INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

QUESTION BANK

Course Title	**ENGINEERING THERMODYNAMCS**				
Course Code	AMED07				
Program	B.Tech				
Semester	III	ME			
Course Type	CORE				
Regulation	IARE-BT23				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	0	0
Course Coordinator	Dr.G Hima Bindu, Assistant Professor				

COURSE OBJECTIVES:

The students will try to learn:

I	The fundamental knowledge on concepts of physics and chemistry for obtaining the axiomatic principles using thermodynamic co-ordinates.
II	The thermodynamic disorderness in the real time physical systems like external/internal heat engines, heat pumps to get the measure of performance characteristics.
III	The performance characteristics of open and closed systems of thermodynamic cycles for effective delineation of real time applications.
IV	The thermodynamiccycles such as power and refrigerant cycles to yield alternative solutions to conserve the environment.

COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** the basic concepts of thermodynamic properties and working principles of energy conversions in physical systems by laws of thermodynamics.	Remember
CO 2	**Summarize** the equivalence of two statements of second law of thermodynamics and the entropy concepts for typical engineering problems.	Understand

CO 3	**Explain** the properties of pure substances and steam to emit relevant inlet and exit conditions of thermodynamic work bearing systems.	Understand
CO 4	**Apply** the significance of partial pressure and temperature to table the performance parameters of ideal gas mixtures.	Apply
CO 5	**Identify** the properties of air conditioning systems by practicing psychrometry chart and property tables.	Apply
CO 6	**Illustrate** the working of various air standard cycles and work out to get the performance characteristics.	Understand

QUESTION BANK:

MODULE I				
BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS				
PART-A PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
Q.No	**QUESTION**	**Taxonomy**	**How does this subsume the level**	**CO's**
1	When a stationary mass of gas was compressed without friction at constant pressure, its initial state of $0.4m^3$ and 0.105MPa was found to change to final state of $0.20m^3$ and 0.105MPa. There was a transfer of 42.5kJ of heat from the gas during the process. What is the change in internal energy of the gas?	Understand	The learner to remember the various energy transfer mechanisms which leads to the understanding properties that are involving thermodynamic cycles and identifying the laws of conservation of energy to yield the relationship between heat, work and change in internal energy	CO 1
2	A mass of gas is compressed in a quasi-static process from 80 kPa, 0.1 m^3 to 0.4 MPa, 0.03 m^3. Assuming that the pressure and volume are related by $pv^n =$ constant, find the work done by the gas system.	Understand	The learner to remember the properties and understand work by explaining the various energy transfer mechanisms which leads to the obtaining properties involving thermodynamic cycles.	CO 1

3	If a gas of volume 6000 cm^3 and at pressure of 100 kPa is compressed quasi statically according to PV^2= constantun til the volume becomes 2000 cm^3, Determine the final pressure and the work transfer.	Apply	The learner to remember the properties and understand work by explaining the various energy transfer mechanisms which leads to the obtaining properties involving thermodynamic cycles.	CO 1
4	A gas of mass 1.5 kg undergoes a quasi-static expansion which follows a relationship p = a + bV, where a and b are constants. The initial and final pressures are 1000 kPa and 200 kPa respectively and the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by the relation u=1.5pV–85 kJ/kg. Where p is in the kPa and v is in m3/kg. Find the net heat transfer and the maximum internal energy of the gas attained during expansion.	Apply	The learner to remember the various energy transfer mechanisms which leads to the understanding properties that are involving thermodynamic cycles and identifying the laws of conservation of energy to yield the relationship between heat, work and change in internal energy.	CO 1
5	A system composed of 2 kg of the above fluid expands in a frictionless piston and cylinder machine from an initial state of 1 MPa, 100°C to a final temperature of 30°C. If there is no heat transfer, find the net work for the process.	Apply	The learner to remember the first law of thermodynamics.	CO 1

6	A mixture of gases expands at constant pressure from 1 MPa, 0.03 m^3 to 0.06 m^3 with 84 kJ positive heat transfer. There is no work other than that done on a piston. Find dE for the gaseous mixture. The same mixture expands through the same state path while a stirring device does 21 kJ of work on the system. Find dE, W, and Q for the process.	Remember	The learner to remember the first law of thermodynamics.	CO 1
7	A mass of 8 kg gas expands within a flexible container so that the p-v relationship is of the from p$v^{1.2}$= constant. The initial pressure is 1000 kPa and the initial volume is 1 m^3 . The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40 kJ/kg, find the heat transfer in magnitude and direction.	Understand	The learner to remember the first law of thermodynamics.	CO 1

8	A nozzle is a device for increasing the velocity of a steadily flowing stream. At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. Find (a) the velocity at exists from the nozzle, (b) the mass flow rate, if the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, (c) the exit area of the nozzle, if the specific volume at the nozzle exit is 0.498 m^3/kg.	Understand	The learner to remember the various energy transfer mechanisms which leads to the obtaining properties involves thermodynamic cycles to determine the network output.	CO 1
9	A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?	Understand	The learner to remember the various energy transfer mechanisms which lead to obtaining properties involves thermodynamic cycles to determine the network output.	CO 1

10	Air flows steadily at the rate of 0.5kg/sec through an air compressor, entering at 7m/sec velocity, 100kPa pressure and 0.95m^3/kg volume and leaving at 5m/sec, 700kpa and 0.19m^3/kg. The internal energy of air leaving is 90kJ/kg greater than that of air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58kW. Find the rate of shaft work input to the air in KW. Find the ratio of the inlet pipe diameter to outlet pipe daimeter.	Understand	The learner to remember the various energy transfer mechanisms which leads to the obtaining properties involves thermodynamic cycles to determine the network output	CO 1
PART B-LONG ANSWER QUESTIONS				
1	Differentiate the system, surroundings and boundary Explain in detail.	Understand	The learner to remember the basic concepts of thermodynamics with definitions.	CO 1
2	Compare the types of systems with examples.	Understand	The learner to remember the different types of systems by recalling basic concepts of thermodynamics.	CO 1
3	Compare the macroscopic and microscopic study of thermo dynamics?	Understand	The learner to remember the different types of methods of thermodynamics study.	CO 1
4	What is concept of continuum? How will you define density and pressure using this concept?	Remember	—-	CO 1
5	Explain thermodynamic equilibrium in detail?	Understand	The learner to remember the basic concepts of thermodynamics which explains the equilibrium nature of systems.	CO 1

