QUESTION BANK

THERMAL ENGINEERING S.Y. B.TECH. (TT/MMTT/TPE/TC)

UNIT 1A. INTRODUCTION TO THERMODYNAMICS

Sr. No.	Theory Question	Marks
1	Write the equations for P,V,T relation for adiabatic process.	
2	Derive necessary equations for P-V-T relationship, work done, internal energy, heat supply & enthalpy change for Isothermal process.	
3	Write the equations for P,V,T relation for polytropic process.	
4	Prove that for an adiabatic process $p.v^{\gamma} = c$	
5	Derive necessary expressions for: i) heat transfer in case of polytropic process, ii) work done in case of adiabatic expansion process.	
6	Write the equations for heat transfer and work done for constant pressure process.	
7	Derive an equation for finding heat supply in case of constant pressure process.	
8	Explain with neat sketches different types of Thermodynamic systems.	
9	Explain with the help of neat sketch constant pressure process & derive necessary expressions for the same.	
10	Write the equations for heat transfer, work done and change in internal energy for constant volume process.	
11	Derive an expression for Pressure- Volume- Temperature relationship and work done in case of an adiabatic process.	
12	Write a note on Open and Closed system.	
13	Derive the different stages of constant temperature process with P-V and P-T diagram.	
	Numericals	
1	1.5 kg of air is compressed polytropically by the law $p.v^{1.25}$=constant from 100 kN/m^2 & 25°C to 1 MN/m^2. Calculate the amount of work input, the change in internal energy & the amount of heat transferred.	
2	Determine the difference in the work done when the air occupying 2 m^3 at the pressure of 0.6 bar expands to 8 m^3 when the expansion is a) isothermal, b) adiabatic.	
3	A system contains 0.15 m^3 of gas at a pressure of 3.8 bar & 150°C. It is expanded adiabatically till the pressure falls to 1 bar. The gas is then heated at a constant pressure till its enthalpy increases by 70 kJ. Determine the total work done. Assume C_p=1KJ/ Kg K & C_v=0.712 KJ/ Kg K	
4	A certain quantity of gas having initial volume, temperature and pressure as 0.4 m^3, 300 K and 450 kN/m^2 respectively. It undergoes an isothermal change of state and has the final pressure as 100 kN/m^2. Draw the process on a P-V diagram and calculate the amount of heat transfer, change in internal energy and work done.	

5	Air at 1.02 bar, 22°C, initially occupying a cylinder volume of 0.015 m^3, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate - a) the final temperature, b) the final volume and c) work done. Assume R = 287 J/kg K and $\gamma = 1.4$.	
6	An air compressor takes in air at 10^5 Pa and 27°C having volume of 1.5 m^3/kg and compresses it to 4.5×10^5 Pa. Find the work done, heat transfer and change in internal energy, if the compression is isothermal.	
7	1 kg of air at 1.02 bar, 20°C is compressed reversibly accordingly to law $pv^{1.3}$ = constant to a pressure of 5.5 bar. Calculate the work done on the air and heat flow to or from the cylinder walls during the compression.	
8	0.05 kg of CO_2 occupying a volume of 0.03 m^3 at 1.025 bar, is compressed reversibly until the pressure is 6.15 bar. Calculate the final temperature, the work done on the CO_2, the heat flow to or from the cylinder walls. a) when the process is according to a law $pv^{1.4}$ = constant. b) when the process is isothermal. c) when the process takes place in a perfectly thermally insulated cylinder. Assume $\gamma = 1.3$	
9	A certain quantity of air has a volume of 0.028 m^3 at a pressure of 1.25 bar & 25°C. It is compressed to a volume of 0.0042 m^3 according to the law $p.v^{1.3}$=constant. Find the final temperature & work done during compression. Also determine the reduction in pressure at a constant volume required to bring the air back to its original temperature.	
10	One Kg of a gas expands reversibly and adiabatically. Its temperature during the process falls from 515 K to 390 K, while the volume is doubled. The gas does 92 KJ of work in this process. Determine C_p, C_v, Molecular mass of gas.	
11	1.4 m^3 of a gas at a pressure of 1.26 bar is compressed to a volume of 0.28 m^3. The final pressure is 7 bar. Assuming the compression to be polytropic, calculate the heat transfer and change in internal energy. Assume ratio of specific heats as a 1.4	
12	A gas initially at 603 K expands until its volume is 5.2 times the initial volume, according to law of PV^n = constant. If the initial and final pressures are observed to be 8.5 bar and 1 bar respectively. Determine, i) Index of expansion, ii) work done per kg of gas and iii) heat transfer per kg of gas. Assume C_V = 0.712 kJ/kg K & ratio of specific heat = 1.4	
13	A quantity of gas is compressed according to law of $pv^{1.25}$ = constant. The initial temperature and pressure of the gas is 15°C and 1 bar respectively. Find the work done in compressing 1 kg of air at 3 bar and the heat rejected through the walls of the cylinder. Assume $\gamma = 1.4$ for air.	
14	0.1 m^3 of air at a pressure of 1.5 bar is expanded isothermally to 0.5 m^3. Calculate the final pressure of the gas and heat supplied during the process.	
15	A cylinder contains 0.084 m^3 of hydrogen at 1.05 bar and 18°C. It is compressed adiabatically to 14 bar and then expanded isothermally to the original volume of 0.084 m^3. The characteristic constant for hydrogen is 4200J/Kg K and its specific heat at constant pressure is 14.28 KJ/Kg K. Determine the final pressure of the gas and the amount of heat which must be added to the gas during isothermal expansion. Also	

