LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering(710)

Bachelor of Engineering (B.E.) – Semester – III

Course Code:	**017103301**
Course Name:	**Thermodynamics 1**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	Physics (017101192), Mathematics 1 (017101191)

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
3	**1**	**0**	**4**	**40**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Thermal Properties**			**4 (10%)**
	1.1 Basic terms (force, pressure, energy, work, power, internal energy, enthalpy, pure substance)	Work, energy, power (017101192-Unit-1.4)	Enthalpy, specific volume, internal energy and dryness fraction of steam (017103403– Unit-1.2)	
	1.2 Heat and work (heat, temperature, sensible heat, latent heat, specific heat, work transfer and its types)	Work, energy, power (017101192-Unit-1.4)	Cyclic heat engine, energy reservoir (017103403– Unit-4.2)	
	1.3 Process, path and cycle (Property, state, change of state, path, process, cycle, path and point functions)	---	First Law of Thermodynamics (017103403– Unit-2.1, 2.2, 2.3)	
02	**Basic Concepts of Thermodynamics**			**4 (10%)**
	2.1 Microscopic and macroscopic point of view	---	---	
	2.2 Thermodynamic systems and control volume	---	---	
	2.3 Homogeneous and heterogeneous systems	---	---	
	2.4 Thermodynamic equilibrium , Concept of continuum	---	---	
	2.5 Quasi-static process	Process, path and cycle (017103301-Unit-1.3)	---	
	2.6 Statements of zeroth and first law, Temperature scales	---	---	

03	**Derivation and Numerical of Gas Laws**			**2 (5.5%)**
	3.1 Boyle's law and Charles's law	---	---	
	3.2 Gay-Lussac's law and Gas constant	---	---	
	3.3 Combined gas law and relation between specific heats and gas constant	Boyle's law and Charles's law (017103301-Unit-3.1), Surds & Indices (017101191-Unit-1.2)	---	
04	**Various Non-flow Processes - Work Done, Internal Energy, Heat Transfer, Enthalpy and Relation between p, V and T and Numerical**			**6 (14%)**
	4.1 Constant volume process and constant pressure process	Gay-Lussac's law and Gas constant (017103301-Unit-3.2)	Carnot vapor cycle (017103403– Unit-7.1)	
	4.2 Isothermal process	---		
	4.3 Adiabatic process and Polytropic process	Expansions and factorization (017101191-Unit-1.3), Basic differentiation by formulae (017101191-Unit-3.1)	---	
	4.4 Index of Compression or Expansion	---	---	
05	**Properties of Gas Mixtures**			**4 (10.5 %)**
	5.1 Avogadro's law and equation of state with numerical	---	---	
	5.2 Vander Waal's equation with numerical and determination of constants a & b	---	---	
	5.3 Reduced properties and law of corresponding states	Vander Waal's equation (017103301-Unit-5.2)	---	
	5.4 Basic Understanding of Compressibility chart	---	---	
	5.5 Statement of Gibbs – Dalton Law	---	---	
06	**Internal Combustion Engines**			**3 (7.5%)**
	6.1 Classification of I.C. engine	---	---	
	6.2 Introduction of Engine Parts with their Functions	---	---	
	6.3 Construction and working of Two-stroke I.C. engine	Constant volume process and constant pressure process & Adiabatic process and Polytropic process (017103301-Unit-4.1, 4.3)	---	
07	**Thermodynamic Cycle for I C Engine**			**7 (17.5 %)**
	7.1 Assumptions of air standard cycles	Constant volume process and constant pressure process (017103301-Unit-4.1), Combined gas law (017103301-Unit-3.3)	---	
	7.2 Carnot gas power cycle	Isothermal process, Adiabatic process and Polytropic process	Second law efficiency (017103403– Unit-	

