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

PAPER ID : 3989 Roll No. | | | | | | | | | | |

B.Tech.

(SEM IV) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

APPLIED THERMODYNAMICS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Use of **steam tables** and **mollier charts** is **permitted**.*

(ii) Make suitable assumptions in case of missing data, if any and state the assumption made.

(iii) Use illustrations wherever required.

*(ii) Attempt **all** questions.*

1. Attempt **any four** of following : **(4x5=20)**

(a) What are Maxwell relations ? Discuss significance briefly.

(b) A steam turbine has steam entering at 50 bar, 500°C and leaving at 0.1 bar, 0.9 dry with flow rate of 3×10^4 kg/hr. Find the loss of available energy.

(c) Define Joule - Thomson coefficient. Also explain the significance of inversion curve.

(d) Determine the air-fuel ratio of C_3H_8 with 150 percent theoretical air supplied.

(e) Differentiate between proximate and ultimate analysis and their relevance.

(f) Define adiabatic flame temperature and isothermal compressibility.

2. Attempt **any two** of the following : (10x2=20)

(a) A boiler has equivalent evaporation of 1400 kg/hr from and at 100°C. Fuel consumption per hour is 160 kg/hr and boiler efficiency is 75%. Determine the actual evaporation if feed is supplied at 110°C to generate steam at 100 kg/m^2 per hour and 15 bar, 200°C. Also find the calorific value of coal burnt and grate area.

(b) Give a neat sketch of a fire tube boiler with complete labelling of mountings and at least three accessories.

(c) Give the classification of condenser. Describe the working of any one and how air leakage effects the performance of condensor ?

3. Attempt **any two** of the following :

(a) (i) A Steam nozzle has steam entering at 6 bar, 300°C and expansion occurs upto steam pressure of 1.5 bar. Determine the nozzle efficiency for mass flow rate of 5 kg/s and nozzle exit area of 6.8 cm^2. 8

(ii) Define the discharge coefficient and critical velocity of nozzle. 2

(b) (i) Explain saturation curve and missing quantity of steam of steam engines. 5

(ii) Explain over expansion and under expansion in nozzles. 5

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(c) A two cylinder double acting compound steam engine has following specifications : 10

Equal power is developed in both cylinders and expansion is hyperbolic.

Stroke of each cylinder : 50 cm

Indicated power output : 228 kW

Speed : 270 rpm

Steam admission pressure : 12 bar

Steam exhaust pressure : 0.28 bar

Total expansion ratio : 10

Neglecting clearance volume determine the diameters of HP and LP cylinders.

Attempt **any two** of the following :

(a) (i) Explain the working of gas/steam combined cycle. 5

(ii) Explain the cogeneration system and its significance. 5

(b) Steam at 70 bar and 450°C is supplied to a steam turbine. After expanding to 25 bar in high pressure stages, it is reheated to 420°C at the constant pressure. Further it is expanded in intermediate pressure stages to an appropriate minimum pressure so that the part of steam bled at this pressure heats feed water upto temperature of 180°C. Left out steam is expanded in low pressure stage upto pressure of 0.075 bar. For isentropic efficiency of each stage being 0.8 find the minimum pressure at which bleeding takes place. Also find the cycle efficiency and quantity of steam bled per kg of flow at turbine inlet, neglecting pump work. Also give layout. 10

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(c) An impulse steam turbine of 180 kW has steam flowing at rate of 165 kg/min and leaving axially. Steam turbine blade speed is 175 m/s and it leaves nozzle at 400 m/s. For the blade velocity coefficient of 0.9 find nozzle angle, blade angles at inlet and exit, axial thrust and diagram efficiency. 10

5. Answer **any four** of the following : (4x5=20)

(a) Define polytropic efficiency and its significance for turbine using its mathematical expression.

(b) Obtain optimum pressure ratio condition for minimum compressor work requirement in two stage perfect inter cooled compression.

(c) Show the influence of reheating and regeneration on performance of gas turbine cycle.

(d) Discuss the working of turbo prop and ramjet engines.

(e) Explain the principle of rocket propulsion.

(f) Define stage efficiency for compressor stage. Also discuss its effect on overall performance of compressor.

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