6	Compare thermal equilibrium and thermodynamic equilibrium, explain.	Understand	The learner to remember the basic concepts of thermodynamics which explains the thermal equilibrium nature of systems	CO 1
7	Define path function and Show that work and heat are path functions?	Understand	The learner to remember thethermodynamic properties and discern the path and point functions through exact differentials.	CO 1
8	Show the Isobaric process from thermodynamic point of view and derive its work done under p-V coordinates.	Remember	—-	CO 1
9	Show the Isochoric process from thermodynamic point of view and derive its work done under p-V coordinates.	Remember	—	CO 1
10	Show the Isothermal process from thermodynamic point of view and derive its work done under p-V coordinates.	Remember	—-	CO 1
11	Show the adiabatic process from thermodynamic point of view and derive its work done under p-V coordinates.	Remember	—-	CO 1
12	Show the polytrophic process from thermodynamic point of view and derive its work done under p-V coordinates.	Remember	—-	CO 1
13	Develop an expression for piston displacement work with neat diagram?	Apply	The learner to remember the piston displacement work by explainingthe various energy transfer mechanisms which leads toobtaining the properties involving thermodynamic cycles.	CO 1
14	Write and explain the first law of thermodynamics undergoing a change of state.	Remember	—-	CO 1

15	Define steady flow process and Derive the Steady flow energy equation?	Remember	—-	CO 1
16	Write steady flow energy equation for turbine and obtain the work done in a device.	Remember	—-	CO 1
17	Develop expression for exit velocity of nozzle by considering steady flow energy equation.	Apply	The learner to remember the basic laws and understand the steady flow process to derive the general expression for steady flow devices by identifyingthe laws of conservation of energy	CO 1
18	Define path function and Show that work and heat are path functions?	Remember	—-	CO 1
19	Explain the first law of thermodynamics applied to closed system when system undergoing a change of state?	Understand	The learner to remember the basic concepts of thermodynamics by summarize working principles of energy conversions in physical systems by fundamental laws of thermodynamics.	CO 1
20	Write the characteristics of quasistatic process and explain the process with a neat diagram.	Remember	—-	CO 1
PART C-SHORT ANSWER QUESTIONS				
1	Write Zeroth law of Thermodynamics.	Remember	—-	CO 1
2	Define System, Surroundings and Boundary.	Remember	—-	CO1
3	What is the need of international practical temperature scale?	Remember	—-	CO 1
4	What are adiabatic and diathermic wall boundaries?	Remember	—-	CO 1

5	Define the terms-Thermodynamic process, cycle, Reversible process.	Remember	——	CO 1
6	Explain the features of constant volume gas thermometer.	Understand	The learner to remember concept of thermometer to explain the features of thermometers.	CO 1
7	Summarize First law of thermodynamics applied to a cyclic process.	Understand	The learner to remember the law of conservation energy which describes the first law of thermodynamics.	CO1
8	Define PMM 1 why it is not possible.	Remember	—-	CO1
9	List the causes of irreversibility?	Remember	——	CO 1
10	Write Steady Flow Energy Equation, when the device is an air compressor.	Remember	——	CO 1
11	When work is said to be done by system and what are positive and negative work interactions.	Remember	———.	CO 1
12	Summarize the closed system features? Give an example.	Understand	The learner to understand the closed system with practical examples by Recalling basic concepts of thermodynamics.	CO 1
13	Define Intensive and Extensive properties.	Remember	—-	CO 1
14	When do you say that the system is in thermodynamically equilibrium in nature?	Remember	—	CO 1
15	Define specific Intensive and Extensive properties.	Remember	—-	CO 1
16	Differentiate closed and open system.	Remember	—-	CO 1
17	Define Specific heat capacity at constant volume	Remember	—-	CO 1
18	Define Specific heat capacity at constant pressure.	Remember	—-	CO 1

19	Give an example of closed and open system.	Understand	The learner to remember the definition of the closed system and open systems with practical examples by Recalling basic concepts of thermodynamics	CO 1
20	Why does free expansion have zero work transfer	Remember	——	CO 1
	MODULE II			
	SECOND LAW OF THERMODYNAMICS			
	PART-A PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS			
1	Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K. If both engines develop equal power determine the intermediate temperature.	Remember	—-	CO 2
2	A reversible heat engine is supplied with heat from two constant temperature sources at 900K and 600 K and rejects heat to a constant temperature at 300K to sink. The engine develops work equivalent to 91kJ/s and rejects heat at the rate of 56kJ/sec. Calculate (i) heat supplied by each source (ii) Thermal efficiency of engine.	Understand	The learner to remember the statements of second law of thermodynamics to calculate efficiency of heat engines	CO 2
3	A house requires 2×10^{5} kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside in winter and send heat to the house. Work required to operate the heat pump is 3×10^4 kJ/h. Determine: (i) Heat abstracted from outside ; (ii) Co-efficient of performance.	Remember	The learner to remember the working principle of heat pump.	CO 2

4	A domestic food freezer maintains a temperature of -15°C , the ambient air temperature is 30°C , if heat leaks into the freezer at thecontinuous rate of 1.75kJ/sec. What is the least power necessary to pump this heat out continuous?	Understand	The learner to remember the statements of second law of thermodynamics to calculate efficiency of heat engines.	CO 2
5	300 kJ/s of heat is supplied at a constant fixed temperature of 290°C to a heat engine. The heat rejection takes place at 8.5°C. The following results were obtained: (i) 215 kJ/s are rejected, (ii) 150 kJ/s are rejected and (iii) 75 kJ/s are rejected. Classify which of the result report a reversible cycle or irreversible cycle or impossible results.	Understand	The learner to remember the statement of clausius inequality.	CO 2
6	A heat pump working on a reversed carnot cycle takes in energy from a reservoir maintained at 5°C and delivers it to another reservoir where temperature is 77°C. The heat pump derives power for its operation from a reversible engine operating within the higher and lower temperatures of 1077°C and 77°C. For 100 kJ/kg of energy supplied to reservoir at 77°C, estimate the energy taken from the reservoir at 1077°C.	Understand	The learner to remember the statements of second law of thermodynamics to calculate efficiency and heat transfer rates of heat engines.	CO 2

