(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0207 Roll No. 0 0 2 7 2 1 0 5 4

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10
THERMAL & HYDRAULIC MACHINES

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Answer **all** questions.*

(2) Use of Steam Tables and Mollier Chart is permitted.

*(3) Assume missing **data suitably**, if any and state the assumptions made.*

1 Answer any **four** of the following : 5×4=20

(a) What are the limitations of first law of thermodynamics? State two statements of second law of thermodynamics.

(b) Determine the heat supplied to 1 kg of steam at 20 bar, 0.9 dry so as to make its temperature as 300°C. The heating occurs reversibly at constant pressure.

(c) Explain reheat vapour power cycle using T-s diagram.

(d) Define entropy and also show that it is a property.

(e) What do you understand by thermodynamic equilibrium? Explain.

(f) Determine thermal efficiency of a Carnot cycle working on pressure limits of 10 MPa and 10 kPa for steam as working fluid in it.

2 Answer any **two** of the following : **10×2=20**

(a) A gas turbine runs at pressure ratio of 8 with the maximum temperature limited to 1100 K in cycle. The isentropic efficiency of turbine is 90% and isentropic efficiency of compressor is 85%. Determine the work done and cycle efficiency if the air enters the compressor at 15°C. Also find the cycle efficiency and back work ratio if a regenerator is fitted with efficiency of 75%. Show the cycle on T-s diagram.

(b) Obtain the mathematical condition for maximum blade efficiency in case of a single stage impulse turbine.

(c) Write short notes on the following : **2.5×4**

(i) Reheat factor

(ii) Polytropic efficiency

(iii) Intercooling in gas turbines

(iv) Difference between impulse and reaction turbines.

3 Answer any **two** of the following : **10×2=20**

(a) A single acting, single cylinder air compressor of 200 mm bore by 250 mm stroke is constructed such that its clearance can be altered by moving

the cylinder head, the stroke being unaffected. Calculate the FAD at 300 rpm when the clearance volume is set at 700 cm^3 and delivery pressure 5 bar. Assume that n=1.25 and suction pressure and temperature are 1 bar and 32°C respectively. Also find the power required assuming mechanical efficiency of 80%. Free air conditions are 1.013 bar and 15°C.

(b) A four stroke gas engine has cylinder bore 30 cm and piston stroke 37.5 cm. Find indicated power, brake power, mechanical efficiency and indicated thermal efficiency for the following observations of test during 45 minutes.

Engine revolution : 9450

Engine explosions : 3600

Net load on brake : 900 N

Effective brake radius : 80 cm

Indicated mean effective pressure : 600 kPa.

Gas used : 9 m^3

Pressure of gas : 150 mm of water gauge

Temperature of gas : 300 K

Atmospheric pressure : 75 cm of mercury

Calorific value of gas : 18.5 MJ/m^3.

Mass of cooling water in jacket : 200 kg

Rise in cooling water temperature : 50°C.

(c) Write short notes on the following : 2.5×4

(i) Stalling

(ii) Indicator diagram

(iii) Spark ignition engine

(iv) Isothermal efficiency.

4 Answer any **two** of the following : **10×2=20**

(a) A water jet of 20 m/s impinges on a concave shaped blade to deflect water jet by 110° when it is stationary. At what angle should the jet strike so that there is no shock at exit if blade is moving with 8 m/s velocity. Also find the work done per kg of water.

(b) Describe the components of a reaction turbine in detail.

(c) Differentiate between impulse turbine and reaction turbine.

5 Answer any **four** of the following : **5×4=20**

(a) Explain the working of a centrifugal pump with its neat sketch.

(b) Describe the principle of operation of jet pump.

(c) What do you understand by cavitation? Explain.

(d) Discuss physical significance of slip in pumps.

(e) Describe the utility of air vessel in reciprocating pumps.

(f) Enlist the different types of casings for impeller and centrifugal pump.
