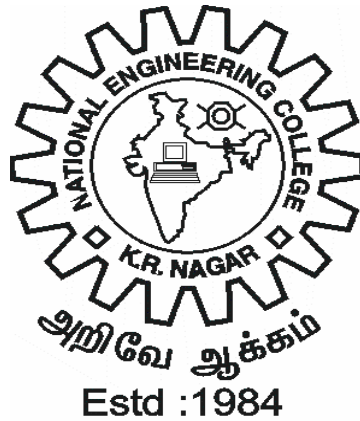


NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University of Technology Tirunelveli)

K.R.NAGAR, KOVILPATTI – 628 503

REGULATIONS - 2011



DEPARTMENT OF

MECHANICAL ENGINEERING

(CENTRE FOR ENERGY STUDIES)

CURRICULUM AND SYLLABI OF

M.E. – ENERGY ENGINEERING

NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University of Technology Tirunelveli)

M.E. – ENERGY ENGINEERING - SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MEN101	Thermodynamics and thermal Systems	3	1	0	4
2	MEN102	Fuels And Combustion Technology	3	1	0	4
3	MEN103	Energy conversion Systems	3	0	0	3
4	MEN104	Non-Conventional Sources of Energy	3	0	0	3
5	MEN105	Environmental Impact of Energy Systems	3	0	0	3
6	E1	Elective I	3	0	0	3
PRACTICAL						
7.	MEN131	Energy Lab I	0	0	3	1
		TOTAL	18	1	3	21

Approved by

Chairman of BOS
Dept. of Mech. Eng.
Dr.D.Ravindran

Dean (Academic)
Dr.B.sankaragomathi

Chairman of Academic
Council & Principal
Dr.P.Subburaj

SEMESTER II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MEN201	Design and Optimization of Energy Systems	3	0	0	3
2	MEN202	Energy Audit And Management	3	0	0	3
3	MEN203	Analysis of Power plants	3	0	0	3
4	E2	Elective II	3	0	0	3
5	E3	Elective III	3	0	0	3
6	E4	Elective IV	3	0	0	3
7		Industrial Training Practice	0	0	0	2
PRACTICAL						
8.	MEN231	Energy Lab II	0	0	3	1
TOTAL			18	0	3	21

Industrial Training Practice : A training of 15 days duration on the practical aspects of various energy technologies will be carried out by the students after the completion of Second Semester during Summer Vacation, at Energy Industry / Energy Projects / Energy Centers / R & D Institutions / Research Laboratories etc. which will be evaluated during Semester – III.

SEMESTER III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	E5	Elective V	3	0	0	3
2	E6	Elective VI	3	0	0	3
3	E7	Elective VII	3	0	0	3
PRACTICAL						
4	MEN331	Project work - Phase I	0	0	12	6
TOTAL			9	0	12	15
Phase I: Review of Literature, Problem Identification, Methodology, Work Plan, Preparation and Presentation.						

SEMESTER IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	MEN431	Project work - Phase II	0	0	24	12
TOTAL			0	0	24	12
Phase II: Analysis, Presentation and Viva						
Total Credits						69

ELECTIVES FOR M.E ENERGY ENGINEERING						
S.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1	MEN001	Advanced Fluid Mechanics	3	0	0	3
2	MEN002	Conventional Energy Systems	3	0	0	3
3	MEN003	Environmental Engineering & Pollution Control	3	0	0	3
4	MEN004	Energy Conservation And Management	3	0	0	3
5	MEN005	Bio Energy Engineering	3	0	0	3
6	MEN006	Solar Energy Systems	3	0	0	3
7	MEN007	Cogeneration And Waste Heat Recovery Systems	3	0	0	3
8	MEN008	Advanced Thermal Storage Technologies	3	0	0	3
9	MEN009	Alternative Fuels	3	0	0	3
10	MEN010	Waste Management And Energy Recovery	3	0	0	3
11	MEN011	Steam Generator Technology	3	0	0	3
12	MEN012	Materials For Energy Applications	3	0	0	3
13	MEN013	Energy Management & Economics	3	0	0	3
14	MEN014	Solar Architecture	3	0	0	3
15	MEN015	Design Of Heat Exchangers	3	0	0	3
16	MEN016	Wind Energy Engineering	3	0	0	3
17	MEN017	Electrical Drives And Controls	3	0	0	3
18	MEN018	Fluidized Bed Systems	3	0	0	3
19	MEN019	Hydro Power Technology	3	0	0	3
20	MEN020	Nuclear Engineering	3	0	0	3
21	MEN021	Advanced Heat Transfer	3	0	0	3
22	MEN022	Instrumentation & Control Systems For Thermal Systems	3	0	0	3
23	MEN023	Solar Refrigeration And Air conditioning	3	0	0	3
24	MEN024	Computational Fluid Dynamics	3	0	0	3
25	MEN025	Fuel Cells And Hydrogen Energy	3	0	0	3

UNIT I**10**

Basic Concepts of Thermodynamics, Thermodynamics Laws, Entropy: Entropy as a property, Combined First and Second Law, Increase of Entropy Principle, Entropy Change of a Pure Substance, Liquid and solids, Efficiency of devices, Availability - irreversibility and second – law efficiency for a closed system and steady – state control volume. Availability analysis of simple cycles.

UNIT II**10**

Properties of steam, phase change process, Rankine cycle, Deviation of Actual Vapor Power Cycles from Idealized Ones, Reheat cycle, Regenerative cycle, Second-Law Analysis of Vapor Power Cycles.

UNIT III**8**

Refrigerators and Heat Pumps, The Reversed Carnot Cycle, The Ideal Vapor-Compression Refrigeration Cycle, Actual Vapor-Compression Refrigeration Cycle, Selecting the Right Refrigerant, Heat Pump Systems, Innovative Vapor-Compression Refrigeration Systems, Gas Refrigeration Cycles, Absorption Refrigeration Systems.

UNIT IV**10**

Introduction to heat transfer processes, Heat transfer from finned surfaces; fin efficiency and effectiveness, two dimensional steady state heat conduction using analytical and numerical methods. Periodic heat conduction. Quantitative analysis of heat transfer co-efficient for all the modes of heat transfer.

UNIT V**7**

Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.

Total: 45 Periods**TEXT BOOKS**

1. Yunus A Cengel, Michael A.Boles “Thermodynamics –An Engineering Approach-6th edition”
2. Nag. P.K., " Engineering Thermodynamics ",Tata McGraw-Hill Publishing Co., Ltd.,1994
3. Ballaney, P.L., Thermal Engineering, Khanna Publishers, 1996.

REFERENCES

1. Kenneth Wark Jt.m, Advanced Thermodynamics for Engineers, McGrew – Hill Inc., 1995.
2. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Cons, 1988.
3. Holman, J.P., Thermodynamics, Fourth Edition, McGraw – Hill Inc., 1988.

MEN102	FUELS AND COMBUSTION TECHNOLOGY	L T P C
		3 1 0 4
UNIT I		9
Fuels & Fuel Analysis-Combustion Stoichiometry, theoretical & actual combustion processes –Air fuel ratio.		
UNIT II		10
Combustion Thermodynamics- calculation of heat of formation & heat of combustion – First Law analysis of reacting systems – Kinetic Reaction – Adiabatic Flame Temperature		
UNIT III		9
Heat Treatment Furnaces- Industrial furnaces – process furnaces – Kilns – Batch & Continuous furnaces		
UNIT IV		9
Flame, Flame Structure, Ignition and Igniters – flame propagation – deflagration – detonations- flame front – Ignition – self & forced ignition – Ignition temperature		
UNIT V		8
Combustion Appliances- Gas burners- Functional requirement of burners – Gas burner Classification –Stoker firing –pulverized system of firing – Fluidized Bed Combustion		
		Total: 45 Periods

TEXT BOOKS

1. S.P. Sharma & Chander Mohan, “Fuels & Combustion”, Tata McGraw Hill Publishing Co. Ltd., 1984
2. Dr. Samir Sarkar, “Fuels & Combustion”, Orient Longman, Second edition, 1990.

