements and Machines: velocity measurement (Pitot tube, Prandtl tube, current meters etc.) flow measurement (orifices, nozzles, mouth pieces, orifice meter, nozzle meter, venturi-meter, weirs and notches). Pumps, compressor, power & head requirement for pumps, piping system (K Factor), valves and joints.

Unit-V : Fluid Flow: Introduction to laminar & turbulent flow, concept of Reynolds number & friction factor; friction factor for rough & smooth pipe loss of head due to friction in pipes & fittings.

COURSE OUTCOMES

1. Ability to understand basic concept of fluid static, viscosity, pressure & vapor pressure and dimensional analysis.
2. Ability to understand different types of flow, streamlines & continuity equation.
3. Ability to understand Euler's equation of motion, Bernoulli's equation, linear momentum equation, velocity measurement and flow measurement
4. Ability to understand working of pump, fan blowers, compressor and vacuum pumps.
5. Ability to understand concept of Reynolds number and friction factor.

Topics for the Laboratory

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of venturimeter.
4. Determination of Cc, Cv, Cd of orifices.
5. Calibration of orifice meter.
6. Calibration of nozzle meter and mouth piece.
7. Reynolds experiment for demonstration of stream lines & turbulent flow.
8. Determination of metacentric height.
9. Determination of friction factor of a pipe.
10. To study the characteristics of a centrifugal pump.
11. Verification of impulse momentum principle.

EVALUATION

Evaluation will be based on continuous an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and interview of each candidate.

REFERENCES

1. McCabe Smith;Unit Operation for Chemical Engg. TMH
2. Modi & Seth; Fluid Mechanics; Standard Book House, Delhi
3. Som and Biswas; Fluid Mechnics and machinery; TMH
4. Cengal; Fluid Mechanics; TMH
5. White; Fluid Mechanics; TMH
6. JNIK DAKE; Essential of Engg Hyd; Afrikan Network & Sc Instt. (ANSTI)
7. Douglas; Fluid Mechanics; Pearson
8. R Mohanty; Fluid Mechanics; PHI
9. Gupta; Fluid Mechanics; Pearson.
10. Rajpoot R. K. ;Fluid Mechanics and Hydrolic Machine.
11. Bansal R.K.; Fluid Mechanics and Hydrolic Machine.

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New Scheme Based On AICTE Flexible Curricula

Chemical Engineering, IV-Semester

CM-404 Fuel Technology

COURSE OBJECTIVE

The objective of this course to understand processing and limitations of fossil fuels (coal, petroleum and natural gas) and necessity of harnessing alternate energy resources such as solar, wind, nuclear, geothermal tidal and biomass. Also, to understand and practice various characterization techniques for fuels.

COURSE CONTENT

Unit-I : Solid Fuels & Coal Carbonization: Coal & lignite reserves in India, classifications of coal, washing of coal, analysis of coal, proximate and ultimate analysis. Mechanism of low temperature carbonization and high temperature carbonization, byproduct recovery from coke oven, properties of coke coal, grinding, pulverization, briquetting of solid fuels.

Unit-II : Liquid Fuels: Origin of petroleum production, distillation, thermal & catalytic cracking, coking, reforming, isomerizations, crude oil classification, reserves of hydrocarbon in India, introduction to petroleum refining and processing.

Unit-III : Petroleum Products Properties and Its Utilization : Petroleum product and their utilization, diesel, petrol, blending of petrol for octane number boosting, AVL (aviation liquid fuel), kerosene, fuel & furnace oil, testing of petroleum product: flash point, pore point, fire point, octane number, cetene number, viscosity and viscosity index, API.

Unit-IV : Gaseous fuels: Natural gas, synthesis gas, producer gas, water gas, coal gas, LPG, CNG and hydrogen as a fuel, composition properties and uses.

Unit-V : Renewable Energy Sources and Fuel cell: Types of solar cell and fabrication, wind energy, principles of tidal energy. Principle and working of fuel cell, various types, construction and its application.

