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Name of Examination : **Winter 2020** - (Preview)

Course Code & Course Name : **ME202U - Thermodynamics**

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Maximum Marks : **60**   Duration : **3 Hrs**

[Edit] [Print] [View Answer Key] [Close] **Answer Key Submission Type:** Marking scheme with model answers and solutions of numerical

Instructions:

1. *All questions are compulsory.*
2. *Illustrate your answer with suitable figures/sketches wherever necessary.*
3. *Assume suitable additional data; if required.*
4. *Use of logarithmic table, drawing instruments and non programmable calculators is allowed.*
5. *Figures to the right indicate full marks.*

1)   **Instruction (Solve all sub-question)**

a) Differentiate between microscopic and macroscopic point of view.   [3]

b) Write the statements of 'Second law of thermodynamics'   [3]

c) The efficiency of a carnot cycle rejecting heat to a cooling pond at 28°C is 30%.If the cooling pond receives 1050 KJ/min of heat, What is the power developed by the cycle?   [6]
Find the temperature of the source.

2)   **Instruction (Solve all sub-question)**

a) Explain the terms i) Sensible heat & Latent heat   [3]
                ii) Dryness fraction   iii) Degree of superheat

b) Explain the terms i) Equivalent evaporation ii) Boiler efficiency   [3]

c) Steam is generated in a boiler at 30 bar 300°C at the rate of 11 kg/s with feed water entering economizer at 100°C. During one hour test 5000 kg fuel is used in boiler.   [6]
Calorific value of fuel is 35000 kJ/kg. For the feed water being supplied to boiler to be at 27°C determine;
(i) the equivalent evaporation per kg of fuel
(ii) the boiler efficiency
(iii) the percentage of fuel energy utilized in economizer

3)   **Instruction (Solve any two sub-question)**

a) A steam turbine plant operates on Rankine cycle with steam entering turbine at 40 bar, 350°C and leaving at 0.05 bar. Steam leaving turbine condenses to saturated liquid   [6]
inside condenser. Feed pump, pumps saturated liquid into boiler. Determine the net work per kg of steam and the cycle efficiency assuming all processes to be ideal. Also
show cycle on T-s diagram. Also determine pump work per kg of steam considering linear variation of specific volume.

b) In a surface condenser the vacuum at inlet is seen to be 72 cm Hg and at outlet it is 73 cm Hg. The barometer reading is 76 cm and the dryness fraction of steam at inlet is   [6]
0.92. Cooling water entering the condenser is at 20°C. Considering no air in the condenser and the temperature rise in cooling water to be maximum, Determine.
(i) the minimum amount of undercooling.
(ii) the amount of cooling water required per kg of steam.

c) i) Discuss the effect of air leakage upon the performance of condenser.   [6]
ii) Explain the terms ' condenser efficiency' and 'vacuum efficiency'

4)   **Instruction (Solve any two sub-question)**

a) Prove that the maximum discharge of fluid per unit area through a nozzle shall occur when the ratio of fluid pressure at throat to the inlet pressure is $(2/n + 1)^{n/n-1}$ [6]
   where n is the index of adiabatic expansion.

b) Steam is expanded reversibly and adiabatically in a nozzle from 13 bar and 150°C to a pressure of 6 bar. The inlet velocity of the nozzle is very small and the process occurs   [6]
under steady flow conditions. Calculate the exit velocity of the nozzle.

c) i) Explain the significance of choked flow.   [6]
ii) Describe the 'over expansion' and 'under expansion' in nozzles.

5)   **Instruction (Solve any two sub-question)**

a) Prove that the volumetric efficiency of a single stage compressor is given by   [6]
$$\eta_v = 1 - \frac{v_c}{v_s}\left[\left(\frac{p_2}{p_1}\right)^{\frac{1}{n}} - 1\right]$$

b) i) What is a rotary compressor ? How rotary compressor are classified ?   [6]
ii) Compare 'Reciprocating and rotary compressor'

c) Determine the size of the cylinder of a double acting air compressor of 32 KW I.P. in which air is drawn in at 1 bar and compressed to 16 bar according to the law   [6]
$pv^{1.25} = C$,   R.P.M.=300,Piston speed = 180 m/min, Volumetric efficiency = 0.8

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