B. E. Semester: 3 Mechanical Engineering
Subject Name: ENGINEERING THERMODYNAMICS (ME-306)

A. **Course Objective:**

- To present a problem oriented in depth knowledge of ENGINEERING THERMODYNAMICS
- To address the underlying concepts and methods behind ENGINEERING THERMODYNAMICS

B. **Teaching / Examination Scheme**

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
CODE	NAME	L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
		Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
ME403	**ENGINEERING THERMODYNAMICS**	3	0	0	3	3	3	70	30	20	--	120

C. **Detailed Syllabus**

1. Basic Concepts:
   Microscopic & macroscopic point of view, Thermodynamic system and control volume, Thermodynamic properties, processes and cycles, Thermodynamic equilibrium, Quasi-static process, pure substance, vapour liquid-solid phase in a pure substance, p-v-t surface, critical and triple point of pure substance.
2. First law of Thermodynamics:
   First law for a closed system undergoing a cycle and change of state, Energy-A property of the system, Perpetual motion machine of the first kind, steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump, heat exchanger, throttling process and filling and emptying process.
3. Second law of thermodynamics & Entropy:
   Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalence, Perpetual motion machine of the second kind, carnot cycle, carnot's theorem, corollary of carnot theorem, thermodynamic temperature scale. Clausius theorem, the property of entropy, inequality of Clausius, entropy change in a open system, reversible and irreversible process, principle of increase of entropy, Third law of thermodynamics, Entropy and disorder, concept of exergy.
4. Availability, Irreversibility & Thermodynamic Relations:
   Available and unavailable energy, available energy referred to a cycle, availability in non-flow and steady flow systems, reversibility and irreversibility. Maxwell's equation, T-ds equations, difference in heat capacities, ratio of heat capacities, Helm-holtz and Gibbs function, Internal energy relations, Clausius- Claperyon equation, Joule-Thomson coefficient.
5. Vapour & Gas Power cycles:
   Carnot cycle, Rankine cycle, comparison of carnot and rankine cycle, modified rankine cycle, calculation of cycle efficiencies, variables affecting efficiency of rankine cycle. Carnot, Otto, diesel, dual, atkinson and brayton cycle. Comparison of otto, diesel and dual cycles, calculation of air standard efficiencies, mean effective pressure, brake thermal efficiencies, relative efficiencies of I.C. engine.
6. Combustion of fuels:
   Combustion of air, combustion equations, minimum air requirement, excess air and air fuel ratio, wet and dry analysis of products of combustion, conversion of volumetric analysis by mass, Determination of calorific value of fuel by Bomb calorimeter and Junkers gas calorimeter, Enthalpy of formation, Enthalpy of reaction, Adiabatic flame temperature.
7. Properties of gases and Mixtures:
   Avogadro's law, equation of state, ideal gas equation, Vander Waal's equation, reduced properties, law of corresponding states, compressibility chart.Gibbs-Dalton law, volumetric analysis of gas mixture, apparent molecular weight and gas constant, specific heat of a gas mixture, adiabatic mixing of perfect gases, gas and vapour mixtures.

D. **Lesson Planning**

Sr.No.	Date/Week	Unit No.	% Weightage	Topic No:
1	1^{st} ,2^{ed} ,3^{ed}	Unit 1	20 % .	1,2
2	4^{th} ,5^{th} ,6^{th}	Unit 2	20 %	3
3	7^{th} ,8^{th} ,9^{th}	Unit 3	20 %	4
4	19^{th} ,11^{th} ,12^{th}	Unit 4	20 %	5
5	13^{th} ,14^{th} ,15^{th}	Unit 5	20 %	6,7

E. **Instructional Method & Pedagogy**

8. At the start of course, the course delivery pattern , prerequisite of the subject will be discussed

9. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.

10. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.

11. One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.

12. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.

13. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

14. The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.

F. **Students Learning Outcomes**

- The student can identify different areas of ENGINEERING THERMODYNAMICS.
- Can find the applications of all the areas in day to day life.

G. **Recommended Study Materials**

- Reference Books:

1. Engineering Thermodynamics by P.K. Nag, Tata McGraw-Hill, New Delhi
2. Engineering Thermodynamics by R.K. Rajput, Laxmi Publications, New Delhi
3. Fundamentals of Engineering Thermodynamics by R.Yadav, Central Publishing House, Allahabad
4. Thermodynamics – An Engineering Approach by Yunus Centel & Boles, Tata Mc Graw-Hill, New Delhi
6. Thermodynamics by J.P. Holman, Tata Mc Graw-Hill.
7. An introduction to Thermodynamics by YVC Rao, New Age publishers, New Delhi.
8. Thermodynamics – Theory & Application by Robert Balmer, Jaico publication house.
9. Fundamentals of Thermodynamics by Sonntag, Borgnakke & Van wylen, John Wiley & sons (ASIA) PVT. LTD.