GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

Thermodynamics and heat engine

(Code: 3336304)

Diploma Programme in which this course is offered	Semester in which offered
Agriculture Engineering	Third semester

1. RATIONALE.

The laws of Thermodynamics are used in almost every industry and also in everyday life. The consumer items like vehicle, refrigerators, compressors, heat exchangers etc are based on second law of thermodynamics and Carnot cycle.

Therefore, a diploma engineer in Agriculture is expected to understand the laws of conversion of heat energy into work or power, laws of thermodynamics and its applications in industries and day today life. The course is intended to develop the basic understanding of steam formation as well as the competency to understand I C Engine behavior and its properties with its concepts in the operation of automotive engines.

2. LIST OF COMPETENCIES.

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:

i. Apply basic concepts, laws and principles of thermodynamics to use and select equipments/devices/machines working on these basics.
ii. Determine steam properties and dryness fractions.
iii. Classify and explain boilers, boiler mountings and accessories.
iv. Heat engine , Performance of I.C.Engine.

3. TEACHING AND EXAMINATION SCHEME.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
03	00	02	05	70	30	20	30	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit,ESE - End Semester Examination; PA - Progressive Assessment.

4. DETAILED COURSE CONTENTS.

Unit	Major Learning Outcomes	Sub-topics
Unit –1 BASIC OF THERMODYNAMICS	1a.Explain common terms related to thermodynamic system.	1.1 Introduction. 1.2 Thermodynamic systems-concept, types, properties of system
	1b.Describe the properties of system, form of energy, work and heat.	1.3 Thermodynamics process, point function, path function, 1.4 Concept of temperature, pressure, volume, energy, heat, work and power- types properties & their units
Unit –2 **LAWS OF THERMODYNAMICS**	2a.Describe various laws of thermodynamic to different situation.	2.1 Zeroth Law of Thermodynamics 2.2 First Law of Thermodynamics, its limitations & Application to flow processes. (No numerical) 2.3 Energy equation & its application to: i. Non flow process. ii. Open system. iii. Steady flow (Steady flow energy equation –SFEE)
	2b.Second law of thermodynamics	2.4 Second la w of Thermodynamics 2.5 Kelvin Planck & Clausius statements, 2.6 Concept, importance of entropy. 2.7 Concept of reversibility
Unit – 3 IDEAL GASES AND THERMODYNAMIC PROCESSES	3a.Explain ideal gas laws and thermodynamic processes.	3.1 Ideal gas laws and equation 3.2 Specific heat of ideal gas
	3b. Draw thermodynamic processes on P-V & T-S diagram	3.3 Various thermodynamic processes like constant pressure, constant volume, constant temperature etc. 3.4 Equations for P-V& T-S relationship, work transfer, heat transfer internal energy (without derivations).

Unit	Major Learning Outcomes	Sub-topics
Unit –4 TWO PHASE SYSTEM	4a. Describe steam formation process and terminology	4.1 Concept of pure substance, its phase 4.2 Formation of steam, its critical point, triple point, definition and representation of wet steam, dry steam, saturated steam and superheated steam on PV, T-s and H-s diagram. 4.3 Concept, definition and determination of dryness fraction 4.4 Concept, definition and determination of latent heat, sensible heat, enthalpy, entropy and specific volume of steam
	4b. Use steam table and Mollier chart for determination of steam property.	4.5 Use of Steam tables and Mollier chart- (Heat Entropy Chart).
	4c. Determine dryness fraction of steam. 1d. Explain throttling process	4.6 Methods of measurement of steam quality, Calorimeters- Bucket, Separating, Throttling and Combined calorimeters. (No numerical Problems).
Unit– 5 STEAM GENERATION	5a.Explain the working of boilers, mountings and accessories.	6.1 Steam boiler-concept, definition as per Indian Boilers Regulation (IBR), functions, features and classification. 2.2 Working, merits and demerits of following low pressure steam boilers: . i. Cochran boiler. ii. Lancashire boiler. . iii. Babcock and Wilcox water tube boiler. vi. Locomotive boiler. 2.3 Boiler mountings and accessories- functions, working and location on boilers.
	5b.Working fluid of Thermal power plant and Rankine cycle	2.4 Desirable properties of working fluid used for power plants. 2.5 Rankine cycle. Expansive and non expansive working. 2.6Saturation curve and missing quantity, governing.

Unit	Major Learning Outcomes	Sub-topics
UNIT –6 HEAT ENGINES	6a.Describe operation of Thermodynamic cycles and their importance	6.1 Concept of Heat engine, type, classification 6.2 Different air standard cycles and their Importance- Carnot cycle, Otto cycle, Diesel cycle, Dual cycle.
	6b.Calculate work done and efficiency of different thermodynamic cycles for a given	6.3 Determine work done and efficiency of above cycles. 6.4Applications of different thermodynamic cycles (I C Engine)
	6c. Performance testing of IC engines	6.5 Performance testing of IC engines IP,BP , Efficiency calculation and its heat balance sheet, (Simple numerical examples) with familiarization with testing as per BIS.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY).

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Basic of Thermodynamics	4	4	2	0	6
2	Laws of Thermodynamics	6	2	6	2	10
3	Ideal Gases and Thermodynamic Processes	6	4	3	3	10
4	Two Phase System	8	2	4	4	10
5	Steam Generation	08	6	4	4	14
6	Heat Engines	10	8	6	6	20
	Total	42	26	25	19	70

Legends: R = Remember U= Understand; A= Apply and above levels (Bloom's revised taxonomy).

