Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Mechanical Engineering

BME 302 – THERMODYNAMICS

Third Semester, 2015-16 (ODd Semester)

Course (catalog) description

To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems.

Compulsory/Elective course :

Credit & contact hours : 4 & 60

Course Coordinator : S. Manavalan

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
V. Srinivasan	2A	JR101		srinivasan.mech@ bharath.univ.ac.in	
S. Manavalan	2B	JR102		manavalan.mech@bharath.univ.ac.in	
J. Manikandan	2C	JR103		manikandan.mech@bharathuniv.ac.in	
S. Nakkeran	2D & 2E	JR104 & SK001		makkeeran.mech@bharathuniv.ac.in	

Relationship to other courses:

Pre –requisites : Mathematics I & II

Assumed knowledge : To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems.

Following courses : Thermal Engineerng-I, Thermal Engineering-II, Refrigeration & Air Conditioning, Power Plant Engineering

Syllabus Contents

UNIT-I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 12

Concept of continuum, Thermodynamic systems-closed, open and control volume, Thermodynamic properties, path, point functions, process - Quasistatic processes, cycle, work, modes of work, heat, temperature, Zeroth law of thermodynamics, First law of Thermodynamics-applications to open and closed systems, internal energy, Specific heats Cp, Cv, enthalpy,steady and unsteady flow conditions.

UNIT-II SECOND LAW OF THERMODYNAMICS 12

Kelvin's and Clausius statements, Reversibility, Applications - Carnot cycle, Reversed Carnot cycle, heat engines,Refrigerators, heat pumps, Concept of Entropy, Clausius Inequality, Principle of increase of entropy, Carnot theorem, Entropy and irreversibility, Available energy, Availability,Gibbs and Helmholtz functions

UNIT III THERMODYNAMIC PROPERTIES OF PURE SUBSTANCES 12

Thermodynamic Properties Of Pure Substances in solid, liquid and vapour phases, P-V, P-T,T-V,T-S,H-S diagrams, PVT surfaces, steam table of thermodynamic properties, Calculations of properties, Work done and heat transferred in non flow and flow processes.

UNIT IV THERMODYNAMIC RELATIONS & GAS LAWS 12

Exact differential,Tds relations, Maxwell, Clausius-Clapeyron equation, Joule Thomson Co-efficient, Avagadro's Law, Vanderwaal's equation of state, mole concept, molar volume, equivalent weight, properties of mixture, Dalton's law of partial pressure, Amagat law, Enthalpy and specific heat, Molecular weight of gas mixture.

UNIT V COMBUSTION OF FUELS 12

Heating value of fuels, Combustion equations, Theoretical and excess air, Air-fuel ratio, Exhaust gas analysis, adiabatic flame temperature.

Total : 60

TEXT BOOKS:

1. P.K.Nag-Basic and Applied Thermodynamics-Tata McGraw Hill Publishing Company, 2002
2. R.K.Rajput-Engineering Thermodynamics-Laxmi Publications

REFERENCES:

1. S.C.Somasundaram-Thermal Engineering-New Age International (P) Ltd,1996
2. Y.V.C.Rao-An Introduction to Thermodynamics-New Age International (P) Ltd, 2004
3. Yunus A.Cengel-Thermodynamics-International Edition, 2006
4.bookboon.com/en/engineering-**thermodynamics-ebook**
Course

Computer usage:

Professional component

General	-	0%
Basic Sciences	-	25%
Engineering sciences & Technical arts	-	75%
Professional subject	-	0%

Broad area :

- The study of thermodynamics is so broad that it helps to divide in several different ways.
- Classical Thermodynamics takes a macroscopic approach to the behavior of matter. We measure properties such as temperature and pressure to help us predict other properties and to predict the behavior of matter as it undergoes a process.
- In contrast, Statistical Thermodynamics strives to predict the behavior of macroscopic masses of matter based on the properties of the individual molecules that make up the mass.
- The study of thermodynamics can also be divided into Pure Component and Solution Thermodynamics.
- Solution Thermodynamics is a bit more complicated than Pure Component Thermodynamics.
- Another major area of Thermodynamics is the study phase equilibrium. .
- Another important area of thermodynamics is the study of chemical reaction equilibrium.