7	Two kg of water at 80°C are mixed adiabatically with three kg of water at 30°C in a constant pressure process of 1 atmosphere. Find the increase in the entropy of the total mass of water due to the mixing process (specific heat of water = 4.187 kJ/kg K).	Understand	The learner to remember the entropy concept.	CO 2
8	An ideal gas is heated from temperature T1 to T2 by keeping its volume constant. The gas is expanded back to its initial temperature according to the law pv^n = constant. If the entropy change in the two processes are equal, find the value of 'n' in terms of the adiabatic index y.	Understand	The learner to remember the entropy concept.	CO 2
9	A block of iron weighing 100 kg and having a temperature of 100°C is immersed in 50 kg of water at a temperature of 20°C. What will be the change of entropy of the combined system of iron and water? Specific heats of iron and water are 0.45 and 4.18 kJ/kg K respectively.	Understand	The learner to remember the entropy concept.	CO 2
10	Using the first Maxwell equation, explain the remaining three equations.	Understand	The learner to remember the thermodynamics relations.	CO 2
PART B-LONG ANSWER QUESTIONS				
1	Explain the limitations of First law of thermodynamics in detail?	Understand	The learner to remember the first law by explaining the relation between heat and work.	CO 2
2	Define the terms thermal reservoir, source, and sink with a neat sketch?	Remember	——	CO 2

3	Explain the heat engine with a neat sketch?	Understand	The learner to remember relation between parameters of thermal device by explaining the laws of thermodynamics.	CO 2
4	Explain the heat pump with a neat sketch?	Understand	The learner to define the performance parameters of thermal device by Contrasting between various statements of laws of thermodynamics.	CO 2
5	List the performance parameters of a system and explain in detail.	Remember	—-	CO 2
6	Compare the first law and second law of thermodynamics by considering example.	Understand	The learner to remember the basic laws for comparison of fundamental laws of thermodynamics.	CO 2
7	Explain the statements of second law of thermodynamics with suitable ketches?	Understand	The learner to remember the basic working of thermal devices.	CO 2
8	Give Kelvin-Plank statement and explain with an example?	Understand	The learner to remember the basic working of thermal devices by stating various statements of thermodynamics.	CO 2
9	Give Claussius statement and explain with refrigerator as an example?	Understand	The learner to remember the basics of first law of thermodynamics to explain second law applicable to refrigerators.	CO 2
10	Illustrate the equivalence between Kelvin-Planck and Claussius statements withsketches?	Understand	The learner to remember the basic working of thermal devices by stating equivalence between statements of thermodynamics laws.	CO 2

11	State PMM1 and PMM2, in which manner both are different?	Understand	The learner to remember the working of devices by checking impossibility of machines in heat to work conversion and notice that thermodynamic direction laws defining them are mutually complementary.	CO 2
12	Compare the relation with process and cycle? Explain.	Remember	—-	CO 2
13	Explain Carnot's principle? What is the importance of theprinciple, explain?	Understand	The learner to remember the basic processes of Carnot to explain the principle of Carnot heat engine.	CO 2
14	Explain the statements of second law of thermodynamics with suitable ketches?	Understand	The learner to remember the basic working of thermal devices.	CO 2
15	Give Kelvin-Plank statement and explain with an example?	Understand	The learner to remember the basic working of thermal devices by stating various statements of thermodynamics.	CO 2
16	Explain the Claussius inequality? Explain.	Understand	The learner to remember Carnot cycle processes to explain the nature of cycle stating claussius inequality.	CO 2
17	Explain the influence of entropy on various parameters?	Understand	The learner to remember the second law of thermodynamics to explain disorderness of universe.	CO 2
18	Explain Gibbs and Helmholtz functions.	Remember	—-	CO 2
19	What is irreversibility and explain.	Remember	—-	CO 2
20	Explain the Availability and derive an expression for it in a thermodynamic system for non-flow process.	Understand	Learner to recall the method of finding line integral in real analysis and understand the variable value along the line and apply integral concepts.	CO 2

PART C-SHORT ANSWER QUESTIONS				
1	Outlinethe limitations of first law of thermodynamics?	Understand	The learner to remember the first law by Identifyingthe laws of conservation of energy to yield the relationship between heat and work.	CO2
2	Summarizesecond law of thermodynamics?	Understand	The learner to remember the working principles of energy conversions in physical systems to describe fundamental 2 ndlaws of heat engines.	CO2
3	Whatis PMM 2? Why is it impossible?	Understand	The learner to remember the laws of thermodynamics to explain the possibility of machines.	CO 2
4	Namethe processes of Carnot Cycle?	Remember	—	CO 2
5	State the Clausius inequality?	Remember	—-	CO2
6	Define COP of refrigerator.	Remember	—.	CO2
7	What is heat pump and how it differs from refrigerator in terms of COP?	Remember	—-	CO2
8	What is absolute thermodynamics temperature scale?	Remember	—-	CO 2
9	WriteMaxwell's 1 and 2 relations?	Remember	—-	CO 2
10	State the third law of Thermodynamics?	Understand	The learner to remember the working principles of energy conversions in physical systems by fundamental laws of thermodynamics to explain third law.	CO 2
11	Define available energy of a system?	Remember	—-	CO 2
12	Write Maxwell's third and fourth relations?	Remember	—-	CO 2

