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B. TECH.

(SEM IV) THEORY EXAMINATION 2018-19

APPLIED THERMODYNAMICS & MACHINE DRAWING-II

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

Note: 1. Attempt all Sections anduse of steam table is permissible.
2.If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. State the Maxwell relations.
b. Define adiabatic flame temperature.
c. State the Dalton's law of partial pressure.
d. Differentiate between artificial draught and natural draught.
e. Define diagram factor.
f. Write the continuity equation for nozzles.
g. What are the factors affecting the efficiency of Rankine cycle?
h. How the leakage occur in steam turbines are prevented?
i. Why water injection is used in gas turbine power plants?
j. What are the advantages of turbojet engines?

SECTION B

2. Attempt any *three* of the following: 10x3=30

a. (i) Methane is burned with dry air. Find the theoretical air fuel ratio for complete combustion and dew point temperature of products of combustion.
(ii) Differentiate between mass fraction and mole fraction.
b. How the boilers are classified? Discuss the working of locomotive boiler with the help of neat sketch.
c. Explain clearly what do you mean by saturation curve and missing quantity. Suggest the way by which missing quantity is reduced.
d. Steam flows from nozzle of a single row impulse turbine with a velocity of 450 m/s at a direction which is inclined at an angle of 16° to the blade velocity. Steam comes out of the moving blade with a velocity of 100 m/s in the direction of 110° with the blade velocity. The blades are equiangular. Steam flow rate is 6 kg/s. Determine the power developed by the wheel and power loss due to friction.
e. What are the assumptions are taken in the analysis of ideal cycle? Derive an expression for air standard efficiency of ideal Brayton cycle in terms of pressure ratio.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

a. An ice skate is able to slide over the ice because the skate blade exerts sufficient pressure on ice that a thin layer of ice is melted in water layer. Determine the pressure an ice skate blade exert to allow smooth ice skate at - 10°C. Take:
Latent heat of fusion of ice = 334 kJ/kg
Specific volume of water = 1×10^{-3} m^3/kg
Specific volume of ice = 1.01×10^{-3} m^3/kg.
b. A sample fuel has the following percentage composition by weight carbon = 84%, hydrogen = 10%, oxygen = 3.5%, nitrogen = 1.5% and ash = 1%.
(i) Determine the stoichiometric air fuel ratio by mass.
(ii) If 20% excess air is supplied, find percentage composition of dry fuel gas by volume.

4. Attempt any *one* part of the following: 10 x 1 = 10

a. Explain the function and working of the following:
   (i) Superheater
   (ii) Air preheater
   (iii) Blow-off cock
   (iv) Spring loaded safety valve

b. A boiler has equivalent 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 of grate area and at 15 bar, 200°C. Also find the calorific value of coal burnt and grate area.

5. Attempt any *one* part of the following: 10 x 1 = 10

a. In a single cylinder double acting steam engine, steam is supplied at a pressure of 12 bar and exhaust takes place at 1.1 bar. The cut-off takes place at 40% of stroke. If the stroke is equal to 1.25 times the cylinder bore and the engine develops an indicated power of 100 kW at 90 rpm. Calculate the bore and stroke of the engine, assuming hyperbolic expansion and a diagram factor of 0.8. Also, determine the theoretical consumption in m^3/min.

b. In case of stem nozzles, show that the pressure ratio of steam at throat to inlet is given by the equation, $\frac{p_t}{p_1} = \left(\frac{2}{n+1}\right)^{n/(n-1)}$ under maximum mass flow rate conditions.

6. Attempt any *one* part of the following: 10 x 1 = 10

a. In a steam power plant boiler pressure is 60 bar and condenser pressure are 0.07 bar. The steam temperature at the boiler outlet is 550°C. Determine the following:
   (i) Turbine work per kg
   (ii) Heat transfer in condenser per kg
   (iii) Cycle efficiency
   (iv) Mass flow rate of steam to produce 5 MW

b. Define the following terms related to turbine:
   (i) Blade efficiency
   (ii) Stage efficiency
   (iii) Blade velocity coefficient
   (iv) Carry over coefficient

7. Attempt any *one* part of the following: 10 x 1 = 10

a. Find the required air fuel ratio in a gas turbine whose turbine and compressor efficiency are 85% and 80% respectively. Maximum cycle temperature is 875°C. The working fluid can be taken as air which enters the compressor at 1 bar pressure and 27°C. The pressure ratio is 4. Calorific value of fuel is 42000 kJ/kg. There is a loss of 10% of calorific value in the combustion chamber.

b. Derive an expression for Thrust power, Propulsive power, Propulsive efficiency, Thermal efficiency and overall efficiency for a jet plane.