

M. Tech. RENEWABLE ENERGY
(3 Years – Part time Degree Programme)

CURRICULUM AND SYLLABUS
(Regulation 2017)

The total credits required for completing the
M.Tech. Programme in Renewable Energy is 74.



**PERIYAR
MANIAMMAI
UNIVERSITY**
(Under Sec. 3 of UGC Act, 1956) • NAAC Accredited
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DEPARTMENT OF MECHANICAL ENGINEERING

Periyar Maniammai University

Vallam, Thanjavur - 613 403

May 2017

SEMESTER I

Code No	Course Title	L	T	P	C
PYRE101	Fuels and combustion technology	3	0	0	3
PYRE102	Hydro Power Technology	3	0	0	3
PYRE103	Solar Energy Engineering	3	1	0	4
PYRE104	Solar Energy and MAT Lab	0	0	3	2

Total Hours – 13

Total Credits – 12

SEMESTER II

Code No	Course Title	L	T	P	C
PYRE201	Bio-Energy Engineering	3	0	0	3
PYRE202	Wind Energy, Tidal Energy and OTEC	3	0	0	3
PYRE203	Electrical Energy Technology	3	0	0	3
PYRE204	Bio and Thermal Energy Lab	0	0	3	2

Total Hours – 12

Total Credits – 11

SEMESTER III

Code No	Course Title	L	T	P	C
PYRE301	Computational Fluid dynamics	3	1	0	4
PYRE302	Hydrogen and Nuclear Energy	3	0	0	3
PYRE303*	Elective – I	3	0	0	3
PYRE304	Computational Fluid Dynamics Lab	0	0	3	2

Total Hours – 13

Total Credits – 12

SEMESTER IV

Code No	Course Title	L	T	P	C
PYRE401	Energy Audit and Management	3	1	0	4
PYRE 402	Statistical tools for a Data analysis	3	0	0	3
PYRE 403*	Elective II	3	0	0	3
PYRE 404	Mini Project	0	0	3	2

Total Hours – 13

Total Credits – 12

SEMESTER V

Code No	Course Title	L	T	P	C
PYRE501	Process Modeling and Simulation in energy systems	3	1	0	4
PYRE502*	Elective – III	3	0	0	3
PYRE 503*	Elective- IV	3	0	0	3
PYRE 504	Project work Phase - I	0	0	10	5

Total Hours – 20

Total Credits – 15

SEMESTER VI

Code No	Course Title	L	T	P	C
PYRE 601	Project work Phase - II	0	0	24	12

Total Hours – 20

Total Credits – 12

LIST OF ELECTIVES					
Code No	Course Title	L	T	P	C
Group – 303					
PYRE303A	Fluid Dynamics and Heat Transfer	3	0	0	3
PYRE303B	Unit Operations in Industries	3	0	0	3
PYRE303C	Waste Management and Energy Recovery	3	0	0	3
Group – 403					
PYRE403A	Environmental Engineering	3	0	0	3
PYRE403B	Optimum Utilization of heat and power	3	0	0	3
PYRE403C	CAD/CAM and Simulation of Renewable Energy systems	3	0	0	3
Group – 502					
PYRE502A	Energy Conservation in HVAC	3	0	0	3
PYRE502B	Carbon Sequestration And Trading	3	0	0	3
PYRE502C	Sustainable Development	3	0	0	3
Group – 503					
PYRE503A	Instrumentation Technology for Energy Systems	3	0	0	3

PYRE503B	Energy Efficient building	3	0	0	3
PYRE503C	Energy Modeling, Economics and Project Management	3	0	0	3

PYRE101 - FUELS AND COMBUSTION TECHNOLOGY

3 0 0 3

UNIT – I FUELS & FUEL ANALYSIS:

8

Types of fuel-Physical and chemical characteristics of solid, liquid, and gaseous fuels-Non conventional fuel-producer gas, hydrogen, biogas etc- Determination of Calorific values-Ultimate and proximate analysis-problems associated with handlings, storage and combustion

COMBUSTION STOICHIOMETRY

Stoichiometry relations – conservation of mass principles – theoretical & actual combustion processes – calculation of air fuel ratio for a fuel of known combustion – calculation of flue gas composition of fuel and excess air supplied from exhaust gas analysis – combustion calculation with sub-stoichiometry air – calculation of atmospheric air moisture – Dew point temperature of the combustion products – Flue gas analysis- Boiler performance analysis

UNIT - II THERMODYNAMICS OF COMBUSTION PROCESSES

10

COMBUSTION KINETICS: Degree of reactions-reactions equilibrium-Laws of mass action-criteria of equilibrium-heat and temperature-Gibbs free energy – equilibrium constant-Vant hoffs isotherm – rate of reaction-factors affecting rate of reaction-calculation of equilibrium constant and composition of reacting systems .

UNIT- III FLAME, FLAME STRUCTURE, IGNITION AND IGNITORS

10

Flame – flame structure – flame propagation – deflagration – detonations – flame front – Ignition – self & forced ignition – Ignition temperature & ignition limits – Factors influencing ignition – SIT – Ignition lag – limits of inflammability & its determination – factors affecting inflammability limits – calculation of inflammability limits – flame blow off, blow out & flash back – flame quenching, Flame structure – flame stability – premixed & diffused flames – velocity of flame propagation – various methods of flame stabilization – swirl number & its significance – Turndown ratio – Ignitors – various types of ignitors – NFPA class I, II & III ignitors – Eddy plate ignitor – plasma ignitor – High energy Arc ignitor – DIPC ignitor.

UNIT- IV BASICS OF FURNACES

10

Industrial furnaces – process furnaces Steam generating furnaces – Kilns – Batch & continuous furnaces – Advantages of ceramic coating – Heat source – Distributions of heat source in furnaces – Blast furnace – open hearth furnace – pot & crucible furnaces – waste heat recovery in furnaces – Recuperator – Regenerators – Furnace atmospheres – Furnace Insulation – Furnace Heat balance calculations, Pipe still Heater.

UNIT - V COAL BURNING EQUIPMENTS

7

Coal burning methods – over feed & underfeed supply of coal – Mechanical Stokers – Travelling grate & spreader stoker – vibrating grate stoker – Advantages & disadvantages of stoker firing over pulverized systems of firing – problems encountered with burning of high ash

coal. Pulverized fuel burners – streamlined burner – turbulent burners – Tangential burner – cyclone burner – special type burners.

A compulsory seminar / Assignment on design /case study / Analysis/ Application in any one of the combustion system and accessories (viz Burner,Draught etc)

L:45; Total:45

Text Books:

1. Dr. SamirSarkar, “Fuels & Combustion”, Orient Longman, Second edition, 2007.
2. Gupta O.P. “Elements of Fuels, Furnaces & Refractories”, 4th edition, Khanna Publishers, 2010.