13	Explain dead state of a system?	Understand	The learner to remember the state of a system by recalling the thermodynamic laws to explain about dead state of system.	CO 2
14	Define the unavailable energy in a system?	Remember	——	CO 2
15	Explain the principle of entropy increase?	Understand	The learner to remember the second law of thermodynamics and explain the concept of disorderness of a substance.	CO 2
16	Explain the exergy of a system?	Remember	—-	CO 2
17	Explain the Claussius statement?	Remember	—-	CO 2
18	Write the Kelvin-Plank statement?	Remember	—-	CO 2
19	Illustrate Carnot cycle with PV and TS diagrams.	Understand	The learner to remember basic processes of Carnot cycle to illustrate on thermodynamic coordinates.	CO 2
20	Classify the processes which constitute the ideal Carnot cycle.	Understand	The learner to understand the basic processes involved in standard cycle by involving heat to work conversion.	CO 2
MODULE III				
PROPERTIES OF PURE SUBSTANCES				
PART-A PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	A vessel having a volume of 0.6 m^3 contains 3.0 kg of liquid water and water vapour mixture in equilibrium at a pressure of 0.5 MPa. Calculate: (i) Mass and volume of liquid, (ii) Mass and volume of vapour.	Understand	The learner to remember the properties of thermodynamic systems to determine the properties of gases from steam tables and Mollier charts	CO 3

2	A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the following: (i) The pressure, (ii) The mass, (iii) The specific volume, (iv) The specific enthalpy, (v) The specific entropy, and (vi) The specific internal energy.	Understand	The learner to remember the properties of thermodynamic systems to determine the properties of gases from steam tables and Mollier charts.	CO 3
3	Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a steam tubine to 40°C. Determine the ideal work output of the turbine per leg of steam.	Understand	The learner to remember the properties of thermodynamic systems to determine the properties of gases from steam tables.	CO 3
4	A mass of 200 g of saturated liquid water is completely vaporized at a constant pressure of 100 kPa. Determine (a) the volume change and (b) the amount of energy transferred to the water.	Understand	The learner to remember the properties of thermodynamic systems to determine the properties of gases from steam tables.	CO 3
5	Steam enters an engine at a pressure 10 bar absolute and 400°C. It is exhausted at 0.2 bar. The steam at exhaust is 0.9 dry. Find: (i) Drop in enthalpy and (ii) Change in entropy.	Understand	The learner to remember the properties of thermodynamic systems to determine the properties of gases from steam tables.	CO 3
6	Steam initially at 0.3 MPa, 250°C is cooled at constant volume. (a) At what temperature will the steam become saturated vapour? (b) What is the quality at 80°C? What is the heat transferred per kg of steam in cooling from 250°C to 80°C?	Understand	he learner to remember the properties of thermodynamic systems to determine the properties of gases from steam tables.	CO 3

7	The volume of a high altitude chamber is 40 m^3. It is put into operation by reducing pressure from 1 bar to 0.4 bar and temperature from 25°C to 5°C. How many kg of air must be removed from the chamber during the process ? Express this mass as a volume measured at 1 bar and 25°C. Take R = 287 J/kg K for air.	Understand	The learner to remember the basic gas law and describe the fundamental relationship between intensive properties for perfect gases to determine the final temperature and heat transfer.	CO 4
8	0.5 kg of air is compressed reversibly and adiabatically from 80 kPa, 60°C to 0.4 MPa, and is then expanded at constant pressure to the original volume. Sketch these processes on the p-v and T-s planes. Compute the heat transfer and work transfer for the whole path.	Understand	The learner to remember the basic gas law and describe the fundamental relationship between intensive properties for perfect gases to determine the internal energy, work done and heat transfer.	CO 4
9	Solve that for an ideal gas the slope of the constant volume line on the T-S diagram is more than that of the constant pressure line.	Understand	The learner to remember the basic gas law and describe the fundamental relationship between intensive properties for perfect gases to determine the internal energy, work done and heat transfer.	CO 4
10	One kg of CO_2 has a volume of 1 m^3 at 100°C. Compute the pressure by (i) Van der Waals' equation (ii) Perfect gas equation. The values of a and b for CO_2 are 362850 Nm^4/(kg-mol)^2 and 0.0423 m^3/kg-mol respectively.	Understand	The learner to remember the basic gas law and describe the fundamental relationship between intensive properties for perfect gases to determine the internal energy, work done and heat transfer.	CO 4
PART-B LONG ANSWER QUESTIONS				
1	Explain the procedure adopted in Steam calorimetry?	Understand	The learner to remember dryness fraction and explain the different methods of its measurement.	CO 3

2	Why can not a throttling calorimeter measure the quality, if the Steam is wet? Explain how is the quality been measured?	Understand	The learner to remember dryness fraction and explain the different methods of its measurement.	CO 3
3	Explain the saturation temperature, the changes in specific Volume, enthalpy and entropy during evaporation at 1MPa.	Understand	The learner to remember properties of steam and determine the property values of thermodynamic systems from Mollier charts.	CO 3
4	Compare the enthalpy, entropy and volume of steam at 1.4MPa, 38°C.	Understand	The learner to remember properties of steam and determine the property values of thermodynamic systems from Mollier charts.	CO 3
5	A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 25°C. The mass of the liquid present is 9kg.Find the pressure, mass, specific volume, enthalpy, entropy and internal energy?	Apply	The learner to remember the basic properties and interpreting concepts of relevant inlet and exit conditions of thermodynamic systems from steamtables and Mollier charts to apply in thermal systems.	CO 3
6	Find the enthalpy and entropy of steam when the pressure is 2 MPa and the specific volume is 0.09 m^3/kg.	Understand	The learner to remember the basic properties and determine work output of thermodynamic systems from steam tables.	CO 3
7	Steam flows in a pipe line at 1.5 MPa. After expanding to 0.1 MPa in a throttling calorimeter, the temperature is found to be 120°C. Determine the quality of the steam in pipe line?	Understand	The learner to remember the basic properties and determine work output of thermodynamic systems from steam tables and Mollier charts.	CO 3

