Course Structure
M. Tech. Fuel Engineering
From Academic Year 2017-18 Onwards

Department of Fuel and Mineral Engineering
Indian Institute of Technology (ISM) Dhanbad
Dhanbad, Jharkhand, India

April 2017

I Semester

Sl.No	Course No.	Subject	L – T – P	Credit Hours
THEORY				
1	FEC51101	Fuel Technology	3– 0 – 0	6
2	FEC51102	Coal Beneficiation	4 – 0 – 0	8
3	FEC51103	Combustion Engineering	3 – 0 – 0	6
4	FEC51104	Clean Coal Technology	3 – 0 – 0	6
5	FEE51101 FEE51102 FEE51103	Elective – I (Any One) i) Coal Carbonization Technologies ii) Furnaces & Refractories iii) Modeling and Simulation of Energy Utilization Systems iv) Global Elective of students choice	3 – 0 – 0	6
		Total	**16 – 0 – 0**	**32**
PRACTICALS				
7	FEC51201	Fuel Technology Practical	0– 0 – 3	3
8	FEC51202	Coal Beneficiation Practical	0 – 0 – 3	3
9	FEC51410	Seminar	0 – 0 - 3	3
10	FEC51610	Plant Visits	0 – 0 - 0	3
	Total		**0 – 0 – 9**	**12**
Total			**16 – 0 – 9**	**44**

II Semester

Sl.No.	Course No.	Subject	L – T – P	Credit Hours
THEORY				
1	FEC52101	Liquid and Gaseous Fuels	3 – 0 – 0	6
2	FEC52102	Power Plant Engineering	4 – 0 – 0	8
3	FEC52103	Energy Conservation Processes	3 – 0 – 0	6
4	APE52101	Alternate Energy Systems	3 – 0 – 0	6
5	FME52101 ESR52101 MMC52101 PEE52102	Elective – II (Any One) i) Cement Technology ii) Environmental aspects iii) Bulk Material Handling Equipment iv) Coal Bed Methane, Gas Hydrates and Shale Gas/ Oil	3 – 0 – 0	6
	Total		**16 – 0 – 0**	**32**
PRACTICALS				
6	FEC52201	Liquid and Gaseous Fuels Practical	0 – 0 – 3	3
7	FEC52411	Seminar	0 – 0 – 3	3
8	FEC52610	Plant Visits	0 – 0 – 0	3
9	FEC52512	Comprehensive Viva Voce	0 – 0 – 0	3
	Total		**0 – 0 – 6**	**12**
Total			**16 – 0– 6**	**44**

III Semester

Sl.No.	Course No.	Subject	L – T – P	Credit Hours
1	FE C53901	Industrial Training	0 – 0 – 0 (4)	4
2	FE C53402	Seminar & Viva-Voce on Industrial Training	0 – 0 – 0 (2)	2
3	FE C53503	Comprehensive Viva-Voce	0 – 0 – 0 (4)	4
4	FE C53804	Dissertation	0 – 0 – 0 (15)	15
5	FE C53405	Seminar & Viva-Voce on Dissertation	0– 0 – 0 (10)	10
6	FE C53006	Teaching Assignment evaluation / Laboratory Development Work etc.	0 – 0 – 0 (5)	5
Total			**0 – 0 – 0 (40)**	**40**

IV Semester

Sl.No.	Course No.	Subject	L – T – P	Credit Hours
1.	FE C54801	Dissertation	0 – 0 – 0 (20)	20
2.	FE C54402	Seminar on Dissertation	0 – 0 – 0 (5)	5
3.	FE C54003	Viva Voce on Dissertation	0 – 0 – 0 (10)	10
4.	FE C54004	Teaching Assignment evaluation / Laboratory Development Work etc.	0 – 0 – 0 (5)	5
		Total	**0 – 0 – 0 (40)**	**40**

FUEL TECHNOLOGY **3 – 0 – 0=06**

Course objective

The main aim of the course is to give an introduction to the different types of fossil fuels. The emphasis of the course will be on the characterizations and utilizations of solid fuels, basics of liquid and gaseous fuels.