REFERENCES

1. Blokh A.G, “Heat Transmission in Steam Boiler furnaces”, Hemisphere Publishing Corpn.ISBN-089-116-626-2
2. Gupta O.P, “Elements of Fuels, Furnaces & Refractories”, 3rd edition, Khanna Publishers, 1996.
3. Combustion Fundamentals by Roger A. Strehlow – McGraw-Hill
4. Combustion Engineering and Fuel Technology by Shaha A.K. – Oxford and IBH.
5. Principles of Combustion by Kenneth K. Kou – John Wiley & Sons.

UNIT – I ENERGY SOURCES**9**

Energy classification – Energy sources – Principal sources of energy: conventional and non conventional sources – bio-mass, fossil fuels, nuclear fuels, solar energy – Energy conversion –prospecting, extraction, resource assessment and their peculiar characteristics.

UNIT – II ENERGY CONVERSION IN THERMAL SYSTEM**10**

Production of thermal energy using bio-mass, fossil fuels, nuclear fuels, solar energy – Conversion of thermal energy, electrical energy, electromagnetic energy and hydraulic energy into mechanical energy – Energy conversion system: steam turbines, hydraulic turbines and wind turbines – Energy conversion system cycles.

UNIT – III ELECTRICAL ENERGY GENERATION**10**

Production of electrical energy using thermal energy, chemical energy, electromagnetic energy and mechanical energy – Magneto hydrodynamic conversion – introduction – MHD plasmas – analysis of MHD generators – MHD power applications – Batteries – basic concepts – electrochemical principles and reactions – selection and application of batteries – fuel cells – general characteristics – low power fuel cell systems – fuel cell power plants.

UNIT – IV ENERGY CONVERSION IN RENEWABLE ENERGY SYSTEMS**8**

Production of electrical energy using non-conventional sources: solar energy, wind energy, wave energy, tidal energy and ocean thermal energy. Solar thermal energy conversion system – photovoltaic conversion – optical effects of p-n junction – analysis of PV cells – wave energy conversion system – tidal energy conversion system – wind energy conversion system.

UNIT – V ENERGY STORAGE**7**

Energy storage: requirements and methods – storage of thermal energy – storage of mechanical energy – storage of electrical energy – storage of chemical energy – storage of nuclear energy.

TOTAL: 45 PERIODS**TEXT BOOKS / REFERENCE BOOKS:**

1. Culp, A.W., - Principles of energy conversion, Tata McGraw Hill, 2000
2. Messerle, Hugo K., - Magnetohydrodynamic Electric Power Generation, John Wiley & Sons, 1995.
3. Linden, D., - Handbook of Batteries and Fuel Cells, McGraw Hill Book Co., 1984.
4. Angrist, S. W., - Direct Energy Conversion, Allyn and Bacon, Boston, 1982.
5. Green, M. A., - Solar Cells, Prentice Hall Inc., Englewood Cliffs, 1982.
6. Appleby, A. J., - Fuel Cell Hand Book, Van Nostrand Reinhold Co., New York, 1989.
7. Considine, D.M., - Energy technology handbook, McGraw Hill, 1977
8. Glasstone, S., and - Nuclear reactor engineering, Van Nostrand Reinhold, 1963
9. Sessouske, A., Russell, C.R., - Elements of energy conversions, Pergamen press, 1967

UNIT-I BIO-FUELS**9**

Bio-fuels classification -biomass production for energy forming - Energy through fermentation -Pyrolysis - Gasification and combustion, biogas, aerobic and anaerobic bio conversion process, feed stock, properties of biogas composition, biogas plant design and operation-Alcoholic fermentation.

UNIT-II HYDROGEN ENERGY**9**

Electrolytic and thermo chemical hydrogen production - Metal hydrides and storage of hydrogen -Hydrogen energy conversion systems, hybrid systems, - economics and technical feasibility.

UNIT-III SOLAR ENERGY**9**

Solar energy, photovoltaic and thermal applications, rural application, limitation of thermal energy.

UNIT-IV OCEAN THERMAL ENERGY CONVERSION**9**

Geothermal, Wave and tidal energy, availability, geographical distribution, Power generation using OTEC, wave and tidal energy, Scope and economics, Geothermal energy, availability, limitations

UNIT-V WIND ENERGY**9**

Wind energy, General considerations, Wind Power plant design, Choice of power plant, Wind mapping and selection of location. Cost analysis and economics of systems utilizing renewable sources of energy.

Total: 45 Periods**TEXT BOOK:**

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd.,1986.

REFERENCES:

1. Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.
3. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
4. Veziroglu, T.N., Alternative Energy Sources, Vol 5 and 6, McGraw-Hill, 1990
5. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, 1980.
6. Bridgurater, A.V., Thermochemical processing of Biomass, Academic Press,1981.
7. Hart, A.B., and Womack, G. J., Fuel Cells: Theory & Applications, Prentice Hall, 1997.
8. Khandelwal K.C, Mahdi S.S., Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986.

MEN105 ENVIRONMENTAL IMPACT OF ENERGY SYSTEMS: L T P C
3 0 0 3

UNIT I: ENVIRONMENTAL IMPACTS 9

Environmental degradation due to energy production and utilization-Primary and secondary pollution-air, thermal and water pollution-depletion of ozone layer-global warming-biological damage due to environmental degradation-Methods of Environmental Impact Assessment.

UNIT II POLLUTION: THERMAL PLANTS 9

Pollution due to thermal power station and its control and systems

UNIT III POLLUTION: NUCLEAR & HYDRO PLANTS 9

Pollution due to nuclear power generation, radioactive waste and its disposal
Effect of Hydro electric power stations on ecology and environment.

UNIT IV INDUSTRIAL WASTE 9

Industrial waste, Waste and effluent treatment-Waste as a source of energy: Industrial, domestic and solid waste as a source of energy-Pollution control: Causes process and exhaust gases and its control- mechanism and devices for pollution control.

