Total No of Questions: [12] *SEAT NO. :*

[Total No. of Pages : 4]

SE (Mechanical) 2008

Applied Thermodynamics (202041)

(Semester - I)

Time: 3 Hours *Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of Calculator is allowed.***
5) ***Assume Suitable data if necessary***

SECTION I

Q1)			
	a.	State first law of thermodynamics. Explain Joules experiment with neat sketch to validate first law.	[2+3+3]
	b.	Define index of expansion. 0.44 kg of air at 180°C expands adiabatically to three times its original volume and during the process there is a fall in temperature to 15°C. The work done during the process is 52.5 kJ. Calculate C_p and C_v.	[2+3+3]
		OR	
Q2)			
	a.	State Kelvin planks statement and Clausius statement. Give application of each with sketch.	[4+4]
	b.	A house requires 2×10^5 kJ/h for heat transfer for heating in winter and for cooling in summer. A device is used to satisfy the requirement of house in summer and winter. Work required to operate the device is 3×10^4 kJ/h. Determine : (i) Heat absorbed by the device in summer and in winter ; (ii) Co-efficient of performance for summer. (iii) Energy Performance Ratio for winter.	[2+3+3]

Q3)			
	a.	Define and Explain available energy and Unavailable energy. Taking example of Heat engine explain the terms.	[4+4]
	b.	Derive the equation of work done and heat transfer and change in internal energy for an ideal gas during constant pressure process.	[4+2+2]
		OR	
Q4)			
	a.	Explain second law efficiency. State formulas for Pump and Turbine.	[4+4]
	b.	1 kg of air at a pressure of 8 bar and a temperature of 100°C under goes a reversible polytropic process following the law $PV^{1.2}$ = constant. If the final pressure is 1.8 bar determine : (i) The final specific volume, temperature (ii) increase in entropy (iii) work done (iv) Heat transfer. Assume R = 0.287 kJ/kg K and $\gamma = 1.4$	[2x4]
Q5)			
	a.	Explain Rankine cycle for thermal power generation with P-V and T-S diagram.	[4+4]
	b.	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)Dryness fraction, (ii)The specific enthalpy, (iii)The specific entropy, (iv) The specific internal energy.	[2x4]
	c.	Define critical Point with sketch.	[2]
		OR	

Q6)			
	a.	Explain Barrel Calorimeter with neat sketch.	[4+4]
	b.	In a steam power cycle, the steam supply is at 15 bars and dry and saturated. The condenser pressure is 0.4 bars. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pumps work.	[4+4]
	c.	Define Dryness fraction of steam.	[2]
		SECTION II	
Q7)			
	a.	Explain Orsat apparatus with neat sketch.	[4+4]
	b.	The following is the ultimate analysis of a sample of petrol by weight : Carbon = 85 %; Hydrogen = 15 %.Calculate the ratio of air to petrol consumption by weight if the volumetric analysis of the dry exhaust gas is:CO2 = 11.5 %; CO = 1.2 %; O2 = 0.9 %; N2 = 86 %.Also find percentage excess air.	[2x4]
		OR	
Q8)			
	a.	Explain Junkers Gas calorimeter with neat sketch.	[4+4]
	b.	The percentage composition by mass of a crude oil is given as follows: C = 90%; H2 = 3.3%; O2 = 3%,N2 = 0.8%; S = 0.9% and remaining incombustible. If 50% excess air is supplied find the percentage of dry exhaust gases found by volume.	[2x4]
Q9)			
	a.	Explain Multistage compression with P-V diagram and explain how efficiency increases during compression?	[2+4+2]
	b.	A single stage single cylinder reciprocating compressor has 60 m3/hr air entering at 1.013 bar, 15°Cand air leaves at 7 bar. Compression follows polytropic process with index of 1.35. Considering negligible clearance determine mass of air delivered per minute, delivery temperature, indicated power and isothermal efficiency.	[2x4]

		OR	
Q10)			
	a.	Explain with neat sketch working of vane type compressor show the process on P-V diagram.	[4+4]
	b.	A reciprocating air compressor has four stage compressions with 2 m^3/min of air being deliveredat 150 bar when initial pressure and temperature is 1 bar, 27°C. Compression occur polytropicallyfollowing polytropic index of 1.25 in four stages with perfect intercooling between stages. For theoptimum intercooling conditions determine the intermediate pressures and the work required for driving compressor.	[2x4]
Q11)			[18]
	a.	Differentiate between Fire tube and water tube boilers (Min 8 Points).	[1x8]
	b.	In a boiler unit forced draught fan delivers ambient air at 20°C with velocity of 20 m/s.The draught lost through grate is 30 mm of water column. Determine the power required to drive the fanif fan's mechanical efficiency is 80% and coal is burnt at the rate of 1000 kg per hour and air issupplied at the rate of 16 kg per kg of coal. Ambient pressure and density of air may be taken as 1.01325bars and 1.29 kg/m3.	[2x4]
	c.	Write the Function of Blow off cock.	[2]
		OR	
Q12)			
	a.	A boiler is capable of generating 8 kg steam per kg of fuel at 400^0C. Feed water is suppliedat pressure of 30 bars, 40^0C and leaves economizer at 150^0C for entering to evaporator. Steam leavesevaporator with dryness fraction of 0.98 and enters the superheater. Fuel used has calorific value 29000 kJ/kg. Considering no pressure loss inside the boiler determine boiler efficiency and fraction ofheat given to steam in each section of boiler.	[2x4]
	b.	Explain with neat sketch working of Benson boiler.	[4+4]
	c.	Write down the use of Fusible plug.	[2]
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