REFERENCES:

1. S.P. Sharma & Chander Mohan, “Fuels & Combustion”, Tata McGraw Hill Publishing Co.Ltd., 1984
2. J.D. Gilchrist, “Fuels, Furnaces & Refractories”, Pergamon Press, ISBN-008-029430-9 ----
3. Blokh A.G. “Heat Transmission in Steam Boiler furnaces”, Hemisphere Publishing Corpn.ISBN-089-116-626-2

PYRE 102 – HYDROPOWER TECHNOLOGY

3 0 0 3

UNIT - I HYDROLOGY`

9

Overview of Hydropower systems-Preliminary Investigation-Rainfall and run off 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

9

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

9

Pelton,Francis and Kaplan Turbine 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 TROBLE SHOOTING

9

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 Life cycle analysis

UNI - V SMALL, MINI AND MICRO HYDRO POWER PLANTS TURBINES

9

Introduction – analysis of micro hydro and mini hydro turbines – Economical and electrical aspects of small, mini and micro hydro turbines potential developments – design reliability of small, mini micro hydro turbines – case studies.

L:45; Total: 45

TEXT BOOKS:

1. P.K Nag “Power plant Engineering” Tata McGrawHill,Fourth edition, New Delhi,2014
2. Domkundwar and Arora “a course in Power plant Engineering” Dhanpat Rai & Co. (P) limited (2016), new Delhi.

REFERENCES:

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

PYRE 103 - SOLAR ENERGY ENGINEERING

3 1 0 4

(Use of approved data book permitted in the examination)

UNIT - I SOLAR RADIATION

9

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, pyranometer, pyrogeometer, net pyradiometer-sunshine recorder – an overview of solar radiation data in India.

UNIT - II SOLAR COLLECTORS – FLAT PLATE COLLECTORS

9

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 greenhouse. Solar Tracking. Solar kilns

UNIT- III CONCENTRIC SOLAR COLLECTORS AND THERMAL APPLICATION 9

Concentric collectors-Limits to concentration – concentrator mounting – tracking mechanism - performance analysis focusing solar concentrators: Heliostats. Solar powered absorption A/C system (Ammonia/water) solar water pump, solar chimney, solar drier, solar dehumidifier, solar still, solar cooker.

UNIT – IV SIMULATION AND ENERGY STORAGE

9

Simulation in Solar Process Design- TRANSYS- Design of active systems- f chart methods for liquid and air heaters- phi bar, of chart method - sensible, latent heat and thermo-chemical storage-pebble bed etc. materials for phase change- Glauber's salt-organic compounds -solar ponds.

UNIT- V SOLAR PV SYSTEM

9

Photovoltaic cell – characteristics -maximum power- tracking-cell arrays-power electric circuits for output of solar panels--inverters-batteries-charge regulators, Construction concepts. Latest trends in PV systems, Life cycle analysis of solar energy system time value of money, evaluation of carbon credit of solar energy system.

A compulsory seminar / assignment on design / case study/analysis /application in any one of the solar thermal energy system

L:45; T:15; Total:60

TEXT BOOKS:

1. Duffie J.A and Beckman, W.A., "Solar Engineering of Thermal Processes", 4th Edition, John Wiley & Sons Inc., New York, April 2013.
2. G.N. Tiwari. "Solar Energy; Fundamentals, design, model and applications" Revised edition, Narosa Publishing House, New Delhi, 2012

REFERENCES:

1. Edward E. Anderson, "Fundamentals for Solar Energy Conversion", Addison Wesley Publishing Co., 1983.
2. Frank Kreith, Jan F. Kreider, "Principles of solar Engg", 1978.
3. Koushika M.D, "Solar Energy Principles and Applications", IBT publications and distributors, 1988.
4. Kaushik S.C, Tiwari G.N and Nayak J.K, "Thermal control in passive solar buildings" .IBT Publishers & Distributors, 1988.

PYRE104 - SOLAR ENERGY AND MAT LAB

0 0 3 2

Solar Energy

1. Performance evaluation of solar flat plate collector
2. Performance evaluation of concentrating solar collector
3. Performance evaluation of solar cooker
4. Performance evaluation air dryer
5. Performance evaluation of a solar PV panel in series and parallel combination
6. Charging characteristics of a battery using PV panel
7. Effect of tilt angle and Effect of shadow on solar PV panel

MAT lab:

1. Integration Techniques: Trapezoidal method, Simpson's $1/3^{\text{rd}}$ rule, Simpson's $3/8$ rule
2. Finding root of Arithmetic Equation
3. Optimization Techniques
4. LPP methods
5. Transportation problems.
6. Image process of Bio gasification process

P:45; Total:45

PYRE 201 - BIO ENERGY ENGINEERING

3 0 0 3

UNIT- I BIO FUELS

9

Bio fuels: types, Properties and sources- Bio fuels first, second and third generation production processes and technologies- Bio diesel comparison with diesel - Biofuel applications – Bio diesel and Ethanol as a fuel for I.C. engines - Relevance with Indian Economy - Bio-based Chemicals and Materials - Commercial and Industrial Products - Govt. Policy and Status of Bio-fuel technologies in India.

UNIT - II CHARACTERISATION OF BIOMASS

9

Biomass: Sources and Classification. – Properties - Energy plantation - Preparation of biomass. Size reduction- Briquetting of loose biomass - Drying, storage and handling of biomass. Conversion of biomass. Biomass processing for liquid and gaseous fuel production. Effect of particle size, temperature, on products obtained – Processing of various biomass for gas production for Thermal and Electrical application.

UNIT- III BIOGAS TECHNOLOGY

10

Feed stock for biogas production, animal residues, Aqueous wastes containing biodegradable organic matter- Microbial and biochemical aspects- factors and operating parameters for biogas production- Kinetics and mechanism-Dry and wet fermentation. Digesters-types-digesters for rural application – High rate digesters for industrial waste water treatment

UNIT- IV GASIFICATION OF BIOMASS

10

Thermo chemical Principles: Effect of pressure, temperature and introducing, steam and oxygen. Design and operation of fixed and fluidized bed Gasifier, circulating fluidized bed gasifiers, Safety aspects, operating characteristics of moving bed and fluidized bed gasifier- different types- advantages and disadvantages- performance analysis of gasifiers.

UNIT – V COMBUSTION OF BIOMASS & COGENERATION SYSTEMS

7

Combustion of woody biomass – theory, calculations and design of equipments, Cogeneration in biomass processing industries. – Economic Case studies: Combustion of rice husk. Use of bagasse for cogeneration.

A compulsory seminar / assignment on design / case study/analysis /application in any one of the Bio Energy systems

L:45; Total:45

TEXT BOOKS;

1. Chakraverthy A, “Biotechnology and Alternative Technologies for Utilisation of Biomass or Agricultural Wastes”, Oxford & IBH publishing Co, 1989.
2. Mittal K.M “ Biogas Systems : “Principles and Applications” New age international publishers (P) Ltd, 1st jan 1997, Nijaguna, B.T Biogas Technology, New age International publishers (P) Ltd

REFERENCES:

- 1 Venkata Ramana P and Srinivas S.N, “Biomass Energy Systems”, ISBN 81-85419- 25-6, Tata Energy Research Institute, 1996.

- 2 Klass D.L and Emert G.M, "Fuels from Biomass and Wastes", Ann Arbor Since Publ. Inc. Michigan, 1985.
- 3 O.P.Chawla, "Advances in Bio-gas Technology" I.C.A.R., New Delhi, 1970.