Course outcome

At the end of this course students should able to analyze quality of fuels based on its properties and possible utilizations.

COURSE CONTENTS

Introduction: Introduction to energy resources, Indian perspective, Origin and formation of coal: Different theories on coal formation.

Coal Characterization: Coal, metamorphism, Rank of coal, coal petrography, classification of coal.

Properties and testing of coal: Size analysis, Proximate analysis, Ultimate analysis, Gross calorific value, Net calorific value, Free Swelling Index, Caking Index, Roga Index, LTGK, Dilatometric properties. Estimation of total moisture. Determination of HGI.

Coal Carbonization: Introduction to coal carbonization, Impact of coal constituents on coal carbonization, Behavior of coal at an elevated temperature, Pre carbonization techniques- Top charging, Stamp charging, Blending, Briquetting, Formed coke, Dry and wet quenching of coke.

Types of Carbonization- Low Temperature Carbonization and High Temperature Carbonization, Types of Ovens- Recovery and Non- recovery coke ovens, Flue arrangements. By- products recovery processes, methods of conservation of coking coal. Physical and Chemical properties of coke: Shatter index, Micum index, Coke reactivity index, Coke strength after reaction.

Coal Combustion: Fundamentals of coal combustion, combustion stoichiometry, Flue gas composition.

Coal Gasification: Fundamentals of coal gasification, producer gas, water gas.

Liquid Fuel: Introduction to crude oil and petroleum products.

Gaseous Fuel: Introduction to different types of gaseous fuels.

Books:

1. Fuels and Combustion: Samir Sarkar, University Press (India) Pvt Limited, India.
2. Elements of Fuels, Furnaces and Refractories: O P Gupta, Khanna Publishers, India
3. Fuels, Furnaces and Refractories: R C Gupta, PHI Learning Private Limited, India

COAL BENEFICIATION **4 – 0 – 0=08**

Course objective

a) To learn the characteristics of coal relevant to its preparation

b) To identify the different unit operations used for the preparation of coal for its utilization in thermal power plants and coke ovens

c) To get fundamental understanding of operation of industrial coal preparation plants

Course outcome: At the end of the course, the students would be able to

a) Appreciate the importance of coal and coal preparation for the Indian and global economies

b) Understand the construction and operation of crushers and screens used for coal preparation

c) Determine the expected yield and quality, and the expected difficulty of beneficiating a coal

d) Understand the operation of beneficiation units for coarse coal and fine coal, in Indian context

e) Carry out the performance analysis of coal beneficiation equipment

f) Get orientation of industrial coal preparation flowsheets.

COURSE CONTENTS

Introduction: coal formation, coal geology, types of coal and coal properties.

Necessity, scope and application of coal preparation; Mining methods and their effects on size, quality and liberation characteristics of coal; Selection, testing and utilization of metallurgical (coking) and thermal (non-coking) coal.

Coal resources, grading, market requirement.

Crushing: rotary breakers, roll and impact group of crushers; Grindability indices.

Screening: grizzley, vibrating screens, sieve bends and dewatering screens; Particle size distribution.

Sink - float tests and washability studies.

Gravity separation: Jigging principle, basic construction, types of commercial jigs; Heavy media separation, media requirement and recovery systems; Different types of bath their merits, demerits and application; Heavy media cyclones – construction and operating principles; Spirals - construction and operation; Choice between the washers.

Performance evaluation: partition curve, misplacement, probable error in separation, imperfection, yield reduction factor, organic efficiency.

Fine coal cleaning: froth flotation and water only cyclones – basic principles and their application; Factors affecting coal flotation performance.

Dewatering of coal by different methods: centrifuges, thickeners, cyclones and filters.

Typical flowsheets for preparation of metallurgical (coking) and thermal (non-coking) coal.

Coal preparation economics.

Books:

1. Coal Processing Technology (D. G. Osborne)
2. Coal Preparation (J. W. Leonard)
3. The Coal Handbook: Towards Cleaner Production (D. Osborne)
4. The Principles of Coal Preparation (G. J. Sanders)

COMBUSTION ENGINEERING **3 – 0 – 0=06**

Course objective: The main objective of the course is to give basic idea of combustion processes, their control and various types of industrial combustion units.