	calculate the heat which must be abstracted from the gas after expansion in order to reduce it to its initial state of pressure.	
16	A volume of 0.5 m^3 of gas at a pressure of 10 bar and 200°C is expanded in a cylinder to 1.2 m^3 at a constant pressure. Calculate the amount of work done by the gas and the increase in internal energy. Assume C_p=1.005 KJ/ Kg K & C_v=0.712 KJ/ Kg K	
17	0.65 m^3 of hydrogen at 100 kPa & 20°C is compressed adiabatically to 1400 kPa & then expanded isothermally to the original volume. Determine – a) the pressure of the gas at the end of isothermal expansion, b) the heat which must be added to the gas during isothermal expansion and c) the heat which must be extracted from the gas after isothermal expansion to reduce it to its original state of pressure at constant volume. Assume C_p=14.256 kJ/kg K & R = 4.124 kJ/kg K for H_2.	
18	A cylinder contains 0.45 m^3 of a gas at 1 x 10^5 N/m^2 and 80°C. The gas is compressed polytropically to a volume of 0.13 m^3, the final pressure being is 5 x 10^5 N/m^2. Determine – a) the mass of gas, b) the value of index 'n' for compression, c) the increase in internal energy of the gas, d) the heat received or rejected by the gas during ompression. Assume R = 294.2 J/kg K and γ = 1.4.	RKR

UNIT 1B. AIR STANDARD CYCLES

Sr. No.	Theory Question	Marks
1	Draw P-V & T-S diagram for Carnot cycle/ Otto cycle/ Diesel cycle and label it.	
2	Derive an expression for the air standard efficiency of an engine working on the Carnot cycle with the help of P-V & T-S diagram.	
3	Derive an expression for air standard efficiency of an engine working on the Otto cycle with the help of P-V & T-S diagram.	
4	Derive an expression for the ideal efficiency of a Diesel cycle with the help of P-V and T-S diagram.	
	Numericals	
	CARNOT CYCLE	
1	A Carnot cycle working between 650 K and 310 K produces 150 kJ of work. Find thermal efficiency and heat added during process.	
2	A Carnot cycle works with adiabatic compression ratio of 5 & isothermal expansion ratio of 2. The volume of air at the beginning of the isothermal expansion is 0.3 m^3. If the maximum temperature & pressure is limited to 550 K & 21 bar, determine i) minimum temperature in the cycle, ii) thermal efficiency of the cycle & iii) pressure at all salient points. Assume ratio of specific heats as 1.4	
3	0.5 kg of air works on Carnot cycle having thermal efficiency 50%. The heat transfer to the air during the isothermal expansion is 40 kJ. At the beginning of the isothermal expansion the pressure is 7 bar and volume is 0.12 m^3. Determine, i) the maximum and minimum temperatures for the cycle, ii) the volume at the end of each process, iii) the heat transfer for each process in kJ. Assume C_P = 1.005 kJ/kg K & C_V = 0.718 kJ/kg K.	