UNIT - I MEASUREMENT TECHNIQUES**12****(Use of approved data book permitted in the examination)**

Introduction-measurement and instrumentation-Beau fort number Guest parameters-wind type-power law index betz constant Terrain value.Wind speed characterization-site survey and site analysis -Energy in wind-Highest, lowest wind speeds-wind speed for return periods-study of wind applicable Indian standards-steel Tables, Structural Engineering.

UNIT – II WINDMILL AND WIND TURBINE**10**

Wind mill characteristics – types of wind mills- performance analysis -Merits and limitation-variables in wind energy conversion system-wind power density-power in a wind stream-wind turbine efficiency-power of a wind turbine for given in-coming wind velocity - forces on the blades of a propeller-examples of wind farm site-mean wind velocity-wind velocity duration curve-energy pattern factor-wind power duration characteristics - Tip speed ratios - Solidity curves.

Terms-study of all types of turbines (HAWT, VAWT)-typical large capacity wind turbines-sizing-tower design-power duration curves-wind rows diagrams –study of characteristics-actuator theory –analysis of Hourly, daily, monthly, annual, wind behavior-control and instrumentations. syncln & power stabilization synchronization & power stabilization.

UNIT - III POWER GENERATION AND HYBRIDISATION**10**

Types of wind energy system-alternatives-Grid-combination of diesel generator, Battery storage-wind turbine circuits-wind map of India-Wind farm-indefinitely developed wind turbine-study of various wind turbines manufactured indigenously - kilowatt rating-retrofits-R&M-OP & FC-speed limitation-fatigue stress.

UNIT - IV WAVE AND TIDAL ENERGY**7**

Wave energy -Tidal changes – Ecological changes – Types Tidal Power – Energy from Sea – Tidal Turbines – Tidal Power Generation – Recent Trends and Developments – Problems and solutions – Case Studies.

UNIT - V OTEC**6**

The concepts- construction and operational problems – history of OTEC development Alternative energy technology – Ocean thermal energy conversion – Techniques – Problems and solutions – Case Studies-ecological and environmental aspects.

A compulsory seminar / assignment on design / case study/analysis /application in any one of the Wid energy,Tidal and OTEC

L:45; Total:45

TEXT BOOKS;

1. E.L Wakil "Power plant technology", McGrawGill Publishers, New York, 2002
2. G. D Rai "Non Conventional Energy sources" Khanna publishers. New Delhi, 2011.

REFERENCES:

1. S.Rao & B.B.Parulekar, "Energy Technology", 3rd edition, Khanna publishers, 1995.
2. Anna Mani & Dr.Nooley, "wind Energy Data for India", 1983.
3. IS 875 part IV and IS 1893 material STDS IS 226 (IS 2862, ASTM A-36, BS. 4360 Gr 43 D)
4. Logan (EARL), "Turbo Machinery Basic theory and applications", 1981.

UNIT - I POWER SYSTEM FUNDAMENTALS**7**

Single line representation – power flow study – power factor improvement, Protection, types of relays, symmetrical components, asymmetrical components, Introduction: Hybrid power system. HVDC - introduction, various coupling methods.

UNIT - II ELECTRIC ENERGY CONVERSION DEVICES**9**

Transformers – Parallel operation, auto transformers, DC machines, Applications of DC machines – performance equation - generator characteristics - motor characteristics – applications of Synchronous machines - alternators – Induction machines.

UNIT - III SOLID-STATE POWER CONVERTERS AND DRIVES**9**

Controlled rectifiers, choppers, inverters, voltage regulators and cyclo -converters. Speed control of dc motors and ac motors – converter fed chopper –fed control Inverter – ac voltage regulators, VFD.

UNIT - IV HYBRID POWER GENERATION**9**

Types of hybrid systems, Integration issues - Steady state performance of Wind-driven induction generators. Grid connected solar photo voltaic system - line commutated converters - Boost converters- selection of inverter. Three phase AC voltage controllers for wind power plants - uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

Micro Grids, Intelligent Grids, Smart grids, Phase Monitoring Unit (PMU), Case studies.

UNIT - V POWER QUALITY IMPROVEMENT**11**

Introduction – Characterisation of Power Quality, impacts, Types of Harmonic filters: passive, Active and hybrid filters. Custom power devices: Load compensation using STATCOM / DSTATCOM, Voltage regulation.

FACT controlled devices, DVR. UPQC control strategies, UPFC, P-Q theory, Status of application of custom power devices.

L:45; Total:45**TEXT BOOKS:**

1. John J Grainger and W.D Stevenson “Power system analysis” McGrawHill publishing company, 1994.
2. T.JE. Miller “FACT controlled device” Johan willey Publications.2002.
3. M.H.Rasheed “Power Electronics” Tata Mc Graw Hill.
4. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Springer; Softcover reprint of the original 1st ed. 2002 edition (30 October 2012)

REFERENCES:

1. Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition)
2. Syed A Nasar, “Electric energy conversion and transmission’, Mac Millan publishing company, Newyork, 1985
3. Sen P.C. “Power Electronics”, NBT Code no (45-36/1980), Tata Mc Graw –Hill Publishing company, 1993.

1. IC Engine test rig
2. Flue gas analysis – IC engine
3. Flue gas analysis – gasifier
4. Proximate analysis of fuels
5. Ultimate analysis of fuels
6. Analysis of green house gases in the exhaust
7. Analysis of chemical oxygen demand (COD)
8. Analysis of biological oxygen demand (BOD)
9. Noise level measurement
10. Determining the calorific value of Bio fuel
11. Effect of P_H on total dissolved solids (TDS)
12. Heat pipes demonstration
13. Comparison of flash and fire point of bio fuel

P:45; Total:45

PYRE 301 - COMPUTATIONAL FLUID DYNAMICS

3 1 0 4

UNIT - I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD **10**

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT - II CONDUCTION HEAT TRANSFER **8**

Steady one-dimensional conduction, Two and Three-dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT - III INCOMPRESSIBLE FLUID FLOW **7**

Governing Equations, Stream Function - Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite difference approach.

UNIT - IV CONVECTION HEAT TRANSFER AND FEM **7**

Steady One-Dimensional and Two-Dimensional Convection - Diffusion, Unsteady one-dimensional convection - Diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - Solution of steady heat conduction by FEM - Incompressible flow - Simulation by FEM.

UNIT - V TURBULENCE MODELS **10**

Algebraic Models - One equation model, K-E Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

L:45; T:15; Total :45
TEXT BOOK

1. P.S.Ghoshdastidar., "Computational Fluid Dynamics and Heat Transfer", 2017, Cengage India Private Limited; First edition

REFERENCES:

1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi 1995.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Anderson, D.A., Tannehill, I.I., and Pletcher, R.H., "Computational Fluid Mechanics and Heat Transfer", Hemisphere Publishing Corporation, New York, USA, 1984.
4. Fletcher, C.A.J., "Computational Techniques for Different Flow Categories, Springer-Verlag 1987.