Course outcome: At the end of this course students will be able to analyze different types of combustion processes and mechanism to be adopted to control combustion process and associated pollution.

COURSE CONTENTS

Combustion Fundamentals: Introduction, Energy Sources, Fuels, Fuel cells, Combustion stoichiometry, excess oxygen, fuel ratio, Flue gas composition and Thermo-chemical Calculations, Chemical Kinetics and Equilibrium: Kinetic theory of gases, Chemical kinetics, Reaction kinetics, activation energy, Equilibrium composition and temperature, Conservation, energy and equilibrium equations.

Theoretical Models: Theoretical models of coal combustion, coal de-volatilization, burning temperatures models and profiles**.**

Influence of Fuel properties: Effects of fuel properties on combustion process and flue gas composition.

Environmental Aspects of combustion: Air Pollution due to combustion, Formation and Oxidation Kinetics of pollutants and related numerical problems. Pollutant Emissions Reduction Techniques.

Industrial combustion Processes: Boiler, Furnace, Oil & Gas Burner, Cement Kiln etc.

Coal firing methods: Grate firing, FBC, Pulverized firing, heat release.

Books:

1. Fundamentals of Combustion: D P Mishra, PHI Learning Private Limited, India
2. Fuels and Combustion: Samir Sarkar, University Press (India) Pvt Limited, India.
3. Fuels, Furnaces and Refractories: R C Gupta, PHI Learning Private Limited, India

CLEAN COAL TECHNOLOGY **3 – 0 – 0=06**

Course objective: The main aim of the course is to give fundamentals concept of efficient way of utilizing coal in different applications with minimum environmental impact.

Course outcome: At the end of the course student will be able to identify various techniques of utilizing coal for cleaner environment.

COURSE CONTENTS

Introduction to clean coal technology: Coal quality parameters for utilization in thermal power plant, cement, steel and DRI plant. Pre-combustion cleaning, during combustion cleaning, post-combustion cleaning, burning time, unburned carbon estimation and control. Biological and chemical cleaning methods.

Emission control: Fly ash, SO_x and NO_x control strategies during combustion and after combustion. Use of ESP, Cyclones, Filters and settling chambers.

Coal gasification: Gasifying agents: oxygen, air, steam, reactions involved in gasification. Effect of fuel properties on product, blending of fuels. Syn gas, Fuel gas.

Types of gasifiers: Fixed bed, moving bed, fluidized bed, entrained bed etc. Product gas cleaning and energy utilization, removal of H_2S, NH_3, tar, suspended particulate matter.

Other technologies: Underground coal gasification (UCG), Coal bed methane, recovery methane from CBM (Coal Bed Methane), CMM (Coal Mine Methane), AMM (Abandoned Mine Methane), combined cycle power generation (IGCC), oxy-fuel combustion.

Books:

1. Clean Coal Engineering Technology: Bruce G Miller, Elsevier Publications.
2. Fuels and Combustion: Samir Sarkar, University Press (India) Pvt Limited, India.
3. The Chemistry and Technology of Coal: James G Speight, Marcel Dekker.

COAL CARBONIZATION TECHNOLOGIES **3 – 0 – 0=06**

Course objective: The main aim of the course is to give detailed information about the coal carbonization technologies.

Course outcome: At the end of the course student will be able to identify various aspects of coal carbonization and identify effect of coal properties for coke making.

COURSE CONTENTS

Coal properties for coke making. Impact of coal constituents on coal carbonization. Behavior of coal during coke formation.

Fundamental aspects of carbonization. High and low temperature carbonization, Kinetics and Modeling of coal carbonization.

Coal carbonization technologies.. Beehive coke oven, Slot type by-product coke ovens, Non-recovery coke ovens, byproduct recovery systems, products from carbonization (solid and volatile products). Flue arrangements, regenerator and recuperators in coke ovens. Design, construction and operational aspects of coke ovens. Different methods of coal charging. Pre-carbonisation and Post-carbonisation technologies. Formed coke processes. Economics of coal carbonization processes.

