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**SYLLABUS**

**M. TECH.**

ENERGY ENGINEERING 2 Year Program

**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**Teaching and Examination Scheme common for M.Tech. (Core) Energy Engineering Edition 2015  
Year: I Semester: I**

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| **S. No.** | | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T** | **P** | **CIE** | **ESE** |
|  | |  | **University Core** |  |  |  |  |  |  |  |
| 1 | |  | Comprehensive Viva Voce examination | 2 | 0 | 0 | 0 |  |  |  |
| 2 | |  | Proficiency in curriculum activity | 2 | 0 | 0 | 0 |  |  |  |
|  | |  | **Program Core** |  |  |  |  |  |  |  |
| 3 | | EN 101 | New and Renewable Energy Technology | 3 | 3 | 0 | 0 |  |  |  |
| 4 | | EN 102 | Energy Instrumentation and Measurements | 3 | 3 | 0 | 0 |  |  |  |
| 5 | | EN 103 | Solar energy technology:thermal and PV | 4 | 4 | 0 | 0 |  |  |  |
| 6 | | EN 110 | Renewable Energy lab | 2 | 0 | 0 | 4 |  |  |  |
|  | |  | **Program Elective (any one)** |  |  |  |  |  |  |  |
| 7 | | EN 104 | Power Generation and System Planning | 3 | 3 | 0 | 0 |  |  |  |
| 8 | | EN 105 | Electrical Power Generation, Transmission and Distribution | 3 | 3 | 0 | 0 |  |  |  |
| 8 | | EN 106 | Alternative Fuels in I.CEngines | 3 | 3 | 0 | 0 |  |  |  |
| 10 | | EN 107 | Process Heat Transfer | 3 | 3 | 0 | 0 |  |  |  |
|  | |  | **University Elective (any one)** |  |  |  |  |  |  |  |
| 13 | | EN 108 | Modelling & Planning of Energy System | 3 | 0 | 0 | 0 |  |  |  |
| 14 | | EN 109 | Design of Combustion System | 3 | 3 | 0 | 0 |  |  |  |
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**Year 1 Semester II**

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| **S. No.** | | **Course Code** | | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T** | **P** | **CIE** | **ESE** |
|  | |  | | **University Core** |  |  |  |  |  |  |  |
| 1 | |  | | Employability Skill 1 | 1 | 0 | 0 | 0 |  |  |  |
| 2 | |  | | Proficiency in Curriculum Activity | 2 | 0 | 0 | 0 |  |  |  |
|  | |  | | **Program Core** |  |  |  |  |  |  |  |
| 3 | | EN 111 | | Wind and Bio Energy Technologies | 4 | 4 | 0 | 0 |  |  |  |
| 4 | | EN 112 | | Energy conservation (thermal systems) | 3 | 3 | 0 | 0 |  |  |  |
| 5 | | EN 113 | | Energy conservation (electrical systems) | 3 | 3 | 0 | 0 |  |  |  |
| 6 | | EN 120 | | Energy Conservation lab | 2 | 0 | 0 | 4 |  |  |  |
| 7 | | EN 121 | | Industry Visits Report | 2 | 0 | 0 | 0 |  |  |  |
|  | |  | | **Program Elective (any one)** |  |  |  |  |  |  |  |
| 8 | | EN 114 | | Waste water treatment system | 3 | 3 | 0 | 0 |  |  |  |
| 9 | | EN 122 | | Mini Project I | 3 | 0 | 0 | 0 |  |  |  |
| 10 | | EN 115 | | Technical Review Writing | 3 | 0 | 0 | 0 |  |  |  |
| 11 | | EN 116 | | Pollution Control Technologies | 3 | 3 | 0 | 0 |  |  |  |
| 12 | | EN 117 | | Energy auditing techniques | 2 | 2 | 0 | 0 |  |  |  |
|  | |  | | **University / Open Elective (any one)** |  |  |  |  |  |  |  |
| 13 | | EN 118 | | Energy Management | 3 | 3 | 0 | 0 |  |  |  |
| 14 | | EN 119 | | Electrical Machines and Drives | 3 | 3 | 0 | 0 |  |  |  |
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| **S. No.** | | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T** | **P** | **CIE** | **ESE** |
|  | |  | **University Core** |  |  |  |  |  |  |  |
| 1 | |  | Employability Skill 2 | 1 | 0 | 0 | 0 |  |  |  |
| 2 | |  | Proficiency in Curriculum Activity | 2 | 0 | 0 | 0 |  |  |  |
|  | |  | **Program Core** |  |  |  |  |  |  |  |
| 3 | | EN 123 | Energy economics & project management | 3 | 3 | 0 | 0 |  |  |  |
| 4 | | EN 124 | Energy acts ,regulations and policy | 2 | 2 | 0 | 0 |  |  |  |
| 5 | | EN 125 | Green Building : Design and Energy efficiency | 3 | 3 | 0 | 0 |  |  |  |
| 6 | | EN 132 | Mini Project II | 6 | 0 | 0 | 0 |  |  |  |
|  | |  | **Program Elective** |  |  |  |  |  |  |  |
| 7 | | EN 126 | Fuel Cell | 3 | 3 | 0 | 0 |  |  |  |
| 8 | | EN 127 | Life Cycle Assessment Analysis |  |  |  |  |  |  |  |
| 9 | | EN 130 | Fuel and biomass testing lab | 2 | 0 | 0 | 4 |  |  |  |
| 10 | | EN 131 | Computational Lab | 2 | 0 | 0 | 0 |  |  |  |
|  | |  | **University / Open Elective (any one)** |  |  |  |  |  |  |  |
| 11 | | EN 128 | Solid Waste Management | 3 | 3 | 0 | 0 |  |  |  |
| 12 | | EN 129 | Computational Fluid Dynamics |  |  |  |  |  |  |  |
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**Year 2 Semester III**