4	A Carnot engine operating between temperatures T_1 and T_2 has efficiency 1/6. If T_2 is lowered by 62 K, its efficiency increases to 1/3, calculate values of T_1 and T_2.	
	OTTO CYCLE	
1	In an air standard Otto cycle, the compression ratio is 7 & the compression begins at 1 bar & 313 K. The heat added is 2510 KJ/kg. Find – i) maximum temperature & pressure, ii) work done per kg of air and iii) efficiency of a cycle. Assume for air C_v=0.713 kJ/kg K & R=0.287 kJ/kg K.	
2	In an Otto cycle, the temperature at the start and end of the isentropic compression are 316 K and 596 K respectively. Determine the air standard efficiency and the compression ratio. Assume ratio of specific heat as 1.4.	
3	An engine working on ideal Otto cycle has temperature and pressure, at the beginning of isentropic compression as $25°C$ and 1.5 bar respectively. Find compression ratio, temperature and pressure at the end of compression if thermal efficiency of the engine is 48%. Assume ratio of specific heat as 1.4.	
4	In an air standard Otto cycle, the compression ratio is 7 and the compression begins at 1 bar and 313 K. The heat added is 2510 kJ/kg. Determine - i) maximum temperature, ii) maximum pressure, iii) work done per kg of air, iv) cycle efficiency, v) mean effective pressure. Assume C_v = 0.713 kJ/kg K & R= 287 J/kg K.	
5	An engine working on Otto cycle has a volume of 0.45 m^3, pressure 1 bar and temperature $30°C$ at the beginning of compression stroke. At the end of compression stroke, the pressure is 11 bar. 210 KJ of heat is added at constant volume. Determine i) Pressure, temperature, and volume at different points, ii) Efficiency & iii) Mean effective pressure. Assume C_P = 1.005 kJ/kg K & C_V = 0.718 kJ/kg K.	
6	In an Otto cycle, the temperatures at the beginning and at the end of the isentropic compression are 320 K and 610 K respectively. Determine the air standard efficiency & the compression ratio.	
7	In an ideal Otto cycle engine the compression and expansion follow the adiabatic law with the value of γ as 1.4. The pressure, temperature and volume at the beginning of the compression are 100 kPa, $40°C$ and 0.03 m^3 respectively. The pressure at the end of constant volume heat addition is 1900 kPa and at the end of compression is 750 kPa. Calculate – i) the temperature at all key points, ii) compression ratio, iii) the air standard efficiency of the engine. Assume C_V = 0.7165 kJ/kg K for air.	
8	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. Represent the air standard Otto cycle on P-V diagram and determine the pressure and temperatures at all points. Assume C_V = 0.72 kJ/kg K, γ =1.4 and compression ratio 8:1	
9	In a constant volume 'Otto cycle', the pressure at the end of compression is 15 times that at the start, 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	RKR
	DIESEL CYCLE	
1	The volume ratios of compression & expansion for a diesel engine as measured from an	

