NSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**THERMAL ENGINEERING - I**			
Course Code	**A40313**			
Regulation	**R13**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4	1	-	4
Course Coordinator	S.V.Durga Prasad, Associate Professor,			
Team of Instructors	A.Anudeep kumar, Asst.Professor.			

I. COURSE OVERVIEW:

This course is intended to introduce basic principles of internal combustion engines, compressors and refrigeration are widely used in automobile, agriculture, industry for transport, water pumping, electricity generation, earth moving and to supply mechanical power to grinders, crushers etc. Compressors are used for supply of gases including air at higher pressure. Compressors are used to supply compressed air to all pneumatic equipments and for gases such as cooking gas, oxygen, nitrogen, neon, argon compressors are also used. Thus there is great relevance for this course for mechanical engineers.

II. PREREQUISITE(S):

Level	Credits	Periods / Week	Prerequisite(s)
UG	4	4	Thorough knowledge of Basic mathematics, Physics, and Thermodynamics.

III. MARKS DISTRIBUTION:

Sessional Marks : 25	University End Exam Marks : 75	Total Marks
Two mid-term exams are conducted. Each mid-term exam consists of one subjective test and one objective test. Subjective test contain 4 questions of 5 marks each. Student is required to answer 2 questions. Objective test contains 10 objective questions each carries ½ mark. 5 marks are for assignment. Average marks obtained in the above 2 mids is considered for 25 marks.	University exam consist of part A and part B, part A consists of 10 compulsory questions. First 5 questions carries 2 marks each, next 5 questions carries 3 marks each. Part B contains 5 questions carry 10 marks each. 1 question from each unit and consist of either or student is required to answer all 5 questions.	100

IV. EVALUATION SCHEME:

S. No.	Component	Duration (hours)	Marks
1	I Mid Examination	1 hour and 20 min	20
2	I Assignment lot		5

		TOTAL	25
3	II Mid Examination	1 hour and 20 min	20
4	II Assignment lot		5
		TOTAL	25
MID Examination marks to be considered as average of above 2 MID's TOTAL			
5	EXTERNAL Examination	3	75
		GRAND TOTAL	**100**

V. COURSE OBJECTIVES:

1. To introduce basic principles of operation of IC engines compressors and refrigeration systems.
2. To understand the procedures of testing and evaluating the performance of these machines.
3. To know the maintenance details and procedures.
4. Teach students to conduct experiments in laboratories and analyze the results with theoretical ones.

VI. COURSE OUTCOMES:

A. Understand main idea and importance behind the 2 - S and 4 - S IC engines.

B. To analyze the working of the basic components in the IC engines, Compressors and Refrigeration systems.

C. Understand the combustion process and also how it does affect the performance of the IC engines.

D. Apply the thermodynamic principles in the design of an IC engines, compressors and refrigeration system.

E. Formulate and perform the procedures required for the maintenance and operation of IC engines, compressors and refrigeration systems.

F. Compare different IC engines, compressors and refrigeration systems and develop a system which meets the requirements.

VII. HOW COURSE OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Capability to apply the knowledge of Mathematics, Science and Engineering in the field of Mechanical Engineering.	H	Assignments, mid-term, external exams
PO2	**Problem analysis**: An ability to analyze complex engineering problems to arrive at relevant conclusions using knowledge of Mathematics, Science and Engineering.	H	Assignments, mid-term, external exams
PO3	**Design/development of solutions**: Competence to design a system, com ponent or process to meet societal needs within realistic constraints.	H	Assignments, mid-term, external exams
PO4	**Conduct investigations of complex problems**: To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	H	Assignments, mid-term, external exams

PO5	**Modern tool usage**: An ability to formulate, solve complex engineering problems using modern engineering and Information Technology tools.	S	Assignments, mid-term, external exams
PO6	**The engineer and society**: To utilize the Engineering practices, Techniq ues, skills to meet needs of the health, safety, legal, cultural and societal issues.	H	Assignments, mid-term, external exams
PO7	**Environment and sustainability**: To understand impact of Engineering solutions in the societal context and demonstrate the knowledge for sustainable development.	S	Assignments, mid-term, external exams
PO8	**Ethics**: An understanding and Implementation of professional and Ethical responsibilities.	S	Assignments, mid-term, external exams
PO9	**Individual and teamwork**: To function as an effective individual and as a member or leader in Multi-disciplinary environment and adopt in diverse teams.	H	Assignments, mid-term, external exams
PO10	**Communication**: An ability to assimilate, comprehends, communicate, give and receive instructions to present effectively with engineering community and society.	S	Assignments, mid-term, external exams
PO11	**Project management and finance**: An ability to provide leadership in managing complex engineering projects at Multidisciplinary environm ent and to become a professional engineer.	S	Assignments, mid-term, external exams
PO12	**Life-long learning**: Recognition of the need and an ability to engage in life-long learning to keep abreast with technological changes.	H	Assignments, mid-term, external exams