**Year: 2 Semester: IV**

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| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T** | **P** | **CIE** | **ESE** |
|  |  | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Not Applicable |  |  |  |  |  |  |  |
|  |  | **Program Core** |  |  |  |  |  |  |  |
| 2 |  | Major project. | 16 | 0 | 0 | 0 |  |  |  |
|  |  | **Program Elective** |  |  |  |  |  |  |  |
| 3 |  | Not Applicable |  |  |  |  |  |  |  |
|  |  | **University / Open Elective ( Not Applicable)** |  |  |  |  |  |  |  |
| 15 |  |  |  |  |  |  |  |  |  |

**ME 501 DESIGN OF THERMAL SYSTEMS C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| I | Mathematical Modeling of thermal Systems:Development of equations based on number-processing operation and physical laws for simulation and optimization of thermal systems | **6** |
| II | The art of equation fitting to performance data; Development of performance equations for heat exchangers, distillation separators and turbo machinery | **6** |
| III | Simulation of thermal Systems: Uses of system simulation, classes of simulation; Information-flow diagrams; sequential and simultaneous calculations | **6** |
| IV | simulation of continuous, deterministic steady-state systems, e.g. gas turbine system; simulation of dynamic behavior of thermal systems | **6** |
| V | Optimization of Thermal Systems:Optimization criteria; use of Lagrange Multipliers, search methods, dynamic programming and geometric programming for optimum design of thermal systems | **6** |

**Reference Books:**

1. W.F. Stocker; “Design of thermal Systems”, McGraw Hill International, 1989.
2. B.K. Hodge, “Analysis and Design of Energy Systems”, Prentice-Hall Inc., 1990.

**ME 502 DESIGN OF COMBUSTION SYSTEM C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Types Of Fuels: Composition-physical, chemical and thermodynamic properties. Proportion of reactants and cooled products: Individual hydro carbons – volumetric fuel blends gravimetric fuel and mixture calculation from product analysis-physical characteristics of mixtures and products | **6** |
| **II** | Proportions Of Hot Products: Kinetic equilibrium – equilibrium product composition in hydrocarbon combustion – Fuel rich mixture dissociation – general mixture dissociation | **6** |
| **III** | Combustion Energies: Standard energy of formation-standard energy of reaction calorific value-maximum useful work.  Combustion Temperatures: Sensible energy – determination of maximum temperature in steady flow – Influence of fuel type and operating parameters.  Combustion Efficiencies: Work transfer applications in now-flow – heat transfer applications in steady flow- work transfer applications in steady flow.  Combustion Control Systems: Controlling fuel flow- controlling air flow- As pollution control flow | **6** |
| **IV** | Design Of Burners: Gas and oil burners- operations characteristics – calculation of gas flow rate; pressure drop efficiency | **6** |
| **V** | Design of furnaces and chimneys, steam generating devices – stokers, fluidized bed combustion – types – performance analysis | **6** |

**Reference Books:**

1. Samir Sarkar, Fuels and Combustion, Orient Longman, 1990.
2. E.M. Goodger, Combustion Calculations, The Macmillan Press Ltd.,1977.
3. Francis G. Shinskey, Energy Conservation through Control, Academic press, 1978.