UNIT V GLOBAL ENVIRONMENTAL CONCERN 9

United Nations Framework Convention on Climate Change (UNFCCC)-Protocol, Conference of Parties (COP)-Clean Development Mechanism (CDM), Prototype Carbon Funds-Carbon Credits and its trading, Benefits to developing countries, Building a CDM Project

Total: 45 Periods

TEXT BOOK & REFERENCES

1. Management of Energy Environment Systems W.K.Foell (John Wiley and Sons).
2. Energy Management and Control Systems M.C.Macedo Jr. (John Wiley and Sons).
3. Environmental Impact Analysis Handbook J.G.Rau, D.C.Wood (McGraw Hill).
4. Energy & Environment – J.M. Fowler,(McGrawHill)

RENEWABLE ENERGY

27

1. Performance testing of Solar Water Collector
2. Characteristics of Solar photovoltaic devices
3. Testing of Gasifier
4. Testing of biogas plant
5. Properties of Fuels
6. Solar Radiation measurement
7. Performance testing of Solar Air Heater
8. Performance testing of Solar Still
9. Performance Study on Concentric Collectors

ENERGY CONSERVATION

12

1. Boiler efficiency testing
2. Heat Exchangers
3. Energy consumption measurement of lighting systems
4. Refrigeration and Air conditioning systems

ADVANCED ENERGY SYSTEMS

6

1. Thermal Storage Systems

TOTAL: 45 PERIODS

MEN201

DESIGN AND OPTIMIZATION OF ENERGY SYSTEMS

L T P C

3 0 0 3

UNIT I INTRODUCTION:

9

Engineering Design- Design as Part of Engineering Enterprise- Thermal Systems

UNIT II BASIC CONSIDERATIONS IN DESIGN

9

Formulation of the Design Problem- Conceptual Design- Steps in the Design Process- Computer-Aided Design of Thermal Systems- Material Selection

UNIT III MODELING OF THERMAL SYSTEMS

9

Types of Models- Mathematical Modeling- Physical Modeling and Dimensional Analysis- Curve Fitting

UNIT IV ECONOMIC CONSIDERATIONS

9

Introduction-Worth of Money as a Function of Time-Series of Payments-Economic Factor in Design- Application to Thermal Systems

UNIT V OPTIMIZATION

9

Basic Concepts- Optimization Methods- Optimization of Thermal Systems- Practical Aspects in Optimal Design

Total: 45 Periods

TEXT BOOK

Design and optimization of thermal systems, Y.Jaluria, Mc Graw Hill, 1998.

REFERENCES

1. Elements of thermal fluid system design, L.C.Burmeister, Prentice Hall,1998.
2. Design of thermal systems, W.F.Stoecker, Mc Graw Hill, 1989.
3. Introduction to optimum design, J.S.Arora, Mc Graw Hill, 1989.
4. Optimization for engineering design - algorithms and examples, K.Deb,Prentice Hall, 1995.

UNIT I

9

Energy Scenario - Role of Energy Managers in Industries – Energy monitoring, auditing & targeting – Economics of various Energy Conservation schemes. Total Energy Systems

UNIT II

9

Energy Audit -various Energy Conservation Measures in Steam -Losses in Boiler. Energy Conservation in Steam Systems -Case studies.

UNIT III

9

Energy conservation in Centrifugal pumps, Fans & Blowers, Air compressor – energy consumption & energy saving potentials – Design consideration.

UNIT IV

9

Refrigeration & Air conditioning - Heat load estimation -Energy conservation in cooling towers & spray ponds – Case studies Electrical Energy -Energy Efficiency in Lighting – Casestudies.

UNIT V

9

Organizational background desired for energy management motivation, detailed process of M&T-Thermostats, Boiler controls- proportional, differential and integral control, optimizers;compensators.

Total: 45 Periods

TEXT BOOKS

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.
2. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.

REFERNECE

1. Larry C Whitetal, Industrial Energy Management & Utilization.
2. Power System Engineering 2nd Ed. D P Kothari, I J Nagrath, Tata McGraw-Hill Co 2008

UNIT I INTRODUCTION 7

Introduction to economics of power generation. Load duration curves, location of power plants, powerplant economics, Indian energy scenario.

UNIT II ANALYSIS OF STEAM POWER PLANTS (SPP): 10

Components of steam power plants, Effect of variations, variation of steam condition on thermal efficiency of steam power plant. Typical layout of SPP. Efficiencies in a SPP.

UNIT III ANALYSIS OF HYDROELECTRIC POWER PLANTS (HEPP): 8

Components of HEPP, Types of turbine- Pelton, Francis, Kaplan, Propeller, Deriaz and Bulb turbines, Typical layout of HEPP, Performance of turbines and comparison.

UNIT IV ANALYSIS OF DIESEL AND GAS TURBINE POWER PLANTS: 10

General layout of Diesel and Gas Turbine power plants, Performance of Diesel and Gas Turbine power plants, comparison with other types of power plants.

UNIT V NUCLEAR AND MHD POWER PLANTS 10

Overview of Nuclear power plants - radioactivity - fission process - reaction rates - diffusion theory, elastic scattering and slowing down - criticality calculations - critical heat flux - power reactors - nuclear safety. MHD and MHD - steam power plants

Total: 45 Periods

TEXT BOOKS:

1. Nag, P.K., Power Plant Engineering, Tata Mcgraw Hill Publishing Co Ltd, New Delhi, 1998.
2. Arora and Domkundwar, A course in power Plant Engineering, Dhanpat Rai and CO, 2004.

REFERENCES:

1. Haywood, R.W., Analysis of Engineering Cycles, 4th Edition, Pergamon Press, Oxford, 1991.
2. Wood, A.J., Wollenberg, B.F., Power Generation, operation and control, John Wiley, New York, 1984.
3. Gill, A.B., Power Plant Performance, Butterworths, 1984.
4. Lamarsh, J.R., Introduction to Nuclear Engg. 2nd edition, Addison-Wesley, 1983

MEN231

ENERGY LAB II

L T P C

0 0 3 1

I CYCLE

24 Periods

1. Steady State Conduction in Solid
2. Steady State Convection in Solid
3. Steady State Radiation in Solid
4. Combined conduction and convection
5. Unsteady state conduction and convection
6. Unsteady state conduction and radiation

II CYCLE

21 Periods

1. Steady state conduction in Fluids
2. Steady state convection in Fluids
3. Two-phase flows
4. Condensation and boiling heat transfer
5. Solar Radiation Model
6. Energy system simulations

TOTAL: 45 PERIODS

ELECTIVE PAPERS (E1 TO E7)

MEN001 ADVANCED FLUID MECHANICS

L T P C
3 0 0 3

UNIT - I

9

Kinematics of fluid flow - introduction – regimes of fluid mechanics - Lagrangian and Eulerian approach - revision of concepts of different types of fluids, stream lines, path lines, velocity potentials, vorticity – substantial derivative – equations of continuity – Euler's equation – Bernoulli's equations for ideal fluid flow - flow past circular cylinder with and without circulation – flow past an aerofoil.

UNIT - II

9

Viscous flow - stress components in real fluids – stress analysis on fluid motions – Navier Stokes equation of motion – energy equation – properties of Navier Stokes equation – exact solution of Navier Stokes equation for flow between parallel plates – couette flow – flow through pipes – flow between two concentric rotating cylinders.

UNIT - III

9

Laminar boundary layer - laminar boundary layer equation – similarity solution for steady two dimensional flow – approximate integral method – numerical solutions - boundary layer control.

UNIT - IV

9

Turbulence - introduction to onset of turbulence – physical and mathematical description of turbulence – Reynolds equation for turbulent motion – semi empirical theories of turbulence – turbulent flow through pipes – turbulent boundary layer equations - turbulent flow with zero pressure gradient on smooth flat plate and rough flat plate.

UNIT - V

9

Compressible flow - fundamental equation of flow of compressible viscous and inviscid fluid – plane couette flow – exact solution – steady flow through constant area pipe – laminar boundary layer equation in compressible flow – boundary layer with pressure gradient and with zero pressure gradient – application of moment integral equation to boundary layers – turbulent boundary layer equations in compressible flow – compressible turbulent flow past a flat plate.

