BTS (C) – V(S) – 06.12 – 042 – M

B.Tech Degree V Semester Special Supplementary Examination June 2012

ME 504 THERMAL ENGINEERING

(*2006 Scheme*)

Time : 3 Hours Maximum Marks : 100

PART A

(Answer *ALL* questions)

(8 × 5 = 40)

I. (a) Mention merits and demerits of Stirling and Ericson cycle.

(b) Define the mean effective pressure. What is its importance in reciprocating engine?

(c) Discuss the limitations of super charging spark ignition engine.

(d) What do you mean by preignition and after burning?

(e) Explain the physical concept of critical pressure ratio. How does it limit the mass flow rate through the nozzle?

(f) List the effect of friction on turbine blades.

(g) Explain with neat sketch closed cycle gas turbine plant.

(h) Draw the h-s diagram of a gas turbine with intercooling and reheating.

PART B

(4 × 15 = 60)

II. Draw and discuss the actual cycle and valve timing diagram of a four stroke spark ignition engine.

OR

III. The oil consumption of a 30kw four stroke engine working on the four stroke cycle is measured by means of a circular orifice of diameter 3.8cm. The coefficient of discharge for the orifice is 0.6 and the pressure across the orifice is 14.5 cm of water. The barometer reading is 75cmg Hg and the air temperature is 24°C. The swept volume of the engine cylinder is 2210cm^3 and the compression ratio is 6.4. The consumption is 0.13 kg/min and the engine speed is 2500 rpm. The calorific value is 44000 KJ/kg. Determine:

(a) Air fuel ratio

(b) $\eta_{volumetric}$

(c) P_m(Brake)

(d) $\eta_{relative}$

IV. Explain with the help of neat sketches, open chamber and divided combustion chamber. Which one gives higher thermal efficiency?

OR

V. Explain the thermodynamic cycle with super charging. What are the practical limits of super charging in C-I engines?

(P.T.O)

VI. (a) Dry saturated steam enters a nozzle at a pressure of 10 bar and velocity of 100m/sec. The discharge pressure is 5 bar and discharge velocity is 500 m/sec. Heat loss from the nozzle is 5 KJ/kg. Determine the final dryness fraction of the steam.

(b) Prove that the maximum flow rate per unit area through the nozzle occurs when the ratio of pressure at throat to inlet pressure is equal to $\left(\frac{2}{n+1}\right)^{n/(n-1)}$, where n = Isentropic index of expansion.

OR

VII. Steam issues from the nozzles of a De Laval turbine with a velocity of 1000 m/sec. The nozzle angle is 20°. Mean blade velocity is 400 m/sec. The blades are symmetrical. The mass flow rate is 1000 kg/hr. Friction factor is 0.8. $m_{nozzle} = 0.95$.

Determine:

(i) Blade angles
(ii) Axial thrust on the rotor turbine
(iii) Work done per kg of steam
(iv) Power developed
(v) Blade efficiency
(vi) Stage efficiency

VIII. In a closed cycle gas turbine, the following data apply:

Working substance = oil Cp = 1KJ/kg. $r = 1.4$
Ampient temperature = 27°C
Top temperature = 823°C
Pressure at compression inlet = 1 bar
Pressure ratio = 4, compression efficiency = 80%
Turbine efficiency = 85%
Heating value of fuel – 41800 kJ/kg.
Heater loss = 10% of heating value.

Find the following:

(i) Compressor work kJ/kg.
(ii) Heat supplied
(iii) Turbine work
(iv) Thermal efficiency
(v) Air fuel ratio
(vi) Specific fuel combustion

OR

IX. With the help of neat sketches explain the various types of combustion chambers of a gas turbine.

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