FACULTY OF ENGINEERING & TECHNOLOGY

Second Year Master of Engineering

Branch: Thermal Engineering
Course Code: 102440301

Course Title: Energy Systems, Modeling & Analysis

Type of Course: Professional Elective Course

Course Objectives: The course provides a comprehensive overview in the field of energy system modelling - a fundamental discipline for being able to perform complete analyses of the connection between energy and economy effect. The course also introduce the students to practical tools and approaches to solve analytical energy system problems.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	40 / 16	20/08	60/24	30/12	150 /60

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**INTRODUCTION** Overview of various technologies and conventional methods of energy conversion, Designing a Workable System: Workable and optimum systems, Steps in arriving a workable system, Creativity in concept selection, Workable Vs Optimum system	06
2	**MODELING OF THERMAL EQUIPMENT** Mathematical modeling, Exponential forms- Method of least squares - Counter flow heat exchanger, Evaporators and Condensers, Effectiveness, NTU, Pressure drop and pumping power	10
3	**SYSTEM SIMULATION** Classes of simulation, flow diagrams, Sequential and simultaneous calculations, Newton-Raphson method- Optimization procedure, mathematical statement of the problem	08
4	**OPTIMISATION** Objectives/constraints, problem formulation. Unconstrained problems- Necessary & Sufficiency conditions. Constrained Optimization- Lagrange multipliers, constrained variations, Kuhn-Tucker conditions Linear Programming - Simplex tableau, pivoting, sensitivity analysis. Dynamic Programming. Search Techniques- Univariate / Multivariate	10

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
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5	**ENERGY ANALYSIS** Methodology of energy demand analysis; Methodology for energy forecasting, Dealing with uncertainty probabilistic techniques. Trade-offs between capital & energy using Pinch Analysis, Energy- Economy Models: Scenario Generation, Input Output Model	**08**

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
10	20	15	25	25	05	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	W.F.Stoecker ,"Design of Thermal Systems" McGraw Hill
2	B.K.Hodg(1990),"Analysis and Design of Thermal Systems",Prentice Hall Inc
3	I.J.Nagrath & M.Gopal, "Systems Modelling and Analysis", Tata McGraw Hill
4	D.J. Wide, "Globally Optimal Design", Wiley- Interscience
5	Yogesh Jaluria, Design and Optimization of Thermal Systems, McGraw-Hill international editions
6	S.S.Rao, Optimisation Theory and Applications, Wiley Eastern
7	S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall
8	P. Meier, Energy Systems Analysis for Developing Countries, Springer Verlag
9	Beveridge and Schechter, Optimisation Theory and Practice, Mcgraw Hill

Course Outcomes (CO):

Sr.	**Course Outcome Statements**	**%weightage**
CO-1	Students will understand the fundamental of energy conversion system	**15**
CO-2	Understand the concepts of energy modelling	**30**
CO-3	Understand and apply the optimization techniques for energy system	**30**
CO-4	Students will be able to apply the principles of economics and management techniques to evaluate energy projects	**25**

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List of Practicals / Tutorials:

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1	Study of conventional methods of energy conversion system
2	Case study of Designing a Workable System
3	Study of mathematical modeling of thermal system
4	Experimental study of solar PV cells
5	Study of simulation methods for energy system
6	Study of optimization techniques for energy system
7	Study of Input –Output model.
8	Study of uncertainty probabilistic techniques
9	Study of Newton-Raphson method for system simulation
10	Study of Pinch analysis

Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-21
Last Reviewed on (Month-Year):	Jul-21
Next Review on (Month-Year):	Apr-23

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