Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – April / May – 2017**

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| **Code :** | **14AE3003** | **Duration :** | **3hrs** |
| **Sub. Name :** | **THERMODYNAMICS AND HEAT TRANSFER** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. |  | The air speed of a turbojet engine in flight is 270m/s. Ambient air temperature is –15 oC. Gas temperature of outlet of nozzle is 600oC. Coresponding enthalpy values for air and gas are respectiely 260 and 912 kJ/kg. Fuel-air ratio is 0.0190. Chemical energy of the fuel is 44.5 MJ/kg. Owing to incomplete combustion 5% of the chemical energy is not released in the reaction. Heat loss from the engine is 21 kJ/kg of air. Calculate the velocity of the exhaust jet. | CO1 | 20 |
| (OR) | | | | |
| 2. |  | What is meant by quality of energy? Derive the expressions for exergy of a steady flow system. | CO1 | 20 |
| 3. | a. | Prove that | CO1 | 10 |
|  | b. | Derive Maxwell’s equations. | CO1 | 10 |
| (OR) | | | | |
| 4. |  | Explain the ways of entropy generation in closed system and open system. | CO2 | 20 |
| 5. |  | A wall is constructed of several layers. The first layer consists of masonry brick 20 cm thick of thermal conductivity 0.66 W/mK, the second layer consists of 3 cm thick mortar of thermal conductivity 0.6 W/mK, the third layer consists of 8 cm thick lime stone of thermal conductivity 0.58 W/mK and the outer layer consists of 1.2 cm thick plaster of thermal conductivity 0.6 W/mK. The heat transfer coefficient on the interior and exterior of the wall are 5.6 W/m2 K and 11 W/m2K respectively. Interior room temperature is 22o C and outside air temperature is – 5o C. Calculate (a) Overall heat transfer co-efficient (b) Overall thermal resistance (c) The rate of heat transfer and (d) The temperature at the junction between the mortar and the limestone. | CO2 | 20 |
| (OR) | | | | |
| 6. | a. | What is critical radius of insulation? Explain. | CO2 | 5 |
|  | b. | A steam pipe 10 cm inner diameter 11 cm outer diameter is covered with an insulating material (K=1W/mK). The steam temperature and the ambient temperatures are 200oC and 20oC respectively. If the convection heat transfer co-efficient between the insulating surface and air is 8W/m2K. Find the critical radius of insulation and the heat lost per meter of pipe for the value of rc. And also find the outer surface temperature. | CO2 | 15 |
| 7. | a. | The velocity distribution in the boundary layer is given by u/U = (3/2)(y/δ) – (1/2)(y2/δ2), δ is being boundary layer thickness. Calculate the ratio of momentum thickness to boundary layer thickness(θ/δ). | CO2 | 10 |
|  | b. | Air at 20o C and at atmospheric pressure flows over a flat plate at a velocity of 1.8 m/s. If the length of the plate is 2.2 m and is maintained at 100oC, calculate the heat transfer rate per unit width using exact and approximate methods. The prperties of air at mean bulk temperature 60oC are ρ = 1.06 kg/m3, Cp = 1.005 kJ/kgoC, k = 0.02894 W/moC, Pr = 0.696, υ = 18.97 x 10-6 m2/s. | CO2 | 10 |
| (OR) | | | | |
| 8. |  | Assuming sun to be black body emitting radiation at 6000 K at a mean distance of 12 x 1010 m from the earth. The diamter of the sun is 1.5 x 109 m and that of the earth is 13.2 x 106 m. Calculate the  (a) total energy emitted by the sun  (b) the emission received per m2 just outside the earth’s atmosphere (c) the total energy received by the earth if no radiation is blocked by the earth’s atmosphere  (d) the energy received by a 2 x 2 m solar collector whosed normal is inclined at 45o to the sun. The energy loss through the atmosphere is 50% and the diffuse radiation is 20% of direct radiation. | CO2 | 20 |
|  | | **Compulsory:** |  |  |
| 9. |  | A liquid oxygen is stored in double walled spherical vessel. Inner wall temperature is -160o C and outer wall temperature is 30 oC. Inner diameter of sphere is 20 cm and outer diameter is 32 cm. Calculate the following.   1. Heat transfer if emissivity of spherical surface is 0.05. 2. Rate of evaporation of liquid oxygen if its rate of vaporization of latent heat is 200 kJ/kg. | CO2 | 20 |