### Chhattisgarh Swami Vivekanand Technical University, Bhilai

#### SCHEME OF TEACHING AND EXAMINATION

**M. E. Mechanical Engineering (Energy Management)**

**Ist Semester**

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<th>S No.</th>
<th>Board Of Studies</th>
<th>Sub. Code</th>
<th>Subject</th>
<th>Periods Per Week</th>
<th>Scheme of Exam</th>
<th>Total Marks</th>
<th>Credit</th>
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<td>Mechanical Engg</td>
<td>583111(37)</td>
<td>Solar Energy Utilization</td>
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<td>Numerical Methods in Energy Management</td>
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<td>Energy Conversion Systems &amp; Devices</td>
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<td>Energy Lab</td>
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<td>Computational Lab</td>
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**L** – Lecture, **T** – Tutorial, **P** – Practical, **ESE** – End Semester Exam, **CT** – Class Test, **TA** – Teacher’s Assessment

#### List of Electives I

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<td>Mechanical Engg</td>
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<td>Energy, Environment &amp; Sustainable Development</td>
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<td>Mechanical Engg</td>
<td>583133(37)</td>
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<td>583134(37)</td>
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Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: I M.E (Energy Management)  Branch: Mechanical Engineering
Subject: Solar Energy Utilization  Code: 583111(37)
Total Theory Periods: 40  Total Tutorial Periods: 12
Total Marks in End Semester Exam.: 100
Minimum number of class test to be conducted: 02

Unit I
Earth & Sun Relationship
i. Earth & Sun Relation: Solar Angles, Day length, Angle of Incidence on Tilted Surface, Sun path Diagram, Shadow Determination.

Unit II.
Solar Collectors
Flat Plate Collectors, Flat Plate Air Collectors, Concentrating Collectors, Evacuated Tubular Collectors.

Unit III
Thermal Energy Storage
Sensible Storage (Water, pebble bed and ground storage), Latent Heat Storage.
Thermal Energy Systems
Solar Water Heating System, Solar Air Heating Systems, Solar desalination system

Unit IV
Solar Refrigeration and Desiccant
ii. Solar Chimney

Unit V
Solar Power Generator

Text Books and References:

9. Markvart, Solar Electricity, John Wiley
Unit I
Introduction: Concepts of consistency, stability and convergence of numerical scheme, Interpolation, finite differences-forward, backward and central differences, Hermite Interpolation, Bivariate Interpolation, spline interpolation

Unit II
Stochastic Process: Poisson process for discrete parameters, Markov chains, queing

Unit III
Numerical solution of ordinary differential equations (ODE) of I order: Euler’s method, modified Euler’s method and Runge Kutta 4th order method, Predictor Corrector method, Shooting Method, initial value problems, boundary value problems

Unit IV

Unit V
Numerical solution of Partial differential equations, Elliptic Equation, Relaxation method, Parabolic equation, Hyperbolic Equation, Wave equation, Laplace equation, Poisson’s Equation, FDM methods

Text Books & References:
1. Numerical Methods for Scientist and Engineers, New Age Publication, Jain, Jain and Iyengar
2. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill International
3. Shepley L Ross, Differential Equations, John Wiley & Sons
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: I M.E (Energy Management) \hspace{1cm} Branch: Mechanical Engineering
Subject: Energy Conversion Systems & Devices \hspace{1cm} Code: 583113(37)
Total Theory Periods: 40 \hspace{1cm} Total Tutorial Periods: 12
Total Marks in End Semester Exam. : 100
Minimum number of class test to be conducted: 02

Unit I : Classification of Energy Sources
Fossil fuels, Nuclear fuels, Conventional & Renewable Energy, Energy Sources, Direct use of primary energy sources, Conversion of primary into secondary energy, Energy Conversion through fission and fusion

Unit II : Thermal and Mechanical Energy
Conversion of Thermal Energy into Mechanical energy & Power, Steam turbines, Hydraulic turbines, Gas turbine, Combined cycle analysis – Inter- cooling, reheating and regeneration-gas turbine cooling. Combined cycles with heat recovery boiler

Unit III : Thermal Energy Utility systems
Boilers Types, combustion in boilers, performance evaluation, analysis of losses, feed water treatment, blow down. FBC Boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, retrofitting FBC system to conventional boilers.

