Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of UGC Act 1956)
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech - Energy Engineering (Part Time)
Curriculum and Syllabus
2013 Regulation

I SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13T001	Advanced Thermodynamics	3	1	0	4
2	MME13T002	Advanced Heat transfer	3	1	0	4
3	MME13T021	Renewable Energy System	3	0	0	3
4	MME13T003	Instrumentation for Thermal Systems	3	0	0	3
TOTAL			**12**	**2**	**0**	**14**

II SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MMA130014	Applied Mathematics for Energy and Thermal Engineers	3	1	0	4
2	MME13E001	Advanced Energy Technologies	3	0	0	3
3	MME13T009	Fuels and Combustion	3	1	0	4
4	MME13E002	Energy Conservation and Management Techniques	3	0	0	3
5	MXX13XXX	Elective I	3	0	0	3
TOTAL			**15**	**2**	**0**	**17**

III SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13T020	Environmental Engineering and Pollution Control	3	0	0	3
2	MME13E003	Co-Generation	3	0	0	3
3	MXX13XXX	Elective II	3	0	0	3
4	MME13EL01	Energy Systems Laboratory	0	0	4	2
TOTAL			**9**	**0**	**4**	**11**

IV SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13E005	Energy Conversion Techniques	3	0	0	3
2	MME13E006	Nuclear Energy Technology	3	0	0	3
3	MXX13XXX	Elective III	3	0	0	3
4	MME13EL02	* Practical Training	0	0	6	3
TOTAL			**9**	**0**	**6**	**12**

* Students should undergo intensive training in any Energy Industry in the area of energy conservation / Energy auditing for a minimum period of one month and should submit a report on the practical training. At the end of IV Semester viva voce examination will be conducted with internal and external examiners and this course carries 3 credits

V SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13E007	Bio Energy Technology	3	0	0	3
2	MXX13XXX	Elective IV	3	0	0	3
3	MME13EL03	Project Phase-I	0	0	6	3
TOTAL			**6**	**0**	**6**	**9**

***** Students should identify the topic of the Project and should collect the literatures and datas, at the end of the semester the students should submit their Project Phase-I report to the Department and Viva-Voce examination will be conducted with external examiners and this carries 3 credits.

VI SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13EL04	*Project Phase-II	0	0	24	12
TOTAL			**0**	**0**	**24**	**12**

*Student should have presented a paper on the project area in International or National conference/Journals and should attach the certificate in proof and the published paper in the project report.

TOTAL NO.OF CREDITS : 75

LIST OF ELECTIVES						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13EE01	Thermal Energy System	3	0	0	3
2	MME13EE02	Fluidized Bed Systems	3	0	0	3
3	MME13EE03	Boiler Technology	3	0	0	3
4	MME13EE04	Hydro Power Systems	3	0	0	3
5	MME13EE05	Energy Management and Economics	3	0	0	3
6	MME13EE06	Wind Energy Engineering	3	0	0	3
7	MME13EE07	Energy Generation and Waste Management	3	0	0	3
8	MME13EE08	Energy Conservation in Buildings	3	0	0	3
9	MME13EE09	Solar Refrigeration and Air-conditioning	3	0	0	3
10	MME13TE01	Thermal Storage Systems	3	0	0	3
11	MEE13AE01	Power generation Transmission and Utilization	3	0	0	3
12	MEE13AE02	Electrical Drives & Controls	3	0	0	3
13	MEE13AE03	Optimization of Power System	3	0	0	3
14	MCS13AE01	Information Technology in Energy Management	3	0	0	3

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MME13T001 **ADVANCED THERMODYNAMICS** **3 1 0 4**

(Common to Thermal and Energy Engineering)

UNIT I: LAWS OF THERMODYNAMICS **12 Hrs**

First law of thermodynamics –concept of enthalpy- thermodynamics systems – energy balance equations. Second law of thermodynamics - thermodynamic temperature scale - inequality of clauses - concept of entropy - third law of Thermo dynamics and its significance. Reversible work, Availability, Irreversibility and Second-Law Efficiency for a Closed System and steady-State Control Volume.

UNIT II: PROPERTIES OF GASES AND GAS MIXTURES **12 Hrs**

Equation of state of gas-ideal gas-Avogadro's law-Properties of mixture of gases-Law of corresponding states-Dalton's law of partial pressures-Internal energy, Enthalpy and specific heats of gas mixtures-Entropy of gas mixtures-Gibbs function of a mixture of inert ideal gases

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UNIT III: THERMODYNAMIC RELATIONS **12 Hrs**

Theorems of mathematical relations- Maxwell relations — Clapeyron equation — Relations for Specific heat, internal energy, enthalpy, entropy — Gibb's functions — Helmoltz function — Joule Thompson coefficient, applications of special functions with reference to reactive and non-reactive systems.

UNIT IV: CHEMICAL THERMODYNAMICS AND EQUILIBRIUM **12 Hrs**

Thermo chemistry, First Law analysis of reacting systems, Adiabatic Flame temperature, Entropy change of reacting systems, Second Law analysis of reacting systems, Criterion for reaction equilibrium composition, Chemical availability, Availability of reacting systems.

UNIT V: STATISTICAL THERMODYNAMICS **12 Hrs**

Microstates and Macrostates,Thermodynamic probability, Degeneracy of energy levels, Maxwell-Boltzman,Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and work, Evaluation of entropy, Partition function, Calculation of the Macroscopic properties from partition functions, Equilibrium constant statistical thermodynamic approach.

Total no. of Hrs : 60

REFERENCES

1. Kenneth Wark, Jr. (1995) *Advanced Thermodynamics for Engineers*, McGraw-Hill Inc
2. Bejan, A. (2006) *Advanced Engineering Thermodynamics*, John Wiley and Sons
3. Holman, J.P. (1997) *Thermodynamics*, Fourth Edition, McGraw-Hill Inc
4. Smith, J.M. and Van Ness., H.C. (2005) *Introduction to Chemical Engineering Thermodynamics*, Fourth Edition, McGraw-Hill Inc
5. Sonntag, R.E., and Van Wylen, G. (1998) *Introduction to Thermodynamics, Classical and Statistical*, Third Edition, John Wiley and Sons
6. Sears, F.W.and Salinger G.I. (1993) *Thermodynamics*, *Kinetic Theory and Statistical Thermodynamics*, Third edition, Narosa Publishing House
7. DeHotf,R.T. (2006) *Thermodynamics in Materials Science*, McGraw-Hill Inc
8. Rao,Y.V.C. (1994) *Postulational and Statistical Thermodynamics*, Allied Publisher Limited

MME13T002 **ADVANCED HEAT TRANSFER** **3 1 0 4**

(Common to Thermal and Energy Engineering)

UNIT I: COUNDUCTION **12Hrs**

Transient Heat Conduction- Exact Solutions, - Semi infinite solids-Use of Hiesler and Grober chart-Integrated Method. Solving conduction problems using Numerical methods. Extended surfaces-Stead State Analysis and optimization-Radial Fins of Rectangular and Hyperbolic Profiles-Longitudinal Fin of Rectangular Profile Radiating to Free space.

UNIT II: CONVECTION **12Hrs**

Review of concept of Boundary Layer- Forced Convection – Momentum and Energy Equations- Turbulent model-Prandtl mixing length-Von-Karman, Reynolds and Colburn analogy Internal and external Flows- Forced Convection over Plates, Cylinders and Spheres- Turbulent flow in a tube- Bank of Tubes. Free convection-empirical correlations- vertical, horizontal plates and cylinders.