NOTES:

a: If mid sem test is part of continuous evaluation, unit numbers 1, 2 and 3 are to be considered.

b: Ask the questions from each topic as per marks weightage. Optional questions must be asked from the same topic. That is weightage of compulsory attendance part of questions will be equal to marks allotted to each topic.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL/EXPERIMENTS

The exercises/practical/experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency. Following is the list of exercises/practical/experiments for guidance.

Sr. No.	Unit Number	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1.	**I,II,& III**	**PREPARATORY ACTIVITY:** a. List and define thermodynamic properties. b. Tabulate thermodynamic SI units and their conversions. c. Explain thermodynamic processes and their examples. d. Given the data, determine properties of steam using steam table and Mollier chart.	**02**
2	**II**	Comparison of different temperature measuri methods	**02**
3.	**IV**	To measure dryness fraction of steam by use calorimeter (Separating, throttling combine)	**02**
4.	**V**	**DEMONSTRATION:** (Video/ Movie/Cut Sections /Models may be used in absence of Required Machine/ Equipment/ Device.): a. Low pressure boilers.	**02**
5	**V**	**DEMONSTRATION:** (Video/ Movie/Cut Sections /Models may be used in absence of Required Machine/ Equipment/ Device.): b. Boiler mountings and accessories.	**02**
6	**V**	**BOILER PERFORMANCE:** Boiler trial- determination of boiler efficiency, equivalent evaporation and Heat balance sheet. (Based on in-house performance or from the da collected during industrial visit.).	**04**
7.	**VI**	**DEMONSTRATION:** (Video/ Movie/Cut Sections /Models may be used in absence of Required Machine/ Equipment/ Device.): **Steam Engine**	**02**
8.	**VI**	**I C ENGINE PERFORMANCE** i) Demonstrate and explain working and function of I.C. Engine. ii) Demonstrate working of two stroke and four stroke engine.	**02**

9.	**VI**	**Valve timing diagram:** a. Write specifications of IC engine undertaken for valve timing diagram. b. Perform and record angles and strokes. c. Prepare valve timing diagram. 1. 2-stroke I.C.Engine 2. 4-stroke I.C.Engine	**02**
10	**VI**	**Perform test and prepare heat balance sheet of IC Engine.** a.Single Cylinder Diesel Engine	**02**
11	**VI**	**Perform test and prepare heat balance sheet of IC Engine.** **a. Single Cylinder Petrol Engine**	**02**
12.	**VI**	**To study about Morse test on multi cylinder petrol engine**	**02**
13		**MINI PROJECT AND PRESENTATION:** (In the group of 3-5students- to be assigned in the beginning of the term). **A.** Downloaded photos/ videos, PPTs. Make one CD/DVD for a batch of students. Also prepare a chart or model on given topic. Prepare the seminar. Topics related to syllabus are to be given by teacher. Advancement in the topics areas may also be given. **B**. Present the seminar at least for 10 minutes for A and B above. This must include photographs /	**02**
		TOTAL	**28**

Notes:

a. It is compulsory to prepare log book of exercises. It is also required to get each exercise recorded in logbook, checked and duly dated signed by teacher.PA component of practical marks is dependent on continuous and timely evaluation of exercises.

b. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.

c. Mini project and presentation topic/area has to be assigned to the group of specified students in the beginning of the term by batch teacher.

d. Student activities are compulsory and are part of term work.

e. Term work content of industrial visit report should also include following.

i. Brief details of industry/ site visited.

ii. Type, location, processes / products, rough layout, human resource, etc of industry.

iii. Details, description and broad specifications of machineries/ processes observed.

iv. Safety norms and precautions observed.

v. Student's own observation on industrial environment, productivity concepts, quality consciousness and quality standards, cost effectiveness, culture and attitude.

vi. Any other details / observations asked by accompanying faculty.

f. For practical ESE part, students are to be assessed for competencies achieved. They should be assigned the necessary data and should be given to:

7. SUGGESTED LEARNING RESOURCES.

A. List of Books:

Sr.No.	Title of Books	Author	Publication
1.	Thermodynamics	R. Yadav	CPH
2.	Applied Thermodynamics	R.C. Patel	Acharya Book Depot
3.	Heat Engines	P.L.Ballaney.	Khanna Publications
4.	Thermodynamics for Engineers	M.L. Mathur	Dhanpatrai & sons
5.	Thermal Engineering	RKRajput.	Laxmi
6.	A Text book of Thermal Engineering	R S Khurmi & J K Gupta.	S Chand & Co.

B. List of Major Equipment/ Instrument.

a: Boiler/ Working model of boiler.
b: Petrol engine test rig.
c: Diesel engine test rig.

C. List of Software/Learning Websites: ---

a. http://www.nptel.iitm.ac.in/video.php?subjectId=112105123(IIT-B Vidéo lectures)
b. http://www.thermofluids.net/
c. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv301-Page1.htm
d. http://www.grc.nasa.gov/WWW/k-12/airplane/thermo.html
e. http://www.youtube.com/watch?v=Xb05CaG7TsQ
f. http://www.youtube.com/watch?v=aAfBSJObd6Y
g. http://www.youtube.com/watch?v=DHUwFuHuCdw
h. http://www.youtube.com/watch?v=kJlmRT4E6R0
i. http://www.youtube.com/watch?v=GKqG6n6nAmg

8.STUDENT ACTIVITIES:

Sr. No.	Details of activity.
1	Student will visit the respective discipline industry and will prepare the list of Thermal engineering related equipments/machineries like Boiler, Steam Engine, I.C.Engine used by that industry / site.
2	Enlist I C Engine specifications at your institute.

3	Prepare Mollier charts and show different regions

9.COURSE CURRICULUM DEVELOPMENT