Methods of conservation of coking coal. Utilization of lignite and low rank coals in coke making.

Books:

1. Introduction to Coal Technology: N N. Berkowitz, Elsevier Publications
2. The Chemistry and Technology of Coal: James G Speight, Marcel Dekker.
3. Chemistry of Coal Utilization, Second Supplementary Volume. Edited by M. A. Elliot.

FURNACES & REFRACTORIES **3 – 0 – 0=06**

Course objective: The main aim of the course is to give detailed information about operations of industrial furnaces, role of refractories in furnace, fabrication and characterization of refractories.

Course outcome: At the end of the course student will be able to identify the refractory properties required for efficient operations of furnaces.

COURSE CONTENTS

Types of furnaces and classification, industrial application of furnaces, design and construction aspects of furnaces. Chimney design, process efficiency. Fundamentals of heat transfer, heat loss, thermal efficiency of furnace, fuel economy, excess air, waste heat recovery etc.

Refractories: refractory material and characterization, types of Refractories and their application in boilers and furnace construction. Properties and testing methods of Refractories. Manufacture of fire bricks, basic, acidic and neutral refractories, refractory mortars, cements and monoliths, special refractory and ceramics. Role of refractories in energy conservation.

Books:

1. Elements of Fuels, Furnaces and Refractories: O P Gupta, Khanna Publishers, India
2. Fuels, Furnaces and Refractories: R C Gupta, PHI Learning Private Limited, India

MODELING AND SIMULATION OF ENERGY UTILIZATION SYSTEMS 3 – 0 – 0=06

Course objective: The main aim of the course is to give information about modelling approaches and simulations used in various industrial energy utilizations units.

Course outcome: At the end of the course, student will be able to theoretically quantify energy utilizing systems for energy efficiency.

COURSE CONTENTS

Introduction to modeling and simulation techniques, Conceptual flow sheet in modeling of a process plant. Modeling of energy exchange systems including heat exchangers, fluidized bed combustion, heating flues in coke oven, and modeling of selected waste heat recovery systems.

Simulation: Classes of simulation, different types of simulation techniques, simulation of heat exchangers, turbine system. Different optimization techniques and their application in coal blending and energy conservation systems.

Books:

1. Design of thermal systems: W F Stoecker
2. Add more books

COAL BENEFICIATION PRACTICAL **0 – 0 – 3=03**

1. Sampling of coal
2. Size analysis of coal
3. Crushing of coal
4. Washability analysis of coal
5. Froth Flotation of coal
6. Beneficiation of coal using
    a) Dense Medium Cyclones
    b) Water only cyclones
    c) Spiral Concentrators
    d) Jigging
    e) Dense medium baths
7. Filtration of coal
8. Flocculation of coal

FUEL TECHNOLOGY PRACTICAL **0 – 0 – 3=03**

1. Proximate Analysis of coal
2. Ultimate Analysis of coal
3. FSI Analysis of coal
4. Determination of Caking Index of coal
5. Determination of GCV of solid fuel
6. Determination of HGI of coal
7. Determination of LTGK of coal

LIQUID AND GASEOUS FUELS **3 – 0 – 0=06**

Course objective: The main aim of the course is to give detailed information about processing and utilization of liquid and gaseous fuels.

Course outcome: At the end of this course students will be able to analyze different types of liquid and gaseous fuels processing and characterizations.

COURSE CONTENTS

Liquid fuels: Liquid fuel resources, world and Indian statistics, methods for characterization of crude oil and its products, refinery operations, industrial process design, utilization of petroleum products, synthetic liquid fuels.