TOTAL: 45 PERIODS

REFERENCES:

1. White, F. M., Viscous Fluid Flow – 2/e, McGraw Hill Book Co., 1991.
2. Schlichting, H. and Gersten, K., Boundary Layer Theory - 8/e, Springer, 2000.
3. Yuan, S. W., Foundations in Fluid Mechanics, Prentice Hall of India Pvt. Ltd., 1988.
4. Fox, R. W. and McDonald, A. T., Introduction to Fluid Mechanics, John Wiley & Sons, 1995.
5. Muralidhar, K. and G. Biswas, Advanced Engineering Fluid Mechanics, Narosa Publishing House, 1999.
6. Bansal, J. L., Viscous Fluid Dynamics, Oxford & IBH Publications Co., 1977.
7. Frederick, S. Sherman, Viscous Flow, McGraw Hill Book Co., 1991.
8. Binder, Advanced Fluid Mechanics – Vols. I & II, MIR Publications.
9. Kaufmann., Fluid Mechanics, McGraw Hill Book Co.

MEN002 **CONVENTIONAL ENERGY SYSTEMS** **L T P C**

3 0 0 3

UNIT I HYDRO ELECTRIC STATIONS : **9**

Selection of site, Essential features and elements, Principal Auxiliaries, Plant Layout ,
Classification of Hydro power plants, Hydraulic Turbines, Water wheel Generators.

UNIT II THERMAL POWER STATIONS: **9**

Selection of site for Coal fired power plants, Essential features and elements, Principal
Auxiliaries, Plant Layout, Steam Turbines, Turbo Alternators. Gas Electric power plants,
Diesel Electric power plants.

UNIT III NUCLEAR POWER STATIONS: **9**

Fission and fusion technology fundamentals. Basic construction and comparison of various
types of nuclear reactors, Plant Layout, Risks and Safety measures. Comparison of various
conventional energy systems, their prospects and limitations.

UNIT IV ECONOMIC ASPECTS OF POWER PLANT OPERATION: **9**

Load curves, load factor, diversity factors and their significance, Economic scheduling of
power stations. Interest and depreciation, Costs of electrical energy, Methods of determining
depreciation Tariff, characteristics and types of tariff. Economic efficiency, time value of
money, types of interests, inflation, interest formulae relating present and future worth of
single amount. Pay back period and Net-present value methods to assess financial efficiency
of power plants.

UNIT V DEMAND SIDE LOAD MANAGEMENT: **9**

Concepts, Barriers, Planning and Implementation methods etc.

TOTAL: 45 PERIODS

REFERENCES

1. Electrical Power by J.B.Gupta
2. Power System by V K Mehta
3. Power Plant Engineering by R.K.Rajput
4. Financial evaluation of renewable technology by T.C.Kaupal

MEN003 ENVIRONMENTAL ENGINEERING & POLLUTION CONTROL
L T P C
3 0 0 3

UNIT I INTRODUCTION 9

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

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

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

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

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: 45 PERIODS

TEXT BOOKS:

1. Rao C .S . "Environmental Pollution Control Engineering," 2nd Edition, New Age International Publishers,2006.
2. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Prentice Hall,1998.

REFERENCES

1. Ludwig, H. W.Evans: Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands, N.J, 1991
2. Arcadio P Sincero and G. A. Sincero, Environmental Engineering – A Design Approach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
3. A. P. Sincero and G.A. Sincero , Environmental Engineering: A Design Approach, Prentice Hall of India pvt Ltd, N.Delhi.1996
4. Pandey G.N and Carney G.C., "Environmental Engineering", Tata McGraw Hill Publishing Co., 1989.
5. Bishop P., Pollution Prevention: Fundamentals and Practice, McGraw-Hill International Edition, McGraw-Hill book Co, Singapore, 2000
6. G. Masters: Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt Ltd, New Delhi, 2003
7. Peavy, H.S. and D.R. Rowe, G.Tchobanoglous: Environmental Engineering - McGraw- Hill BookCompany, NewYork, 1985

UNIT I INTRODUCTION 8

Energy Scenario - Principles and Imperatives of Energy Conservation - Energy Consumption Pattern – Resource Availability - Role of Energy Managers in Industries

UNIT II THERMAL ENERGY AUDITING 12

Energy Audit-Purpose, Methodology with respect to process Industries - Power plants, Boilers etc., -Characteristic method Employed in Certain Energy Intensive Industries - Various Energy Conservation Measures in Steam System - Losses in Boiler, Methodology of Upgrading Boiler Performance Energy conservation in pumps, Fans & Compressors, Air conditioning and refrigeration systems, Steam Traps- Types, Function, Necessity

UNIT III ROLE OF INSTRUMENTATION IN ENERGY CONSERVATION 10

Total Energy systems - Concept of Total Energy - Advantages & Limitations - Total Energy system & Application - Various Possible Schemes Employing Steam Turbines Movers Used in Total Energy Systems - Potential & Economics of Total Energy Systems

UNIT IV ELECTRICAL ENERGY AUDITING 10

Potential Areas for Electrical Energy Conservation in Various Industries-Energy Management Opportunities in Electrical Heating, Lighting system, Cable selection - Energy Efficient Motors - Factors involved in Determination of Motor Efficiency Adjustable AC Drives, Applications & its use variable speed Drives/Belt Drives

UNIT V ENERGY MANAGEMENT 5

Importance of Energy Management, Energy Economics - Discount Rate, Payback Period, Internal Rate of Return, Life Cycle Costing

Total : 45 Periods

TEXT BOOKS/REFERENCES:

1. CB Smith, Energy Management Principles, Pergamon Press, NewYork, 1981
2. Hamies, Energy Auditing and Conservation; Methods, Measurements, Management & Case study, Hemisphere, Washington, 1980
3. Trivedi, PR, Jolka KR, Energy Managemnt, Commonwealth Publication, NewDelhi, 1997
4. Witte, Larry C, Industrial Energy Management & Utilization, Hemisphere Publishers, Washington,1988
5. Diamant, RME, Total Energy, Pergamon, Oxford, 1970.

UNIT - I SOLAR RADIATION**8**

Source of radiation – Sun earth relationship- extra terrestrial radiation.– Atmospheric attenuation – Terrestrial radiation-radiation on a horizontal surfaces and inclined planes relations between horizontal radiation and inclined surfaces – relations between monthly, daily and hourly radiation and components of the radiations– solar charts – Critical radiation-Measurement of global, direct and diffuse solar radiation- pyroheliometer, pyrano meter, pyro geo meter, net pyradiometer-sunshine recorder – an overview of solar radiation data in India..

UNIT II SOLAR COLLECTORS**10**

Design considerations – classification- Flat plate collectors- air heating collectors liquid heating –Temperature distributions- Heat removal rate- Useful energy gain – Losses in the collectors-for efficiency of flat plate collectors – selective surfaces – tubular solar energy collectors analysis of concentric tube collector – testing of flat plate collectors. Solar green house. Concentric collectors-Limits to concentration – concentrator mounting – tracking mechanism - performance analysis focusing solar concentrators: Heliostats.

UNIT III SOLAR CELLS**9**

Conversion of Solar energy into Electricity - Photovoltaic Effect, Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells, Role of nano-technology in Solar cells.

UNIT IV SOLAR PHOTOVOLTAIC SYSTEM DESIGN**10**

Solar cell array system analysis and performance prediction, Shadow analysis: Reliability, Solar cell array design concepts, PV system design, Design process and optimization: Detailed array design, Voltage regulation, Maximum tracking, Quick sizing method, Array protection.

