M.Tech. Regular-Semester 2012-Heat Power Engineering Sem II

MT-1018 - Thermal Engineering - II

P. Pages : 3 **GUG/W/16/3966**

Time : Three Hours * 3 6 4 8 * Max. Marks : 70

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
5. Answer **any five** questions.

1. a) Describe with a neat sketch the working of a simple constant pressure open cycle gas turbine. How does actual cycle differ from the theoretical cycle. **7**

b) The pressure ratio of an open cycle constant pressure Gas turbine plant is 06. The temperature range of the plant is 15ºC and 800ºC. Using the following data: $c_{p_a} = 1\ kJ/kgk$, $c_{p_g} = 1.075\ kJ/kgk$ & $\gamma = 1.4$ for air & gas. c.v. of fuel = 43000 kJ/kg; $\eta_c = 0.85$; $\eta_1 = 0.8$ and $\eta_{comb} = 0.95$ Find **7**

i) The thermal efficiency of the plant.

ii) I.P. of the plant if the circulation of air is 5kg/sec.

iii) A.F. ratio and

iv) Specific fuel consumption

2. a) Explain optimum pressure ratio for maximum cycle thermal efficiency for constant pressure closed cycle Gas turbine. **5**

b) The following data apply to a gas turbine set using Heat exchanges **9**
Isentropic efficiency of compressor = 0.83
Isentropic efficiency of turbine = 0.85
Mechanical transmission efficiency = 0.99
Combustion efficiency = 0.98
Heat Exchanger effectiveness = 0.80
Pressure ratio = 4.0
Maximum cycle temperature = 1100 k
Ambient conditions = 1 bar and 288k
Lower heating value of fuel = 43100 kJ/kg
Take $c_{p_a} = 1.005\ kJ/kg\,k$; $\gamma = 1.4$ during compression

$c_{p_a} = 1.147\ kJ/kg\,k$; $\gamma = 1.3$ during combustion & expansion

Calculate the specific work output; specific fuel consumption and cycle efficiency Neglect the losses.

3. a) Why the method of obtaining friction power by computing the difference between indicated power and brake power is mostly used in Research Laboratories. **7**

b) The following data were recorded during a trial on a single cylinder 2-stroke diesel engine. Power supplied by electric motor for motion at a rated speed = 1.5kw; Rated speed = 500rpm; Net load on brake = 225N; Diameter of brake wheel = 100cm; Rate of cooling water through engine jacket = 13.65 kg/min; Rise in temperature of cooling water = 10ºC; fuel consumption = 2 kg/hr; c.v. of fuel = 43000 kJ/kg; Air fuel ratio = 32:1 $c_{p_g} = 1.0\ kJ/kg\,k$; Exhaust gas temperature = 345ºC; Ambient temperature = 25ºC & Ambient pressure = 1 bar. Take L = D = 30 mm **7**
Determine :

i) Mechanical efficiency ii) Thermal efficiency

iii) Brake specific fuel consumption iv) Brake mean effective pressure

Draw a Heat balance sheet on percentage basis.

4. a) With the help of neat figure; Explain in detail the Exhaust Gas Calorimeter. **7**

b) The following data were obtained from a test on a single cylinder 4-stroke oil engine. **7**
Cylinder bore = 15cm; stroke 25 cm;
Area of indicator diagram = 450 sq.mm;
Length of indicator diagram = 50mm;
Indicator spring rating = 1.2mm for a pressure of $9.80\ N/m^2$; Engine speed = 400 rpm.
Brake Torque = 225 Nm
Fuel consumption = 3 kg/hr; c.v. of fuel =44200 kJ/kg;
cooling water flow rate = 4 kg/min; cooling water
Temp. rise = 42ºC; specific heat of cooling water = 4.18 kJ/kgk
Compute :

i) Mechanical efficiency

ii) Brake thermal efficiency

iii) Specific fuel consumption

iv) Draw Heat balance sheet in kw

5. a) Name the three basic types of Accumulators. Which type of accumulator operates at constant pressure. How can the pressure be changed. **7**

b) Explain with neat sketch Hydraulic circuit for the planning machine. **7**

6. a) Design a circuit using the standard symbols, showing how to obtain two different pressure in a pneumatic circuit. **7**

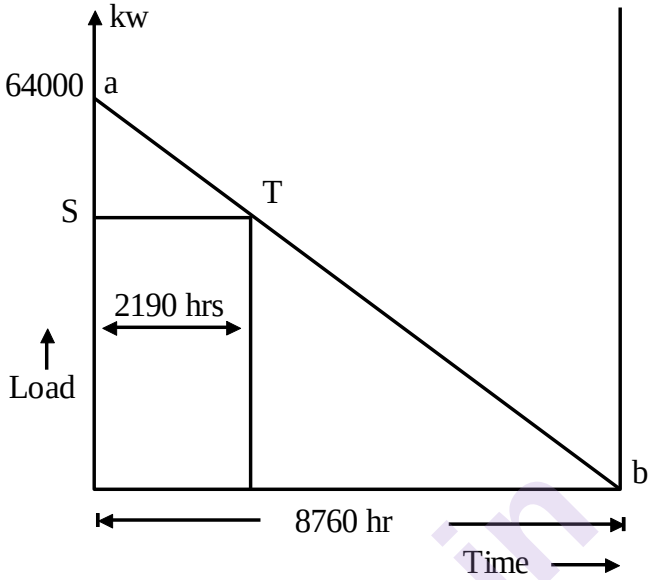
b) Explain any one Industrial Application of pneumatic system with diagram. **7**

7. a) Explain 'Economic Analysis of Power Plants". **7**

b) The Annual load duration curve of a station varies uniformally from 64000kw to zero. The load is supplied by two stations whose cost equations are given as: **7**

C_1 = Rs.(840000 + 840 kw + 0.116 kwh)

C_2 = Rs.(50000 + 440 kw + 0.2955 kwh)



Find the maximum cost of Generation in Rs./kw hr for the system.

8. a) What are the effects of variable load on the power plants design and operation. **7**

b) Determine the load factor at which the cost of supplieng a unit of electricity is same in Diesel station as in a steam station its the respective annual fixed and running charges are given below: **7**

Diesel Rs. (300/kw + 0.5/kwh)

Steam Rs. (1200/kw + 0.125/kwh)

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