**ME 503 ELECTRICAL POWER GENERATION, TRANSMISSION AND DISTRIBUTION C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Basic Concept: Power in Single Phase, AC Circuits, Complex Power, Power Triangle, Power in Balanced Three- Phase Circuit. Phasor Diagram. Types of Conductors, Skin Effect, Corona Losses, Basics of Transmission & Distribution System, Layout of substation and component of substation | **6** |
| **II** | Inductance of Transmission Lines, Capacitance of Transmission Lines, Representation of Power Systems, Bundle conductors. Performance of Short, Medium and Long Transmission Lines, Transmission Line Losses, Underground Cables, Voltage Regulation. | **6** |
| **III** | Distribution: Radial and Ring Type Distribution Systems, Kelvin’s Economic Depreciation and Tariffs, economics of generation, power factor Improvement Law, Distribution Network, Distribution and feeder, Distribution losses. | **6** |
| **IV** | Generation: Various Method of Electrical Generation, Thermal Power Plants, Nuclear Power Plant | **6** |
| **V** | Major equipment of power plant, Hydroelectric Power Plants, Wind Power Plants | **6** |

**Reference Books:**

1.Gupta B.R., “Power System Analysis and Design”, S.Chand, New Delhi, 2003  
2.Singh S.N., “Electric Power Generation, Transmission and Distribution”, Prentice Hall of India, New Delhi, 2002  
3. Luces M. Fualkenberry, Walter Coffer, “Electrical Power Distribution and  
 Transmission”, Pearson Education, 1996  
4. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Publishing Company,2003  
5. Wadhwa C.L, “Electric Power Systems”, New Age International (P) Ltd., 2000.  
6. Turan Gonen “Electric Power Distribution Engineering”, CRC Press, 2nd Edition, 2007

**ME 504 WIND ENERGY UTILIZATION C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Wind Characteristics: Sources of wind, wind hazards, sitting in flat terrain, sitting in non-flat terrain, ecological indicators of site suitability, site analysis methodology. Wind Energy System: Energy from the wind, work-energy and power, different types of rotors, over speed control, electric power generation and storage. Water pumping systems – major components – lift – transport – storage sitting and sizing | **6** |
| **II** | Applied Aerodynamics: Role of aerodynamics in wind power – cross wind axis machines – wind axis machines – general momentum theory – vortex strip theory, forces and moments due to vertical wind gradient | **6** |
| **III** | Towers And Systems Installation: Specific types of tower, Tower height, Tower and systems raising, wiring, lightning protection, Installation, maintenance of other equipments | **6** |
| **IV** | Energy Conversion And Storage: Synchronous inverters, dc/ac inverters, battery storage, battery characteristics, battery system installation, other types of storage systems. Wind Energy Conversion Systems: Specifications and characteristics of commercial water-pumping wind mills, electricity producing wind energy. Conversion systems, selection of systems-case study. Environmental aspects | **6** |
| **V** | Applications: Potential application of wind energy conversion systems, residential applications, wind power use in agriculture | **6** |

**Reference Books:**

1. V. Daniel Hunt, Wind Power, Van Nostrand Reinhold Company, 1981.
2. Wind Energy Basics: A Guide to Small and Micro Wind Systems; Paul Gipe, Chelsea Green Pub Co; April 1999.

**ME 505 SOLAR POWER ENGINEERING C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Solar Radiation: Solar Radiation, instruments for measuring solar radiation, solar radiation geometry, empirical equations, solar radiation on tilted surfaces. Solar time and equation of time, pyranometer & pyrheliometer, solar spectrum ,selective surfaces. | **6** |
| **II** | Liquid Flat Plate Collectors: Basic elements, performance analysis, transmissivity - absorptive, heat transfer Coefficients and Correlations, Collector efficiency and heat removal factors, effects of various parameters, types of other liquid flat-plate Collectors, transient analysis |  |
| **III** | Solar Air Heaters: Type of air heaters, solar performance analysis of a Conventional air heater, other types of air heater, Concentrating Collectors: Type of Concentrating Collectors and their general characteristics. | **6** |
| **IV** | Thermal Energy Storage: Basic methods, Sensible heat storage – liquids- solids-analysis, latent heat storage, thermo chemical storage. solar cooker & performance, animal feed cooker. | **6** |
| **V** | Solar Refrigeration: absorption based solar refrigeration technologies .photovoltaics: fundamental of photovoltaic conversion, semiconductor materials, photon energy, solar cell, material used in solar cell, polycrystalline & amorphous silicon, current voltage characteristics. | **6** |