PYRE302 - HYDROGEN AND NUCLEAR ENERGY

3 0 0 3

UNIT - I HYDROGEN ENERGY

9

Hydrogen as a renewable energy source - Sources of Hydrogen - Fuel for Vehicles - Hydrogen Production - Direct electrolysis of water - direct thermal decomposition of water - biological and biochemical methods of hydrogen production - Storage of hydrogen - Gaseous, Cryogenic and Metal hydride - Utilization of hydrogen.

UNIT - II BATTERIES & FUEL CELL

12

Battery – Storage cell Technologies -storage cell fundamentals- characteristics – Emerging trends in batteries-Carbon- Zinc & alkaline cells, Mercury, Zinc –air &Silver oxide button cells, Lead acid, Edison, Nicad & Nimh cells and lithium Technology

Fuel cell – Principle of working- construction- Design and performance analysis of fuel cells- The alkaline fuel cell, Acidic fuel cells, PEM Fuel cells, SOFC - Emerging trends in fuel cells, - Applications – Industrial and commercial

UNIT - III NUCLEAR POWER

9

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

UNIT - IV NUCLEAR POWER

10

Fuel rod design - Steam cycles for nuclear power plants - reactor heat removal – Coolant channel orificing - Core thermal design - Thermal shields - Fins in nuclear plants – Core thermal hydraulics - Safety analysis - LOCA - Time scales of transient flow and heat transfer processes.

UNIT - V NUCLEAR WASTE MANAGEMENT

5

Segregation and safe disposal of nuclear waste –case studies

L:45; Total:45

TEXT BOOKS'

1. E.L Wakil "Power plant technology", McGrawGill Publishers,New York,2002
2. Hand book Fuel cells: advances in electrocatalysis, materials, diagnostics and durability volume 5 and 6 edition,Wiley blackwell,20 mar 2009.
3. Fuel cell, Principles and applications, Viswanathan,B and Scibioh,Aulice M. CRC,1st edition,31 mar 2008.

REFERENCES:

1. A. W. Culp Jr: Principles of Energy Conversion, McGraw Hill, 2001
2. Principles of fuel cells by Xianguo Li, Taylor & francis,2006
3. T. F. Morse: Power Plant Engineering, Affiliated East West Press, 1978
4. R. H. S. Winterton: Thermal Design of Nuclear Reactors, Pergamon Press, 1981
5. R. L. Murray: Introduction to Nuclear Engineering, Prentice Hall, 1961

PYRE 304- COMPUTATIONAL FLUID DYNAMICS

0 3 0 2

The fluid engineering laboratory serves to provide the tools needed to analyze and solve fluid flow problems in different engineering applications and to provide the link between theories with real life applications. The laboratory introduces the students to the fundamentals of laminar and turbulent flow as well as state of art flow measurement techniques and equipment. The laboratory also includes state of the art computational fluid dynamics (CFD) software as important and effective tool in studying complex flow problems encountered in most industrial applications. The experiments involve th study of viscous flow applications, boundary layers, lift and drag on immersed bodies.

1. Introduction to fluid mechanics laboratory.
2. Experiments on flow patterns.
3. Velocity profile in an air pipe.
4. Wind tunnel calibration.
5. Draining of a tank.
6. Pipe friction.
7. Boundary layer studies.
8. Falling ball experiments.
9. Viscosity measurements.

P:45; Total:45

PYRE 401 ENERGY AUDIT AND MANAGEMENT

3 1 0 4

UNIT - I INTRODUCTION

10

Energy scenario – Principles and imperatives of energy conversion – Energy consumption pattern – Resource availability – Why save energy – reasons to save energy – an over view of energy consumption and its effects – current energy consumption in India – Role of Energy Managers in Industries.

UNIT - II ENERGY CONSERVATION OF THERMAL UTILITIES

10

Energy Audit–Characteristic Methods Employed in Certain Energy Intensive Industries – Various Energy Conservation Measures in Steam – Losses in Boiler. Methodology of Upgrading Boiler Performance – Boiler Blow Down Control – Excess Air control – Pressure Reducing Stations. Energy Conservation in Steam Systems – Importance of correct Pressure, Temperature, & Quality of Steam – Condensate Recovery – Condensate Pumping – Thermo Compressors – Recovery of Flash Steam – Air Removal & Venting – Moisture Removal. Steam Traps – Types, Function, Necessity – Section and application. Co-generation – in-plant power generation systems – co-generation Schemes and configuration – Design Considerations – Heat Rate Improvement. Case Studies.

UNIT - III ENERGY CONSERVATION OF UTILITIES

10

Centrifugal pumps – energy consumption & energy saving potentials – Design consideration minimizing over design – case studies – Fans & Blowers – Specification – Safety margin – choice of fans controls – design considerations. Air compressor & compressed air systems – selection of compressed air layout – Encon aspects to be considered at design – Design consideration. Refrigeration & Air conditioning – Heat load estimation – methods of minimizing heat loads – optimum selections of equipments – case studies. Energy conservation in cooling towers & spray ponds – Case studies.

UNIT - IV ENERGY AUDITING

8

Potential areas for Electrical Energy Conservation in various Industries – Conservation methods – Energy Management Opportunities in Electrical Heating, Lighting System, Cable Selection – Energy Efficient Motors – Factors Involved in Determination of Motor Efficiency Adjustable AC Drivers, Application & its Uses – Variable speed Drivers / Belt Drives Energy Efficiency in Electrical Systems – HT Power Distribution – Control system in HT/LT side, Harmonics – Energy Efficiency in Lighting – Case studies.

UNIT - V ENERGY MANAGEMENT

7

Organizational background desired for energy management persuasion / motivation / publicity role, tariff analysis, detailed process of M&T Energy monitoring, auditing & targeting – Economics of various Energy conservation schemes, instrumentation and calibration Electronics Control and Industrial Energy Management Systems. Thermostats, Boiler controls; proportional, differential and integral control, optimizers; compensators.

L:45; T:15; Total:60

TEXT BOOKS

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Longman Scientific & Technical, ISBN – 0-582 – 03184, 1990.

REFERENCES:

1. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.
2. Larry C whitetal, Industrial Energy Management & Utilization.

PYRE 402 - STATISTICAL TOOLS FOR DATA ANALYSIS

3 0 0 3

UNIT - I RESEARCH

8

Objectives – types: descriptive, analytical, applied fundamental, quantitative, qualitative, conceptual, empirical – approach – significance – methods – process – Research design – need – concepts – sampling design.

UNIT - II LITERATURE SEARCH

11

Offline search: Abstracts-subject index, author index, formula index and other indices-examples-current. Contents – organization – titles and index. On line Search: Computer browsing for literature search and down loading-basics of internet services-sources of abstracts, articles for browsing for literature search and down loading – basics of internet services-sources of abstracts, articles for browsing and downloading, technique for conversion form one format to another.

