Printed Pages : 4

ME403

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

PAPER ID : 140407

Roll No. | | | | | | | | | | |

B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15

APPLIED THERMODYNAMICS & MACHINE DRAWING II

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

NOTE : Use of 'Steam Table' is Permitted.

SECTION-A

1 Attempt ALL questions.: **2×10=20**

(a) What do you understand by "Heat of formation"?

(b) What do you understand by inversion curve?

(c) What is missing quantity of steam?

(d) What is metastable flow in nozzle?

(e) What is coefficient of volume expansion?

(f) Explain effect of nozzle friction.

(g) What is the polytropic efficiency?

(h) Explain reheat factor in steam turbine.

(i) What is Heat balance sheet for steam engine?

(j) Draw P-V & T-s diagram for Ranine cycle with Reheating and write its relation for efficiency.

SECTION- B

2 Attempt any THREE questions : **10×3=30**

(a) Explain Joule Thomson coefficient and show that the Joule Thomson coefficient for a perfect gas is equal to zero.

(b) The product of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by orsat apparatus, CO_2=8%, CO=0.9%, O_2=8.8% and N_2=82.3%.
Determine :

(i) composition of the fuel,

(ii) air fuel ratio

(iii) % of excess air used.

(c) The following result were obtained in a boiler trial: feed water per hour = 700 kg at 27°C; steam produced at 8 bar, 0.97 dry; coal used = 100kg/hr or C.V of 25000 kJ/kg. Ash and Unburned coal collected from beneath the grate bars = 7.5 kg/hr of C.V of 2000 kJ/kg, Mass of flue gases produced per kg of fuel= 17.3kg. Flue gas temperature 3270C, temperature of air in the room= 160C, specific heat of flue gases= 1.025 kJ/Kg hr. Draw the energy balance on minute basis. What is the boiler efficiency?

(d) What is the mass flow rate per unit area through nozzle? Find the condition for the Max. Mass flow rate.

(e) Steam at a pressure of 14 bar and dryness fraction of 0.9 is discharged through a convergent – divergent nozzle up to a back pressure of 0.2 bar. The mass flow rate is 10 kg/kW-hr when the power developed is 250 kW. Determine the throat pressure and no. of nozzles required if each nozzle has a throat area of 32×10^{-6} m^2. If 10% of overall enthalpy drop occurs in the divergent portion due to friction, find the exit area of the nozzle.

SECTION-C

3 Attempt any FIVE questions : **10×5=50**

(a) Steam enters a nozzle at a pressure of 10 bar and 200°C. the back pressure is maintained at 1 bar. The expansion is under metastable conditions up to the throat and further it expands under thermal equilibrium. For unit mass flow rate find (1) throat pressure (2) Exit Area (3) Degree of under cooling (4) Degree of super saturation.

(b) In a regenerative feed heating cycle, the steam enters the turbine at 25bar and 250°C. The condenser pressure is 0.05 bar. The steam is bled off for feed water heating for a closed heater at 3.5bar and for an open heater at 0.7bar. The condensate of the closed heater is discharged into the low pressure open heater. Calculate the thermal efficiency of the cycle. Neglect the pump work. Also, determine the corresponding efficiency of the Rankine cycle.

(c) Explain both the combined power cycles with neat schematic diagram and T-S diagrams.

(d) In a delaval (impulse) turbine the steam issues from the nozzles with a velocity of 800 m/sec at the nozzle angle of 20°. The mean blade speed is 350 m/sec. the blades are equiangular. The mass flow rate is 1000 kg/min. the friction factor is 0.8. Determine (1) Blade angles (2) Axial thrust (3) Power Developed (4) blade efficiency (5) Stage efficiency.

(e) Explain the methods of improving the thermal efficiency and work output of Rankine cycle.

(f) A simple gas turbine admits air at atm pressure and 15°C. and compresses air in the compressor up to 16 bar. Then the air enters the combustion chamber and is heated to a max. Temp. of 1350° C. further it enters the turbine and expands to atm pressure. The isentropic efficiency of compressor and turbine is 0.85. Combustion efficiency is 0.98. Determine mass flow rate of air for a net power developed of 200 MW.

(g) Draw a neat labeled sketch of a Fire-tube boiler, and explain its working. Also compare the water tube boiler and fire tube boiler.

(h) With the help of Enthalpy-Entropy and schematic diagrams explain the difference between the working of a propeller turbine and a jet turbine. Derive expressions for specific thrust, thermal efficiency, propulsive efficiency for a jet plane.

(i) Draw the velocity diagram of a compounded impulse and 50% reaction turbine stage. Find out the expression for tangential force, axial force, blade efficiency, and stage efficiency for both the impulse and reaction turbines.