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

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B. TECH.

(SEM. IV) (EVEN SEM.) EXAMINATION, 2013

APPLIED THERMODYNAMICS

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

Note : Attempt all questions. Assume any missing data suitably. All questions carry equal marks. Steam tables are allowed.

1 Attempt any four of the following : 5×4

(a) Why do the isobars on Mollier diagram diverge from one another?

(b) What are the important performance parameters of condenser?

(c) What is supersaturation? Under what conditions does it occur?

(d) Discuss the desirable characteristics of a working fluid in a vapor power cycle.

(e) Draw the schematic diagram of gas turbine plant with intercooling, reheating and regeneration and define the overall plant efficiency.

(f) A diesel engine has a compression ratio of 14 and cut off takes place at 6% of the stroke. Find the air standard efficiency.

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2 Attempt any two of the following : 10×2

(a) What is boiler? Give boilers classification and explain the working of fire tube and water tube boilers.

(b) A steam boiler initially contains 5 m^3 of steam and 5 m^3 of water at 1MPa. Steam is taken out at constant pressure until 4 m^3 of water is left. What is the heat transferred during the process?

(c) In a gas turbine plant, air enters the L.P. compressor having a pressure ratio of 3.5 and efficiency 0.85 at 1 bar and 300 K. It enters the intercooler where it is cooled down to 310 K. The cooled air is further compressed in the H.P. compressor also having a pressure ratio of 3.5 and an efficiency of 0.85. It enters the regenerator having an effectiveness of 0.8. The gases coming out of the combustion chamber enter the H.P. turbine of efficiency 0.88 at 1100 K. The H.P. turbine drives the compressor and there is a reheater between the two turbines. The gases enter the L.P. turbine at 1050 K and the exhaust gases coming out of L.P. turbine of 0.88 efficiency are used to heat the air in regenerator before leaving to the atmosphere. Determine : (a) the power output, and (b) the overall efficiency of the plant. Take c_p for air as 1.005 and for gases as 1.15 kJ/kgK, and γ for air as 1.4 and for gases 1.33.

3 Attempt any two of the following : 10×2

(a) Give the flow and T-s diagrams of the ideal regenerative cycle. Why is the efficiency of this cycle equal to Carnot efficiency? Why is this cycle not practicable?

(b) Explain different types of compounding in steam turbines with the help of neat sketches.

(c) A convergent-divergent nozzle has a throat area 500 mm^2 and an exit area of 1000 mm^2. Air enters the nozzle with a stagnation temperature of 360 K and a stagnation pressure of 1MPa. Determine the maximum flow rate of air that the nozzle can pass, and the static pressure, static temperature, Mach number and velocity at the exit from the nozzle, if (a) the divergent section acts as a nozzle, and (b) the divergent section acts as a diffuser.

4 Attempt any two of the following : 10×2

(a) Draw the phase equilibrium diagram on p-v coordinates for a substance which shrinks in volume on melting and then for a substance which expands in volume on melting. Indicate there on the relevant constant property lines

(b) What are boiler mounting and accessories? Explain any two mountings and two accessories in detail.

(c) A cyclic steam power plant is to be designed for a steam temperature at turbine inlet of 360°C and an exhaust pressure of 0.08 bar. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition.

5 Write short notes on any four of the following : 5×4

(a) Comparison of Rankine and Carnot cycle.

(b) Triple point, critical point and saturation point.

(c) Governing of turbines.

(d) Deviation of actual gas turbine cycle from ideal cycles.

(e) Principle of rocket propulsion.

(f) Losses in steam turbines.