Unit IV : Co-generation, Tri-generation & Waste Energy Recovery

Unit V : Mechanical Energy Utility Systems
Compressed Air System, Fans and blowers, Variable speed drives, Diesel generating systems, Vapour compression system

Text Books & References:

5. Industrial Furnaces (Vol I & II) and M.H. Mawhinney, John Wiley Publications
7. Domestic and commercial oil Burners Charles H. Burkhadt, McGraw Hill
8. Boilers – Types, Characteristics and functions – Carl D. Shields, Mcgraw Hill
Chhattisgarh Swami Vivekanand Technical University, Bilai

Semester: I M.E (Energy Management) Branch: Mechanical Engineering
Subject: Energy Optimization Code: 583114(37)
Total Theory Periods: 40 Total Tutorial Periods: 12
Total Marks in End Semester Exam. : 100
Minimum number of class test to be conducted: 02

Unit I : Regression and Curve Fitting
Need for regression in simulation and optimization. Concept of best fit and exact fit. Exact fit - Lagrange interpolation, Newton's divided difference, Least square regression, Power law forms - Gauss Newton method for nonlinear least squares regression

Unit II : Optimization
Introduction, Formulation of optimization problems, Concept of interval of uncertainty, reduction ratio, reduction ratios of simple search techniques like exhaustive search, dichotomous search, Fibonacci search and Golden section search Method of steepest ascent / steepest descent, conjugate gradient method examples.

Unit III : Orthogonal Arrays
Different test strategies, Degrees of freedom, selection of a standard orthogonal array, ANNOVA / S/N ratios for static problems, S/N ratios for dynamic problems Taguchi Technique, Case study 1 - matrix experiment using orthogonal arrays

Unit IV : Designing a optimized product / process
Selection of noise factors and testing conditions, Quality characteristics and objective function, Control factors and their levels, Matrix experiment and Data Analysis

Unit V : Nontraditional Optimization Techniques
New generation optimization techniques – Genetic algorithm and simulated annealing, Introduction to Bayesian framework for optimization, Particle Swarm optimization, Ant colony optimization

Text Books & References:
1. Essentials of Thermal System Design and Optimization, Prof. C.Balaji, Aue
2. Books, New Delhi
7. Optimization for engineering design - algorithms and examples, K.De, Prentice Hall.
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: I
M.E (Energy Management)  Branch: Mechanical Engineering
Subject: Energy, Environment & Sustainable Development  Code: 583131(37)
Total Theory Periods: 40  Total Tutorial Periods: 12
Total Marks in End Semester Exam: 100
Minimum number of class test to be conducted: 02

Unit I
Classification of Various Energy Sources, Renewable And Non-Renewable Energy Sources, Energy and us: Energy terms; Current energy scenario (World, US, India); Electricity; Future projections; Externalities of energy use, Remedial Measure to Energy Crises, Energy Conservation, Laws of Energy Efficiency

Unit II
Carbon Cycle: Natural systems – autotrophs, heterotrophs, energy flows, pre-industrial humanity; Photosynthesis- efficiency of natural ecosystems, forests and various crops; Respiration, combustion and other oxidation processes; Biomethanation

Unit III
Climate Science Research: Climate history; Greenhouse gas effect; Anthropogenic climate change; Role of different gases; Global problem; Integrated assessment models; Impacts and adaptation; Uncertainties; Precautionary principle

Unit IV
Carbon Sequestration: Biological pathways; Physico-chemical methods; CO2 capture from large point sources; Pre-, post- and oxy-combustion technology; Transport, storage and monitoring; Feasibility, economics and public perceptions; Case studies

Unit V
Climate Policy: Kyoto protocol; UNFCCC; IPCC; Geopolitics of GHG control; Carbon market - CDM and other emission trading mechanisms; Non-CO2 GHGs; Relevance for India

Text Books & References:
3. IPCC Special Report on Carbon Dioxide Capture and Storage: B Metz et al (Eds), Cambridge University Press
4. CDM Country Guide for INDIA: Institute for Global Environmental Strategies (Ed), Ministry of the Environment, Japan
5. Global Environmental Issues:F Harris (Ed),John Wiley
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: I M.E (Energy Management) Branch: Mechanical Engineering
Subject: Computer Applications: Energy Software Code: 583132(37)
Total Theory Periods: 40 Total Tutorial Periods: 12
Total Marks in End Semester Exam. : 100
Minimum number of class test to be conducted: 02

Unit I
Introduction, Use and application of various Energy System designing and simulation Programme. PREBID, BIDWIN, PRESIM, TRNSHELL & TRNSE D.