UNIT V INDUSTRIAL APPLICATIONS OF SOLAR HEAT**8**

Temperature requirements, consumption pattern, Solar Passive Heating and Cooling, Solar Thermal Power Plant, Modeling of Solar Thermal Systems, Solar Desalination, Solar Drying, Solar Cooking, Solar Greenhouse technology: Fundamentals, design, modeling and applications in agriculture and space heating

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Sukhatme S P, Solar Energy, Tata McGraw Hill, 1984.
2. Kreider, J.F. and Frank Kreith, Solar Energy Handbook, McGraw Hill, 1981.
3. Goswami, D.Y., Kreider, J. F. and Francis., Principles of Solar Engineering, 2000.

REFERENCES:

1. Garg H P., Prakash J., Solar Energy: Fundamentals & Applications, Tata McGraw Hill, 2000.
2. Duffie, J. A. and Beckman, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.
3. Alan L Fahrenbruch and Richard H Bube, Fundamentals of Solar Cells: PV Solar Energy Conversion, Academic Press, 1983.
4. Larry D Partain, Solar Cells and their Applications, John Wiley and Sons, Inc, 1995.
5. Roger Messenger and Jerry Vnetre, Photovoltaic Systems Engineering, CRC Press, 2004.

MEN007 COGENERATION AND WASTE HEAT RECOVERY SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction - principles of thermodynamics – cycles - topping - bottoming – combined cycle - organic ranking cycles – performance indices of cogeneration systems – waste heat recovery – sources and types – concept of tri generation.

UNIT II COGENERATION TECHNOLOGIES 9

Configuration and thermodynamic performance – steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – advanced cogeneration systems: fuel cell, Stirling engines etc.,

UNIT III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES 9

Cogeneration plants electrical interconnection issues – utility and cogeneration plant interconnection issues – applications of cogeneration in utility sector – industrial sector – building sector – rural sector – impacts of cogeneration plants – fuel, electricity and environment

UNIT IV WASTE HEAT RECOVERY SYSTEMS 9

selection criteria for waste heat recovery technologies - recuperates - Regenerators - economizers - plate heat exchangers - thermic fluid heaters - Waste heat boilers classification, location, service conditions, design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps – sorption systems.

UNIT V ECONOMIC ANALYSIS 9

Investment cost – economic concepts – measures of economic performance – procedure for economic analysis – examples – procedure for optimized system selection and design – load curves - sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford, 1987.
2. Institute of Fuel, London, Waste Heat Recovery Chapman and Hall Publishers, London, 1963

REFERENCES:

1. Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984.
2. EDUCOGEN – The European Educational tool for cogeneration, Second Edition, 2001
3. Sengupta Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.
4. De Nevers, Noel, Air Pollution Control Engineering, McGrawHill, New York, 1995.

MEN008 ADVANCED THERMAL STORAGE TECHNOLOGIES L T P C

3 0 0 3

UNIT I INTRODUCTION 8

Necessity of thermal storage – types-energy storage devices – comparison of energy storage technologies - seasonal thermal energy storage - storage materials.

UNIT II SENSIBLE HEAT STORAGE SYSTEM 9

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

UNIT III REGENERATORS 10

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 9

Modeling of phase change problems – temperature based model - enthalpy model - porous medium approach - conduction dominated phase change – convection dominated phase change.

UNIT V APPLICATIONS 9

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: 45 PERIODS

TEXT BOOKS:

Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.

REFERENCES

1. Schmidt.F.W and Willmott.A.J, Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.
2. Lunardini.V.J, Heat Transfer in Cold Climates, John Wiley and Sons 1981

MEN009

ALTERNATIVE FUELS

L T P C

3 0 0 3

UNIT – I OVERVIEW

9

Introduction – Alternative fuels – Potential solid - liquid - and gaseous fuels. – Alcohols – ethanol, methanol, M85, E85 and gashol – properties – SI engine combustion performance and emission characteristics. Alcohols for CI engine – Alcohol fumigation – Dual fuel injection – Surface ignition and spark ignition- storage, dispensing and safety – material compatibility.

UNIT – II VEGETABLE OILS AND OTHER SIMILAR FUELS DERIVED 9

Vegetable oils- properties – advantages and disadvantages – Biodiesel – trans-esterification - Factors affecting the process – Properties- Biodiesel blends – engine combustion, performance and emission characteristics- material compatibility , other alternative liquid fuels – benzol – acetone – diethyl ether.

UNIT – III NATUARAL GAS AND LPG 9

Alternative gaseous fuels – natural gas and LPG – production – properties of natural gas and LPG – CNG conversion kits – Advantages and disadvantages of NG and LPG – comparison of gasoline and LPG – CNG and LPG fuel feed system – LPG & CNG for CI engine – methods of fuel induction engine combustion, performance and emission characteristics.

UNIT – IV HYDROGEN AS ALTERNATIVE FUEL 9

Hydrogen energy – properties , production , thermo- chemical methods – Hydrogen storage – Delivery – conversion – safety – Hydrogen engines, methods of usage in SI and CI engine – Hydrogen injection system – Hydrogen induction in SI engine.

UNIT – V BIOGAS FOR IC ENGINES 9

Biogas – properties – Biogas for running IC engine – Biogas as vehicle fuel – biogas consumption – engine performance and emission- Biomass gasification – producer gas – consumption – dual fuel operation – engine performance and emission.

TOTAL: 45 PERIODS

TEXT BOOKS/REFERENCE BOOKS

1. Ganesan.V, - Internal Combustion Engines, Tata Mc Graw Hill Publishing company Ltd, New Delhi.
2. Ramalingam K.K, - Internal Combustion Engines Theory and practice, Scitech Publications (India) Pvt, Ltd
3. Gupta, H. N., - Fundamentals of internal combustion engines, Prentice Hal,India, 2006.
4. Mittal K.M., - Biogas System Principles and application New Age International (P) Ltd, Publishers, 1996
5. Richard L. Bechtold, - Alternative fuels guide book SAE International, Wattendale,1997.

MEN010 WASTE MANAGEMENT AND ENERGY RECOVERY L T P C
3 0 0 3

UNIT I SOLID WASTE – CHARACTERISTICS AND PERSPECTIVES 6

Definition - types – sources – generation and estimation. Properties: physical, chemical and biological – regulation

UNIT II COLLECTION, TRANSPORTATION AND PROCESSING TECHNIQUES 8

Onsite handling, storage and processing – types of waste collection mechanisms - transfer Stations : types and location – manual component separation – volume reduction : mechanical, thermal – separation : mechanical, magnetic electro mechanical

UNIT III ENERGY GENERATION TECHNIQUES 16

Basics, types, working and typical conversion efficiencies of composting – anaerobic digestion – RDF – combustion – incineration – gasification – pyrolysis

UNIT IV HAZARDOUS WASTE MANAGEMENT 8

Hazardous waste – definition - potential sources - waste sources by industry – impacts – waste control methods – transportation regulations - risk assessment - remediation technologies – Private public paternership – Government initiatives.

UNIT V ULTIMATE DISPOSAL 7

Landfill – classification – site selection parameters – design aspects – Leachate control – environmental monitoring system for Land Fill Gases.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tchobanoglous, Theisen and Vigil, Integrated Solid Waste Management, 2d Ed. McGraw-Hill, New York, 1993.
2. Howard S. Peavy etal, Environmental Engineering, McGraw Hill International Edition, 1985

REFERENCES:

1. LaGrega, M., et al., Hazardous Waste Management, McGraw-Hill, c.1200 pp., 2nd ed., 2001.
2. Stanley E. Manahan. Hazardous Waste Chemistry, Toxicology and Treatment, Lewis Publishers, Chelsea, Michigan, 1990
3. Parker, Colin and Roberts, Energy from Waste – An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
4. Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997

MEN011 STEAM GENERATOR TECHNOLOGY

L T P C

3 0 0 3

UNIT I INTRODUCTION

10

Boilers – components - classification – general design considerations – boiler specifications. Fuel stoichiometry calculations – enthalpy calculation of air and combustion products – heat balance.