Gaseous fuels : Different types of gaseous fuels, resources of gaseous fuels and their characteristics, principles of manufacturing of gaseous fuels from coal and oil, kinetics and mechanism of gasification, production of industrial fuel gases, rich gases such as SNG, purification, storage and transportation of gaseous fuels**.**

Books:

1. Fuels and Combustion: Samir Sarkar, University Press (India) Pvt Limited, India.
2. Elements of Fuels, Furnaces and Refractories: O P Gupta, Khanna Publishers, India

POWER PLANT ENGINEERING **4 – 0 – 0=08**

Course objective: The main aim of the course is to give detailed information about operations of thermal power plants based on coal.

Course outcome: At the end of the course student will get detailed knowledge of thermal power plants.

COURSE CONTENTS

Introduction to modern power plants, electricity generation, transmission, power grid system. Electricity consumption pattern and importance of power grid for capacity estimation.

Types of power plant, General layout of modern power plant, site selection, and material requirement. Coal handling system, storage and feeding system, combustion equipment for steam boilers, ash-handling system.

Power Plant Cycles: Rankine, Reheat, Regenerative, Otto, Diesel, Dual Combustion, Gas Turbine. **Types of boiler:** Water tube, Fire tube, and High pressure. Feed and cooling water system, Boiler, condenser, cooling tower, process water recycle Heat balance, boiler and plant efficiency.

Introduction to gas and other fuel based power plant systems.

Books:

1. Power plant Engineering: P K Nag, Tata-Mcgraw Hill Publishing Company Limited, India
2. Power plant Engineering: Manoj Kumar Gupta, PHI Learning Private Limited, India
3. Green Power: The eco- friendly energy engineering; Nikolai V. Khartchenko

ENERGY CONSERVATION PROCESSES **3 – 0 – 0=06**

Course objective: The main aim of the course is to give detailed information about various energy conservation methods and their significance in plant operations.

Course outcome: At the end of the course student will be able to identify wastage of energy from various units and ways to minimize them.

COURSE CONTENTS

Introduction, definition, Need for Energy management, general principles of Energy management, planning for energy management, Energy Basics for Energy manager, starting of Energy management program, world Energy Utilization.

High temperature recovery systems, ceramic radiant tubes, boilers. Energy efficient utilization system. Thermal insulation, pipe line insulation, insulation materials. Insulation on thermal system and its effect on economics.

Heat exchangers for waste heat recovery. Heat pipes, liquid coupled and gas coupled indirect heat exchangers. Rotating regenerators, plate heat exchangers, economizers, recuperators, waste heat boilers, heat pumps, performance and application of waste heat recovery system. Design of waste heat recovery systems. Ideal heat pump cycles.

Energy conservation in thermal power plant, coke ovens, etc.

Factors influencing the efficiency of energy conservation systems. Efficient heat distribution & utilization. Reduction & recovery of excess energy. Performance and application of waste heat recovery system. Industrial wastes as sources of energy. Capital and operational cost for different alternatives on economics sensitivity analysis.

Books:

1. Energy management principle- Applications, benefits, savings by craig B.Smith Pergamon press.
2. Guide to energy management, Barney.L capehart, Wayne C Tar ner, William J Kennedy
3. Energy Efficiency in Electrical Utilities : Guide Book National Certification Examination for Energy Manager and Energy Auditors , Bureau of Energy Efficiency, New Delhi

ALTERNATIVE ENERGY SYSTEMS **3 – 0 – 0=06**

Course objective: The main aim of the course is to introduce students about non-conventional energy systems, power productions from non-fossil fuel sources.

Course outcome: At the end of the course student will get overview of various alternate energy options available in earth.

COURSE CONTENTS

Thermal System: Solar energy and Spectral Distribution, Sun Tracking, Heat Transfer for Solar Energy, Solar Energy Collection, Parabolic Trough, Central Receiver, Parabolic Dish, Solar thermal Power Plant, Flat Plate Solar collectors, Solar air heaters and their applications, Photovoltaic conversion, Solar cell, Storage of Solar energy, Solar ponds. Solar Thermal Power Plants.

Solar Photovoltaic Power System: The photovoltaic cell, Module and Array, Equivalent Electrical Circuit, Open Circuit Voltage and Short Circuit Current, Array Design, Sun Intensity, Sun Angle, Shadow Effect, Temperature Effect, Effect of Climate, Electrical Load Matching, Sun Tracking, Peak Power Point Operation, PV System Components.