8	The following data were obtained with a separating and throttling calorimeter. Pressure in pipe line is 1.5 MPa. Condition after throttling is at 0.1 MPa, 110°C, During 5 minutes moisture collected in the separator is 0.15 litre at 70°C. Steam condenses after throttling during 5 min is 3.24 kg. Determine the quality of steam in the pipe line.	Understand	The learner to remember the basic properties and determine work output of thermodynamic systems from steam tables and Mollier charts.	CO 3
9	Determine the enthalpy and entropy of steam and the pressure is 4 MPa and the specific volume is 0.02 m^3/kg.	Understand	The learner to remember the basic properties and determine work output of thermodynamic systems from steam tables and Mollier charts.	CO 3
10	Saturated steam has entropy of 3.56 kJ/kg K. Determine the saturated pressure, temperature, specific volume, enthalpy.	Understand	The learner to remember the basic properties and determine work output of thermodynamic systems from steam tables and Mollier charts.	CO 3
11	Name the properties describes the equation of state.	Remember	—-	CO 4
12	Explain the equation of state with variations?	Understand	The learner to remember the state equation to describe the fundamental relationship between intensive properties in form of partial derivatives implemented for perfect gases.	CO 4
13	Explain, how the heat and work transfer observed in perfect gas?	Understand	The learner to remember the perfect gas equation and describe fundamental relationship between intensive properties to determine work and heat transfer.	CO 4

14	Explain the change in internal energy in perfect gas?	Understand	The learner to remember the perfect gas equation and describe fundamental relationship between intensive properties to determine internal energy of a gas.	CO 4
15	State Vander Waals equation, what is the importance of it?	Remember	—-	CO 4
16	What is compressibility chart, explain the procedure of usage?	Remember	——	CO 4
17	Explain about law of corresponding states.	Understand	The learner to remember the perfect gas equation and describe fundamental relationship between intensive properties to explain the law of corresponding states.	CO 4
18	What are the assumptions for deriving ideal gas equation?	Understand	The learner to recall the basic gas laws to explain the ideal gas equation.	CO 4
19	Summarize the Clausius Claperon equation?	Understand	The learner to remember the steam relations to explain basic equation that describesthe fundamental relationship between them.	CO 4
20	Find the constants of Vander wall's equation.	Understand	The learner to remember real gas equation to determine the property constants of real gas equation.	CO 4
PART C-SHORT ANSWER QUESTIONS				
1	Define Pure Substance and what do you understand by a saturationstage?	Remember	—-	CO 3
2	Show the phase diagram on p-v diagrams with water as puresubstance?	Remember	—-	CO 3

3	Explain the concept of p-v-T surface? Represent on p-Tcoordinates?	Understand	The learner to remember the basic properties and Interpret the properties of pure substances by illustrating on thermodynamic coordinates.	CO 3
4	Explain the critical state of water?	Remember	——	CO 3
5	Show the phase equilibrium diagram for a pure substance on T-splot with relevant constant property line?	Remember	—–	CO 3
6	Show the phase equilibrium diagram for a pure substance on h-s plot with relevant constant property line?	Understand	The learner to remember the basic properties and Interpret the properties of pure substances by illustrating on thermodynamic coordinates.	CO 3
7	Why isobar lines on Mollier diagram diverse from one another?	Remember	—-	CO 3
8	Explain Mollier chart by representing all the properties on it?	Remember	—-	CO 3
9	Explain the degree of superheat and degree of sub cooling?	Understand	The learner to understand the basic properties and Interpret the properties of pure substances and steam with help of mollier chart.	CO 3
10	Define dryness fraction? What are the different methods ofmeasurement of dryness fraction?	Remember	—-	CO 3
11	Explain the equation of state?	Understand	The learner to remember the state equation by recalling the properties to describe fundamental relationship between intensive properties for perfect gases.	CO 4

12	Deduce the changes in internal energy during a process withvariable specificheats.	Remember	—-	CO 4
13	Derive the changes in enthalpy during a process with variable specific heats.	Remember	—-	CO 4
14	Explain the process of free expansion?	Understand	The learner to remember the state equation by recalling the properties to describe fundamental relationship between intensive properties for perfect gases.	CO 4
15	Explain the process of Throttling?	Remember	—-	CO 4
16	Write the expression for Vander Wall's equation and determine theconstants?	Remember	—-	CO 4
17	Explain On what coordinates compressibility charts can be drawn?	Understand	The learner to remember the ideal gas equation and to explain the compressibility chary on coordinates.	CO 4
18	List the molar specific heats, explain?	Remember	—	CO 4
19	Derive the expression for work done in a non-flow process, if the process is adiabatic.	Understand	The learner to remember the ideal gas equation and understand the possibility of process and apply piston displacement work to analyze the work in different processes in nature.	CO 4
20	Outline briefly the reduced properties?	Understand	The learner to remember the basic properties and describe the relation with critical parameters.	CO 4

MODULE IV				
MIXTURE OF PERFECT GASES				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	A vessel of 0.35 m^3 capacity contains 0.4 kg of carbon monoxide (molecular weight = 28) and 1 kg of air at 20°C. Calculate: (i) The partial pressure of each constituent, (ii) The total pressure in the vessel, and the gravimetric analysis of air is to be taken as 23.3% oxygen (molecular weight = 32) and 76.7% nitrogen (molecular weight = 28).	Understand	The learner to remember the performance parameters of gaseous mixtures.	CO 5
2	A vessel contains at 1 bar and 20°C a mixture of 1 mole of CO_2 and 4 moles of air. Determine for the mixture: (i) The masses of CO_2, O_2 and N_2, and the total mass, (ii) The apparent molecular weight and the gas constant for the mixture, and (iii) The specific volume of the mixture. The volumetric analysis of air can be taken as 21% oxygen and 79% nitrogen.	Understand	The learner to remember the performance parameters of gaseous mixtures.	CO 5
3	A mixture of ideal gases consists of 4 kg of nitrogen and 6 kg of carbon dioxide at a pressure of 4 bar and a temperature of 20°C. Determine: (i) The mole fraction of each constituent, (ii) The equivalent molecular weight of the mixture, (iii) The equivalent gas constant of the mixture, (iv) The partial pressures and partial volumes.	Understand	The learner to remember the performance parameters of gaseous mixtures.	CO 5