UNIT III: HEAT EXCHANGERS **12Hrs**

Heat Exchanger equipments and analysis – Logarithmic Mean Temperature Difference, Effectiveness and Number Transfer Units approach – Overall heat transfer coefficient-correction factors for multi pass arrangements-Pressure drop and pumping power- Compact heat exchangers, packed and fluidized systems. Heat exchangers applications- Industrial gas liquefaction (oxygen, nitrogen, argon, helium)

UNIT IV: PH ASE CHANGE HEAT TR ANSFER **12Hrs**

Boiling heat transfer–boiling regimes-bubble growth and collapse-boiling correlations- Nucleate and film boiling-Boiling heat transfer in heat exchangers.Condensation heat transfer –Laminar film condensation on vertical plates-turbulent film condensation on horizontal tubes- Influence of presence of Non condensable gases in refrigeration system.

UNIT V: RADIATION **12Hrs**

Review of radiation shape factor- Thermal shields- concept of Radiosity method- radiation by gases and flames-Radiative heat Exchange in Furnaces- Radiation Characteristics of particle systems, Thermal Radiation of a luminous fuel oil - Soot Flame.

Total no. of Hrs : 60

***NOTE:** *Use of approved heat transfer data book permitted*

REFERENCES

1. Incropera F.P and DeWitt,D.P (2011) *Fundamentals of Heat & Mass Transfer,* John Wiley & Sons
2. Ozisik,M.N.(1985*) Heat Transfer – Basic Approach,* McGraw-Hill Co
3. Schlichting, Gersten,(2000) *Boundary layer Theory,* Springer
4. Nag, P.K. (2002)*Heat Transfer*, Tata McGraw-Hill
5. Rohsenow ,W.M. Harnett, J.P. and Ganic, E.N.(1998) *Handbook of Heat Transfer Applications,* Tata McGraw Hill,
6. Anthony F Mills, (1995) *Basic Heat and Mass Transfer*, Irwin Publishers.

MME13T021 **RENEWABLE ENERGY SYSTEM** **3 0 0 3**

(Common to Thermal and Energy Engineering)

UNIT I: INTRODUCTION **7 Hrs**

World energy use – Reserves of energy resources – Environmental aspects of energy utilization – Renewable energy scenario in India – Potentials – Achievements – Applications.

UNIT II: SOLAR ENERGY **10 Hrs**

Solar thermal – Flat plate and concentrating collectors – Solar heating and cooling techniques – Solar desalination – Solar Pond – Solar cooker – Solar thermal power plant – Solar photo voltaic conversion – Solar cells – PV applications.

UNIT III: WIND ENERGY **10 Hrs**

Wind data and energy estimation – Types of wind energy systems – Performance – Details of wind turbine generator – Safety and Environmental Aspects.

UNIT IV: BIOMASS ENERGY **9 Hrs**

Biomass direct combustion – Biomass gasifier – Biogas plant – Ethanol production – Bio diesel – Cogeneration – Biomass applications.

UNIT V: OTHER RENEWABLE ENERGY SOURCES **9 Hrs**

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro – Geothermal energy – Fuel cell systems.

Total no. of Hrs : 45

REFERENCES

1. Rai, G.D. (1999) *Non Conventional Energy Sources*, Khanna Publishers
2. Sukhatme, S.P. (1997) *Solar Energy*, Tata McGraw Hill Publishing Company Ltd., New Delhi
3. Godfrey Boyle,(1996) *Renewable Energy, Power for a Sustainable Future*, Oxford UniversityPress
4. Twidell, J.W. & Weir, A.(1986) *Renewable Energy Sources*, EFN Spon Ltd
5. Tiwari, G.N. (2002)Solar Energy – *Fundamentals Design, Modeling and applications*, Narosa Publishing House
6. Freris, L.L. (1990) *Wind Energy Conversion systems*, Prentice Hall
7. Johnson Gary, L. (1985) *Wind Energy Ssystems*, Prentice Hall

MME13T003 INSTRUMENTATION FOR THERMAL SYSTEMS 3 0 0 3

(Common to Thermal and Energy Engineering)

UNIT I: MEASUREMENT CHARACTERISTICS 10 Hrs

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT II: MICROPROCESSORS BASED MEASUREMENTS 7 Hrs

Data logging and acquisition – elements of microcomputer interfacing, intelligent instruments in use

UNIT III: MEASUREMENT OF PHYSICAL QUANTITIES 10 Hrs

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables.

UNIT IV: ADVANCED MEASUREMENT TECHNIQUES 9 Hrs

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, Heat flux sensors, Telemetry in measurement.

UNIT V: MEASUREMENT ANALYSERS 9 Hrs

Orsat apparatus, Gas Analyzers, Smoke meters, gas chromatography, spectrometry.

Total no. of Hrs : 45

REFERENCES

1. Holman, J.P. (1988) *Experimental methods for engineers*, McGraw-Hill
2. Barney,(1988) *Intelligent Instrumentation*, Prentice Hall
3. Prebrashensky,V.(1980)*Measurements and Instrumentation in Heat Engineering*, Vol.1 and 2, MIR Publisher
4. Raman, C.S., Sharma, G.R., Mani, V.S.V.(1983) *Instrumentation Devices and Systems*, Tata McGraw Hill
5. Doeblin, (1978) *Measurement System Application and Design*, McGraw Hill.
6. Morris,A.S.(1998) *Principles of Measurements and Instrumentation*, Prentice Hall
7. George C barney, (1995) *Intelligent Instrumentation Microprocessor and Applications in Measurements and Control*, Prentice Hall

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DEPARTMENT OF MECHANICAL ENGINEERING

MMA130014 APPLIED MATHEMATICS FOR ENERGY AND THERMAL ENGINEERS 3 1 0 4

(Common to I yr. / I Sem. M.Tech (Full Time) – Mechanical (Energy, Thermal))
[2013 batch onwards]

UNIT I: ANALYTIC FUNCTIONS **12 Hrs**

Analytic functions – Cauchy Riemann equations – Construction of analytic functions – Conformal mapping - – Simple Transformations – Standard transformations : $w = z^2$, $w = e^z$, $w = \sin z$, $w = \cosh z$ – Bilinear transformations.

UNIT II: TRANSFORM METHODS **12 Hrs**

Fourier Transform methods – One dimensional heat conduction problems in infinite and semi- infinite rod – Laplace equation – Poisson equation.

UNIT III: CALCULUS OF VARIATIONS **12 Hrs**

Variation and its properties – Euler's equations – Functionals dependent on First and higher order derivatives – Functionals depend on functions of several independent variables – Problems with moving boundaries – Direct methods – Ritz and Kantorovich methods.

UNIT IV: CONFORMAL MAPPING AND APPLICATIONS **12 Hrs**

The Schwarz-Christoffel transformation – Transformation of boundaries in parametric form – Physical applications: Fluid flow and Heat flow problems**.**

UNIT V: FINITE DIFFERENCE METHODS **12 Hrs**

One dimensional Parabolic equation – Schmidt explicit formula – Crank-Nicolson implicit scheme – Two dimensional Parabolic equations – ADI method – Elliptic equations – Solutions of Laplace and Poisson equations in a rectangular region.

Total no. of Hrs: 60

REFERENCES

1. Grewal, B.S. (2012) *Higher Engineering Mathematics*, Khanna Publishers
2. Gupta, A.S. (2004) *Calculus of variations with applications*, Prentice Hall
3. Sankara Rao, K. (2010) *Introduction to Partial Differential Equations* (3rd ed.), Prentice Hall
4. Sneddon, I.N. (2006) *Elements of Partial Differential Equations*, Dover Publications
5. Sankara Rao, K. (2009) *Numerical methods for Scientists and Engineers* (3rd ed.), Prentice Hall
6. Kreyszig, E. (2011) *Advanced Engineering Mathematics* (9 th ed.), John Wiley & Sons
7. Spigel, M.R. *Theory and problems of complex variables*, Mcgraw-Hill
8. .Hildebrand, F.B. (1992) *Methods of Applied Mathematics*, Dover Books

MME13E001 **ADVANCED ENERGY TECHNOLOGIES** **3 0 0 3**

UNIT I: FLUIDIZED BED COMBUSTION **9 Hrs**

Clean coal technologies — Fluidized bed combustion — particles and fluidization. Fluidized bed heat transfer — Types of fluidized bed combustion — Design of simple fluidized beds.