UNIT II COAL PREPARATION SYSTEM OF BOILERS

8

Pulverizing properties of coal – air system for pulverization – size – reducing machines. Design of coal preparation system for PC Boilers – fuel-feeding arrangements

UNIT III DESIGN OF BURNERS

8

Design of oil supply system - tangential fired burners - oil atomizers - air registers - design principles of oil fired boilers

UNIT IV BOILER FURNACE DESIGN

9

General design Principles – flame Emissivity – heat transfer calculation for PC Boiler furnace – water wall arrangement – furnace emissivity – distribution of heat load in furnace. Fluidized bed boilers - major features of fluidized bed boilers – basic design principles.

UNIT V DESIGN OF CONVECTIVE HEAT TRANSFER SURFACE

10

Design of economizer – superheater – reheater – air preheater. Temperature control in superheaters and reheaters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Prabir Basu, Cen Kefa and Louis Jestin, Boilers and Burners: Design and Theory, Springer 2000.
2. Ganapathy, V., Industrial Boilers and Heat Recovery Steam Generators, MarcelDekker Ink 2003

REFERENCES:

1. David Gunn and Robert Horton, Industrial Boilers, Longman Scientific and Technical Publication, 1986
2. Carl Schields, Boilers: Type, Characteristics and Functions, McGraw Hill Publishers, 1982
3. Howard, J.R., Fluidized Bed Technology: Principles and Applications, Adam Hilger, NewYork, 1983.

UNIT I MATERIALS**9**

Glazing materials, Properties and Characteristics of Materials, Reflection from surfaces, Selective Surfaces: Ideal coating characteristics, Types and applications, Anti-reflective coating, Preparation and characterization. Reflecting Surfaces and transparent materials., Types of Insulation and properties

UNIT II PHYSICS OF SOLAR CELLS**9**

Intrinsic, extrinsic and compound semiconductors, Electrical conductivity, Density of electrons and holes, Carrier transport: Drift, diffusion, Absorption of light, Recombination process, Materials for Photovoltaic's Conversion, Si and Non-Si materials, crystalline, semi-crystalline, Polycrystalline and Amorphous materials, p-n junction: homo and hetero junctions, Metal-semiconductor interface

UNIT III TECHNOLOGY FOR SI EXTRACTION**9**

Purification, Method of doping and junction fabrication, Cell fabrication and metallization techniques: Preparation of metallurgical, electronic and solar grade Silicon, Production of single crystal Silicon: Procedure of masking, photolithography and etching, Design of a complete silicon, GaAs, InP solar cell

UNIT IV SENSIBLE HEAT STORAGE MATERIALS**9**

Stratified storage systems, Rock-bed storage systems, Thermal storage in buildings, Earth storage, Energy storage in aquifers, Heat storage in SHS systems, Aquifers storage

UNIT V PHASE CHANGE MATERIALS, PIEZOELECTRICITY AND FERRO ELECTRICITY**9**

Selection criteria of Phase change, Materials use in Solar heating or cooling, Research Status Optical properties, Interaction of solids with radiation, Luminescence, Photoconductivity

TOTAL: 45 PERIODS**TEXT BOOKS/REFERENCES**

1. HP Garg et.al, Solar Thermal Energy Storage, D Reidel Publishing Co, 1985
2. V Alexiades and AD Solomon Mathematical Modeling of Melting and Freezing process, Hemisphere Publishing Corporation, Washington,1993
3. R Narayan, B Viswanathan, Chemical and Electrochemical Energy System, Universities Press, 1998
4. A Ter-Gazarian, Energy Storage for Power Systems, Peter Peregrinus Ltd London, 1994
5. B Kilkis and S Kakac(Ed), Energy Storage Systems, KAP, London, 1989
6. WD Callister, Jr, Materials Science and Engineering: An Introduction, John Wiley, New York, 1997
7. ZD Jastrzebski, The Nature and Properties of Engineering Materials, John Wiley, New York, 1987

UNIT I BASIC CONCEPTS OF ENERGY ECONOMICS**9**

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**

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**

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**

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**

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: 45 PERIODS**TEXT BOOKS/REFERENCES:**

1. EA Diulio, Macroeconomic Theory, Schaum's Outline Series, 2nd Ed, McGraw-Hill Publishing Company (1990)
2. R Loulou, P R Shukla and A Kanudia, Energy and Environment Policies for a sustainable Future, Allied Publishers Ltd, New Delhi, 1997
3. J Parikh, Energy Models for 2000 and Beyond, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1997
4. CB Smith, Energy Management Principles, Pergamon Press, New York, 1981
5. P. O'Callaghan: Energy Management, McGraw - Hill Book Company, 1993.
6. Y P Abbi and Shashank Jain. Handbook on Energy Audit and Environment Management, TERI Publications, 2006.

UNIT I INTRODUCTION**9**

Bio-climatic classification of India, Passive Solar Passive Building and Green Building Concepts, National Building Code, Energy Star Rating , Policies on Energy Efficient and Green buildings

UNIT II PASSIVE HEATING & COOLING CONCEPTS**9**

Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces, Solar Green Houses, Solar Wall, Solar Trombe wall

Evaporative cooling, radiative cooling, Application of wind, water and earth for cooling, Shading, paints and cavity walls for cooling, Roof radiation traps, Earth air-tunnel systems for cooling

UNIT III THERMAL ANALYSIS AND DESIGN FOR HUMAN COMFORT**9**

Thermal comfort, Criteria and various parameters, Psychometric chart, Thermal indices, Climate and comfort zones, Concept of sol-air temperature and its significance, Calculation of instantaneous heat gain through building envelope, Calculation of solar radiation on buildings, Building orientation, Introduction to design of shading devices, Overhangs, Factors that affect energy use in buildings, Ventilation and its significance, Air-conditioning systems,

UNIT IV HEAT TRANSMISSION IN BUILDINGS**9**

Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, Wall and windows, Heat transfer due to ventilation/infiltration, internal heat transfer, solar temperature, Decrement factor, Phase lag, Day lighting, Estimation of Building loads: Steady state method, network method, numerical method, correlations

UNIT V PASSIVE SOLAR DESIGNS OF BUILDING**9**

Thumb rules for design of buildings and building codes, Typical design of selected buildings in various climatic zones, Simulation Software's for carrying out thermal design of buildings and predicting performance

TOTAL: 45 PERIODS**TEXT BOOKS/ REFERENCES:**

1. MS Sodha, NK Bansal, PK Bansal, A Kumar and MAS Malik, Solar Passive Building, Science and Design, Pergamon Press, 1986
2. JR Williams, Passive Solar Heating, Ann Arbor Science, 1983
3. RW Jones, JD Balcomb, CE Kosiewicz, GS Lazarus, RD McFarland and WOWray, Passive Solar Design Handbook, Vol 3, Report of US Department of Energy (DOE/CS-0127/3), 1982
4. J Krieder and A Rabi, Heating and Cooling of Buildings: Design for Efficiency, McGraw-Hill, 1994
5. RD Brown, TJ Gillespie Microclimatic Landscape Design, John Wiley and Sons, New York, 1990
6. Climatology, DS Lal, Sharda Pustak Bhawan, Allahabad, 2003
7. TA Markus, EN Morris, Building, Climate and Energy, Spottwoode Ballantype Ltd, London, 1980

MEN015 DESIGN OF HEAT EXCHANGERS

L T P C

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UNIT I FUNDAMENTALS OF HEAT EXCHANGER

9

Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – LMTD and effectiveness method.