		(017103301-Unit-4.2, 4.3)	6.5)	
	7.3 Terminology of I.C. engine with numerical (Indicated Power, Brake Power, Friction Power, Mechanical Efficiency, Thermal Efficiency, Relative Efficiency)	Details of I.C. engine (017103301-Unit-6.2)	---	
	7.4 Construction and working of Four stroke I.C. engine	---	---	
	7.5 Air standard efficiency & Mean Effective Pressure of Otto cycle with numerical	Constant volume process and constant pressure process (017103301-Unit-4.1)	---	
	7.6 Air standard efficiency of Diesel cycle with numerical	Constant volume process and constant pressure process (017103301-Unit-4.1)	---	
08	**Mixed Cycle**			**4 (10%)**
	8.1 Air standard efficiency of Dual cycle with numerical	Air standard efficiency of Otto cycle, Diesel cycle (017103301-Unit-7.5, 7.6)	---	
	8.2 Comparison of Otto, Diesel and Dual cycles (For Same Compression Ratio & For Same Maximum Pressure and Temperature)	---	---	
	8.3 Comparison of SI and CI engines	---	---	
	8.4 Comparison of two and four stroke engines	Two-stroke I.C. engine (017103301-Unit-6.3), Four stroke I.C. engine (017103301-Unit-7.4)	---	
09	**Joule Cycle**			**2 (5%)**
	9.1 5 Air standard efficiency of Brayton cycle with numerical	Constant volume process and constant pressure process, Adiabatic process and Polytropic process (017103301-Unit-4.1, 4.3), Combined gas law (017103301-Unit-3.3)	---	
	9.2 Comparison of Brayton and Otto cycle	---	---	
10	**Combustion**			**4 (10%)**
	10.1 Combustion equations, stoichiometric air fuel ratio	---	---	
	10.2 Calculation of Minimum Air Requirement			
	10.3 Enthalpy of formation, adiabatic flame temperature	---	---	
	10.4 Construction and Working of Bomb calorimeter	Thermocouples and RTD (017101192-Unit-8.3), Pressure gauges and bourdon tube (017101192-Unit-7.3)	---	
	10.5 Construction and Working of Junker gas calorimeter	Basics of temperature measurement	---	

		(017101192-Unit-8.1), Pressure gauges and bourdon tube (017101192-Unit-7.3)		

Proposed Theory + Practical Evaluation Scheme by Academicians (% Weightage Category Wise and it's Marks Distribution)					
L :	**3**	**T:**	**1**	**P:**	**0**
Note : In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject. **Each Test will be of 25 Marks.** **Each Test Syllabus Weightage: Range should be 20% - 30%**					
Group (Theory or Practical)	**Group (Theory or Practical) Credit**	**Total Subject Credit**	**Category**	**% Weightage**	**Marks Weightage**
Theory	**4**	**4**	MCQ	57%	57
Theory			Theory Descriptive (Mainly Programming)	0%	0
Theory			Formulas and Derivation	10%	10
Theory			Numerical	33%	33
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	**0**		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**0**
Overall %	**100%**			**100%**	**100**

Course Outcome	
	Upon completion of the course students will be able to
1	Narrate the various sources of energy and basic terminology related with thermodynamics along with basic calculations related to gas law.
2	Recognize various thermodynamic processes & use various gas laws of real gas and their mixture.
3	Analyze various heat engine cycles and understand construction and working of IC engines.
4	Characterize combustion equation & learn calorimeter.
Suggested Reference Books	
1	Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2	Fundamentals of Thermodynamics by Borgnakke , Sonntag, 7th Ed. Wiley India (P) Ltd.
3	Thermodynamics – An Engineering Approach by Yunus Cengel , Boles, McGraw-Hill Education
4	Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd
5	Engineering Thermodynamics by Krieth, CRC Press

6	Engineering Thermodynamics by Jones and Dugan, PHI Learning Pvt. Ltd

List of Open Source Software/Learning website	
1	http://nptel.ac.in
2	www.coursera.org