MEEM 201: Clean Coal & Green Power Technology

Clean Coal Technologies- Super Critical Power cycles, Integrated Gasification Combined Cycles, Circulating fluidized bed combustion and gasification, Gas cleaning systems and environmental issues, Principles of Waste Heat Recovery and Co-Generation, Analysis of Heat Recovery Systems, Regenerators & Recuperators for waste Heat Recovery, Condensate and Back Pressure Steam Turbines, Design of Waste Heat Recovery Boilers, Combined Cycle Power Plants based on waste Heat Recovery

Zero Emission Technology
CO_2 Capture – Flue Gas Approach, Oxygen combustion Approach, Hydrogen/Syngas Approach.

Green Productivity: New Power cycles, Dry Ice co- generation, Biological CO_2 fixation with Algae, Zero Emission Technologies, Recycling of CO_2., Carbon Credits.
CO_2 Transportation, CO_2 Utilization & Storage:- Deep Saline Aquifers, Cost Considerations, CO_2 Capture, CO_2 Transportation, CO_2 Storage, Legal Issues, Environmental Health & Safety.

Advanced Energy Systems, Fluidized Bed Combustion, Atmospheric Fluidized Bed Combustion (AFBC), Pressurized Fluidized Bed Combustion (PFBC) and Circulating Fluidized Bed Combustion (CFBC),Clean Coal Technologies-Supercritical Cycles, Integrated Gasification Combined Cycle (IGCC), IGCC Power Plants, Flue Gas De-Sulfurization and Coal Beneficiation, IGCC Power Plant Cycle Efficiency, Cold and Hot Gas Clean-Up

Hydrogen, Fuel Cell, Thermoelectric Generator, MHD-generator, Fusion reactor: Hydrogen Production & Utilization as Energy Source ;Fuel Cells; Types of Fuel cells; Fuel Cell Power Plant concepts.

References:

1. Power Generation Technology-Dr.V.K.Sethi,Book Paradise
2. Solar Energy Thermal Processes, J. A. Duffire and W. A. Beckmen .
3. Applied Solar Energy, A. B. Meinel .
4. Wind Power, V. D. Hunt.
5. Energy and Environment, Himalya Publishing House, Mumbai, H.V. Jadhav.
6. Biomass, Energy and Environment Oxford University Press, NH Ravindranath and DO Hall.
7. Power Plant Engineering by Domkundwal
8. A Rationale on Adoption of IGCC Technology for Indian Coals... By Dr V K Sethi & Dr D N Reddy
9. Green Engineering (Environmental Conscious Design of Chemical Processes) by Allen & Shonnard
10. Green Power : The Eco-friendly Energy Engineering by Nikolai V Khartchenko
11. Power Plant Performance Monitoring by Gay, Palme,r Erbes\
12. TEDDY: TERI Year book Solutions for the 21st Century IEA Publications & TSR, USA

MEEM 202: Wind Power Generation

The Wind Energy Resource :

Nature of atmospheric winds ; wind resource characteristics and assessment; anemometry; wind statistics; speed frequency distribution, effect of height, wind rose, weibull distribution, atmospheric turbulence, gust wind speed, effect of topography.

Aerodynamics:

Velocity and force vector diagrams of wind turbine blades, Aerodynamics of aerofoil, lift forces, drag forces , stall, effect of Reynolds's number, actuator disc, momentum theory and Betz coefficient. Coefficient of power optimal choice of cut- in, rated and cut- out wind speeds, blade element theory, Residual velocity capture-Contour Rotation.

Design Features:

Vertical and horizontal axis turbines, design characteristics, multiple stream tube theory, vortex wake structure, tip losses, rotational sampling, wind turbine design programs aerodynamics loads, tower shadow, wind shear blade coning gyroscopic, transient and extreme loads.

Operation and Controls Mechanisms:

Power performance, pitch control, yaw control, aerodynamic braking, teeter mechanism, control policies and their effect on energy capture and mechanical stress on wind turbine components. Wind turbine dynamics with induction and synchronous generators. Power electronics interfaces for variable speed operation wind farm electrical design.

Economic, Environmental and Social issue:

Planning/ Economic considerations for wind power generation, Environmental impact and assessment, noise impact electromagnetic interface. Site selection for wind farms, maintenance and operation. Case studies of wind power generation plants.

Books and References :

1. Wind Energy Technology – John F. Bakar & Jenkins .
2. Paul Gipe, wind Energy Comes of Age, John Wiley & Sons Inc.
3. L.L. Freris, Wind Energy conversion System, Printice Hall.
4. Tony Burton et al, wind Energy Hand Book, John Wiley & Sons Inc.
5. Directory, Indian Wind power 2004, CECL, Bhopal .
6. Wind Energy,Theory & Application-Siraj Ahmed .

MEEM 203: FUEL TECHNOLOGY & AIR POLLUTION

Introduction: Types, composition, properties, resources and classification of solid fuels, Principal of combustion: Solid, Liquid, and gaseous fuels, coal as a source of energy and chemicals in India. Classification of coals, analysis of coal, Coal carbonization – Mechanism, Low temperature carbonization high temperature carbonization, Coal preparation, Natural Gases and its derivatives, Sources and potential,Combustion appliance for solid and gaseous fuels.