	indicator diagram are 15.3 and 7.5 respectively. The pressure and temperature at the beginning of the compression are 1 bar and 27°C. Assuming an ideal engine, determine i) the mean effective pressure, ii) the ratio of maximum pressure to mean effective pressure and iii) cycle efficiency. Assume C_P = 1.005 kJ/kg K & C_V = 0.718 kJ/kg K	
2	A diesel engine contains 0.1 m^3 of air at 0.98 bar and 30°C at the beginning of compression. The compression ratio is 15 and the volume at cut-off is 0.0125 m^3. Determine- a) the cut-off ratio, b) the work done and c) the air standard efficiency. Assume C_P = 1.005 kJ/kg K and γ =1.4	
3	The compression ratio of an ideal diesel cycle is 15. The heat transfer is 1465 kJ/kg of air. Find the pressure and temperature at the end of each process and determine air standard efficiency if the inlet conditions are 300 K and 1 bar. Assume C_v = 0.712 kJ/kg K & R= 287 J/kg K.	
4	A diesel engine working on the ideal cycle draws in air at a pressure of 110 kPa and temperature of 288 K. The air is compressed adiabatically to 3.5 MPa. Heat is taken in at constant pressure and expansion takes place adiabatically, the ratio of expansion being 5. The air is exhausted at the end of the stroke at constant volume. Calculate - i) the temperature at all key points of the cycle, ii) the heat received per kg of working fluid, iii) the heat rejected per kg of working fluid, iv) the ideal thermal efficiency. Assume C_P = 1.0035 kJ/kg K & C_V = 0.7165 kJ/kg K.	

UNIT 2. PROPERTIES OF STEAM

Sr. No.	Theory Question	Marks
1	Define dryness fraction and write the equation for the same, describe the terms involved in it.	
2	Define enthalpy of wet steam and write the expression for the same.	
3	Explain with neat sketch the formation of steam at constant pressure.	
4	Explain the use of steam in various textile departments.	
5	What do you mean by super heating the steam? State the advantages of the same.	
6	What are the types of calorimeter? Explain with neat sketch Separating calorimeter/ Throttling calorimeter/ Combined separating & throttling calorimeter.	
7	Define and explain with necessary expressions: sensible heat of water, latent or hidden heat, dryness fraction, total heat or enthalpy of wet steam, total heat or enthalpy of dry steam, superheated steam, volume of wet and dry steam, volume of superheated steam.	
8	Define and explain with necessary expressions: external work done during evaporation, internal latent heat and internal energy of steam.	
9	What is internal latent heat? Write the expression for the same.	

10	Explain with neat sketch temperature vs total heat graph during steam formation.	
Numericals – STEAM PROPERTIES		
1	Calculate the internal energy of 1 kg of steam at a pressure of 10 bar when the steam is a) 0.9 dry, b) dry saturated. The volume of water may be neglected.	
2	Find the external work done during evaporation, internal latent heat and internal energy per kg of steam at a pressure of 15 bar when the steam is a) 0.9 dry, b) dry saturated.	
3	Find the mass of 0.5 m^3 wet steam at pressure of 4 bar and 0.8 dryness fraction.	
4	A vessel contains 2 kg of steam at a pressure of 8 bar. Find the amount of heat which must be rejected, so as to reduce the quality of steam in the vessel to be 70%.	
5	Find the Internal energy of 1 kg steam at pressure of 20 bar and 300° C. If this steam be expanded to a pressure of 5 bar and 170° C. determine the change in internal energy. For superheated steam assume C_P = 2.1kJ/kg K	
6	Find the internal energy of 1 Kg of steam at a pressure of 10 bar and 290° C. If this steam be expanded to a pressure of 2 bar and 0.8 dry. Determine the change in internal energy. Assume C_p for superheated steam = 2.1 KJ/Kg K.	
7	Calculate the Internal energy of 1 kg steam for pressure 15 bar, when i) steam quality is 0.85% dry, ii) steam is dry saturated, iii) temperature of steam is 250° C. For superheated steam assume C_P = 2.1kJ/kg K.	
8	A steam engine obtains steam from a boiler at a pressure of 30 bar & 0.98 dry. It was observed that when steam flows through a pipe line, heat loss to the surroundings is 50 kJ/kg and pressure remains constant. Calculate dryness fraction of the steam at engine end of pipe line.	
9	Determine the amount of heat, which should be supplied to 2 kg of water at 25° C to convert it into steam at 5 bar and 0.9 dry.	
10	What amount of heat would be required to produce 4.4 kg of steam at a pressure of 6 bar and temperature of 250° C from water at 30° C ? Take specific heat of superheated steam as 2.2 kJ/kg K.	
11	If a certain amount of steam is produced at a pressure of 8 bar and dryness fraction 0.8. Calculate : i) External work done during evaporation, ii) internal latent heat of steam.	
12	Find the internal energy of 1 kg of steam at 20 bar when i) it is superheated, it's temperature being 400° C ; ii) it is wet, it's dryness being 0.9. Assume specific heat for superheated steam = 2.3 kJ/kg K.	
13	Find the internal energy of one kg of steam at 14 bar under the following conditions : i) when the steam is 0.85 dry; ii) when steam is dry and saturated; and iii) when the temperature of steam is 300° C. Assume specific heat for superheated steam = 2.25 kJ/kg K.	
	Numericals - CALORIMETER	
1	In an experiment, it was found that the steam enters a throttling calorimeter at a pressure of 12 bar, after throttling pressure and temperature was measured as 1.013 bar and 115°C respectively. Find the quality of steam.	