4	The pressure and temperature of mixture of 4 kg of O_2 and 6 kg of N_2 are 4 bar and 27°C respectively. For the mixture determine the following: (i) The mole fraction of each component, (ii) The average molecular weight, (iii) The specific gas constant, (iv) The volume and density.	Understand	The learner to remember the performance parameters of gaseous mixtures.	CO 5
5	A perfect gas mixture consists of 4 kg of N_2 and 6 kg of CO_2 at a pressure of 4 bar and a temperature of 25°C. Calculate Cv and Cp of the mixture. If the mixture is heated at constant volume to 50°C, find the change in internal energy, enthalpy and entropy of the mixture. Take: Cv(N_2) = 0.745 kJ/kg K, Cv(CO_2) = 0.653 kJ/kg K, Cp(N_2) = 1.041 kJ/kg K, Cp(CO_2) = 0.842 kJ/kg K.	Understand	The learner to remember the performance parameters of gaseous mixtures. the mass and volume of gas mixture.	CO5
6	The atmospheric conditions are; 20°C and specific humidity of 0.0095 kg/kg of dry air. Calculate the following: (i) Partial pressure of vapour, (ii) Relative humidity and (iii) Dew point temperature.	Understand	The learner to remember the definition of psychrometric properties.	CO 5
7	200 m^3 of air per minute at 15ºC DBT and 75% R.H. is heated until its temperature is 25ºC. Determine: (i) R.H. of heated air, (ii) Wet bulb temperature of heated air and (iii) Heat added to air per minute.	Understand	The learner to remember the definition of psychrometric processes.	CO 5

8	Atmospheric air with dry bulb temperature of 28°C and a wet bulb temperature of 17°C is cooled to 15°C without its moisture content. Determine: (i) original relative humidity, (ii) final relative humidity and (iii) final wet bulb temperature.	Understand	The learner to remember the definition of psychrometric properties of psychrometry.	CO 5
9	The air supplied to a room of a building in winter is to be at 17°C and have a relative humidity of 60%. If the barometric pressure is 1.01325 bar, determine: (i) The specific humidity and (ii) The dew point under these conditions.	Understand	The learner to remember thedefinition of psychrometric properties of psychrometry.	CO 5
10	The sling psychrometer in a laboratory test recorded the following readings: Dry bulb temperature = 35°C, Wet bulb temperature = 25°C. Calculate the following: (i) Specific humidity, (ii) Relative humidity, (iii) Vapour density in air and (iv) Dew point temperature.	Understand	The learner to remember the definition of psychrometric properties of psychrometry and illustrate to determine them.	CO 5
PART B-LONG ANSWER QUESTIONS				
1	Explain the Mole fraction and Mass fraction in the Mixture of Perfect gas?	Understand	The learner to remember the terms for expressing the portion of molecules in a system by showing the performance parameters of gaseous mixtures	CO 5
2	Explain Gravimetric Analysis of mixtures?	Understand	The learner to remember the properties of gas mixtures and explain gravimetric and volumetric analysis.	CO 5

3	Explain the Volumetric Analysis of mixtures?	Understand	The learner to remember the properties of gas mixtures and explain gravimetric and volumetric analysis.	CO 5
4	Explain the Dalton's law of partial pressure with an example?	Understand	The learner to remember the basic laws for properties by recalling the significance of partial pressure and temperature of gaseous mixtures	CO 5
5	Explain the Avogadro's laws of additive volumes?	Understand	The learner able to write the basic laws for properties by recalling the thermodynamic properties and shows the significance of partial pressure and temperature of gaseous mixtures.	CO 5
6	Compare the Volumetric and Gravimetric Analysis of mixtures?	Understand	The learner understands gaseous mixtures by comparing gravimetric and volumetric analysis with the help of concepts of gas mixtures.	CO 5
7	Using definitions of mass and mole friction, derive a relation between them.	Remember	—-	CO 5
8	Somebody claims that the mass and mole fraction for mixture of CO_2 and N_2O are identical. Is it true? Why? Explain.	Understand	The learner Defines the terms for expressing the portion of molecules in a system of gaseous mixtures	CO 5
9	Explain Equivalent gas constant of a gas mixture?	Remember	—-	CO 5
10	Explain Molecular internal energy of a gas mixture?	Understand	The learner obtains property relations by recalling the thermodynamic properties of gaseous mixtures to obtain molecular internal energy.	CO 5

11	Fine the expressions for enthalpy and entropy of a gas mixture?	Remember	—-	CO 5
12	Are the dry bulb temperature and dew point temperature are same? Explain when they are same.	Understand	The learner describes the different terms applicable in air-conditioning systems by recalling the properties of psychrometry processes applicable in air-conditioning systems.	CO 5
13	Explain the various properties of psychrometry?	Understand	The learner understands to explain the charts which describes the properties of psychrometry processes applicable in air-conditioning systems	CO 5
14	Compare dry bulb temperature and wet bulb temperature with a sketch?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems in psychrometric chart.	CO 5
15	Explain the concept of dew point temperature?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems in psychrometric chart	CO 5
16	Differentiate the Relation between specific humidity and relative humidity and derive the relation between them?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems in psychrometric chart	CO 5
17	Explain the degree of saturation with an example?	Understand	The learner to remember the moist air properties and explains the saturation temperature.	CO 5
18	Explain the adiabatic saturation and compare with degree of saturation.	Understand	The learner to remember the properties of psychrometry and explains the concept of adiabatic saturation temperature.	CO 5

19	List out different psychrometric processes that are taking place.	Remember	—-	CO 5
20	How will you construct psychrometric chart?	Remember	—-	CO 5
PART C- SHORT ANSWER QUESTIONS				
1	Write Dalton's law of partial pressures?	Remember	—-	CO 5
2	Compute the characteristic gas constant and the molecular weightof the gas mixture?	Remember	——	CO 5
3	Write the expression for internal energy?	Remember	——	CO 5
4	Define mole fraction?	Remember	——	CO 5
5	Explain about volumetric and gravimetric analysis?	Understand	The learner to remember the properties of gas mixtures and explain gravimetric and volumetric analysis.	CO 5
6	Define dry bulb temperature, wet bulb temperature, dew pointtemperature and degree of saturation?	Remember	—-	CO 5
7	Explain adiabatic saturation temperature?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems.	CO 5
7	Write Dalton's law of partial pressures?	Remember	—-	CO 5
8	Explain psychometric charts while representing all the properties?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems.	CO 5
9	Show i) sensible heating ii)sensiblecoolingiii) heating and Humidification iv)Heating and Dehumidification on psychometric chart?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems.	CO 5