UNIT II FLOW AND STRESS ANALYSIS

9

Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures.

UNIT III DESIGN ASPECTS

9

Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe - finned tube - shell and tube heat exchangers - simulation of heat exchangers.

UNIT IV COMPACT AND PLATE HEAT EXCHANGERS

9

Types – merits and demerits – design of compact heat exchangers, plate heat exchangers – performance influencing parameters - limitations.

UNIT V CONDENSERS AND COOLING TOWERS

9

Design of surface and evaporative condensers – cooling tower – performance characteristics

TOTAL: 45 PERIODS

TEXT BOOKS:

Sadik Kakac and Hongtan Liu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002

REFERENCES

1. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988.
2. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co. 1980.
3. Hewitt.G.F, Shires.G.L and Bott.T.R, Process Heat Transfer, CRC Press, 1994.

MEN016

WIND ENERGY ENGINEERING

L T P C

3 0 0 3

UNIT I

9

Measurement and instrumentation – Beau fort number -Gust parameters – wind type – power law index -Betz constant -Terrain value.

UNIT II

9

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

UNIT III

9

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

UNIT IV

9

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

UNIT V

9

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

TOTAL: 45 PERIODS

TEXT BOOKS

1. S. Rao & B. B. Parulekar, “Energy Technology”, 4th edition, Khanna publishers, 2005.
2. Wind energy Handbook, Edited by T. Burton, D. Sharpe, N. Jenkins and E. Bossanyi, John Wiley & Sons, 2001
3. Wind and Solar Power Systems, Mukund. R. Patel, 2nd Edition, Taylor & Francis, 2001
4. L .L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
5. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press

REFERENCES

1. Anna Mani & Nooley, “Wind Energy Data for India”, 1983.
2. IS 875 Part IV and IS 1893 semics D+STDS mareials STDS IS 226 (IS 2862, ASTMS 36, BS 4360 GR 43D and A).
3. Logan (EARL),“Turbo Machinery Basic theory and applications”, 1981.

UNIT I CONVENTIONAL MOTOR DRIVES 9

Characteristics of DC and AC motor for various applications - starting and speed control - methods of breaking.

UNIT II PHYSICAL PHENOMENA IN ELECTRICAL MACHINES 9

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

UNIT III SOLID STATE POWER CONTROLLERS 9

Power devices - Triggering Circuits – Rectifiers – Choppers - Inverters – AC Controllers.

UNIT IV SUPERCONDUCTIVITY 9

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

UNIT V SOLID STATE MOTOR CONTROLLERS 9

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

TOTAL: 45PERIODS

TEXT BOOKS:

1. Pillai.S.K, A First course on Electrical Drives, Wiley Eastern Limited (1982).
2. NKDE and P.K.Sen, Electrical drives, Prentice Hall of India Pvt Ltd (2001)
3. P.S.Bimbhra, Power Electronics, Khanna Publishers.

REFERENCES:

1. S.B. Devwan, G.R. Slevnon, A.Strangher, Power Stream and Control Drives, John Wiley & Sons (1984).
2. Eedam subramanyan, Thyristor Control of Electrical Drives, Tata McGraw-Hill Co.Ltd.,(1988).
3. J.M.D. Murphy, F.G. Turnbull, ;Power Electronics: Control of AC Motors-Pergamon Press(1988).
4. C.G. Say-Introduction to the Theories of Electromagnetic Machines, Pitman (1971).
5. Rakesh Dal Begamudre-Electro Mechanical Energy Conversion with
6. Dynamics of Machines – Wiley Eastern (1988).

UNIT I FLUIDIZED BED BEHAVIOUR**12**

Characterization of bed particles - comparison of different methods of gas – solid contacts. Fluidization phenomena - regimes of fluidization – bed pressure drop curve. Two phase and well-mixed theory of fluidization. Particle entrainment and elutriation – unique features of circulating fluidized beds.

UNIT II HEAT TRANSFER**6**

Different modes of heat transfer in fluidized bed – bed to wall heat transfer – gas to solid heat transfer – radiant heat transfer – heat transfer to immersed surfaces. Methods for improvement – external heat exchangers – heat transfer and part load operations.

UNIT III COMBUSTION AND GASIFICATION**6**

Fluidized bed combustion and gasification – stages of combustion of particles – performance - start-up methods. Pressurized fluidized beds.

UNIT IV DESIGN CONSIDERATIONS**9**

Design of distributors – stoichiometric calculations – heat and mass balance – furnace design – design of heating surfaces – gas solid separators.

UNIT V INDUSTRIAL APPLICATIONS**12**

Physical operations like transportation, mixing of fine powders, heat exchange, coating, drying and sizing. Cracking and reforming of hydrocarbons, carbonization, combustion and gasification. Sulphur retention and oxides of nitrogen emission Control.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Howard, J.R., Fluidized Bed Technology: Principles and Applications, Adam Hilger, New York, 1983.
2. Geldart, D., Gas Fluidization Technology, John Willey and Sons, 1986.

REFERENCES:

1. Kunii, D and Levespiel, O., Fluidization Engineering, John Wiley and Son Inc, New York, 1969.
2. Howard, J.R. (Ed), Fluidized Beds: Combustion and Applications, Applied Science Publishers, New York, 1983.
3. Botteril, J.S.M., Fluid Bed Heat Transfer, Academic Press, London, 1975.
4. Yates, J.G. Fundamentals of Fluidized bed Chemical Processes, Butterworths, 1983.

UNIT - I HYDROLOGY**9**

Overview of Hydropower systems-Preliminary Investigation- Rainfall and Run of measurements- Hydrographs- flow duration graph and mass storage graphs- Determination of site selection- types hydro electric power plants- General arrangements and Layouts- Preparation of Reports and Estimates-Review of World Resources-Basic Factors in Economic Analysis of Hydropower projects-Project Feasibility-Load Prediction and Planned Development.

UNIT- II DEVELOPMENT OF PROTO TYPE SYSTEMS**12**

Advances in Planning, Design and Construction of Hydroelectric Power Stations-Trends in Development of Generating Plant and Machinery-Plant Equipment for pumped Storage Schemes-Some aspects of Management and Operations-Updating and Refurbishing of Turbines-Case Studies

UNIT - III SELECTION AND ANALYSIS OF TURBINES**7**

Measurement of pressure head, Velocity- Various parameters for finding out the potential of Hydro Energy- Selection of turbines based on Specific quantities- Case study

UNIT - IV HYDRO POWER STATION OPERATION, MAINTENANCE AND TROUBLE SHOOTING**10**

Governing of Power Turbines-Functions of Turbine Governor-Condition for Governor Stability-Surge Tank Oscillation and Speed Regulative Problem of Turbine Governing in Future Planning, Design and Construction of Hydroelectric Power Stations-Remaining Lifecycle Analysis.

UNIT - V SMALL, MINI AND MICRO HYDRO POWER PLANTS TURBINES**9**

Introduction – Analysis of Small, mini and micro hydro turbines – Economical and Electrical Aspects of Small, mini and micro hydro turbines- potential developments – Design and reliability of Small, mini and micro hydro turbines – Case Study. A compulsory Seminar/ Assignment on Design/Case Study/Analysis/Application in any one the Small, Mini and Micro Hydro Power Plants and Components(viz.. Turbines, Controls, and Storage etc..)