2	In a laboratory experiment, the following observations were recorded to find the dryness fraction of steam by combined separating and throttling calorimeter. Total quantity of steam passed = 36 kg, water drained from separator = 1.8 kg, steam pressure before throttling = 12 bar, temperature of steam after throttling = $110°C$, pressure after throttling = 1.013 bar, specific heat of steam = 2.1 kJ/kg K. Determine the dryness fraction of steam before inlet to the calorimeter.	
3	In a laboratory experiment, the following observations were recorded to find the dryness fraction of steam by combined separating and throttling calorimeter. Total quantity of steam passes = 38 kg, water drained from separator = 2 kg, steam pressure before throttling = 14 bar, steam temperature after throttling= 115° C, pressure after throttling = 1.013 bar, specific heat of steam = 2.1 KJ/Kg K. Determine the dryness fraction of steam before inlet to the calorimeter.	
4	The following observations were taken with a separating and a throttling calorimeter arranged in series: water separated = 2 kg, steam discharged from the throttling calorimeter = 20.5 kg, temperature of steam after throttling= 110° C, initial pressure = 12 bar, pressure after throttling = 1 bar. Determine the quality of steam supplied. Assume specific heat of superheated steam as 2 kJ/kg K.	
5	Steam at 11 bar is passed through a throttling calorimeter and reduced to a pressure to 1.5 bar. Find out the dryness fraction of steam entering the calorimeter, if the condition of steam leaving the calorimeter is dry and saturated.	
6	In carrying out a test using a throttling calorimeter to determine the quality of sample of steam from a steam main pipe at a pressure of 11 bar. It was found that the pressure and temperature of steam after throttling was 1.15 bar and $130°C$ respectively. Calculate the dryness fraction of sample of steam. Take Cp of superheated steam as 2.1 kJ/kg K.	
7	The following data were obtained in a test on a combined separating and a throttling calorimeter : pressure of steam sample = 15 bar, pressure of steam at exit = 1 bar, temperature of steam at exit = $150°C$, discharge from separating calorimeter = 0.5 kg/min, discharge from throttling calorimeter = 10 kg/min. Determine the dryness fraction of the sample steam.	

UNIT 3A. STEAM BOILERS

Sr. No.	Theory Question	Marks
1	Describe with neat sketch construction and working of Cochran boiler.	
2	Describe with neat sketch construction and working of Babcock & Wilcox boiler.	
3	Classify boilers.	
4	Write the equation for efficiency of a boiler & explain the terms involved in it.	
5	What is internal energy of a steam? Write the expression for the same.	