10	Define bypass factors represent adiabatic mixing of two air streamson psychrometric chart?	Remember	—-	CO 5
11	What is dry bulb temperature?	Remember	—-	CO 5
12	What is wet bulb temperature?	Remember	—-	CO 5
13	Define specific humidity?	Remember	—-	CO 5
14	Define relative humidity?	Remember	—-	CO 5
15	Explain Psychrometric chart?	Understand	The learner to remember properties of moist air and explain the psychrometric processes applicable in air-conditioning systems in psychrometric chart.	CO 5
16	What do you mean by adiabatic saturation temperature?	Remember	—-	CO 5
17	Define degree of saturation?	Remember	—-	CO 5
18	Write the expression for enthalpy of gas mixture?	Remember	—-	CO 5
19	Define mass fraction?	Remember	—-	CO 5
20	Write the law of additive volumes?	Remember	—-	CO 5
MODULE V				
POWER CYCLES				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	The minimum pressure and temperature in an Otto cycle are 100 kPa and 27°C. The amount of heat added to the air per cycle is 1500 kJ/kg. (i) Determine the pressures and temperatures at all points of the air standard Otto cycle. (ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8 : 1. Take for air : cv = 0.72 kJ/kg K, and $\gamma = 1.4$	Apply	The learner to remember the processes of air refrigerant system and understand working to determines the coefficient of performance of refrigeration systems	CO 6

2	An engine working on Otto cycle has a volume of $0.45m^3$ pressure 1bar and temperature 30°C at the beginning of the compression stroke. At the end of the compression stroke the pressure is 11bar. 210kJ of heat is added at constant volume. Solve for the efficiency and mean effective pressure.	Apply	The learner to remember the processes of SI engine and understand working to determine its performance characteristics	CO 6
3	An engine with 200mm cylinder diameter and 300mm stroke working on theoretical diesel cycle. The initial pressure and temperature of air used are 1bar and 27°C. The cut of is 8 % of the stroke. Determine air standard efficiency, mean effective pressure and power of the engine if the working cycles per minute are 300? Assume the compression ratio is 15 and the working fluid is air.	Apply	The learner to remember the processes of CI engine and understand working to determine its performance characteristics	CO 6
4	Find the Compression ratio, if efficiency of an Otto cycleis 60%and $\gamma = 1.5$?An inventor claims that a new heat cycle will develop 0.4kw for a heat addition of 32.5kJ/min.The temperature of heat source is1990K and that of sink is 850K. Is his claim possible? Discuss.	Apply	The learner to remember the processes of CI engine and understand working to determine its performance characteristics to check the existence of system.	CO 6

5	In a constant volume 'Otto cycle', the pressure at the end of compression is 15 times that at the start, the temperature of air at the beginning of compression is 38°C and maximum temperature attained in the cycle is 1950°C. Determine : (i) Compression ratio. (ii) Thermal efficiency of the cycle. (iii) Work done. Take γ for air = 1.4	Apply	The learner to remember the processes of CI engine and understand working to determine its performance characteristics	CO 6
6	The stroke and cylinder diameter of Compression Ignition engine are 250mm and 150mm respectively. If the clearance volume is $0.0004m^3$ and fuel injection takes place at constant pressure for 5% of the stroke. Find the efficiency of the engine. Assumethe engine working on Diesel cycle?	Apply	The learner to remember the processes of CI engine and understand working to determine its performance characteristics.	CO 6
7	An engine of 250mm bore and 375mm stroke works on Otto cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1bar and 50°C. The maximum pressure is limited to 25 bars. Find the air standard efficiency and the mean effective pressure of the cycle? Assume ideal conditions?	Apply	The learner to remember the processes of SI engine and understand working to determine its performance characteristics	CO 6

8	The stroke and cylinder diameter of a compression ignition engine are 250 mm and 150 mm respectively. If the clearance volume is 0.0004 m3 and fuel injection takes place at constant pressure for 5 per cent of the stroke determine the efficiency of the engine. Assume the engine working on the diesel cycle.	Understand	The learner to remember the processes of refrigerant cycle and determine the performance characteristics.	CO 6
9	An isentropic air turbine is used to supply 0.1 kg/s of air at 0.1 MN/m^2 and at 285 K to a cabin. The pressure at inlet to the turbine is 0.4 MN/m^2. Determine the temperature at turbine inlet and the power developed by the turbine. Assume cp= 1.0 kJ/kg K	Understand	The learner to remember the working of Bell-Coleman refrigerant cycle and work out the performance characteristics.	CO 6
10	The swept volume of a Diesel engine working on Dual cycle is 0.0053m^3 and clearance volume is 0.00035m^3. The maximum pressure is 65bar. Fuel injection ends at 5% of stroke. The temperature and pressure of the start of the compression are 80°Cand 0.9bar. Determine air standard efficiency of cycle? Take γ of air is 1.4.	Apply	The learner to remember the processes of dual cycle and understand working to determine its performance characteristics	CO 6
PART B-LONG ANSWER QUESTIONS				
1	Define compression ratio. What is the range for (a) SI engines (b)the CI engine? What factors limit the compression ratio in each type of engine?	Remember	—	CO 6