**Reference Books:**

1. Krith F. and Krelder J.F., Principles of Solar Engineering**,** McGraw hill book company, 1978.
2. John A, Duffie, William A. Beckman ; Solar Engineering of thermal processes, , John Wiley and Sons, 1991.
3. Garg H.P. and Prakash J., Solar energy fundamentals and application, TATA McGraw Hill Publishing company limited, New Delhi, 2000.
4. Sukhatme S.P., Solar Energy Principle of thermal collection and storage, TATA McGraw Hill Publishing company limited, New Delhi, 1996

**ME 506 POLLUTION CONTROL TECHNOLOGIES C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Introduction: Introduction to air pollution, classification of pollutants, their effects, impact of environment on human | **6** |
| **II** | Air Pollution Sources: Mobile and stationary sources, types of plume dispersion mechanisms, air quality measurement concepts | **6** |
| **III** | Control devices for particulate contaminants: gravitational settlement, centrifugal and wet collectors, fabric filters, cyclon separators, electrostatic precipitators  Control devices for gaseous contaminants from stationary sources: adsorption, adsorption, condensation, combustion based pollution control systems | **6** |
| **IV** | Automotive Emission control: Types and construction of catalytic converters, emission control through operating parameters and engine design, alternative fuels for emission reduction | **6** |
| **V** | Laws and regulations: National and international standards for mobile and stationary sources of air pollution | **6** |

**Reference Books:**

1. Howard S. Peavy, Donald Rowe; Environmental Engineering; Tata Mc-Graw Hill, 1989.

**ME 507 MODELING & PLANNING OF ENERGY SYSTEM C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Introduction: Energy policy analysis; need for energy modeling; classification of energy models; types of computer based tools for energy planning; national and rural energy planning; sect oral energy planning. | **6** |
| **II** | Input-Output Models: Types and Characteristics of I-O models; use of I-O models; I-O transaction tables; method of estimation and sources of data; mathematical expression on the methodology of construction of I-O tables; case studies. Econometric Models: Statistical estimation techniques; time series; regression analysis; advantages and limitations of econometric models; elastic ties of energy demand; case studies | **6** |
| **III** | Optimization Models: Linear and non-linear optimization models; advantage and limitation of optimization models; case studies of linear optimization models for national and rural energy planning | **6** |
| **IV** | Process Analysis Models: End-use models; process analysis models for industrial, domestic and transport energy conservation; advantage and limitations of process analysis models; case studies | **6** |
| **V** | System Dynamic and Other Simulation Models: Concept of closed system; causal loop diagram; flow diagram and system equations; dynamic behavior of energy systems; advantages and limitations of simulation models; case studies | **6** |

**Reference Books:**

1. Richard de Nenfville, “ Applied Systems Analysis” Mc Graw Hill International Eds. 1990.
2. J.P. Weyant & T. A. Kuczmowski “Engineering- Economy Modeling: Energy Systems” Energy-The International Issue (Special issue an energy modeling), Pergaman Press. Vol. 15, No. ¾ PP 145-715, 1990.
3. J. W. Forrester, “ Principle of Systems” MIT Press, 1982.
4. Rene Codoni, Hi- Chun Park, K.V. Ramani, “ Integrated Energy Planning: A Manual” Volume on policy planning, Asian & Pacific Development Center, Kuala Lumpur 1985.