N = None **S = Supportive** **H = Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** To produce engineering professional capable of synt hesizing and analyzing mechanical systems including allied engineering streams.	H	Assignments, mid-term, external exams
PSO2	**Design/Analysis:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	H	Assignments, mid-term, external exams
PSO3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become Technocrat.	S	Assignments ,mid-term, external exams

IX. SYLLABUS:

UNIT - I
I.C. ENGINES:
Four and Two stroke engine-SI &CI engines-valve and port timing diagrams-Fuel injection systems for SI engines-Fuel injection systems for CI engines-Ignition sysrems-Cooling and Lubrication system-Fuel properties and combustion – stoichiometry

UNIT - II

COMBUSTION IN S.I. ENGINES and CI ENGINES

Normal Combustion and abnormal combustion- Importance of flame speed and effect of engine variables, Type of Abnormal combustion, pre-ignition and knocking -Fuel requirements and fuel rating, anti knock additives, combustion chamber – requirements, types.

Combustion in C.I. Engines:

Four stages of combustion, Delay period and its importance, Effect of engine variables, Diesel Knock, Need for air movement, open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT - III

TESTING AND PERFORMANCE:

Parameters of performance, measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power, Determination of frictional losses and indicated power, Performance test, Heat balance sheet. And chart.

COMPRESSORS:

Classification, of compressors-fans, blower and compressor, positive displacement and dynamic types, reciprocating and rotary types.

UNIT –IV

ROTARY, DYNAMIC AND AXIAL FLOW (POSITIVE DISPLACEMENT)

Roots Blower, vane sealed compressor, mechanical details and principle of working efficiency considerations.

CENTRIFUGAL COMPRESSORS: mechanical details and principle of operation, velocity and Pressure variation, Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient, velocity diagrams, power.

AXIAL FLOW COMPRESSORS: Mechanical details and principle of operation, velocity triangles and energy transfer per stage degree of reaction, work done factor, isentropic efficiency, pressure rise calculations, polytropic efficiency.

UNIT-V

REFRIGERATION:

Mechanical Refrigeration and types-units of refrigeration-Air Refrigeration system, details and principle of operation-applications of air refrigeration, vapour compression refrigeration systems-calculation of cop-effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants-vapour absorption system-mechanical details-working principle-use of p-h chart.

TEXT BOOKS:

1. V. Ganesan (2011), I.C. Engines, 3rdedition, Tata McGraw-Hill, New Delhi, India.
2. B. John Heywood (2011), Internal combustion engine fundamentals, 2ndedition, Tata McGraw-Hill, New Delhi.
3. R. K. Rajput (2011), Thermal Engineering, 18thedition, Lakshmi Publications, New Delhi, India.

REFERENCE BOOKS:

1. Mathur, Sharma (2008), IC Engines,3rdedition, Dhanpat Rai & Sons, New Delhi, India.
2. Pulkrabek (2008), Engineering fundamentals of IC Engines, 2ndedition, Pearson Education, New Jersey.
3. Rudramoorthy (2003), Thermal Engineering, 5thedition, Tata McGraw-Hill, New Delhi, India
4. Refrigeration and air conditioning by CP Arora.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-2	**Define** Heat engine and **classify** IC engines	Brief discussion of Thermal Engineering syllabus **UNIT - I** I.C. ENGINES: Four and Two stroke engine	T1
3	**Discuss** working of SI &CI engines	SI &CI engines	T1
4-6	**Illustrate** crank angle valve and port diagrams	valve and port timing diagrams.	T1
7-8	**Explain** carburetor..fuel supply for SI engine	Fuel injection systems for SI engines	T1
9-10	**Explain** different Fuel injection systems for CI engines	Fuel injection systems for CI engines	T1
11	Discuss Ignition system	Ignition system	T1
12-13	**Explain** Cooling and Lubrication system	Cooling and Lubrication system	T1
14	**Illustrate** different fuels and its properties with their stochiometry.	Fuel properties and combustion – stoichiometry.	T1
15	Discuss phenomena of combustion process	UNIT-II COMBUSTION IN S.I. ENGINES and CI ENGINES	T1
16	**Emphasize** Normal and abnormal compbustion phenomena**.**	Normal Combustion and abnormal combustion	T1
17-18	**Discuss** Importance of flame speed and its effect on engine variables	Importance of flame speed and effect of engine variables,	T1
21-22	**Demonstrate** Knocking and its additives	requirements and fuel rating, anti knock additives,	T1
23-24	Illustrate different types of combustion chambers	combustion chamber – requirements, types..	T1
25-26	**Explain** Four stages of combustion in C.I. Engines.discuss delayperiod	Combustion in C.I. Engines: Four stages of combustion, Delay period and its importance,	T1
27	**Discuss** knocking and its effect on engine variables**.**	Effect of engine variables, Diesel Knock	T1
28	What is the need for air movement and discuss different combustion chambers..	Need for air movement , open and divided combustion chambers and nozzles used	T1
29	**What** are the fuel requirements	fuel requirements and fuel rating. .	T1
30	**Definition** of performance characterstics.	UNIT-III TESTING AND PERFORMANCE: Parameters of performance, measurement of cylinder pressure, fuel consumption, air intake,	T1
31-32	**Determination** of frictional power , efficiency ,brake power.	Exhaust gas composition, Brake power, Determination of frictional losses and indicated power, Performance test.	T1
33-34	**Discuss** sankey diagram for heat balance sheet.by means of losses.	, Heat balance sheet. And chart	T1
35-37	**Performance analysis of** IC engines..	Problems	T1

38	**Classify** compressors	COMPRESSORS: Classification, of compressors-fans, blower and compressor Positive displacement and dynamic types, reciprocating and rotary types.	T3
39-40	**Discuss** different types	fans, blower	
41-43	**Explain** the working of roots blower vane sealed compressor and its mechanisms	UNIT –IV ROTARY, DYNAMIC AND AXIAL FLOW (POSITIVE DISPLACEMENT) Roots Blower, vane sealed compressor, mechanical details and principle of working efficiency considerations.	T3
44	**Mechanism details** of centrifugal compressors	CENTRIFUGAL COMPRESSORS: mechanical details and principle of operation, velocity and Pressure variation, Energy transfer-impeller blade shape-losses,	T3
45	Define power input factor, pressure coefficient and adiabatic coefficient	Slip factor, power input factor, pressure coefficient and adiabatic coefficient	T3
46	**Draw** velocity diagrams and find power	Velocity diagrams, power.	T3
47-48	Discuss working principle of Axial floe compressor and find the efficiency.	AXIAL FLOW COMPRESSORS: Mechanical details and principle of operation, velocity triangles and energy transfer per stage degree of reaction	T3
49-50	Define work done factor, isentropic efficiency	work done factor, isentropic efficiency	T3
51-53	**Define** pressure rise calculations, polytropic efficiency	pressure rise calculations, polytropic efficiency	T3
54-56	Define refrigerating effect and its principle of opeataion.	UNIT-V REFRIGERATION: Mechanical Refrigeration and types-units of refrigeration Air Refrigeration system, details and principle of operation	R4
57-60	**Explain** Air refrigeration system	. units of refrigeration Air Refrigeration system, details and principle of operation applications of air refrigeration	R4
61-64	**Discuss** vapour compression system componets and calculate cop.	- vapour compression refrigeration systems calculation of cop desired properties of refrigerants and common refrigerants	R4
65-66	**Explain** vapour absorption system working	vapour absorption system-mechanical details-working principle	R4
67-68	Problems on p-h chart.	-use of p-h chart.	R4

XI. MAPPING COURSE OBJECTIVES LEADING TO ACHIEVEMENT OF THE PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	H	H			S	S									
II		H			S	S	S					S	S		
III			H	S										H	
IV	H	H	H	S	S	S	S			S				H	

XII. MAPPING COURSE OUTCOMES LEADING TO ACHIEVEMENT OF THE PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1		H	H	H		S							H		S
2	H	H	H	H	H		H		H	H		H		H	
3	H	H	H	H	S	S	S						H		S
4	H	H	H	H										S	
5	H	H	H	H						H					

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