UNIT - III STATISTICAL PROCESS CONTROL (SPC)

9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT - IV DESIGN AND ANALYSIS OF EXPERIMENTS

9

Treatment and interpretation of engineering data. Curve fitting non linear least square regression. Tests of significance – test of hypothesis, chi square test, analysis of variance and covariance. Introduction to factorial designs- 2^k factorial designs, introduction-Blocking and confounding in two level factorial designs- 2^{k-p} fractional factorial designs, introduction -Random factors in experiments - Random factors in factorial experiments, mixed models

UNIT - V ERROR ANALYSIS IN MECHANICAL MEASUREMENTS

8

Types of errors-Precision and accuracy-Statistical tests on the accuracy of results-Binomial distribution-Gaussian distribution T-tests, Comparison of precision of two methods by test.

L:45; Total :45

TEXT BOOKS

1 C.R.Kothari, Research Methodology – Methods and techniques, Wishwa Prakashan, New Delhi,third edition, new age publisher,2014.

2. Design and Analysis of Experiments, by D.C. Montgomery, John Wiley & Sons, New York, 8th edition, 2013

REFERENCES:

1..W.I.Cochron, ‘Statistical methods’, Oxford and IBH publishers.

2.<http://www.sciencedirect.com/science/journal>

3.James R.Evans & William M.Lidsay, The Management and Control of Quality, (5thEdition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5

PYRE 404 - MINI PROJECT

0 0 3 2

The objective of the mini project work is enable the students to involve in making of many mechanical components and it should make to execute, functioning of operation.

Every project work shall have a guide who is the member of the faculty of the institution.

Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. The final report shall be as per the guide lines.

PYRE 501- PROCESS MODELLING AND SIMULATION IN
ENERGY SYSTEMS

3 1 0 4

UNIT – I 6
Introduction to modeling, a systematic approach to model building, classification of models. Modeling Techniques-Response function and Numerical methods- Conservation principles, thermodynamic principles of process systems

UNIT-II 9
Introduction to development of steady state and dynamic lumped and distributed parameters models based on first principles, Analysis of ill-conditioned systems, Block diagrams and computer simulation, Modeling of process elements consisting of Mechanical (translational and rotational) electro- Mechanical ,fluid flow, thermal and chemical reaction system elements

UNIT-III 9
Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

UNIT-IV 12
Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method. shooting method,finite difference methods. Solving problems using MATLAB/ SCILAB

UNIT- V 9
Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

TEXT BOOKS

1. K.M. Hangos and I.T Cameron," Process Modelling and Model analysis".academic Press 2001.
2. W. L Luyben, " Process Modelling, Simulation and control for chemical Engineers" 2nd Edn, McGraw Hill Book Co, New York,1990.
3. W.F Ramirez " Computational Methods for Process Simulation" Butterworths,20 NOV,1997

REFERENCES

1. Mark E. Davis," Numerical Methods and Modelling for Chemical Engineers" JohnWiley & Sons,1984.
2. Singiresu S. Rao "Applied Numerical Methods for Engineers and Scientists" Prentice hall, Upper saddle River , NJ 2001
3. Francis vanek, Louis D. Albright," Energy systems Engineering" McGraw- Hill book Company, N.Y 2008
4. "Power System Engineering" 2nd Ed.D.P Kothari, I.J. Nagrath, Tata MaGraw- Hill Co 2008.

PYRE 303A - FLUID DYNAMICS AND HEAT TRANSFER 3 0 0 3

UNIT – I 8

Basic equations and flow of nonviscous fluids – Fluid and Fluid Properties – The differential equation of fluid flow – Flow of Nonviscous fluids.

UNIT - II 12

The flow of viscous fluids – Laminar flow in closed conduits – turbulence – Dimensional analysis and its application to fluid dynamics – Turbulent flow in closed conduits – the laminar sub layer - Flow in the entrance section of closed conduits – Flow of incompressible fluids past immersed bodies – Flow in the shell side of multitude heat exchangers.

UNIT - III 10

The convection-heat – transfer coefficient – Dimensional Analysis in convection heat transfer – Heat transfer during laminar flow in closed conduits – turbulent flow heat transfer in closed conduits – Empirical correlation for high – Prandtl – Number fluids.

UNIT - IV 8

The analogy between momentum and heat transfer – Heat transfer with liquid metals – Heat transfer during incompressible flow past immersed bodies.

UNIT – V 7

Recent development in the designing of heat exchanger – Plate heat exchanger – run around coils – heat pipes – regenerators - effectiveness of heat exchanger.

L:45; Total:45

TEXT BOOKS;

1. P.S.Ghoshdastidar.,“Computational Fluid Dynamics and Heat Transfer”, 2017, Cengage India Private Limited; First edition

REFERENCES:

1. Kern D.C., “Process Heat Transfer”, Mc Graw Hill Publishers.

UNIT - I CRUSHING, GRINDINGSIZE SEPARATION & CONVEYING OF BULK SOLIDS**12**

Various Laws of Crushing – classification of crushing and grinding machineries – Coarse crushers – Intermediate crushers – fine grinders – jaw crusher – Gyratory Crusher – Crushing rolls – Hammer mills – Ball and tube mills – Ultrafine grinders – Closed circuit grinding – Grindability Index. Introduction – characterization of solid particles – standard screens – screen analysis – Types of screening equipments – Air separation methods – Cyclone and bag filters – Size separation by settling - Laws of Settling – Classifiers – Material separation by difference in density – Heavy media cyclone - Froth floatation – Hindered settling – working of thickener. Conveying of bulk solids – conveyor of bulk materials – screw conveyors – Belt conveyors – Bucket Elevators – Pneumatic Conveyers.

UNIT - II MIXING AND FILTRATION**8**

Introduction – mixing of liquids/Liquids, Liquids/Gases, Liquids/Solid – Types of mixers – various mixing equipments – Power requirement for an Impeller Mixer. Theory of Industrial filtration – Constant pressure and constant rate filtration – Filter Aids – Filtration Equipment Classification – Filter Presses – Leaf Filters – Rotary Drum Filter – Centrifuges

UNIT - III EVAPORATION**8**

Introduction – Duhrings Chart – Boiling Point Elevation – Capacity and Economy of Evaporators – Evaporators Classification – Short tube and Long Tube Evaporators – Forced Circulation Evaporators – Climbing and Falling Film Evaporators – Multiple Effect Evaporator – Evaporator Accessories

UNIT - IV HUMIDIFICATION AND DRYING**8**

Definition – Adiabatic Saturation Temperature – Humidity Chart – Wet bulb Temperature and Measurement of Humidity – Spray Ponds and Cooling Towers – Cooling Tower Designing considerations. Introduction – Drying Theory – Equilibrium Moisture Content – Bound, Unbound, Free Moisture – Drying Rate Curves – Constant Drying Rate – Falling Rate Period – Classification of Dryers – Tray Dryers – Rotary Dryers – Turbo Dryer – Cylinder Dryer – Festoon Dryer – Drum Dryer – Spray Dryer – Fluid Bed Dryer

UNIT - V DISTILLATION**9**

Introduction – Various Distillation Methods – Flash Distillation – Batch Distillation – Steam Distillation – Continuous Distillation – Minimum Reflux Ratio- Total Reflux – Optimum Reflux Ratio – Steam Distillation Calculations – Ideal Plate – Actual Plate – Plate Efficiency - Distillation column Internals – Concepts of Azeotropic and Extractive Distillation – Enthalpy Balance for a Continuous Distillation Column (for binary system)

L:45; Total:45

REFERENCES:

1. P.Chattopadhyay, "Unit operations of chemical Engineering", 2nd edition, Khanna Publishers, 1996.
2. W.L.McCabe and J.C.Smith, "Unit operations of Chemical Engineering", 5th edition, McGraw Hill International editions, 1993.
3. Alan S Foust, "Principles of Unit Operations", 2nd edition, Wiley International Edition, 1960.
4. J.M. Coulson & Richardson, Chemical Engineering, 5th edition, Butterworth Heinemann, 1996.