Unit II

Unit III

Unit IV
Introduction, Components, Design and Development issues, Concept of Energy Data, Energy Reporting, role of metering and measurement etc.

Unit V
Case studies of real energy problem

Text Books & References:
1. Turba, Information Technology, Wiley & Sons
2. Dennis P Curtin, Information Technology, TMH
3. Whitten, System Analysis & Design, TMH
4. A Handbook to EMIS, Published by the Office of Energy Efficiency of Natural
5. Resources Canada
6. Manuals of TRNSYS
7. Manuals of Design Builder
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: I M.E (Energy Management) Branch: Mechanical Engineering
Subject: Electric Power Generation and Distribution Code: 583133(37)
Total Theory Periods: 40 Total Tutorial Periods: 12
Total Marks in End Semester Exam: 100
Minimum number of class test to be conducted: 02

Unit I

Unit II
Basic Concept, Power in Single Phase, AC Circuits, Complex Power, Power Triangle, Phasor Diagram Power in Balanced Three-Phase Circuit. Types of Conductors, Skin Effect, Corona Losses,

Unit III

Unit IV
Radial and Ring Type Distribution Systems, Kelvin’s Economic Law, Distribution Network. Distributions and Feeder, Voltage Regulation Distribution Losses.

Unit V
Depreciation and Tariffs, Economics of Generation, Power Factor Improvement.

Text Books & References:
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: I M.E (Energy Management) Branch: Mechanical Engineering
Subject: Energy Resources and Economics Code: 583134(37)
Total Theory Periods: 40 Total Tutorial Periods: 12
Total Marks in End Semester Exam.: 100
Minimum number of class test to be conducted: 02

Unit I
Overview of World Energy Scenario – Dis-aggregation by end-use, by supply, Fossil Fuel Reserves – Estimates, Duration Overview of India's Energy Scenario - Disaggregation by end-use, by supply

Unit II

Unit III
Energy Economics - Simple Payback Period, Time Value of Money, IRR, NPV, Cost of Saved Energy, Cost of Energy generated, Examples from energy generation and conservation, Elements of nuclear power plant cost

Unit IV
Cash flows covering the entire life cycle, Cost estimation and revision methods, Cost of capital, Unit energy cost, Mandatory liabilities like decommissioning and international safeguard obligations, Financial planning, analysis and control

Unit V
Interest during construction, Comparison of cost of nuclear power plant with thermal & other power plants, Energy Chain, Primary energy analysis Life Cycle Assessment, Net Energy Analysis.

Text Books & References:
1. Energy and the Challenge of Sustainability, World energy assessment, UNDP
Chhattisgarh Swami Vivekanand Technical University, Bilai

Semester: I M.E (Energy Management) Branch: Mechanical Engineering
Subject: Energy Lab Code: 583121(37)
Total Practical Periods: 40
Total Marks in End Semester Exam.: 75

List of Experiments
1. Determine efficiency of pump
2. Determine efficiency of fan
3. Determine efficiency of the blower
4. Determine the actual free discharge of a given air compressor system
5. Determination of “Star Rating” of Refrigerator
6. Calculate COP of the refrigeration plant
7. Calculate COP of the AC unit
8. Determine efficiency of the lighting system
9. Determine energy consumption of different electrical appliances for 6,8,12 and 24 hours

Equipments required
1. Pump test rig
2. Fan with different blades
3. Blower
4. Air compressor system
5. Refrigerator
6. Refrigeration Test rig
7. Air conditioner test rig
8. CO2 and CO meter for analysis of exhaust gas
Chhattisgarh Swami Vivekanand Technical University, Bilai

Semester: I M.E (Energy Management) Branch: Mechanical Engineering
Subject: Computational Lab Code: 583122(37)
Total Practical Periods: 40
Total Marks in End Semester Exam.: 75

One Lab/Field/Industrial oriented Project/Problem will be allotted to each student related to subject taught in 1st semester.
Software required: Ansys, Creo, Solar simulator