**ME 508 ENERGY CONSERVATION (ELECTRICAL) C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Electrical Systems: Basis of Energy and its various forms: Electrical Basis-DC & AC, currents active power, reactive power and apparent power, star, delta connection, electricity billing, electrical load management, maximum demand control. Power Factor: Power factor, Power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors and energy conservation opportunities | **6** |
| **II** | Electric Motors: Types, losses in induction motors, motor efficiency, factor affecting motor performance, rewinding and motor replacement issues, energy saving opportunities in motors, energy efficient motors, soft starter with energy savers | **6** |
| **III** | Transformers and Electric Distribution:Types of transformers, transformer losses, energy efficient transformers, factor affecting the performance of transformers and energy conservation opportunities, cables, switch gears, distribution losses, energy conservation opportunities in-house electrical distribution system. Compressed Air Systems:Types of air compressors, compressor efficiency, efficient compressor operation, compressed air systems components, capacity assessment, leakage test, factors affecting the performance and energy savings opportunities | **6** |
| **IV** | Pumps and Pumping System: types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Fans & Blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities | **6** |
| **V** | Lighting System: Light source, choice of lighting, energy efficient lighting controls Luminance requirements and energy conservation avenues. Energy Conservation through: Variable Speed Drives, Occupancy Sensors, Energy Savers, Day Lighting | **6** |

**Reference Books:**

1.H. Partab, ‘Art and Science of Utilisation of Electrical Energy’, Dhanpat Rai and Co, New Delhi, 2004.  
2.Gopal.K.Dubey, ‘Fundamentals of Electrical Drives’, Narosa Publishing House, New Delhi, 2002.  
3.C.L. Wadhwa, ‘Generation, Distribution and Utilization of Electrical Energy’, New Age International Pvt.Ltd, 2003.

**ME 509 ALTER NATIVE FUELS IN I.C.ENGINES C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Introduction: Need of alternative gaseous fuels, future automotive gaseous fuels, hydrogen, CNG, LNG, and Producer gas, biogas, LPG. Stochiometric air fuel ratio, Physical properties of different gaseous fuels, mode of engine operations, spark ignition and dual fuel mode, multi fuel mode, combustion and performance of engines, specific problems, safety and environmental aspects, economic aspects, production | **6** |
| **II** | Use of alcohol in four stroke spark ignition engines and diesel engines, use of alcohol in two stroke engines, use of bio diesels, combustion and performance of engines, stochiometric air fuel ratio, specific problems, safety and environmental aspects, economic aspects, production. | **6** |
| **III** | Impacts: Impact of alternative fuels on engine test and test procedures, guidelines for emission measurements, emission norms for engines using alternative fuels | **6** |
| **IV** | Legal Aspects: Legal aspects of blending alternative fuels into conventional liquid fuels, properties of blends, comparison of neat versus blended fuels, fuel testing | **6** |
| **V** | Computer simulation: Computer simulation of engines using alternative fuels | **6** |

**Reference Books:**

1. Future automotive fuels, Edited by Joseph M. Colucci and Nicoles C. Gallopoulos, Plenum press, New York
2. Dual fuel engines, edited by R.L.Evans, Plenum Press, 1987
3. SAE hand book, volume III, Engines, fuels, lubricants, emissions and noise
4. Automotive fuels and fuel systems, volume II, T.K.Garrett, Pantech Press, London
5. Gaseous fuels for transportation I, proceedings of the conference held at Vancouver, british Columbia, Canada, 1987
6. Pandel U, Poonia M.P.; Energy Technologies for Sustainable Development,.,Prime Publishing House Gajiabad, 2003.

**ME 510 ENERGY MANAGEMENT C (L, T, P) = 3(3, 0, 0)**

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| **Unit** | **Course Contents** | **Total Contact Hrs. 30** |
| **I** | Introduction to Energy Management: Aims and approaches of auditing, types of energy audit, energy indices in residential, commercial and industrial sector, data collection | **6** |
| **II** | Energy in Manufacturing: Energy and environmental analysis of products, energy consumption in manufacturing, laws of energy and materials flow.  Energy in Residential Sector: Supply of energy for rural and urban housing, fuel substitution, efficiency improvement of domestic appliances | **6** |
| **III** | Instrumentation for Energy Management: Measurement of heat flux, radiation, psychometric variables, fluid flow & velocities, data analysis | **6** |
| **IV** | Life Cycle Analysis: LCA of energy systems, concept of life cycle costing and its use | **6** |
| **V** | Demand Side Management: Principles of DSM, rules and tools of DSM, fundamentals of demand response, DSM tools and practices | **6** |

**Reference Books:**

1. C.B. Smith, Energy Management Principles, Pergamon Press, New York, 1981.
2. Hamies, Energy Auditing and Conservation: Methods, Measurements, Management & case study, hemishpere, Washington, 1980.
3. Diamant R.M.,Total Energy, Pergamon Press, Oxford, 1970.