6	Explain with neat sketch Combined separating and Throttling Calorimeter.	
7	Classify boilers in detail. What are the basic requirements of good Boiler?	
8	State any two types of fire tube boilers and water tube boilers.	
9	Differentiate between Water tube and Fire tube Boiler.	
10	What are the essential requirements of good Boiler?	
11	Explain with neat sketch Separating calorimeter.	
12	Explain with neat sketch Throttling Calorimeter.	
	Numericals	
1	The following are the observations were made in a boiler trial: coal used = 200 kg, calorific value of coal = 30,000 KJ/Kg, water evaporated = 2000 kg, steam pressure= 12 bar, steam quality = 0.95 dry, feed water temperature= $40°$C. Calculate i) equivalent evaporation from and at $100°$C, ii) factor of evaporation & iii) boiler efficiency.	
2	6300 kg of steam is produced per hour at pressure of 7.5 bar in boiler with feed water at $41.5°$C. The quality of the steam is 0.98 dry. The amount of coal burnt is 700 kg/hour with calorific value 31000 kJ/kg. Determine i) the boiler efficiency, ii) equivalent evaporation from and at $100°$C., iii) factor of evaporation.	
3	The following observations were made on a boiler plant during test. steam pressure = 7.5 bar, Mass of steam generated = 5400 kg, Mass of coal used = 670 kg, Calorific value of coal = 31000 kJ/kg, Feed water temperature = $41.5°$C, Quality of steam = 0.98. Determine: i) Boiler efficiency, ii) Equivalent evaporation from and at $100°$C & iii) Factor of evaporation.	
4	A steam generator generates 3000 kg of steam at a pressure of 12.5 bar and 0.97 dry when feed water temperature is $105°C$. The coal fired is 375 kg and calorific value is 27.4 MJ/kg. Find i) equivalent evaporation and ii) thermal efficiency of a boiler.	
5	5400 kg of steam is produced per hour at a pressure of 7.5 bar in a boiler with feed water at $41.5°C$. The dryness fraction of steam is 0.98. The amount of coal burnt per hour is 670 kg of calorific value 31000 kJ/kg. Determine boiler efficiency and equivalent evaporation.	
6	A Boiler produces 9000 kg of steam while 1 tonne of coal is burnt. The steam is produced at 10 bar from water at $15°C$. The dryness fraction is 0.9. Determine the efficiency, equivalent evaporation of the boiler when the calorific value of coal is 32000 kJ/kg.	
7	The following observations were made on boiler plant during test. steam pressure = 25 bar, steam temperature = $300°$C, steam generated = 40,000 kg, feed water temperature = $25°$C, fuel used = 5000 kg, energy of combustion of fuel = 35,000 kJ/Kg. Determine: i) Thermal efficiency of Boiler, ii) Equivalent evaporation, iii) Factor of evaporation.	
8	6300 kg of steam is produced per hour at pressure of 7.5 bar in boiler with feed water at $41.5°$C. The quality of the steam is 0.98 dry. The amount of coal burnt is 700 kg/hour with calorific value 31000 kJ/kg. Determine i) the boiler efficiency, ii) equivalent	

	evaporation from and at 100° C., iii) factor of evaporation.	
9	A boiler generates 800 kg of steam per hour at a pressure of 10 bar and 50° C superheat and burns 100 kg of coal per hour. If the calorific value of coal is 30000 kJ/kg and feed water temperature is 40° C. Calculate i) equivalent evaporation from and at 100° C, ii) factor of evaporation & iii) boiler efficiency.	
10	The following readings were obtained during a boiler trial: Mean steam pressure= 12 bar, mass of steam generated = 40,000 kg, mean dryness fraction = 0.85, mean feed water temperature = 30° C, coal used = 4000 kg, Calorific value of coal = 33,400 kJ/kg. Calculate: i) Factor of equivalent evaporation; ii) Equivalent evaporation from and at 100° C; iii) Efficiency of the boiler. Assume specific heat of water as 4.18 kJ/kg K.	RKR
11	A steam generator evaporates 18000 kg/h of steam at 12.5 bar and a quality of 0.97 from feed water at 105° C, when coal is fired at the rate of 2040 kg/h. If the calorific value of the coal is 27400 kJ/kg, find : i) The equivalent evaporation; ii) The thermal efficiency.	RKR
12	In a boiler test 1250 kg of coal is consumed in 24 hours. The mass of water evaporated is 13000 kg and the mean effective pressure is 7 bar. The feed water temperature was 40° C, Calorific value of coal is 30000 kJ/kg. Determine : i) Equivalent evaporation per kg of coal; ii) Efficiency of the boiler.	RKR
13	Compare the thermal efficiency of two boilers for which the data is given below :	