PYRE303C- WASTE MANAGEMENT AND ENERGY RECOVERY 3 0 0 3

UNIT – I SOLID WASTE 8

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

Size Reduction – Aerobic Composting – Incineration – Furnace Type and Design, Medical/Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT – III WASTE DISPOSAL 8

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

UNIT – IV HAZARDOUS WASTE MANAGEMENT 10

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 – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation and Closure.

UNIT – V ENERGY GENERATION FROM WASTE 11

Types – Biochemical Conversion – Sources of Energy Generation – Industrial Waste, Agro Residues – Anaerobic Digestion – Biogas Production - Types of Biogas Plant Thermo chemical Conversion – Sources of Energy Generation – Gasification – Types of Gasifiers – Briquetting – Industrial Applications of Gasifiers – Utilization and Advantages of Briquetting – Environment Benefits of Biochemical and Thermo chemical Conversion.

L:45; Total:45

TEXT BOOKS

REFERENCES:

1. Parker, Colin & Roberts, Energy from Waste – An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
2. Shah, Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997.
3. Rich, Gerald et.al., Hazardous Waste Management Technology, Povevan Publishers, 1997.
4. Bhide AD., Sundaresan BB, Solid Waste Management in Developing Countries, INSDOC, New Delhi, 1983.

PYRE403A - ENVIRONMENTAL ENGINEERING

3 0 0 3

UNIT - I ENVIRONMENTAL POLLUTION**10**

Mass and energy transfer – units of measurements, material balance and energy fundamentals – Environmental chemistry stoichiometry, chemical equilibria. Mathematics of growth – exponential growth, resource consumption and population growth, resource consumption and population growth – problems. Atmosphere – Regions of atmosphere – Earth's natural atmosphere – consequences of population growth – classification of pollution – pollution of Air, Water & Soil – Effect of pollutants on living system – Environmental legislation.

UNIT - II AIR POLLUTION CONTROL METHODS & EQUIPMENT**10**

Sources of air pollution –classification & properties of air pollutants – scales of concentration – Effects of air pollution – meteorological aspects of air pollution – urban air pollution – carbon-di-oxide & climate change – Acid deposition – Industrial air pollution – Automobile air pollution – Sampling, measurement and analysis of air pollutants such as SO_x, NO_x, CO, NH₃, C_nH_n, SPM, Opacity, Volatile organic compounds, Trace metals.

UNIT - III WATER POLLUTION**9**

Water Sources – Origin of waste water – Classification of Water Pollutions – Effects of water pollutants – Water Pollution Laws and Standards – Water Pollution & Health – Waste Water Sampling – BOD – COD analysis – Waste Water Treatment – primary treatment – secondary treatment – Advanced waste water treatment – Anaerobic Digestion. Desalination – micro filtration – ultra filtration – Reverse Osmosis.

UNIT - IV SOLID WASTE DISPOSAL**9**

Solid waste- Sources, types, Compositions and Properties - Land Fill Method of Solid Waste Disposal – Land Fill Classification, Types, Methods and Site Consideration – Layout and Preliminary Design of Land Fills – Composition, Characteristics, generation, Movement and Control of Landfill Leachate and Gases – Environmental Monitoring System for Land Fill Gases.

UNIT - V OTHER TYPES OF POLLUTION**7**

Noise Criteria - Noise Sources - Noise Control Measures - Thermal Pollution - Oil pollution – Pesticides - Radioactivity Pollution control - Tanneries and other Industries and their control

L:45, Total: 45**TEXT BOOKS**

1. James Gilbert M. Masters, "Introduction to Environmental Engineering And Science", 3rd edition, 2014.

REFERENCES:

Rao C.S Environmental Engineering and Pollution Control, 1st edition, New Age International Publishers, 1991.

PYRE403B - OPTIMUM UTILISATION OF HEAT AND POWER 3 0 0 3

UNIT - I ENERGY CONVERSION TECHNIQUES

12

Energy resource assessment – energy supply, demand and storage planning methods – economic feasibility and assessment methods – energy transfer and conversion methods – thermodynamic and efficiency analysis methods – system analysis methodologies.

UNIT - II TOTAL ENERGY SCHEMES

12

Basic concepts of CHP – The benefits of CHP – Problems associated with CHP – The balance of energy demand – Types of Prime demand – Types of prime movers – The economics of CHP generation – CHP in the industrial sector – CHP in the commercial sector – CHP in the domestic sector district heating – Conclusions.

UNIT - III PROCESS INTEGRATION AND PINCH TECHNOLOGY

10

Pinch Technology – Basic concepts of pinch technology – Streams networks – The significance of the Pinch – Design of energy recovery systems – Selection of pinch temperature difference – Tabular method – Stream splitting – Process retrofit – Installation of heat pumps – Installation of heat engines – The grand composite curve – General comments about process integration.

UNIT - IV ENERGY RECOVERY

6

Insulation – Recuperative heat exchanger – Run -around coil systems – Regenerative heat exchangers – Heat pumps – Heat pipes – Selection of energy recovery methods, Cogeneration.

UNIT - V APPLICATION OF CHP

5

CHP in agricultural sector - processing - energy requirements - potential. CHP in industrial sector - Processing - energy requirements - source of waste heat.

L:45; Total:45

Text Books;

1. Eastop T.D & Croft D.R, “Energy efficiency for engineers and Technologists”, 2nd edition, Longman Harlow, 1990.

REFERENCES:

O’Callaghan, Paul W, “Design and Management for energy conservation”, Pergamon, ,1993.

PYRE 403C - CAD/CAM AND SIMULATION OF RENEWABLE

ENERGY SYSTEMS

3 0 0 3

UNIT - I BASIC CONCEPTS OF CAD

9

CAD Hardware and software operating system, application software, CAD workstation Principles of computer graphics – graphics programming, input techniques, transformation. Elements of mechanical drafting package, graphic standards, graphic libraries, design and drafting interface. Advanced modeling techniques.

UNIT - II ADVANCED MODELLING TECHNIQUES

9

Modeling of curve and surface, non uniform rational B splines, commercial surface modeling software – principles of solid modeling – rendering methods – CAD/CAM data base development and database management systems –principles of optimum design

UNIT- III COMPUTER AIDED MANUFACTURING AND PROCESS MONITORING

9

Computer aided manufacturing- fundamentals of CAD/CAM – computers in manufacture – Programming languages, process interface hardware – hierarchy of computers in CAM. Computer process monitoring, types of production monitoring systems – process control – modeling and analysis – direct digital control – supervisory computer control – steady state optimal control – adaptive control, on – line search strategies. Systems for manufacturing support.

