



Q.P. Code : 608602

(3 Hours)

[Total Marks : 80

- N.B.:** (1) Question No.1 is compulsory.
 (2) Attempt **any Four** out of the remaining **Five** questions.
 (3) Assume suitable **data** wherever **required**.
 (4) **Use of steam tables, and psychometric chart is permitted.**

1. Answer **Any Four** :

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- (i) Simple carburetor
- (ii) Psychrometric chart and processes
- (iii) Compare open cycle and close cycle gas turbine plant
- (iv) Advantages of multistage compression
- (v) Comfort air-conditioning
- (vi) Vapour absorption refrigeration system

2. (a) A simple constant pressure gas turbine operates at a pressure ratio 5:1 and the turbine inlet temperature is 580°C . The air inlet temperature is 15°C and the pressure is 1.01325 bar. The compressor has adiabatic efficiency of 80%. What must be the adiabatic efficiency of the turbine in order that the overall cycle efficiency will be 18%?. Assume C_p for air to be 1.005kJ/kgK and C_p for combustion gases 1.093kJ/kgK . Take R to be 0.287kJ/kgK for both air and combustion gases.

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(b) An exterior wall of a house consists of a 10.16cm layer of common brick having thermal conductivity 0.7W/mK . It is followed by a 3.8cm layer of gypsum plaster with thermal conductivity of 0.48W/mK . What thickness of loosely packed Rockwool insulation ($k = 0.065\text{W/mK}$) should be added to reduce the heat loss through the wall by 80%.

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TURN OVER

3. (a) A vapour compression refrigeration cycle operates between the condensation temperature of 20°C and evaporator temperature of -10°C with CO_2 as refrigerant. Temperature after isentropic compression is 40°C and condensate leaves at 10°C before being passed through expansion valve. Dry and saturated vapour enters the compressor. Determine COP of system and mass flow rate of CO_2 required to get refrigeration effect of 2kW . Properties of CO_2 are given as under : 10

T_{sat} $^{\circ}\text{C}$	P_{sat} bar	V_g m^3/kg	H_r kJ/kg	H_g kJ/kg	S_r kJ/kgK	S_g kJ/kgK	C_{p1} kJ/KgK	C_{pg} kJ/KgK
20	57.27	-	144.11	299.62	0.523	1.0527	2.889	2.135
-10	26.49	0.014	60.78	322.28	0.2381	1.2324	-	-

- (b) 2kg/s of air enters the L P cylinder of a two stage, reciprocating compressor. 10
The overall pressure ratio is 9. The air at inlet to compressor is at 100kPa and 35°C . The index of compression in each cylinder is 1.3. Find intercooler pressure for perfect intercooling. Also, find the minimum power required for compression and percentage saving over single stage compression.
4. (a) A two stroke cycle, 21cm bore and 28cm stroke, single cylinder oil engine 12
gives the following results on test :
- Speed = 350 rpm
 Net brake load = 620N
 Diameter of brake drum = 1m
 Oil consumption = 4.25 kg/hr
 I.m.e.p. = 275 kN/m^2
 Heating value of fuel used = 43000 kJ/kg
 Air fuel ratio by weight = 32
 Temperature of exhaust gases = 370°C
 Temperature of air in test room = 20°C
- Calculate : indicated power, brake power, indicated thermal efficiency, brake thermal efficiency and % heat lost to exhaust. Assume mean C_p for the exhaust gases as 1 kJ/kgK . State Fourier's Law of Heat Conduction and explain significance of each term.

TURN OVER

- (b) Also explain Newton's Law of cooling. 8
5. (a) 500kg of sulphuric acid is cooled per hour from 70°C to 30°C in a counter flow (a) double pipe heat exchanger with the use of 400kg of water per hour available at 20°C. Using the following data find area of heat exchanger required. Specific heat of sulphuric acid is 3.36 kJ/kgK. Convective heat transfer coefficient of water side is 500W/m²K and that of sulphuric acid side is 400 W/m²K. Neglect the resistance of the tube and assume there is no loss of heat in the system. 10
- (b) Explain significance of volumetric efficiency and derive an expression for calculating the same for an air compressor. 10
6. (a) The following data refers to a single cylinder four stroke petro engine : 10
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|-------------------------|---------------|-------------|
| Compression ratio | = 5.6 | |
| Mechanical efficiency | = 80% | |
| Bsfc | = 0.37kg/kWh | Assume γ.p. |
| Calorific value of fuel | = 44000 kJ/kg | |
| Adiabatic index for air | = 1.4 | |
- Find brake thermal efficiency, indicated thermal efficiency, air standard efficiency, relative efficiency wrt indicated thermal efficiency and relative efficiency wrt brake thermal efficiency.
- (b) Explain the working of a battery ignition system and Valve timing diagram. 10