COURSE OUTCOMES

1. Ability to give the overview of coal reserves in India. Classifications and Washing of coal. Ability to understand mechanism of low and high temperature carbonization.
2. Ability to enhance the knowledge of petroleum processing like cracking, reforming, distillation and isomerization.
3. Ability to familiar with properties and testing of petroleum products.
4. Ability to know composition and properties of gaseous fuels and fuel cells.
5. Ability to understand renewable energy sources

Topics for the Laboratory

1. To carry on proximate analysis of the given coal sample.
2. To determine the calorific value of the coal by Bomb-Calorimeter method.
3. To determine the viscosity of the given oil sample by Redwood Viscometer. No. 1 and No. 2
4. To determine the viscosity of a given oil sample by Saybolt viscometer.
5. To determine viscosity of a given coal tar with the help of tar viscometer.
6. To determine the flash and fire points of the given oil sample by Penskey Martin'sapparatus..
7. To determine the flash and fire points of the given oil sample by Abel's apparatus.
8. To determine the flash and fire points of the given oil sample by Cleveland apparatus.
9. To determine the carbon residue of the given oil by Conradson method.
10. To determine cloud and pour point of given oil sample (coconut) by cloud and pour point apparatus.
11. To determine the composition of given gas by Orsat apparatus.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and interview of each candidate.

REFERENCES

1. Sarkar S; Fuel and Combustion; Orient Long men Ltd.
2. Gupta OP; Fuel and Combustion; Khana Pub
3. Gary ; Refining of Petroleum Techonology
4. D.P. Kothari, K. C. Signal, R. Rajan, Renewable Energy Sources and Emerging technology, PHI Learning pvt. Ltd.
5. G.D. Roy, Non Conventional Energy Source, Khanna Publisher
6. J. Twidel, T Weir, Renewable Energy Sources, Taylor and Francis

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New Scheme Based On AICTE Flexible Curricula

Chemical Engineering, IV-Semester

CM-405 Inorganic Process Technology

COURSE OBJECTIVE

The objective of this course to understand preparation, characteristics and use of various inorganic materials such as soad ash, caustic soda, sulphar and their compound, nitrogen and their compound etc. In addition study the number of important product like cement, Halogen group based product etc.

COURSE CONTENT

Unit-I : Salts and sodium compounds, soda ash, caustic soda, chlorine and potassium salts.

Unit-II : Hydrochloric acid, Sulphur and sulfuric acid, Phosphoric acid and phosphates

Unit-III: Nitrogenous Industries, Ammonia and Nitric acid, Nitrogenous Fertilizer, mixed fertilizers, N-P-K Fertilizers and micronutrients.

Unit-IV : Cement industries, Industrial gases: Nitrogen, Oxygen, Hydrogen, Helium and Argon.

Unit-V : Inorganic chemicals, Bromine, Iodine and Fluorine, soaps and detergents, glass, ceramic and inorganic pigments.

COURSE OUTCOMES

1. Ability to familiarize process flow diagram of salts and sodium compounds, soda ash, caustic soda.
2. Ability to familiarize process flow diagram of hydrochloric acid, sulphur and sulphuric acid, phosphoric acid and phosphate.
3. Ability to familiarize process flow diagram of nitrogenous industries, ammonia and nitric acid, nitrogenous fertilizer.
4. Ability to familiarize process flow diagram of cement industries and industrial gases
5. Ability to familiarize process flow diagram of bromine, iodine, Fluorine, soaps and detergents, glass, ceramic and inorganic pigments.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment, assignment, quiz etc.

REFERENCES

1. Austine G.T.and Shreeves; Chemicasl Process Industries; Mc GrawHill
2. Dryden C.E., M. Gopala Rao; Outlines Of Chemical Technology. Affiliated East-West Press
3. Pandey G.N.; Chemical Technology Volume- I; Lion Press, Kanpur.

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Chemical Engineering, IV-Semester

CM- 406 – Computer Programming –II (Computer Aided Process Calculations)

1. Introduction to Microsoft Excel.
2. Basic Operations
3. Using function
4. Unit conversions of chemical process.
5. Material Balance solution using Excel.
6. Energy Balance Solution Using Excel.