Nuclear Energy: Fission and Fusion, Lawson's criteria for fusion, impacts of. byproducts on environment, Geothermal and Hydel energym Fissile and Fissionable materials, Heavy water, Theory of reactors.

Bio-energy: Bio diesel, anaerobic reactors, gas composition and yield etc. Biomass for industrial applications.

Wind energy: Speed and Power Relations, Power Extracted from the Wind, Rotor Swept Area, Air Density, Global Wind Patterns, Wind Speed Distribution.

Wind Power System: System Components, Tower, Turbine Blades, Yaw Control, Speed Control, Turbine Rating, Electrical Load Matching, Variable-Speed Operation, System Design Features, Number of Blades, Rotor Upwind or Downwind, Horizontal Axis Versus Vertical Axis, Spacing of the Towers, Maximum Power Operation, Constant Tip-Speed Ratio Scheme, Peak Power Tracking Scheme, System Control Requirements, Speed Control, Rate Control, Environmental Aspects, Audible Noise, Electromagnetic Interference (EMI)**.**

Tidal Energy, Hydro-power plants, Fuel cell.

Books:

1. Wind and Solar Power Systems: Mukund R. Patel, CRC Press, London.
2. B. H. Khan, Non-conventional energy resources, McGraw Hill, New Delhi.
3. C. S. Solanki, Renewable energy Technology, Prentice Hall Publication, 2008.

4. S. P. Sukhatme, Solar Energy, Tata McGraw Hill, New Delhi, 1996.
5. W. C. Turner, Energy management handbook, Wiley Press, 1982

CEMENT TECHNOLOGY **3 – 0 – 0=06**

Course objective: The aim of this course is to provide fundamental knowledge about cement manufacturing processes and utilization of different types of fuels in cement manufacturing.

Course outcome: After attending the course students will be able to understand cement manufacturing process and role of various fuels in cement manufacturing.

COURSE CONTENTS

Various processes of cement manufacture – dry, semi-dry and wet, overview of various unit operations. Indian cement industry, the global scenario.

Phase composition of clinker minerals and cement, pozzolanic reaction, hydration of cement, Raw mix proportioning, 2-, 3- and 4-component mixes, concepts of burn ability, absorption and effect of coal ash Different zones in a cement kiln, preheaters and precalcinators.

Coolers, burners, fuels, waste-derived fuels, Pet coke, refractory and refractory practices.

Approaches to energy conservation, energy audits, co-generation of power, Pollution control, noise abatement, concepts of LCA. EIA and EMP.

Books:

1. Chemistry of Cement and Concrete: F M Lea, Arnold, London
2. Cement Data Book: W. H Duda , Verlag G m Bh, Berlin, R. H. Bouge.
3. Chemistry of Portland Cement, Reinhold, New York

ENVIRONMENTAL ASPECTS **3-0-0=6**

Course objective: The aim of this course is to provide fundamentals knowledge about environmental protection during mining, processing and utilization of fossil fuels and well as various minerals.

Course outcome: After attending the course, students will be able to understand various reasons for environmental pollution and its preventive techniques in fuel processing industries.

COURSE CONTENTS

Introduction: Sustainable development, environmental carrying capacity concepts & principles; Environmental impacts of mining and associated activities.

Ecology: Introduction to ecology, ecosystem structures and functions.

Air pollution: Atmospheric composition and meteorology; sources of air pollution, point and non-point; emission factors; control measures, extraction, suppression and consolidation of dust.

Noise and vibration: Basic concepts, sources, monitoring and control measures.

Water pollution: Global hydrological cycle; Self-purification mechanism, sources of water pollution, important parameters–pH, turbidity, oil & grease, nitrates, DO, BOD, COD; Eutrophication, deoxygenation, acid mine drainage and heavy metal pollution– preventive and control measures.

Land environment: Land degradation due to mining; Physical and biological reclamation.

Environmental administration: Laws related to mining environment; EIA of mining projects.