UNIT- IV CAD MODELLING AND SIMULATION OF SOLAR AND WIND ENERGY SYSTEMS

9

Solar collectors, solar cooker, solar water heater, solar pasteuriser, solar drier, wind mill and wind generator.

UNIT- V CAD MODELLING AND SIMULATION OF SYSTEMS USING BIOMASS

9

Updraft gasifier – downdraft gasifier, cross draft gasifier – multi fuel gasifier – fixed and fluid bed gasifier –Biogas plant.

L:45; Total: 45

REFERENCES:

1. William M Newman and Robert Sproul “principles of interactive graphics” McGraw Hill, 1984.
2. Radha Krishnan.P. & Kothandaraman.C.P. “Computer graphics design” Dhanpat Rai and Sons, 1990.
3. Groover.M.P. “Automation, Production systems and Computer Aided Manufacturing” Prentice Hall, 1984.
4. CAD/CAM Theory & practice, Inbrahim & Zeid Pub: Tata McGraw Hill.

PYRE 502A - ENERGY CONSERVATION IN HVAC

3 0 0 3

UNIT - I DESIGN OF HVAC SYSTEM COMPONENTS

9

Vapour compression Systems-Refrigerant properties- Energy Efficient compressor- Condensers-Evaporators-expansion devices- Cooling Systems other auxiliaries-Design and Analysis for Energy conservation- Case Studies- VAR Systems- Utilization of Waste heat and other sources- Analysis for Energy Efficiency Ratio.

UNIT – II AIR CONDITIONING SYSTEMS

9

Psychrometry – Comfort conditions -Types of A/c Systems- Energy conservation of Humidifiers, Air Washers- Air distribution and handling systems-Controls for AHU-Passive and Active A/c Systems-Thermal Properties and Energy content of Building materials.

UNIT - III ESTIMATION OF BUILDING LOADS

9

Steady state method – Network method-Numerical method – correlations – computer packages for carrying out thermal design of buildings and predicting performance- 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-standards on indoor parameters.

UNIT - IV FACTORS AFFECTING THE ENERGY USE

9

Factors that affect energy use in building- functional factors, environmental factors-Envelope factors-Air conditioning system factors- Energy source factors and Electrical systems factors- Fenestration design for optimal day lighting- Lighting and Visual ability – Light sources and Luminaries – Lighting System- Design-Day lighting-Day light factors- Luminance Efficacies- CRI for Lighting source and Usage- Economics and Aesthetics.

UNIT-V MODELING AND SIMULATION

9

Evaluation of natural ventilation in buildings, determination of probable indoor wind speed and direction- Ventilation heat transfer - Sol-air temperature-Introduction to Natural and artificial ventilation simulation systems- Energy Calculations- Degree Days procedure- BIN methods- Comprehensive simulation methods

L:45; Total: 45

TEXT BOOKS:

1. Faye C. McQuiston and Jerald D. Parker “ Heating, Ventilating and Air Conditioning –Analysis and Design”, 4th Edition, John-Wiley & Sons, Inc, NewYork.1994.
2. C.P.Arora “ Refrigeration and Air-conditioning”, Tata-McCraw Hill Publishers, New Delhi,2008.

REFERENCES:

1. J.Krieder and A.Rabi “Heating and Cooling of Buildings. Design for Efficiency Mcgraw Hill (1994).
2. J.R.Williams, Passive Solar Heating, Ann Arbor Science(1983).
3. R.W.Jones, J.D.Balcomb, C.E.Kosiewiez, G.S.Lazarus, R.D.Mc Farland and W.O.Waray, Passive Solar Design Handbook, Vol.3 Report of U.S. Department of Energy (DOE/CS-0127/3) (1982).

PYRE 502B - CARBON SEQUESTRATION AND TRADING 3 0 0 3

UNIT - I GREENHOUSE GAS 9

Stabilization of greenhouse gas concentrations – greenhouse gas risks and reservoirs – green gas mitigation – Carbon di oxide and climate change, acid rain, global warming, impacts of global warming-Kyeto-procal.

UNIT - II CARBON 9

Practices for sequester carbon - car bon sequestration types – carbon credits – carbon testing – potential for carbon sequestration.

UNIT - III MANAGEMENT 9

Risk management and risk reduction – carbon economics – Verification of carbon change.

UNIT - IV CASE STUDIES 9

Carbon trading model – Century Model – Case Studies.

UNIT - V RULES AND REGULATIONS 9

Implication Nethanl and Nitrous Oxide carbon bank – Best Management Practices 0 Publics issues – policies.

L:45; Total:45

TEXT BOOKS

1.Emission Trading:Environmental Policies New approach-Richard F. Kosobud, Douglas L. Schreder, Holly M. Biggs Published 2000 , John Wiley and Sons.

REFERENCES:

- 1 Agricultural Practices and Policies for Carbon Sequestration in Soil By John M. Kimble, Rattan Lal Published 2002CRCPress
2. The Impact of Carbon Dioxide and Other Greenhouse Gases on Forest Ecosystems By David F. Karnosky Published 2001 CABI Publishing

PYRE 502C – SUSTAINABLE DEVELOPMENT

3 0 0 3

UNIT - I INTRODUCTION

12

Industrial activity and Environment industrialization and sustainable development – Industrial Ecology – Prevention versus control of industrial pollution – Regulations to encourage cleaner production based approached.

UNIT - II CLEANER PRODUCTION CONCEPT

7

Importance – Historical evolution – Benefits – promotion – barriers – Role of Industry, government and Institutional – Resume, recovery, recycle, substitution – Internet information & other CP resources.

UNIT- III CLEANER PRODUCTION PROJECT DEVELOPMENT

10

Overview of CP Assessment steps & skills – preparing for the site – material balance – Technical and Environmental feasibility analysis – Economic Evolution of alternatives – Total cost analysis – CP financing - Established programme – Preparing & programme plan – reset audit – Environmental statement

UNIT - IV LIFE CYCLE ANALYSIS & ENVIRONMENTAL MANAGEMENT SYSTEM

8

Elements of LCA - life cycle costing – ECO labelling - Design for the Environment Environmental standards – ISO 14001 – Environmental audit.

UNIT - V CASE STUDY

8

Industrial application of CP, LCA, EMS & Environmental audit

L:45; Total: 45

REFERENCES:

1. Pollution prevention: Fundamental and Practice, Paul L Bishap, McGrawhill , INC
2. Pollution prevention and abatement Handbook – Towards cleaner production – World bank and UNDP, Washington, D.C
3. Cleaner Production Audit, Prasad Modak, Asian Institute of Technology, Bangkok

PYRE 503A- INSTRUMENTATION TECHNOLOGY FOR ENERGY SYSTEMS

3 1 0 4

UNIT - I INTRODUCTION TO MEASUREMENT TECHNIQUES

6

General concepts of measurements, static and dynamic characteristics, Introduction to calibrations, calibration standards – characteristics of instruments – Definition – True value – Accuracy – Precision – Sensitivity – Resolution – errors & its measurements, Data acquisition & Display.