2	What is an air standard cycle? What are the limitations of airstandard cycle? State the assumptions to be taken for its analysis	Remember	—-	CO 6
3	Develop an expression for the air standard efficiency on a volume basis of an engine working on the Otto cycle. And represent theprocesses on p-V and T-S diagrams.	Apply	The learner to remember the processes of Otto cycle and understand the working to develop expression for efficiency.	CO 6
4	What are the characteristic of air cycles? And what is the use of airstandard cycle analysis	Remember	The learner explains the terms related to performance of power cycles and their significance in real world systems.	CO 6
5	Define air standard efficiency of an Otto cycle and show that the efficiency of Otto cycle is lower than that of Carnot cycle.	Remember	—-	CO 6
6	Develop an expression for mean effective pressure of the Otto cycle?	Apply	The learner to remember the processes of Otto cycle and understand the working to develop expression for mean effective pressure.	CO 6
7	Develop an expression for air standard efficiency of diesel cycle	Apply	The learner to remember the processes of diesel cycle and understand the working to develop expression for efficiency.	CO 6
8	Develop an expression for air standard efficiency of dual cycle	Apply	The learner to remember the processes of dual cycle and understand the working to develop expression for efficiency.	CO 6

9	What is the difference between Otto and Diesel cycle? Show that the efficiency of Diesel cycle is always lower than the efficiency ofthe Otto cycle for the same compression ratio.	Remember	—-	CO 6
10	Show by graphs how the efficiency of Diesel cycle varies with compression ratio and cutoff ratio.	Apply	The learner to remember the processes of Diesel cycle and illustrate the working of diesel air standard cycles and work out the performance characteristics.	CO 6
11	Explain the dual combustion cycle? Why the cycle is also calledlimited pressure cycle? Represent on p-V and T-S diagrams.	Apply	The learner to remember the processes of dual cycle and Illustrate the working of dual air standard cycles and work out the performance characteristics by representing on plots.	CO 6
12	What are the processes involved in Otto cycle. Explain theirstandard efficiency of Otto cycle.	Remember	—-	CO 6
13	Compare the Otto and Diesel cycles for same constant maximumpressure and same heat input.	Understand	The learner to remember processes of Otto, diesel cycles andcompare the working with performance characteristics by representing on plots.	CO 6
14	Compare the thermal efficiency of Otto and dual and diesel cycleson the basis of same compression ratio and same heat input?	Apply	The learner to remember processes of Otto, diesel cycles andcompare the working with performance characteristics by representing on plots..	CO 6
15	In an Otto cycle, the pressure at the beginning of the compressionis 1 bar and pressure at the end of compression is 15 bar. What the pressure ratio and the air standard efficiency of engine.	Understand	The learner to remember the processes of Otto cycle to determine the efficiency of engine.	CO 6

16	Determine the air standard efficiency of the diesel engine having a cylinder with a bore of 250 mm and a stroke of 375mm and aclearance volume of 1500 cc. with fuel cutoff occurring at 5% of the stroke.	Apply	The learner to remember the processes of Otto cycle and understand the working to determine the efficiency of engine.	CO 6
17	Describe the components of vapour compression system with thehelp of P-V and T-S diagram.	Understand	The learner to remember the processes of vapour compression system and illustrate the processes on thermodynamic coordinates.	CO 6
18	Describe with neat diagram a closed cycle gas turbine. State also its merits and demerits.	Understand	The learner to remember the processes of vapour compression system and explain with different conditions of the refrigerant.	CO 6
19	Calculate the percentage loss in the ideal efficiency of a diesel engine with compression ratio 14 if the fuel cut-off is delayed from 5% to 8%.	Understand	The learner to remember the processes of Bell-Coleman cycle and illustrate on thermodynamic coordinates.	CO 6
20	The mean effective pressure of a Diesel cycle is 7.5 bar and compression ratio is 12.5. Find the percentage cut-off of the cycle if its initial pressure is 1 bar.	Understand	The learner to remember the processes of cycles and compare them with performance characteristics by representing on plots.	CO 6
PART C-SHORT ANSWER QUESTIONS				
1	Classify the assumptions to be made for the analysis of allairstandard cycles?	Remember	—	CO 6
2	List theProcessesof Otto cycle and represent on P-V and T-S diagrams?	Remember	—–	CO 6
3	List the Processes in Constant pressure cycle and represent on P-V and T-S diagrams?	Remember	—-	CO 6

4	What are the variable factors used for comparison of cycles?	Remember	—-	CO 6
5	Outline the modified Otto cycle? How it differs from Otto cycle?	Remember	—-	CO 6
6	Write the expression for air standard efficiency of Diesel cycle?	Remember	—-	CO 6
7	Define mean effective pressure?	Remember	—-	CO 6
8	Listfunctional parts of simple vapor compressionsystemrepresent the processes on T-S diagram?	Remember	—-	CO 6
9	Illustrate Bell-Coleman cycle with P-V and T-S diagrams whilerepresenting process and hence deduce its COP?	Understand	The learner to remember the processes of refrigerant cycles and illustrate on p-v and T-S diagrams.	CO 6
10	Discuss limited pressure cycle, represent the processes of it on P-Vdiagram?	Understand	The learner understands to Illustrate the working of various air standard cycles and work out the performance characteristics.	CO 6
11	Compare Otto cycle with Diesel cycle?	Understand	The learner to remember processes of Otto and diesel cycle and compare the working mechanism with the performance characteristics.	CO 6
12	Derive expressions of efficiency for otto cycle	Remember	—-	CO 6
13	Derive expressions of efficiency for Diesel cycle	Remember	—-	CO 6
14	Show the PV diagram of Otto Cycle?	Understand	The learner to remember the Otto cycle process and illustrate on thermodynamic coordinates.	CO 6
15	Illustrate Otto cycle on TS diagram.	Understand	The learner to remember the Otto cycle process and illustrate on thermodynamic coordinates.	CO 6

16	Illustrate the PV diagram of diesel Cycle?	Understand	The learner to remember the Diesel cycle process and illustrate on thermodynamic coordinates	CO 6
17	Illustrate the TS diagram of diesel Cycle?	Understand	The learner to remember the Diesel cycle process and illustrate on thermodynamic coordinates	CO 6
18	Write the processes involved in Brayton cycle.	Remember	—-	CO 6
19	Derive expressions of efficiency for Carnot cycle	Remember	—-	CO 6
20	Show the PV and TS diagrams of dual combustion cycle?	Understand	The learner to remember the Dual cycle process and illustrate on thermodynamic coordinates	CO 6

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