UNIT II: CIRCULATING FLUIDIZED BED **9 Hrs**

Introduction to circulating fluidized bed - Hydrodynamics - Solids motion and mixing in circulating fluidized beds - Combustion performance – Design considerations for CFB boilers -Applications of CFB technology to gas-solid reactions - Design and scale-up of CFB catalytic reactors.

UNIT III: COMBINED CYCLE **9 Hrs**

Combined cycle power generation - topping and Bottoming cycles - Variations - Matching of power cycles - Base and peak load considerations vis-à-vis efficiency.

UNIT IV: INTEGRATED GASIFICATION COMBINED CYCLE **9 Hrs**

Integrated gasification combined cycle - Gasifier - Operation and Configuration details Fuel flexibility and other issues.

UNIT V: FUEL CEL **9 Hrs**

Fuel cell based power generation - types of fuel cells, Solid oxide and proton exchange membrane type fuel cells - Power generation and automotive applications, fuel cell based combined cycles - fuel cell stacks - relative performance.

Total no. of Hrs : 45

REFERENCES

1. Howard, J.R.(1989) *Fluidized Bed Technology Principles and Applications* - Adam Hilger
2. Howard,J.R. (Ed) (1997) *Fluidized Beds Combustion and applications*, Applied Science publishers
3. Grace,J.R., et al. (1997) *Circulating fluidized Beds* Blackie Academic and Professional
4. Reed,T.B. (1981) *Biomass gasification : Principles and technology*, Noyes Data Corporation
5. Horlock,J.H.., (1997) *Co-generation combined Heat and Power* ,Pergamon press
6. Twidell, J.W. and Weir AD. (1986) *Renewable Energy Sources*, ELBS
7. Bansal, N.K., et al,(1990) *Renewable Energy Sources*, Tata McGraw Hill Book Co
8. *ASME Journal of Energy Resources Technology* ,Back volumes

MME13T009 **FUELS AND COMBUSTION** **3 1 0 4**
(Common to Thermal and Energy Engineering)

UNIT I: CHARACTERIZATION **11 Hrs**

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation – Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

UNIT II: SOLID FUELS AND LIQUID FUELS **13 Hrs**

Solid fuels- Types – Coal Family – Properties – Calorific Values – ROM, DMMF, DAG and Bone Dry Basis – Ranking – Bulk & Apparent Density – Storage – Washability – Coking & Caking Coals – Renewable Solid Fuels – Biomass – Wood Waste – Agro Fuels – Manufactured Solid Fuels.
Liquid Fuels - Types – Sources – Petroleum Fractions- Classification – Refining – Properties Of Liquid Fuels – Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols – Tar Sand Oil – Liquefaction Of Solid Fuels.

UNIT III: GASEOUS FUELS **10 Hrs**

Classification – Composition & Properties – Estimation Of Calorific Value – Gas Calorimeter. Rich & Lean Gas – Wobbe Index – Natural Gas – Dry & Wet Natural Gas Stripped NG – Foul & Sweet NG – LPG – CNG – Methane – Producer Gas - Gasifiers Water Gas – Town Gas – Coal Gasification – Gasification Efficiency – Non – Thermal Route – Biogas – Digesters – Reactions – Viability – Economics.

UNIT IV: COMBUSTION STOICHIOMETRY & KINETICS **15 Hrs**

Stoichiometry – Mass Basis & Volume Basis – Excess Air Calculation – Fuel & Flue Gas Compositions – Calculations – Rapid Methods – Combustion Processes – Stationary Flame Combustion Explosive Combustion. Mechanism Of Combustion – Ignition & Ignition Energy – Spontaneous Combustion- Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion – Flame Temperature – Theoretical, Adiabatic & Actual – Ignition Limits – Limits Of Inflammability.

UNIT V: COMBUSTION EQUIPMENTS **11 Hrs**

Coal Burning Equipments – Types – Pulverized Coal Firing – Fluidized Bed Firing – Fixed Bed & Recycled Bed – Cyclone Firing – Spreader Stokers – Vibrating Grate Stokers Sprinkler Stokers, Traveling Grate Stokers. Oil Burners – Vaporizing Burners – Air Aspiration Gas Burners – Burners Classification According To Flame Structures – Factors Affecting Burners & Combustion.

Total no. of Hrs : 60

REFERENCES

1. Samir Sarkar,(1990) *Fuels & Combustion,* 2nd Edition, Orient Logman,latest Edition
2. Bhatt,Vora(1984) *Stoichiometry,*2nd Edition, tata Mcgraw Hill
3. Blokh AG,(1988) *Heat Transfer in Steam Boiler Furance*, Hemisphere Publishing Corpn
4. Civil Davies, *(*1966) *Calculations in Furnace Technology,* Pergamon Press, Oxford
5. Sharma SP,Mohan Chander, (1984) *Fuels & Combustion,* Tata Mcgraw Hill

MME13E002 ENERGY CONSERVATION AND MANAGEMENT TECHNIQUES 3 0 0 3

UNIT 1: NECESSITY FOR ENERGY AUDIT AND MANAGEMENT 9 Hrs

An overview of energy consumption and its effects. Current India energy consumption; Major sectors & fuels, delivered and end-use energy; trends; reasons to save energy (financial and environmental); global warming; global political impact of high fossil fuel and nuclear consumption; some possible futures.

UNIT II: PROCESS INTEGRATION 9 Hrs

Pinch technology, Basic concepts of pinch technology, stream networks. The significance of pinch, Design of energy recovery system, selection of pinch temperature difference, Tabular method, stream splitting, process retrofit, Installation of heat pumps, Installation of heat engines. The grand composite curve, general comment about process Integration.

UNIT III: ENERGY ANALYSIS, ASSESSMENT AND MONITORING 9 Hrs

Financial techniques for assessing energy conservation measures, Lifestyle costing; paybacks; discounted cash flow methods; spider diagrams. Lifecycle analysis and energy accounting. Concept of net lifetime energy balance; difficulty of deciding which energy costs/gains to include.

UNIT IV: ENERGY MANAGEMENT AND CONTROLS 9 Hrs

Energy management and monitoring & targetingOrganisational background desired for energy management; persuasion/motivation/ publicity role; tariff analysis; detailed process of M&T. Electronics controls and industrial energy management systems. Thermostats, Boiler controls; proportional, differential and integral control, optimizers; compensators.

UNIT V: ENERGY AUDITS AND ENERGY MODELING 9 Hrs

Surveys; steady — state computer models; dynamic models; advantages and disadvantages.

Total no. of Hrs : 45

REFERENCES

1. Eastop, T.D. & Croft, D.R., (1990) *Energy Efficiency for Engineers and Technologists* Longman Harlow,
2. O' Callaghan, Paul,W.(1980) *Buildings for Energy Conservation*, Pergamaon Press, London.
3. O' Callaghan, Paul, W. (1981) *Design and Management for Energy Conservation*, Pergamaon Press, London.
4. Macmillan, (1985) *Macmillan Dictionary of Energy*, London.
5. Kothandaraman,C.P. & Subramanyan, S (1977), *Heat and Mass Transfer Data Book*, John Wiley & Sons
6. Sborn, Peter D,(1990) *Hand book of Energy data and Calculations including directory of products and Services*, Butterworths, London

MME13T020 **ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL** **3 0 0 3**

(Common to Thermal and Energy Engineering)

UNIT I: INTRODUCTION **9 Hrs**

Global atmospheric change – green house effect – Ozone depletion - natural cycles - mass and energy transfer – material balance – environmental chemistry and biology – impacts – environmental. Legislations.