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	24.08.2016	Session 1 to 14	2 Periods
2	Cycle Test-2	28.09.2016	Session 15 to 28	2 Periods
3	Model Test	26.10.2016	Session 1 to 45	3 Hrs
4	University Examination	15.11.2016	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behaviour of the simple physical systems.	Correlates to program outcome		
	H	**M**	**L**
Solve first law thermodynamics based types of problems.	A,b,c,f,i	K,l	H
Solve second law thermodynamics based types of problems.	F	K	H
Understand Thermodynamic properties of pure substances	F	K,l	H
understand Thermodynamic relations & gas laws	F	K	H
Extend the ideas in implementation of mini/major project	F	K	H
Understand combustion of fuels	F	K	H

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
Unit-I Basic Concepts And First Law of Thermodynamics			
1.	Concept of continuum	NO	[T1] – Chapter - 1,3,5 [T2] – Chapter - 2,4
2.	Thermodynamic systems-closed, open and control volume,	NO	
3.	Thermodynamic properties, path, point functions,	NO	
4.	Tutorial	YES	
5.	Process - Quasistatic processes,	NO	
6.	Cycle, work, modes of work, heat, temperature	NO	
7.	Zeroth law of thermodynamics, First law of Thermodynamics-	NO	
8.	Tutorial	YES	
9.	Applications to open and closed systems	NO	
10.	Internal energy, Specific heats	NO	
11.	Steady and unsteady flow conditions	YES	
12.	Tutorial	YES	
Unit-II Second Law of Thermodynamics			
13.	Kelvin's and Clausius statements	NO	[T1] – Chapter – 7,8 [T2] – Chapter – 5,6
14.	Reversiblityand irreversibility	NO	
15.	Carnot cycle, Reversed Carnot cycle, Carnot theorem	NO	
16.	Tutorial	YES	
17.	Heat engines, Refrigerators, Heat pumps	YES	
18.	Entropy , Concept of Entropy,	NO	
19.	Clausius Inequality	NO	
20.	Principle of increase of entropy	NO	
21.	Tutorial	YES	
22.	Available energy ,	YES	
23.	Availablity,Gibbs and Helmholtz functions	NO	
24.	Tutorial	YES	
Unit III Thermodynamic Properties of Pure Substances			
25.	Thermodynamic Properties Of Pure Substances	NO	[T1] – Chapter - 9 [T2] – Chapter - 3
26.	Solid, liquid and vapour phases	NO	
27.	P-V, P-T,T-V	NO	
28.	Tutorial	NO	
29.	T-S,H-S diagrams, PVT surfaces	NO	
30.	Steam table of thermodynamic properties	NO	
31.	Calculations of properties	YES	
32.	Tutorial	YES	
33.	Work done and heat transferred in non flow processes	NO	

34.	Work done and heat transferred in flow processes	NO	
35.	Tutorial	YES	
36.	Tutorial	YES	
Unit IV Thermodynamic Relations and Gas Laws			
37.	Exact differential,Tds relations	NO	[T1] – Chapter – 10,11 [T2] – Chapter – 7,8,9
38.	Maxwell	NO	
39.	Joule Thomson Co-efficient	NO	
40.	Tutorial	NO	
41.	Avagadro's Law, Vanderwaal's equation of state	NO	
42.	Mole concept, molar volume, equivalent weight	NO	
43.	properties of mixture	YES	
44.	Tutorial	YES	
45.	Dalton's law of partial pressure, Amagat law	NO	
46.	Enthalpy and specific heat	NO	
47.	Molecular weight of gas mixture	NO	
48.	Tutorial	YES	
Unit V Combustion of Fuels			
49.	Introduction	NO	[R1] – Chapter - 2 [R3] – Chapter - 9
50.	Heating value of fuels	NO	
51.	Combustion equations	YES	
52.	Tutorial	YES	
53.	Theoretical and excess air	YES	
54.	Air-fuel ratio	YES	
55.	Octane number and Cetane number	NO	
56.	Tutorial	YES	
57.	Exhaust gas analysis	YES	
58.	Adiabatic flame temperature.	YES	
59.	Bomb calorimeter, Orsat apparatus	NO	
60	Tutorial	YES	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment / Seminar / Online Test / Quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by : S. Manavalan

Addendum

ABET Outcomes expected of graduates of B.Tech / MECH / program by the time that they graduate:

a) The ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) The ability to identify, formulate and solve engineering problems.

c) The ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) The ability to design and conduct experiments, as well as to analyze and interpret data

e) The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) The ability to apply reasoning informed by the knowledge of contemporary issues.

g) The ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) The ability to understand professional and ethical responsibility and apply them in engineering practices.

i) The ability to function on multidisciplinary teams.

j) The ability to communicate effectively with the engineering community and with society at large.

k) The ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) The ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION:
Mechanical Engineering graduatesare enthusiastic to provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Mechanical Engineering.

PEO2: CORE COMPETENCE:
Mechanical Engineering graduates have competence to enhance the skills and experience in defining problems in the field of Mechanical Engineering and Technology design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:

Mechanical Engineering graduates made competence to enhance their skills and embrace new thrust areas through self-directed professional development and post-graduate training or education.

PEO4: PROFICIENCY:
Mechanical Engineering graduates became skilled to afford training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:
Mechanical Engineering graduates are morally merged to apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

BME302 - THERMODYNAMICS

Course Teacher	Signature
V. Srinivasan	
S. Manavalan	
J. Manikandan	
S. Nakkeeran	

Course Coordinator **HOD/MECH**
S. Manavalan