Land Acquisition & Revenue: Concepts: Related laws and regulations.

Corporate Social Responsibility: Concepts and principles.

Mine and Plant closure: Concepts and principles.

Books:

1. Water Resources Engineering - LW Mays, Wiley Text Books, 2000.
2. Environmental Engineering- HS Peavy, RR Donald, G Tchobanoglous, MGH Int. Ed. NY, 1985.
3. Environmental Engineering - AP Sincero and GA Sincero, Prentice Hall of India, 1999.
4. Environmental Impact of Mining - CG Down & J Stocks, Applied Sc. Pub, London, 1978.
5. Environmental Impacts of Mining: Monitoring, Restoration and Control – M Sengupta, Lewis Publishers, Boca Raton, 1993.

BULK MATERIAL HANDLING EQUIPMENT **3 – 0 – 0=06**

Course objective: The objective of this course is to provide fundamental knowledge about different types of heavy equipment's, their design and operation and maintenance used in fuel industries.

Course outcome: after attending the course students will be able to understand design and regular maintenance activity of various heavy equipment's used in fuel industries.

COURSE CONTENTS

Properties of bulk material sand their handle-ability; Construction and operation of crushers-jaw, gyratory, cone, roll, hammer, ring granulator, feeder breaker, rotary breaker, in-pit crushers.

Construction and operation of feeders, screens, conventional belt conveyors, high angle conveyors, cable belt conveyor, chain conveyors, stackers, reclaimers, wagon loaders, wagon tipplers, bucket elevators, bins, bunkers, silos, selection, productivity and power calculations.

Books:

1. Materials Handling Equipment, MP Alexand Rov, MIR Publishers.
2. Good year hand book of belting, conveyor and elevator
3. Pneumatic Conveying; H. A. Stoess; John Wiley & Sons

COAL BED METHANE, GAS HYDRATES AND SHALE GAS/ OIL 3 – 0 – 0=06

Course objective: The aim of this course is to introduce students about alternate fossil fuel sources and their production methods.

Course outcome: After attending this course students will be aware of alternate fossil fuels, their production methods etc.

COURSE CONTENTS

Coal bed methane: Introduction & present status of coalbed methane, Global and Indian Scenario, Formation and properties of coalbed methane, Generation of coal bed methane gas & its properties, properties of coal as reservoir rock & Reserve Estimation. Thermodynamics of coalbed methane: isotherm studies, Overview of Drilling and Production systems of coalbed methane wells. Hydro-fracturing of coal seams. Treating and disposal of produced water. Testing of coal bed methane wells.

Natural gas hydrates: Introduction & present status of gas hydrates. Formation, accumulation and properties of gas hydrates. Thermodynamics, kinetics and phase behavior of gas hydrates. Drilling and production systems of gas hydrate wells. Prevention & control of gas hydrates. Gas extraction from gas hydrates. Uses and application of gas hydrates.

Shale gas/ oil: Global Scenario of shale gas/ Oil production. Nature, origin and distribution of Shale Gas/ Oil. Characterization of Shale for Production of Shale Gas/ Oil. Extraction methods of Shale gas/ Oil: development of current practices. Location and size of production areas: estimated reserves and economics. Environmental issues in shale gas exploration. Markets and Global impact on energy scenario. Economics of shale gas/oil production.

Books:

1. Coal Bed Methane: From Prospect to Pipeline: Edited by Pramod Thakur, Steve Schatzel, Kashy Aminian.
2. Fundamentals of Coalbed Methane Reservoir Engineering: John Seidle

LIQUID FUEL PRACTICAL **0 – 0 – 3=03**

1. Determination of Flash Point and Fire point of Liquid Fuel,
2. Determination of Viscosity of petroleum oils.
3. Determination of Aniline Point of diesel oil.
4. Determination of Carbon Residue of fuel oil
5. Determination of softening point of Bitumen.
6. Determination of Penetration Index of Bitumen & Wax.
7. Determination of Cloud and Pour Point of diesel oil
8. ASTM Distillation of crude oil and petroleum products.
9. Determination of Smoke point of kerosene oil.