UNIT II: AIR POLLUTION **9 Hrs**

Pollutants - sources and effect – air pollution meteorology – atmospheric dispersion – indoor air quality - control methods and equipments - issues in air pollution control – air sampling and measurement.

UNIT III: WATER POLLUTION **9 Hrs**

Water resources - water pollutants - characteristics – quality - water treatment systems – waste water treatment - treatment, utilization and disposal of sludge - Monitoring compliance with standards.

UNIT IV: WASTE MANAGEMENT **9 Hrs**

Sources and Classification – Solid waste – Hazardous waste - Characteristics – Collection and Transportation - Disposal – Processing and Energy Recovery – Waste minimization.

UNIT V: OTHER TYPES OF POLLUTION FROM INDUSTRIES **9 Hrs**

Noise pollution and its impact - oil pollution - pesticides - instrumentation for pollution control - water pollution from tanneries and other industries and their control – environment impact assessment for various projects – case studies.

Total no. of Hrs : 45

REFERENCES

1. Masters, G. (2003) *Introduction to Environmental Engineering and Science*, Prentice Hall of India Pvt Ltd
2. Rao, C .S.(2006) *Environmental Pollution Control Engineering*, 2nd Edition, New Age International Publishers
3. Ludwig, H., Evans, W (1991) *Manual of Environmental Technology in Developing Countries*, International Book Company, Absecon Highlands
4. Arcadio P Sincero and Sincero, G. A.(2002) *Environmental Engineering – A Design Approach*, Prentice Hall of India Pvt Ltd

MME13E003 **CO - GENERATION** **3 0 0 3**

UNIT I: CO-GENERATION **9 Hrs**

Concept of cogeneration - Combined cycles for power generation and process heat - Topping and Bottoming cycles - Thermodynamic analysis of Integrated energy systems includes Fuel Cell based combined cycle plants.

UNIT II: INTEGRATED ENERGY SYSTEMS **9 Hrs**

Comparative thermodynamic performance of integrated energy systems - Performance evaluation - Numerical examples - calculations of typical heat to power ratios and performance parameters - Effect of irreversibility.

UNIT III: THERMODYNAMIC ANALYSIS OF HEAT TRANSFER EQUIPMENT **9 Hrs**

Thermodynamic analysis of waste heat recovery, Second law perspective, Waste heat recovery equipment and design, Organic fluid system design, Heat pipe heat exchangers and heat pumps.

UNIT IV: APPLICATIONS OF INTEGRATED ENERGY SYSTEMS **9 Hrs**

Applications of integrated energy systems - Diesel generators case studies in sugar mills, rice mills, textile factories and other process and engineering industries.

UNIT V: ECONOMICS OF INTEGRATED ENERGY SYSTEMS **9 Hrs**

Economics of integrated energy systems, Operating and maintenance costs, Investment costs of waste heat recovery and cogeneration systems, environmental and air quality considerations.

Total no. of Hrs : 45

REFERENCES

1. Horlock, J.H., Co-generation.(1986) *Combined heat and power Thermodynamics and Performance*, Pergamon Press
2. Spiewak, S.A.,(1991) *Co-generation*, Fairmont Press Inc
3. Kiang, Y.H. (1981) *Waste Energy utilization Technology*, Marcel Dekker Inc
4. Charles, H., Butler.(1984) *Co-generation*, McGraw Hill Book Co
5. Sydney Reiter, (1985) *Industrial and Commercial Heat Recovery Systems*, Van Nostrand Reinhold

MME13EL01 **ENERGY SYSTEMS LABORATORY** **0 0 4 2**

1. Evaluation of heating and cooling loads for different psychrometric process.
2. Performance Tests on Refrigeration and Air Conditioning set ups.
3. Lift and Drag measurements on Bluff bodies and Aerofoils
4. Determination of Pressure coefficients and Static pressure distributions over cylinders and Aerofoils.
5. Performance test on Steam turbine
6. Heat balance test on boiler
7. Energy balance tests on SI & CI Engines.
8. Fuel and flue gas analysis using Gas Chromatograph.
9. Determination of Calorific value of Solid/Liquid fuels /Gaseous fuels.
10. Performance test on a Steam condenser.

Total no. of Hrs : 60

MME13E005 ENERGY CONVERSION TECHNIQUES 3 0 0 3

UNIT 1: ENERGY ECONOMICS AND RESOURCES 9 Hrs

Energy dependence, Energy types, Sources and Utilization, Energy resources, Economics and growth rates, Electrical Power generation and consumption, Comparison of fossil fuels, Nuclear fuels and solar energy, Review of combustion calculations.

UNIT II: DESIGN OF THERMAL POWER PLANTS 9 Hrs

Conventional thermal power plant design and operation, Reheat and regeneration calculations, Variable superheat effect, Deviation concept, Analysis of other auxiliaries of thermal power plant, High pressure boilers, Steam generator control.

UNIT III: GAS TURBINE AND COMBINED CYCLE ANALYSIS 9 Hrs

Gas turbine and combined cycle analysis, Inter-cooling, regeneration and re-heating, Design for high temperature, Combined cycles with heat recovery boiler, STAG combined cycle power plant, Combined cycle with multi pressure steam, Influence of component efficiencies on cycle performance.

UNIT IV: NUCLEAR ENERGY CONVERSION TECHNOLOGY 9 Hrs

Nuclear energy conversion, Chemical and nuclear equations, Nuclear reactions. Fission and fusion, Energy from fission and fuel burnup, Radioactivity Neutron energies, Fission reactor types, Nuclear power plants, Fast breeder reactor and power plants, Production of nuclear fuels.

UNIT V: DESIGN OF NUCLEAR REACTORS AND SAFETY ANALYSIS 9 Hrs

Fuel rod design, Steam cycles for nuclear power plants reactor heat removal coolant channel orficing, Core thermal design, thermal shields, fins in nuclear plants, Core thermo-hydralic design, Safety analysis, Time scales of transient flow and heat transfer process, LOCA.

Total no. of Hrs : 45

REFERENCES

1. El-Wakil, M.M. (1985) *Power plant Technology*, Mc Graw Hill
2. Culp Jr, A.W. (1984) *Principles of Energy Conversion*, McGraw Hill
3. Sorensen, H.A.(1983) *Energy Conversion Systems*, John Wiley & Sons
4. Morse, T.F.(1978) *Power plant Engineering*, Affiliated East West Press Ltd
5. El-Wakil, M.M.(1982) *Nuclear Power Engineering*, McGraw Hill
6. Winterton, R.H.S. (1981) *Thermal Design of Nuclear Reactors*, Pergamen Press
7. Murray, R.L.(1961) *Introduction to Nuclear Engineering*, 2nd ed., Prentice Hall
8. Glasstone, S. & Sesopske, A. (1967) *Nuclear Reactor Engineering*, Van Nostrand

MME13E006 **NUCLEAR ENERGY TECHNOLOGY** **3 0 0 3**

UNIT I: NUCLEAR REACTIONS **9 Hrs**

Mechanism of Nuclear Fission and Fusion - Nuclides - Radioactivity - Decay Chains - Neutron Reactions - the Fission Process - Reactors - Types of Fast Breeding Reactors - Design and Construction of Nuclear reactors - Heat Transfer Techniques in Nuclear Reactors - Reactor Shielding.

UNIT II: REACTOR MATERIALS **9 Hrs**

Nuclear Fuel Cycles - Characteristics of Nuclear Fuels - Uranium - Production and Purification of Uranium - Conversion to UF4 and UF6 - Other Fuels like Zirconium Thorium - Berylium

UNIT III: REPROCESSING **9 Hrs**

Nuclear Fuel Cycles - Spent Fuel Characteristics - Role of Solvent Extraction in Reprocessing - Solvent Extraction Equipment.