Origin of Petroleum: Production, Composition classification of petroleum, Indian Petroleum resources and their nature, Petroleum processing distillation cracking thermal and catalytic coking reforming. Fuel Oils, Octane number, properties and testing of petroleum and petroleum products, Liquefaction of coal, oil burners.

Gasoline: Production, Composition properties, knocking and Octane Number, Diesel fuels, Kerosene. Types of Gaseous Fuels, composition and calorific values, Natural gas, Liquefied petroleum gas, cleaning and purification of gaseous fuels; CNG, Nuclear fuel.

Biofuels: Introduction, classification, Importance, Production and applications; Production processes and technologies; Production of alcohol and biogas. Bio-diesel: Fundamentals; Trans-esterification of vegetable oils for biodiesel production; Characterization of biodiesel; **Biomass based Power Generation**, Combustion & Gasification Routes, Co-generation; Bagasse based Power Generation, BIG-GT system.

Air Pollution: Air Pollution and Air Pollutants – Classifications and Sources. Effects of Air pollutants on man, material and vegetation, Global effects of air pollution; Generation, transport and decay of air pollutants; Air pollution indices; air-fuel ratio; Control of particulates, Control Equipment, Sampling and monitoring methods.

References:

1. Coke, Cake and Coal Chemicals, by Wilson, P.J., Wells, G.H.-- McGraw Hill
2. Fuels and Fuel Technology, by Francis– Vol. I and II Pergamon Press
3. Fuels, Solid, liquid and Gaseous, by Brame, J.S. and King, J.C. -- St. Martin Press
4. Fuels and their combustion, by Haslam, R.T. Russal, R.P. -- .McGraw hill
5. Fuel & Combustion, 2nd by Samir Sarkar.– Orient Longman.
6. Air pollution By M.N.Rao and H.V.N.Rao – Tata Mc.Graw Hill Company.
7. Air pollution by Wark and Warner.- Harper & Row, New York.
8. An introduction to Air pollution by R.K. Trivedy and P.K. Goel, B.S. Publications.
9. Biomass as Fuel – L.P.White (Academic press1981)

MEEM 204: Energy Conservation, Management & Audit

Energy Scenario: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change, Energy Conservation Act-2001 and its features.

Electrical Billing, Power Factor & Capacitors, Load Management, Energy Conservation in Motors & Transformers (Types, Characteristics), Pumps, Compressors, Blowers, Fan Cooling Towers.

Energy Conservation Opportunities in Compressed Air Distribution System, Lighting System, Energy Conservation through: Variable Speed Drives.

Energy Audit, Need, Types of Energy Audit, Energy Management Audit Approach,- Understanding Energy Costs, Matching Energy Use to Requirement, Maximizing System Efficiencies, Optimizing the Input Energy Requirements, Energy Audit Instruments.

Investment Need, Appraisal and Criteria, Financial Analysis Techniques-Simple Payback Period, Return on Investment, Net Present Value, Internal Rate of Return, Cash Flows, Risk and Sensitivity Analysis; Financing Options, Energy Performance Contracts and Role of ESCOs.

References:

1. Energy Conservation in Process Industry, Kenny W.F.
2. Energy Conservation & Utilization, Krenz H. Jerrold
3. Waste Energy Utilization Technology, Kiang, Yen Hsiung
4. Waste less Chemical Processing, Kafarov, V.V.
5. Electrical Energy Utilization & Conservation, Tripathy, S.C.
6 Efficient Electrical use by C.B. Smith
7 Savings Electricity in Utility Systems of Industrial Plants by B. G. Desai, B.S. Vaidya D.P. Patel &R. Parman
8 Efficient Use of electricity in industries by B.G. Desai, B.S. Vaidya, M.P. Parmarad R. Parman
9 Pump application desk Book by P.N. Garagy
10 Electrical Power Distribution in Industrial plants by M.D. Parmar
11 Electronic Energy Utilization and Conservation by S.C. Tripaths
12 Industrial Energy Management & Utilization, Hemisphere Publishing Corporation, Washington, G.L. Witte, Philips S. Scbmidt and Daid R. Brown.
13 Principles of Management , Vol I, II,& III by S. Tarachand.
14 Industrial Management by O.P. Khanna.

MEEM 205: Clean Development Mechanism

Major objective of CDM, Projects for benefit from CDM finance, CDM methodology, CDM opportunities & priorities in India, flow of fund in Kyoto protocol.

Status of CDM today, Technology assimilation, Transfer of technology, Flow of fund under CDM, Competitors and major developers in India.

Technology & Market Assessment of various Power plants- IGCC, Super Critical, Combined Cycle, CFBC and Novel Energy devices.

Analysis of selected CDM options: Micro- Hydro Power Generations, Biomass Power Generation, Wind Power Generation, Clean Coal Technology, Indicative Simplified Baseline and Monitoring Methodologies for selected Small Scale CDM project activity Categories.

Case Studies, Typical Case studies of BOF Gas Waste Heat Recovery, Optimal Utilization of clinker and Conversion, Example of Calculation.

References:

- **CDM and JI in Charts:** IGES-Institute for Global Environmental Strategies, Ver-1.0 and Ministry of the Environment, Japan
- **A Rational on CDM:** Dr. V. K. Sethi, Prof & Head (Energy Deptt.) RGTU, Bhopal