Total: 45 PERIODS**TEXT BOOKS:**

1. P.K Nag “Power plant Engineering”, TataMcGrawHill, NewDelhi,2004
2. Domkundwar and Arora” A Course in Power plant Engineering”, Khanna Publishers, NewDelhi.

REFERENCES:

1. L.Monition,M.Lenir and J.Roux Micro Hydro Electric Power Station(1984)
2. AlenR. Inversin,Micro Hydro Power Source Book(1986)

UNIT I NUCLEAR REACTIONS**9**

Mechanism of nuclear fission - nuclides - radioactivity – decay chains – neutron reactions - the fission process - reactors - types of fast breeding reactor - design and construction of nuclear reactors - heat transfer techniques in nuclear reactors - reactor shielding.

UNIT II REACTOR MATERIALS**9**

Nuclear Fuel Cycles - characteristics of nuclear fuels - Uranium - production and purification of Uranium - conversion to UF₄ and UF₆ - other fuels like Zirconium, Thorium - Beryllium.

UNIT III REPROCESSING**9**

Nuclear fuel cycles - spent fuel characteristics - role of solvent extraction in reprocessing - solvent extraction equipment.

UNIT IV SEPARATION OF REACTOR PRODUCTS**9**

Processes 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**

Types of nuclear wastes - safety control and pollution control and abatement - international convention on safety aspects - radiation hazards prevention.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, 3rd Edition, Von Nostrand, 1984.
2. Duderstadt, J.J. and Hamilton, L.J., Nuclear Reactor Analysis, John Wiley, 1976.

REFERENCES:

1. Lamarsh, J.R., Introduction to Nuclear Reactor Theory, Wesley, 1996.
2. Walter, A.E. and Reynolds, A.B., Fast Breeder Reactor, Pergamon Press, 1981.
3. Winterton, R.H.S., Thermal Design of Nuclear Reactors, Pergamon Press, 1981.

UNIT I MEASUREMENT CHARACTERISTICS**12**

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 AND COMPUTERS IN MEASUREMENT**5**

Data logging and acquisition use of sensors for error reduction elements of micro – computer interfacing - intelligent instruments in use.

UNIT III MEASUREMENT OF PHYSICAL QUANTITIES**10**

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

UNIT IV ADVANCE MEASUREMENT TECHNIQUES**8**

Shadow graph – Schlieren – interferometer - Laser doppler anemometer - hot wire anemometer, heat flux sensors - telemetry in measurement.

UNIT V CONTROL SYSTEMS**10**

Adaptive Control: Introduction, controllability, observability, Time optimal control system, Adaptive control.

Digital Control: Introduction, Microprocessor PC based control applications, PID controllers.

TOTAL PERIODS:45**REFERENCES:**

1. Holman, J.P. Experimental methods for engineers, McGraw – Hill, 1988
2. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988.
3. Prebrashensky, V., Measurements and Instrumentation in Heat Engineering, Vol. 1 and 2, MIR Publishers, 1980
4. Raman, C.S., Sharma, G.R., and Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill, New Delhi, 1983
5. Doebelin, Measurement System Application and Design, McGraw Hill, 1978
6. Morris A.S., Principles of Measurements and Instrumentation, Prentice Hall of India, 1998.

MEN023

SOLAR REFRIGERATION AND AIRCONDITIONING

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UNIT I

9

Potential and scope of solar cooling. Types of solar cooling systems, solar collectors and storage systems for solar refrigeration and airconditioning.

UNIT II

9

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

UNIT III

9

Thermal modelling and computer simulation for continuous and intermittent solar refrigeration and airconditioning systems.

UNIT IV

9

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

UNIT V

9

Solar thermoelectric refrigeration and airconditioning. Solar economics of cooling systems.

TOTAL PERIODS: 45

REFERENCES:

1. Solar Air Conditioning and Refrigeration by Sayigh, A.A.M.;McVeigh, J.C.
2. Solar-assisted air conditioning in buildings by Hans-Martin Henning
3. Solar heating and cooling: Active and Passive design by Frank Kreith
4. Solar technologies for buildings by Ursula Eicker

MEN024 COMPUTATIONAL FLUID DYNAMICS

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UNIT I

9

Governing Equations of Fluid Flow, Finite Difference, Finite Volume, Finite Element Methods, Laplace Equation, Diffusion Equation or Wave Equation

UNIT II

9

Application of Finite Volume Method to Fluid Flow problems - Pressure Correction Techniques-Gauss Siedel, Gauss Jordan. Introduction to Multi grid Methods. Boundary Conditions

UNIT III

9

Structured and Unstructured Mesh- Introduction to CAD systems and Different Standards used for DATA Exchange.

UNIT IV

9

Governing Equations for Turbulent Flow, Rotating Machinery, Combusting Flow, Multiphase Flow.

UNIT V

9

Simple Internal Flows: T-Junction, Driven Cavity, Manifold, Valves, External Flows: Flow Over Ahmed Body, Car-Reacting Flow in a Gas Burner, Multiphase Flow in an Air Lift Reactor.

TOTAL PERIODS:45

TEXT BOOKS

1. H.K. Versteeg & W. Malalasekera, "An Introduction to Computational Fluid Dynamics -The finite volume approach" Longman, 1995
2. Segerlind .L. J., "Applied finite Element Analysis", 2nd edition, John Wiley, 1984

REFERENCES

1. Anderson, "Computational Fluid Dynamics" McGraw Hill Company, 1995
2. D.A. Caughey and M.M.Hafez, "Frontiers of Computational Fluid Dynamics 1994" John Wiley & Sons, 1994

UNIT-I FUEL CELL BASICS**9**

Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells Fuel cell thermodynamics - second law analysis of fuel cells, efficiency of fuel cells fuel cell electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation

UNIT-II FUEL CELL TYPES**9**

Classification by operating temperature/electrolyte type, Fuel Cell Performance, Activation, Ohmic and Concentration over potential

UNIT-III FUEL CELL DESIGN AND COMPONENTS**9**

Cell components, stack components, system components Overview of intermediate/high temperature fuel cells - Solid oxide fuel cells (SOFC), Molten carbonate fuel cells (MCFC), Phosphoric acid fuel cells (PAFC) Polymer Electrolyte fuel cells ,Heat and mass transfer in polymer electrolyte fuel cells, water management in PEFCs, Current issues in PEFCs, Direct methanol fuel cells (DMFC) - Electrochemical kinetics methanol oxidation, Current issues in MFCs, Fuel crossover in DMFCs, Water management in DMFCs, high methanol concentration operation, limiting current density

UNIT-IV HYDROGEN PRODUCTION METHODS**9**

Production of hydrogen from fossil fuels, electrolysis, thermal decomposition, photochemical and photo-catalytic methods.

UNIT-V HYDROGEN STORAGE METHODS**9**

Metal hydrides, metallic alloy hydrides, carbon nano-tubes, sea as source of deuterium.

TOTAL PERIODS:45**TEXT BOOKS/REFERENCE:**

1. J Larminie and A Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley,2003
2. Xianguo Li, Principles of Fuel Cells, Taylor and Francis, 2005
3. S Srinivasan, Fuel Cells: From Fundamentals to Applications, Springer €
4. O'Hayre, SW Cha, W Colella and FB Prinz, Fuel Cell Fundamentals, Wiley, 2005
5. A Faghri and Y Zhang, Transport Phenomena in Multiphase Systems, Elsevier 2006