UNIT IV: SEPARATION OF REACTOR PRODUCTS **9 Hrs**

Process to be Considered - 'Fuel Element' Dissolution - Precipitation Process - Ion Exchange - Redox - Purex - TTA - Chelation - U235 - Hexone - TBP and Thorax Processes - Oxidative Slaging and Electro - Refining - Isotopes - Principles of Isotope Separation.

UNIT V: WASTE DISPOSAL AND RADIATION PROTECTION **9 Hrs**

Types of Nuclear Wastes — Safety Control and Pollution Control and Abatement — International Convention on Safety Aspects — Radiation Hazards Prevention.

Total no. of Hrs : 45

REFERENCES

1. Lamarsh, J.R.(1966) *Introduction to Nuclear Reactor Theory*, Wesley
2. Duderstadt, J.J. and Hamilton, L.J. (1976) *Nuclear Reactor Analysis* John Wiley
3. Walter, A.E. and Reynolds, A.B.(1981) *Fast Breeder Reactors*, Pergamon Press
4. Glasstone, S. and Sesonske, A. (1981) *Nuclear Reactor Engineering* (3r Edition), Von Nostrand
5. Winterton, R.H.S. (1981) *Thermal Design of Nuclear Reactors*—Pergamon Press

MME13EL02	**PRACTICAL TRAINING**	**0**	**0**	**6**	**3**

Students should undergo intensive training in any Energy Industry in the area of energy conservation / Energy auditing for a minimum period of one month and should submit a report on the practical training. At the end of III Semester viva voce examination will be conducted with internal and external examiners and this course carries 3 credits.

MME13E007 **BIO - ENERGY TECHNOLOGY** **3 0 0 3**

UNIT I: INTRODUCTION **9 Hrs**

Biomass: types – advantages and drawbacks – Indian scenario – characteristics – carbon neutrality – conversion mechanisms – fuel assessment studies

UNIT II: BIOMETHANATION **9 Hrs**

Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design – constructional details and comparison – biogas appliances – Burner, illumination and power generation – effect on engine performance.

UNIT III: COMBUSTION **9 Hrs**

Perfect, complete and incomplete – equivalence ratio – fixed Bed, fluid Bed – fuel and ash handling – steam cost comparison with conventional fuels. Briquetting: types of Briquetting – merits and demerits – feed requirements and pre-processing – advantages – drawbacks.

UNIT IV: GASIFICATION **9 Hrs**

Types – comparison – application – performance evaluation – economics – dual fuel engines – 100 % Gas Engines – engine characteristics on gas mode – gas cooling and cleaning train.

UNIT V: PYROLYSIS AND CARBONIZATION **9 Hrs**

Types – process governing parameters – thermo gravimetric analysis – differential thermal analysis – differential scanning calorimetry – Typical yield rates.

Total no. of Hrs : 45

REFERENCES

1. David Boyles,(1984) *Bio Energy Technology Thermodynamics and costs*, Ellis Hoknood Chichester
2. Khandelwal, K.C, Mahdi, S.S. (1986) *Biogas Technology* – A Practical Handbook, Tata McGraw Hill
3. Mahaeswari, R.C.(1997) *Bio Energy for Rural Energisation*, Concepts Publication
4. Tom B Reed,(1981*) Biomass Gasification – Principles and Technology*, Noyce Data Corporation, Best Practises Manual for Biomass Briquetting, I R E D A, 1997
5. Eriksson S. and M. Prior, (1990) *The briquetting of Agricultural wastes for fuel*, FAO Energy and Environment paper
6. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S

MME13EL03	**PROJECT PHASE - I**	**0 0 6 3**

Students should identify the topic of the Project and should collect the literatures and datas, at the end of the semester the students should submit their Project Phase-I report to the Department and Viva-Voce examination will be conducted with external examiners and this carries 3 credits.

MME13EL04	**PROJECT PHASE - II**	**0**	**0**	**24**	**12**

Student should have presented a paper on the project area in International or National conference/Journals and should attach the certificate in proof and the published paper in the project report.

MME13EE01 **THERMAL ENERGY SYSTEM** **3 0 0 3**

UNIT 1: STEAM GENERATION **9 Hrs**

Steam generation - Classification, Modern high Pressure boilers - Methods of fixing conventional thermal power plant systems - Fuel handling systems,Reheaters, Super heaters, Economisers, Condensers and Cooling towers.

UNIT II: STEAM NOZZLES **9 Hrs**

Nozzles - Forms and general relations for isentropic flow - Effect of friction - Supersaturated flow.

UNIT III: STEAM TURBINES **9 Hrs**

Steam turbines - Impulse and Reaction turbine, Compounding.

UNIT IV: TURBINE BLADE PROFILE AND TURBINE GOVERNING **9 Hrs**

Blade profiles of impulse and reaction stages, Calculation of blade width and pitch, Blade height and blade angles - Losses from turbine - Governing of turbines.

UNIT V: POWER PLANT ECONOMICS **9 Hrs**

Power plant economics - Definitions - Actual load curves - Fixed costs - Operating costs - Off peak rates - Variable load operations.

Total no. of Hrs : 45

REFERENCES

1. Fredrick J. Morse,(1953) *Power Plant Engineering*, East - West Press Pvt. Ltd
2. Wakil, M.M. (Et), *Power Plant Technology*, McGraw Hill Book Company
3. Kadumbi, V and Manohar Prasad,(1984) *An Introduction to Energy Conservation*, Wiley Eastern Limited
4. Archie W Culp,(1985) *Principles of Energy Conservation*, McGraw Hill Kogakusha Ltd
5. Hussain,(1985) *Steam Turbines*, Tata McGraw Hill Book Co

MME13EE02 **FLUIDIZED BED SYSTEMS** **3 0 0 3**

UNIT I: FLUIDIZED BED BEHAVIOUR **9 Hrs**

Fluidization Phenomena - Regimes of Fluidized Bed Behaviour - Characterization of Fluidized Particles - Two Phase and Well Mixed Theory of Fluidization - Solids Mixing - Particle Entrainment and Carryover.

UNIT II: HEAT TRANSFER **9 Hrs**

Different Modes of Heat Transfer in Fluidized Bed - Use of Immersed Tubes - Finned Tubes - Heat Recovery Systems.

UNIT III: COMBUSTION AND GASIFICATION **9 Hrs**

Fluidized Bed Combustion and Gasification,Pressurised Systems, Sizing of Combustion and Gasification Systems, Start-up Methods, Fast Fluidized Beds, Different Modes of Heat Transfer in Fluidized Beds.

UNIT IV: SYSTEM DESIGN **9 Hrs**

Design of Distributors, Fluidized Bed Furnaces for Fossil and Agricultural Fuels, Fluidized Bed Heat Recovery Systems, Fluid Bed Dryers.

UNIT V: INDUSTRIAL APPLICATIONS **9 Hrs**

Sulpher Retention - Nitrogen Emission Control - Furnaces, Dryers, Heat Treatment, etc. pollution Control and Environmental Effects - Cost Analysis

Total no. of Hrs : 45

REFERENCES

1. Howard, J.R.(1983) *Fluidized Bed Technology: Principles and Applications*, Adam Hilger
2. Geldart, D.(1986) *Gas Fluidization Technology*, John Wiley & Sons
3. Howard, J.R.(Ed),(1983) *Fluidized Beds: Combustion and Applications*, Applied Science Publishers
1. 4.Yates, J.G.(1983) *Fundamentals of Fluidized bed Chemical Processes*, Butterworths
4. Reed, T.B.,(1981) *Biomass Gasification: Principles and Technology*, Noyes Data Corporation

MME13EE03 **BOILER TECHNOLOGY** **3 0 0 3**

UNIT I: INTRODUCTION **9 Hrs**

Parameter of a Steam Generator - Thermal Calculations of a Modern Steam Generator - Tube Metal Temperature Calculation and Choice of Materials - Steam Purity Calculations and Water Treatment

UNIT II: HEAT BALANCE **9 Hrs**

Heat transfer in Furnace - Furnace Heat Balance - Calculation of Heating Surfaces - Features of Firing Systems for Solid - Liquid and Gaseous Fuels - Design of Burners

UNIT III: BOILER DESIGN **9 Hrs**

Design of Boiler Drum - Steam Generator Configurations for Industrial Power and Recovery Boilers - Pressure Loss and Circulation in Boilers

UNIT IV: DESIGN OF ACCESSORIES **9 Hrs**

Design of Air Preheaters - Economisers and Superheater for High Pressure Steam Generators - Design Features of Fuel Firing Systems and Ash Removing Systems.