	Boiler 1	Boiler 2
Steam pressure	14 bar	14 bar
Steam produced per kg of coal fired	10 kg	14 kg
Quality of steam	0.9 dry	superheated to 240° C
Feed water temperature	27° C	27° C
Calorific value of fuel	34000 kJ/kg	46000 kJ/kg

Specific heat of feed water is 4.18 kJ/kg K and specific heat of steam is 2.1 kJ/kg K. Which boiler is more efficient?

UNIT 3B. BOILER MOUNTINGS & ACCESSORIES

Sr. No.	Question	Marks
1	Categorize the following into boiler mountings and accessories – fusible plug, air pre-heater, feed pump and water level indicator.	
2	State the function of Fusible plug/ Steam stop valve/ Blow-off cock/ Economizer/Air pre-heater/ superheater.	
3	Explain with neat sketch the working of Water level indicator/ pressure gauge/ lever type safety valve/ Dead weight safety valve/superheater.	
4	Which of the following are not boiler accessories – fusible plug, economizer, feed pump, superheater and safety valve?	

5	Which of the following are not boiler mountings – fusible plug, economizer, feed pump, superheater and safety valve?	
6	Which of the following are not boiler accessories – feed check valve, economizer, air pre-heater and steam pressure gauge?	
7	Which of the following are boiler mountings – fusible plug, economizer, feed pump, super-heater and safety valve?	

UNIT 4. THERMIC FLUID HEATING SYSTEM

Sr. No.	Question	Marks
1	State the function of following in thermic fluid heating system - expansion tank, De-aeration tank, buffer tank.	
2	Explain in detail cleaning of thermic fluid heating system.	
3	State any four requirements of fluid used in Thermic fluid heating system.	
4	State and explain causes of deterioration of fluid in thermic fluid heating system.	
5	State main causes of deterioration of thermic fluid.	
6	State any four advantages of thermic fluid heating system.	
7	State any six desirable properties of fluid used in thermic fluid heating system.	
8	State any two methods of cleaning of thermic fluid heating system.	

UNIT 5A. REFRIGERATION

Sr. No.	Question	Marks
1	Define ‘Coefficient of performance’ of a refrigerator.	
2	Derive an expression for coefficient of performance of a Reversed Carnot cycle with the help of P-V and T-S diagram.	
3	Define “Tonne of refrigeration”/ Unit of refrigeration.	
4	With neat block diagram explain the difference between Heat engine, Refrigerator and Heat pump and write the expression for effectiveness of each.	
5	Define & explain refrigeration.	
6	Why Reversed Carnot cycle cannot be brought in actual practice?	
7	Write the expression for the energy performance ratio for a heat pump in terms of heat addition, heat rejection and work done.	

