

**Indian Maritime University**  
(A Central University, Government of India)  
**June/July 2019 End Semester Examinations**  
**B.Tech. (Marine Engineering)**  
**Semester- III**  
**Applied Thermodynamics-II (UG11T1303 / UG11T2303)**

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Date:13.07.2019

Maximum marks: 100

Time: 3 Hrs

Pass Marks: 50

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**PART A**

**Q1) Answer all the questions**

**[3x10=30 marks]**

- a) What is stoichiometric combustion?
- b) Explain the effect of dissociation on I.C. engine
- c) Explain the critical condition of nozzle.
- d) Define Mach number.
- e) Define Impulse-Reaction turbine.
- f) What is compounding of Impulse-Reaction turbine?
- g) Explain effect of friction on turbine blades.
- h) Define Tones of refrigeration.
- i) Define Fourier's law of heat conduction
- j) Explain free and forced convection.

**PART-B**

**Answer any five of the following**

**[14x5=70 marks]**

**Q2)**

A single cylinder was supplied with a gas having the following percentage volumetric analysis; CO=5, CO<sub>2</sub>=10, H<sub>2</sub>=50, CH<sub>4</sub>=25, N<sub>2</sub>=10, The percentage volumetric analysis of dry gases was CO<sub>2</sub>=8, O<sub>2</sub>=6 and N<sub>2</sub>=86. Determine air fuel ratio by volumes.

**[ 14 marks ]**

**Q3 )** Two slabs each 120 mm thick have thermal conductivities of 14.5 W/m<sup>0</sup>C and 210 W/m<sup>0</sup>C. These are placed in contact, but due to roughness only 30 percent of area is in contact and gap in the remaining area is 0.025 mm thick and is filled with air. If the temperature of the face of the hot surface is at 220 <sup>0</sup>C and the outside side surface of other slab is at 30<sup>0</sup>C. Determine 1] Heat flow through the composite system. 2] The contact

resistance and temperature drop in contact. Assume that the conductivity of air is  $0.032 \text{ W/m}^0\text{C}$  and that half of contact ( of the contact area ) is due to either metal.

**[ 14 marks ]**

**Q 4)** The flow rate of hot and cold water streams running through a parallel flow heat exchanger are  $0.2 \text{ Kg/s}$  and  $0.5 \text{ Kg/s}$  respectively. The inlet temperatures on the hot and cold sides are  $75^0\text{C}$  and  $20^0\text{C}$  respectively. The exit temperature of hot water is  $45^0\text{C}$ . If the individual heat transfer coefficients on both sides are  $650 \text{ W/m}^2 \text{ }^0\text{C}$ , Calculate the area of heat exchanger.

**[ 14 marks ]**

**Q5)** A steel pipe with  $50 \text{ mm}$  outside diameter is covered with a  $6.4 \text{ mm}$  asbestos insulation [  $K = 0.166 \text{ W/mk}$  ] followed by a  $25 \text{ mm}$  layer of fiber glass insulation [  $K = 0.0485 \text{ W/mK}$  ]. The pipe wall temperature is  $393 \text{ K}$  and the outside insulation temperature is  $311 \text{ K}$ . Calculate the interface temperature between the asbestos and fiber glass.

**[ 14 marks ]**

**Q6 )** A simple vapour compression plant produces  $5$  tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor and at exit from the condenser are  $183.19, 209.41$  and  $74.59 \text{ KJ/Kg}$  respectively. Estimate 1] Refrigerant flow rate 2] The COP 3 ] The power required to drive the compressor 4] The rate of heat rejection to the condenser

**[ 14 marks ]**

**Q7 )** Consider a engine burning hydrogen and oxygen in combustion chamber at temperature and pressure are  $3571 \text{ K}$  and  $25 \text{ atm}$  respectively. The molecular weight of chemically reacting gas in the combustion chamber is  $16$  and index  $= 1.22$ . The pressure at the exit C-D Nozzle of engine is  $1.174 \times 10^2 \text{ atm}$ . The area of the throat is  $0.4 \text{ m}^2$ . Assuming calorically perfect gas Find 1] The exit Mach number 2] The exit velocity, 3] The mass flow rate through the nozzle, 4] The area of the exit

**[ 14 marks ]**

**Q8)** Derive a formula for speed of sound in terms of adiabatic index and temperature.

**[ 14 marks ]**