UNIT V: BOILER CODE **9 Hrs**

IBR and International Regulations - ISI Code's Testing and Inspection of Steam Generator - Safety Methods in Boilers - Factor of Safety in the Design of Boiler Drums and Pressure Parts - Safety of Fuel Storage and Handling - Safety Methods for Automatic Operation of Steam Boilers

Total no. of Hrs : 45

REFERENCES

1. Carl Schields, Boilers - Type, (1982) *Characteristics and Functions*, McGraw Hill Publishers
2. David Gunn, Robert Horton, (1986) *Industrial Boilers - Longman Scientific & Technical Publication*
3. Modern Power Station Practice (1980),(8 Vol) - Central Electricity Generation Board
4. Large Boiler Furnaces,(1980) Richard Dolezal Elsevier Publishing Company

MME13EE04 **HYDRO POWER SYSTEMS** **3 0 0 3**

UNIT I: INTRODUCTION **9 Hrs**

Overview of Hydropower Systems — Preliminary Investigation — Determination Requirements — Preparation of Reports and Estimates — Review of World Resource Cost of Hydroelectric Power — Basic Factors in Economic Analysis of Hydropower Projects — Project Feasibility — Load Prediction and Planned Development.

UNIT II: DEVELOPMENT OF PROTOTYPE SYSTEMS **9 Hrs**

Advances in Planning, Design and Construction of Hydro electric Power Stations — Trends Development of Generating Plant and Machinery — Plant Equipment for Pumped Store Schemes — Some aspects of Management and Operation — Uprating and Refurbishing of turbines.

UNIT III : POWER STATION OPERATION AND MAINTENANCE **9 Hrs**

Governing of Water Turbines - Function of Turbine Governor - Condition for Governing stability - Surge Tank Oscillation and Speed Regulative Problem of Turbine Governing Future.

UNIT IV: RESERVOIRS **9 Hrs**

Problem of Management - Maintenance of Civil Engineering Works - Maintenance of electrical Engg.Works.

UNIT V: INFORMATION TECHNOLOGY IN HYDRO POWER SYSTEMS **9 Hrs**

Development of Software .Computer Aided Hydropower System Analysis - Design - Execution - Testing - Operation and Control and Monitoring of Hydropower Services.

Total no. of Hrs : 45

REFERENCES

1. Monition, L., M. Lenir and J. Roux,(1984) *Micro Hydro Electric Power Station*
2. Alen R. Inversin,(1986) *Micro Hydro Power Source Book*
3. Tyler G. Hicks (1988), *Power Plant Evaluation and Design*
4. http://www.digiserve.com/inship
5. http://www.siemens.de
6. www.tva.gov/power

MME13EE05 **ENERGY MANAGEMENT AND ECONOMICS** **3 0 0 3**

UNIT I: BASIC CONCEPTS OF ENERGY ECONOMICS 9 Hrs

Law of demand, Elasticities of demand, Theory of firm: Production function, output maximization, cost minimization and profit maximization principles. Theory of market, National income and other macroeconomic parameters. Calculation of unit cost of power generation from different sources with examples Ground rules for investment in Energy sector, Payback period, NPV, IRR and Benefit-cost analysis with example

UNIT II: OVERVIEW OF ENERGY POLICIES 9 Hrs

National energy policy in the last plan periods, Energy use and Energy supply, Overview of renewable energy policy and the Five Year Plan programmes, Basic concept of Input-Output analysis, Concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy

UNIT III: MODELS AND ANALYSIS OF ENERGY DEMAND 9 Hrs

Analysis of Environmental Pollution through decomposition of different sectors using I-O model, Interdependence of energy, economy and environment, Modeling concepts and application of SIMA model and I-O model for energy policy analysis, Simulation and forecasting of future energy demand consistent with macroeconomic parameters in India. Basic concept of Econometrics (OLS) and statistical analysis (Multiple Regression), Econometrics techniques used for energy analysis and forecasting with case studies from India

UNIT IV: ENERGY AUDIT 9 Hrs

Definition, need, and types of energy audit; Energy management (audit) approach: Understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements; Fuel & energy substitution; Energy audit instruments; Energy Conservation Act; Duties and responsibilities of energy managers and auditors.

UNIT V: THERMAL ENERGY MANAGEMENT 9 Hrs

Energy conservation in boilers, steam turbines and industrial heating systems;; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management.

Total no. of Hrs : 45

REFERENCES

1. Michael Wickens Macroeconomic Theory(2009): A Dynamic General Equilibrium Approach, Princeton University Press
2. YP Abbi and Shashank Jain. (2006) *Handbook on Energy Audit and Environment Management*, TERI Publications
3. R Loulou, P R Shukla and A Kanudia, (1997) *Energy and Environment Policies for a sustainable Future*, Allied Publishers Ltd
4. J Parikh, (1997) *Energy Models for 2000 and Beyond*, Tata McGraw-Hill Ltd
5. P. O'Callaghan(1993) *Energy Management*, McGraw - Hill Book Company
6. CB Smith,(1981) *Energy Management Principles*, Pergamon Press

MME13EE06 WIND ENERGY ENGINEERING 3 0 0 3

UNITI: MEASUREMENT AND INSTRUMENTATION 9 Hrs

Iinstrumentation – Beau fort number -Gust parameters – wind type – powerlaw index -Betz constant -Terrain value.

UNIT II: WINDMILL STRUCTURES AND STANDARDS 9 Hrs

Energy in wind– study of wind applicable Indian standards – Steel Tables, StructuralEngineering

UNIT III: VARIABLES IN WIND ENERGY CONVERSION SYSTEMS 9 Hrs

Variables in wind energy conversion systems – wind power density – power in a windstream– wind turbine efficiency – Forces on the blades of a propeller – Solidity and selectioncurves.

UNIT IV: WIND TURBINES AND CHARACTERISTICS 9 Hrs

HAWT, VAWT– tower design-power duration curves- wind rose diagrams- study ofcharacteristics - actuator theory- controls and instrumentations – Blade Element Theory

UNIT V: WIND ENERGY STORAGE 9 Hrs

Grid-combination of diesel generator, Battery storage – wind turbine circuits- Wind farms—fatigue stress – Hybrid Systems

Total no. of Hrs : 45

REFERENCES

1. Burton , T et.al, (2011)*Wind Energy Handbook*, 2nd Edition, John Wiley and Sons
2. Manwell, J.F. et.al,(2009)*Wind Energy Explained*, 2nd Edition, John Wiley and Sons
3. Spera, D. A. (2009)*Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering*, 2nd Edition, ASME Press
4. William W. Peng ,(2008)*Fundamentals of turbomachinery*, John Wiley and Sons
5. Mukund. R. Patel,(2006)*Wind and solar power systems* 2nd Edition, Taylor & Francis
6. Rao, S. & Parulekar,B. B. (2005) *Energy Technology*, 4th edition, Khanna publishers,
7. Anna Mani,(1990) India. Dept. of Non-conventional Energy Sources, *Wind energy resource survey in India* , Allied Publishers
8. IEEE Journals for Power, Energy, & Industry Applications

MME13EE07 ENERGY GENERATION AND WASTE MANAGEMENT 3 0 0 3

UNIT 1: SOLID WASTE **8 Hrs**

Definitions - Sources, Types, Compositions, Properties of Solid Waste - Municipal Solid Waste - Physical, Chemical and Biological Property - Collection - Transfer Stations - Waste Minimization and Recycling of Municipal Waste.