UNIT - II MEASUREMENT OF PRESSURE AND TEMPERATURE

9

MEASUREMENT OF PRESSURE

Different units of pressure – Classification of pressure gauges – manometers – pressure balance gauges – force balancing gauge – elastic deformation – commercial pressure gauges using the above principles – ring balance type elements. Measurement of vacuum–McLeod gauge – Pirani gauge. Measurement using strain gauges. Measurement of Pressure using electronic / micro processor based transmitter, calibration of the instrumentation.

UNIT-III MEASUREMENT OF TEMPERATURE & HEAT FLUX

9

Difference temperature scales – Non-electrical methods – change in volume of liquid – change in pressure of gas – change in vapour pressure. Electrical methods – Thermocouple – Resistance Temperature Detector – Radiation Pyrometer – Optical Pyrometer – Thermostats. Temperature measurement using electronic / micro processor based transmitter, Incidental radiation heat flux, conduction heat flux, calibration. Measurement of Electrical Energy – Voltage – Current – Power Factor.

UNIT - IV MEASUREMENT OF FLOW, LEVEL, HUMIDITY AND OTHER MISCELLANEOUS PARAMETERS

12

Flow measurement – types – differential pressure type flow meter – orifice meter – ventury tube – flow nozzle – pitot tube – positive displacement type flow meter – Inferential flow meter – turbine flow meter – variable area flow meter (rotameter) – mass flow meter. Low flow measurement using pizzo ring, Ultra Sonic flow meter for high flow. Level measurement – Basic methods – Measuring hydrostatic pressure – measuring the movement of the float – electric conduction method – sight glass. Non-Contact measurement techniques. Level measurement by DP transmitter. Definition of humidity – hydrometer & psychrometer – Humidity measurement. Measurement of pH:-pH scale – methods of pH measurements.mass spectrometer & Chromatograph. Hazardous area and its classification, calibration.

Classification of Transducers – Active and passive transducers - Analog and digital transducers. Advantages of electrical transducers over mechanical transducers – Different types: Resistance – Inductance – Capacitance – Piezo electric transducers.

PROCESS CONTROL

Functional block diagram of a process control loop and their elements. Definition of set point, dead zone, dead time, disturbance, deviation- Control system – Open and closed loop control system – feed forward control – Ratio control – cascade control. Closed loop controllers with examples. Programmable logic controllers & Disturbed controlled system. Computer control using Supervisory Computer.

L:45; T:15; Total: 60

TEXT BOOKS

1. John P.Bentley, “Principles of Measurement System”, Pearson education,2012.

REFERENCES:

1. Instrument Transducers: An introduction, Neubert H.K.P., Their performance and Design. 2nd edition, Oxford University Press, Cambridge, 1999, Sensors and Transducers, Patranabis, Wheeler Publishing 1999.
2. Stephanopoulos, “Chemical Process Control – An Introduction, to Theory and practice”, PHI, New Delhi, 1984.

PYRE503B - ENERGY EFFICIENT BUILDING

3 0 0 3

UNIT - I INDOOR ENVIRONMENT

9

Introduction of Architecture as the art and science of designing. Building Science its significance indoor Environment. Components of Indoor Environment. Quality of Indoor Environment.

UNIT - II THERMAL ANALYSIS AND DESIGN FOR HUMAN COMFORT

12

Human comfort- Thermal, Visual, Acoustical and Olfactory comfort, comfort, Energy and indoor Environment. Concept of Solar temperature and its significance. Calculation of instantaneous heat gain through building envelopes. Calculation of solar radiation on buildings. Building orientation and significance. Introduction to design of shading devices (horizontal, vertical and egg-crate). Factors that affect energy use in buildings. Ventilation and its significance. Lighting and visual ability- Lighting system Design – Day lighting Economics.

UNIT - III SOLAR PASSIVE CONCEPTS FOR COOLING FOR BUILDINGS

8

Passive concepts- passive heating concepts, passive cooling concepts and passive heating & cooling concepts. passive concepts appropriate for the various climatic zones in India.

UNIT-IV ENERGY MANAGEMENT AND ENERGY AUDIT OF BUILDINGS

9

Introduction to energy management of buildings and energy audit of buildings. Aims of energy management of buildings. The historical and diagnostic energy audit, their objectives and benefits. Introduction energy management matrix monitoring and targeting. Building energy survey and audit report form.

UNIT V ENERGY EFFICIENT LANDSCAPE DESIGN

7

Modification of microclimate through landscape elements for energy conservation. Energy conservation through site selection, siting & orientation. Energy conservation through integration of buildings and site, site planning and design.

L:45; Total:45

REFERENCES:

1. Sodha M. Bansal, N.K.bansal, P.K., Kumar. A, and Malik, M.A.S., “Solar Passive Buildings” Pergamon Press, 1986.
2. Evans, Martin, “ Housing , Climate and Comfort.” ISBN 0 85139 102 8, The Architectural Press, London, 1980.
3. Bureau of Indian standards, I.S. 11907- 1986 Recommendations for calculation of Solar Radiation Building, 1986.
4. Givoni,. B, “ Man, Climate and Architecture”, Elsevier, Amsterdam, 1986.
5. Smith Ajitha, D. ., “ Building Environment”, Tata McGraw Hill publishing company Limited, New Delhi, 1985
6. Robinette, G.O., (ed), “ Landscape Planning for Energy Conservation”. Van Nostrand Reinhold, New Yark, 1990.

**PYRE 503C - ENERGY MODELING, ECONOMICS AND PROJECT
MANAGEMENT 3 0 0 3**

UNIT - I MODELS AND MODELING APPROACHES 8

Macroeconomic Concepts - Measurement of National Output - Investment Planning and Pricing
- Economics of Energy Sources - Reserves and Cost Estimation.

UNIT - II INPUT OUTPUT ANALYSIS 9

Multiplier Analysis - Energy and Environmental Input / Output Analysis - Energy Aggregation –
Econometric Energy Demand Modeling - Overview of Econometric Methods.

UNIT - III ENERGY DEMAND ANALYSIS AND FORECASTING 12

Methodology of Energy Demand Analysis - Methodology for Energy Technology Forecasting -
Methodology for Energy Forecasting - Sectoral Energy Demand Forecasting.

UNIT - IV ECONOMICS OF STANDALONE POWER SUPPLY SYSTEMS 10

Solar Energy - Biomass Energy - Wind Energy and other Renewable Sources of Energy -
Economics of Waste Heat Recovery and Cogeneration - Energy Conservation Economics.

NIT - V PROJECT MANAGEMENT-FINANCIAL ACCOUNTING 6

Cost Analysis - Budgetary Control - Financial Management - Techniques for Project Evaluation.

L:45; Total:45

REFERENCES:

1. M.Munasinghe and P.Meier (1993): Energy Policy Analysis and Modeling, Cambridge University Press.
2. W.A.Donnely (1987): The Econometrics of Energy Demand: A Survey of Applications, New York.
3. S.Pindyck and Daniel L.Rubinfeld (1990): Econometrics Models and Economic Forecasts, 3rd edition MC Graw -Hill, New York.
4. Energy Management handbook, Turner.