UNIT 5B. AIR CONDITIONING

Sr. No.	Theory Question	Marks
1	Define - dry air, moist air, water vapour, sensible heat of air, humid specific volume, Degree of saturation, Dew point temperature, Wet bulb temperature, Dry bulb temperature, specific humidity, relative humidity, absolute humidity, Total heat of humid air.	
2	Define & explain Dalton's law of partial pressure.	
3	Explain with the help of neat sketch Sensible heating process and write the expression for the bypass factor of the same.	
4	Explain with the help of neat sketch Sensible cooling process and write the expression for the bypass factor of the same.	
5	Explain with neat sketch Humidification and dehumidification process.	
6	With neat sketch of psychrometric chart explain the process of Cooling with dehumidification and write the expressions of BPF and SHF for the same.	
7	Explain with the help of neat sketch "Cooling with adiabatic humidification of air" and write the expression for effectiveness of the same.	
8	Explain with neat sketch of psychrometric chart the process of Adiabatic chemical dehumidification.	
9	Explain with the help of neat sketch Humidification by steam injection and write necessary expressions for the same.	
10	Explain with the help of neat sketch "Mixing of air streams" and derive the necessary expressions for the same.	
11	Explain with neat sketch "Sling psychrometer"/ "Hair type humidistat".	
	Numericals	
1	If the DBT of air is $35°C$ and WBT is $25°C$. Find using the psychrometric chart –i) RH, ii) DPT of air, iii) the enthalpy per kg of dry air and iv) the specific volume per kg of dry air. Illustrate your answer with neat sketch.	
2	If the enthalpy of air is 90 kJ per kg and DBT is $38°C$. Find using the psychrometric chart – i) WBT of air, ii) RH, iii) the specific volume per kg of dry air and iv) the moisture content per kg of dry air. Illustrate your answer with neat sketch.	
3	If the DBT of air is $30°C$ and WBT is $21°C$. Find using the psychrometric chart – i) RH, ii) DPT of air, iii) the enthalpy per kg of dry air and iv) the moisture content per kg of dry air. Illustrate your answer with neat sketch.	
4	If the enthalpy of air is 90 kJ per kg and DBT is $40°C$. Find using the psychrometric chart – i) WBT of air, ii) DPT of air, iii) RH and iv) the moisture content per kg of dry air. Illustrate your answer with neat sketch.	

5	With the help of psychrometric chart, find – i) WBT of air, ii) DPT of air, iii) enthalpy of air per kg of dry air, iv) the moisture content and v) specific volume. If the DBT is $30°C$ and RH is 60%. Illustrate your answer with neat sketch.	
6	If the DBT of air is $35°C$ and WBT is $25°C$. Find using the psychrometric chart – i) RH, ii) DPT of air, iii) the enthalpy per kg of dry air and iv) the moisture content per kg of dry air. Illustrate your answer with neat sketch.	
7	With the help of psychrometric chart, find – i) WBT of air, ii) DPT of air, iii) enthalpy of air per kg of dry air and iv) the moisture content per kg of dry air. If the DBT is $25°C$ and RH is 40%**.** Illustrate your answer with neat sketch.	

UNIT 6A. PUMPS & COMPRESSORS

Sr. No.	Question	Marks
1	Which compressor is used for high discharge and low pressure application & which compressor gives intermittent air supply?	
2	Explain with neat sketch construction and working of reciprocating pump.	
3	Compare rotary and reciprocating air compressors.	
4	Enlist important parts of reciprocating pump.	
5	Explain with neat sketch axial flow & rotary vane compressor.	
6	Classify compressors.	
7	Explain with neat sketch construction & working of Axial flow compressor.	
8	Compare centrifugal and reciprocating pumps.	
9	State important parts of a reciprocating pump.	
10	Explain with neat sketch construction & working of screw compressor.	
11	Draw a neat labeled diagram of reciprocating pump.	
12	Explain with neat sketch construction & working of Centrifugal pump.	
13	Explain with neat sketch construction & working of vane compressor.	

UNIT 6B. INTRODUCTION TO PNEUMATICS

Sr. No.	Question	Marks
	Draw the symbol for - 1) separator with automatic drain, 2) 3/2 poppet valve, 3) two	

1	way spool valve, 4) temperature gauge, 5) simple 2/2 poppet valve, 6) weight loaded accumulator, 7) Twin pressure sequence valve, 8) flow meter, 9) 3/2 D.C. valve-normally closed, 10) 3/2 D.C. valve normally open, 11) shuttle valve, 12) quick exhaust valve, 13) two way spool valve, 14) spring loaded accumulator, 15) 4/3 D.C. valve zero position all ports closed, 16) 5/2 D.C. valve, 17) 4/2 D.C. valve**,** 18) Four way spool valve, 19) gas charged accumulator, 20) lubricator, 21) 2/2 directional control valve (normally closed), 22) Non-return valve**,** 23) double acting cylinder, 24) shuttle valve, 25) Non-return flow control valve, 26) filter, 27) separator with manual drain, 28) 3/3 D.C. valve – zero position all ports closed.	2 each