FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester I

Course Code: 102440102

Course Title: Advanced Thermodynamics

Type of Course: Core Course II

Course Objectives: To apply the concept of entropy principle for different applications. Study of exergy analysis for reversible and irreversible process. Understand the behaviour of real gas with their of state and its applications in day to day life. To study the role of combustion phenomenon in thermal science.

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	2	0	4	40 /16	20 /08	60 /24	30 / 12	150 /60

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

Detailed Syllabus:

Sr.	Contents	Hours
1	ENTROPY AND EXERGY ANALYSIS Recapitulations of thermodynamic concepts and its laws, Transient flow analysis, Clausius theorem, Entropy, Inequality of Clausius, entropy principle and its applications, entropy change for closed and open system, exergy and its types, exergy concepts for control volume and closed system, irreversibility, second law efficiency, exergy analysis of processes and cycles, pictorial representation of exergy balance, exergy based property diagram, exergy costing, exergoeconomic analysis.	12
2	REAL GAS BEHAVIOUR Equation of state. Vander Waal's equation, Bertholot equation, Dieterici equation, Virial equation of state, Fugacity, compressibility. Principle of Corresponding States, Use of generalized charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kesler generalized three parameter tables. Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Equilibrium in multi-phase systems, Gibbs phase rule for non-reactive components. Phase transition, types of equilibrium and stability, multi-component and multiphase systems, equations of state for multicomponent system. Energy properties of real gases. Vapour pressure, Clausius - Clapeyron equation	12

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3	COMBUSTION Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat of reaction, Adiabatic flame temperature generated product, Enthalpies, Equilibrium. Chemical equilibrium of ideal gases, Effect of non-reacting gases equilibrium in multiple reactions, The vent hoff's equation	**9**
4	POWER CYCLES Review of binary vapour cycle, co-generation and combined cycles, Second law analysis of cycles.	**3**
5	DIRECT ENERGY CONVERSION SYSTEMS Fuel cells, Thermo-electric energy, Thermo-ionic power generation, Thermodynamic devices, magneto-hydrodynamic generations, Photovoltaic cells	**3**
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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%	20%	25%	20%	5%	

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	Advance Thermodynamics for Engineers, D. Winterbone, Ali Turan, Elsevier Science
2	Basic and Applied Thermodynamics, P.K.Nag, McGraw-Hill Education
3	Thermodynamics by J P Holman, McGraw-Hill
4	Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Publication
5	Advanced Engineering Thermodynamics, Adrian Bejan, John Wiley and Sons
6	Thermodynamics by Sonnatag & Van Wylen, John Wiley & Sons
7	Advanced Thermodynamics for Engineers, Kenneth Wark, McGraw Hill
8	Fundamentals of Engineering Thermodynamics, Michael J. Morgan and Howard N. Shapiro, Wiley Publication
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10	Click or tap here to enter text.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the concept of exergy and exergeconomic analysis	**20**
CO-2	Understand the combustion reactions	**25**
CO-3	Students able to know the various direct energy conversion systems	**30**
CO-4	To apply the knowledge of power cycles in energy sector	**25**
CO-5	Click or tap here to enter text.	Click
CO-6	Click or tap here to enter text.	Click
CO-7	Click or tap here to enter text.	Click
CO-8	Click or tap here to enter text.	Click
CO-9	Click or tap here to enter text.	Click
CO-10	Click or tap here to enter text.	Click

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List of Practicals / Tutorials:

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1	Entropy and its Applications
2	Exergy Analysis
3	Various Equation of State for real gas
4	Compressibility, Generalized Compressibility Chart, Compressibility factor
5	Multicomponent system
6	Low and high temperature combustion Products and its Problems
7	Binary Vapour Cycle, Co-generation and Combine cycle
8	Direct Energy Conversion Systems
9	Second Law efficiency and its problems
10	Exergy costing, Exergy economic Analysis
11	Click or tap here to enter text.
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Supplementary learning Material:	
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Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22

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