UNIT II: WASTE TREATMENT **8 Hrs**

Size Reduction - Aerobic Composting - Incineration - furnace Type & Design, Medical / Pharmaceutical Waste Incineration - Environmental Impacts - Measures to Mitigate Environmental Effects due to Incineration

UNIT III: WASTE DISPOSAL **8 Hrs**

Land Fill Method of Solid Waste Disposal — Land Fill Classification, Types, Methods & Siting Consideration — Layout & Preliminary Design of Land Fills — Composition, Characteristics, generation, Movement and Control of Landfill Leachate & Gases — Environmental Monitoring System for Land Fill Gases

UNIT IV: HAZARDOUS WASTE MANAGEMENT **10 Hrs**

Definition and identification of Hazardous Waste — Sources and Nature of Hazardous Waste — Impact on Environment — Hazardous Waste Control — Minimization and Recycling — Assessment of Hazardous Waste Sites - Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure

UNIT V: ENERGY GENERATION FROM WASTE **11 Hrs**

Types — Biochemical Conversion — Sources of Energy Generation — Industrial Waste, Agro Residues — Anaerobic Digestion — Biogas Production — Types of Biogas Plant Thermochemical Conversion — Sources of Energy Generation — Gasification — Types of Gasifiers — Briquetting — Industrial Applications of Gasifiers — Utilization and Advantages of Briquetting — Environmental benefits of Biochemical and Thermo chemical Conversion

Total no. of Hrs : 45

REFERENCES

1. Parker, Colin & Roberts, Energy from Waster(1985.) *An Evaluation of Conversion Technologies*, Elsevier Applied Science
2. Shah, Kanti L.,(2000) *Basics of Solid & Hazardous Waste Management Technology*, Prentice Hall
3. Manoj Datta,(1997) *Waste Disposal in Engineered Landfills*, Narosa Publishing House
4. Rich, Gerald et.al.,(1987) *Hazardous Waste Management Technology*, Podvan Publishers
5. Bhide AD., Sundaresan BB,(1983) *Solid Waste Management in Developing Countries*, INSDOC New Delhi

MME13EE08 ENERGY CONSERVATION IN BUILDINGS 3 0 0 3

UNIT I: CLIMATES AND BUILDINGS 9 Hrs

Thermal Properties and Energy content of Building materials — Psychrometry — Comfort conditions — Air conditioning systems.

UNIT II: ESTIMATION OF BUILDING LOADS 9 Hrs

Steady state method-Network method — Numerical method correlations — computer packages for carrying out thermal design of buildings and predicting performance.

UNIT III: EFFICIENT LIGHTING AND DAYLIGHTING 9 Hrs

Lighting and Visual ability — Light sources and Luminaries — Lighting System Design — aylighting — Lighting Economics and aesthetics — Impacts of Lighting efficiency.

UNIT IV: INDOOR ENVIRONMENTAL REQUIREMENT AND MANAGEMENT 9 Hrs

Thermal comfort-Ventilation and air quality - Air conditioning requirement - visual perception - Illumination Requirement - Auditory requirement -Energy Management Options - Energy Audit and Energy Targeting - Technological options for Energy Management.

UNIT V: ENERGY CONSERVATION IN AIR CONDITIONING SYSTEMS 9 Hrs

Cycles - Energy Conservation in pumps/fans/blowers - Refrigerating machines - Heat Rejection Equipment - Energy efficient motors insulation.

Total no. of Hrs : 45

REFERENCES

1. J. Krieder and A. Rabl (1994) *Heating and Cooling of Buildings : Design for Efficiency*, McGraw - Hill
2. M.S. Sodha, N.K.Bansal, P.K. Bansal, A. Kumar and M.A.S.Malik, (1986) *Solar Passive Building, Science and Design*
3. Pergamon Press J.R.Williams, (1983). Passive Solar Heating, Ann Arbar Science
4. R.W. Jones, J.D.Balcomb, C.E.Kosiewiez, G.S. Lazarus, R.D.McFarland and W.O. Wray (1982), *Passive Solar Design Handbook*, Vol.3, Reportof U.S. Department of Energy (DOE/CS - 0127/3)
5. J.L.Thrlkeld, (1976) *Thermal Environmental Engineering*, Prentice Hall
6. (1993): *IES Lighting Handbook*, Reference and Application Volume, IESNA
7. Thumann (1992) *Lighting Efficiency Applications*, Fairmont Press
8. http://www.21design.com
9. www.ashrae.org
10. www.log-one.com

MME13EE09 SOLAR REFRIGERATION AND AIRCONDITIONING 3 0 0 3

UNIT I: INTRODUCTION 9 Hrs

Potential and scope of solar cooling. Types of solar cooling systems, solar collectors and storage systems for solar refrigeration and air-conditioning.

UNIT II: REFRIGERATION CYCLES 9 Hrs

Solar operation of vapour absorption and compression refrigeration cycles and their assessment.

UNIT III: THERMAL MODELLING 9 Hrs

Thermal modelling and computer simulation for continuous and intermittent solar refrigeration and air-conditioning systems.

UNIT IV: SOLAR COOLING SYSTEMS 9 Hrs

Solar desiccant cooling systems. Open cycle absorption/ desorption solar cooling alternatives. Advanced solar cooling systems.Refrigerant storage for solar absorption cooling systems.

UNIT V: ECONOMICS 9 Hrs

Solar thermoelectric refrigeration and air-conditioning.Solar economics of cooling systems.

Total no. of Hrs : 45

REFERENCES

1. Ursula Eicker ,(2009) *Low Energy Cooling for Sustainable Buildings*, John Wiley and Sons
2. Hans-Martin Henning,(2007)*Solar-assisted air conditioning in buildings*: a handbook for planners , Springer
3. Santamouris , M. Asimakopoulos, D. (1996) *Passive cooling of buildings*, Earthscan
4. Sayigh , A. A. M., McVeigh, J. C. (1992) *Solar air conditioning and refrigeration*, Pergamon Press
5. IEEE Journals for Power, Energy, & Industry Applications

MME13TE01 **THERMAL STORAGE SYSTEMS** **3 0 0 3**

(Common to Thermal and Energy Engineering)

UNIT 1 : INTRODUCTION **5 Hrs**

Necessity of thermal storage — Energy storage devices — Types of storage system Specific areas of application — Heat transfer enhancement methods.

UNIT II: SENSIBLE HEAT STORAGE SYSTEM **10Hrs**

Basic concepts and modeling of heat storage units modeling of simple water and rock bed storage system. Use of TRNSYS - Pressurized water storage system for power plant applications packed beds.

UNIT III: REGENERATORS **10Hrs**

Parallel flow and Counter flow Regenerators - Finite Conductivity model-Non-linear model - Transient performance-step changes in inlet gas temperature. Step changes in gas flow rate - Parameterization of transient response - Heat Storage exchangers

UNIT IV: LATENT HEAT STORAGE SYSTEMS **10Hrs**

Storage materials Modeling of phase change problems and solution methodologies -Enthalpy modeling - Heat transfer enhancement configuration - Parameterization of rectangular, cylindrical geometric problems.

UNIT V: THERMAL STORAGE APPLICATIONS **10Hrs**

Specific areas of application of energy storage food preservation - waste heat recovery - Solar energy Storage - Green house heating - power plant applications - Drying and heating for process industries.

Total no. of Hrs : 45

REFERENCES

1. Schmidt, F.W. and Willmott, AJ. (1981). *Thermal Storage and Regeneration*, Hemisphere Publishing Corporation
2. Lunardini, V.J.(1981) *Heat Transfer in Cold Climates*, D.VanNost and, Reinhold
3. Proc.(1998). *1st IEA Workshop on Phase Change Materials and Chemical Reaction for Thermal Energy Storage*, Adana

MEE13AE01 POWER GENERATION, TRANSMISSION & UTILIZATION 3 0 0 3

UNIT I: ELECTRIC POWER GENERATING SYSTEMS 9 Hrs

Principles of electrical generators and alternators — Economics of generation, tariffs — economic operation of generating units — dynamic programming.

UNIT II: TRANSMISSION SYSTEM 9 Hrs

OH, UG transmission, HVDC transmission, voltage levels, relative merits and demerits - single line diagram, per unit representation - computational line inductance, capacitance, ABCD parameters - long line theory, surge impedance loading, line compensation.

UNIT III: DISTRIBUTION SYSTEMS & SUB-STATIONS DISTRIBUTION SYSTEMS 9 Hrs

AC & DC distribution systems, radial systems, ring main system - Kelvins law, distributors fed at one end, both ends, uniformly loaded - comparison of distribution systems. Sub-stations Indoor, Outdoor & pole mounted sub-stations - Bus bar systems, single bus bar, sectionalized bus bar, duplicate bus bar etc - layout of sub-stations.

UNIT IV: UTILIZATION OF ELECTRICAL ENERGY 9 Hrs

Types of consumers, domestic, industrial, traction, agricultural etc and models - Electric heating & welding - Resistance heating, Induction heating, Arc furnace heating, dielectric heating etc. - illuminating systems - Polar curves, Laws of illumination, flood and street lighting schemes – Electrolytic Process - Laws of electrolysis, Calculation of energy, consumption in electrolytic process.

UNIT V: ELECTRIC DRIVES IN INDUSTRY AND TRACTION 9 Hrs

Electric drives in Industries Electric drives for particular application, General factory applications, Textile mills, paper mills, Cranes, Lifts, Centrifugal pumps etc — Factors affectingchoice of drives — Group and Individual drives, Electrical factors & Mechanical features desired, Selection of motor size and rating & cost. Electric Traction.Systems of Traction — Steam, IC engine and direct electric drive Traction, relative merits and demerits — Speed time curves. Tractive effort & specific energy calculations and control of traction methods.

Total no. of Hrs : 45

REFERENCES

1. Chwadhwa, *Generation Distribution and Utilization of Electrical Energy* , New Age India Pvt Ltd
2. OlleElgerd,*Electric energy systems*, TMH Publications
3. Uppal SL , *A Course in Electric Power* , Khanna Publications

MEE13AE02 ELECTRICAL DRIVES AND CONTROLS 3 0 0 3

UNIT I: REVIEW OF CONVENTIONAL MOTOR DRIVES 10Hrs

Characteristics of DC and AC motors for various applications — starting and speed control — methods of breaking.

UNIT II: PHYSICAL PHENOMENA IN ELECTRICAL MACHINES 10Hrs

Various losses in motors - Saturation and Eddy current effects -mmf harmonics and their influence of leakage - stray losses -vibration and noise.

UNIT III: INTRODUCTION TO SOLID STATE POWER CONTROLLERS 10Hrs

Power devices - Triggering Circuits - Rectifiers - Choppers. Invertors - AC Controllers

UNIT IV: SUPERCONDUCTIVITY 9Hrs

Super conducting generators — motors and magnets — Super conducting magnetic energy storage (SMES).

UNIT V: SOLID STATE MOTOR CONTROLLERS 6Hrs

Single and Three Phase fed DC motor drives — AC motor drives — Voltage Control — Rotor resistance control Frequency control — Slip Power Recovery scheme.

Total no. of Hrs : 45

REFERENCES

1. Pillai, S.K.(1982) *A First Course on Electrical Drives*, Wiley Eastern Ltd
2. Dewan, S.B., Slevnon,G.R., Strangher, A.(1984) *Power Stream and Control Drives*, John Wiley & Sons
3. EedamSubramanyan,(1988) *Thyristor Control of Electrical Drives*, Tata McGraw-Hill Co.Ltd
4. Murphy, J.M.D., Turnbull,F.G.(1988) *Power Electronics: Control of AC Motors* -Pergamon Press
5. Say, C.G. (1971) *Introduction to the Theories of Electromagnetic Machines*, Pitman
6. Rakesh Dal Begamudre-(1988). *Electro Mechanical Energy Conversion with Dynamics of Machines* - Wiley Eastern Ltd
7. http://www.ascorinc.com
8. http://www.soltek.ca
9. http://www.siemens.com

MEE13AE03 OPTIMIZATION OF POWER SYSTEM 3 0 0 3

UNIT I: INTRODUCTION 9 Hrs

Operational problems of power systems-review of economic dispatch and loss formula calculations.

UNIT II: OPTIMAL POWER FLOW 9 Hrs

Formulation of OPF Problem — cost minimization — loss minimization — solution using NLP methods successive LP methods.

UNIT III: HYDROTHERMAL CO-ORDINATION 9 Hrs

Long Range and Short Range hydro scheduling — Short Term hydrothermal Scheduling — a gradient approach — solution method using iteration and dynamic programming.

UNIT IV: UNIT COMMITMENT 9 Hrs

Constraints in Unit commitment-thermal unit constraints — hydro constraints — solution methods — priority list methods — dynamic programming solution.

UNIT V: MAINTENANCE SCHEDULING 9 Hrs

Preparation of maintenance schedules for generating units-turbines-boilers-taking into account forced outages and normal outages— optimal maintenance scheduling using mathematical programming.

Total no. of Hrs : 45

REFERENCES

1. Allen Wood, J. and Bruce, Wollenberg, F. (1984)."*Power Generation, Operation and Control*", John Wiley & Sons
2. Murthy, P.S.R(1984)*Power System Operation and Control*, Tata McGraw- Hill Publishing Co.Ltd
3. http ://www.powerlight.com
4. http://www.tecsol.fr

MCS13AE01	**INFORMATION TECHNOLOGY IN ENERGY MANAGEMENT**	**3**	**0**	**0**	**3**

UNIT I: INTRODUCTION OF COMPUTER APPLICATION **9 Hrs**

Programming languages - Introduction to Visual *C"~,* C-Programming Design - Computer Organization

UNIT II: INTRODUCTION TO COMPUTER BASED INFORMATION SYSTEM **9 Hrs**

Types of CBIS -Relationship among CBIS systems concepts and CBIS-general systems theory - Energy Management concepts andCBIS

UNIT III: DATABASE MANAGEMENT SYSTEM **9 Hrs**

Intelligence based systems - energy data bases -networking - time sharing concepts.

UNIT IV: SOFTWARE ENGINEERING **9 Hrs**

The need for and scope of software engineering - survey of software life cycle models - Transform theory of software performance - network model of structured programs.

UNIT V: COMPUTER BASED MONITORING AND ONLINE CONTROL SYSTEMS **9 Hrs**

Data acquisition system - expert based systems for energy management - Parallel Processing Concepts - Typical applications in energy management area.

Total no. of Hrs : 45

REFERENCES

1. Herbert Schildt,(2000) *C/C++ PROGRAMMER'S reference,* McGraw-Hill
2. David McMahon,(1999) *Rapid Application Development with Visual C++",* McGraw-Hill
3. Gerrit Blaauw,(1997) Frederick Brooks, *Computer Architecture: Concepts and Evolution,* Addison Wesley
4. Ian Sommerville,(1996) *Software Engineering,* 5/e, University of Lancaster, England Addison Wesley
5. Peter Jackson,(1998) *Introduction to Expert Systems,* 3/e, Addison Wesley