

Seat No.: _____
No. _____

Enrolment

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 712101N

Date: 01-12-2014

Subject Name: Applied Thermodynamics and Heat Transfer

Time: 10:30 am - 01:00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** What is Applied Thermodynamics? Explain in brief laws of thermodynamics. **07**
- (b)** Explain the following terms : **07**
(i) Exergy (ii) Irreversibility (iii) Entropy
- Q.2 (a)** Explain Modes of Heat transfer with suitable examples. Write short note on 'Significance of Heat transfer.' **07**
- (b)** With usual notations derive an expression for change in internal energy of gas obeying vanderwaal's equation. **07**
- OR**
- (b)** Derive the generalized equation for a fin. **07**
- Q.3 (a)** Explain in brief Clausius-Clapeyron equation, Joule Thomson coefficient and Maxwell relations. **09**
- (b)** A cylinder piston device contains 0.05 kg of steam at 1 MPa and 300°C. The steam now expands to a final state of 200 kPa and 150°C, during work. Heat losses from a system to the surroundings are estimated to be 2 kJ during this process. Assuming the surroundings to be at $T_0 = 25^\circ\text{C}$ and $P_0 = 100\text{ kPa}$. Calculate the availability of steam at the initials and the final states. **05**
- OR**
- Q.3 (a)** State and explain the following : **07**
(i) Nusselt number (ii) Grashof number (iii) Prandtl number
(iv) Lewis number
- (b)** Air at 10°C and at a pressure of 100 kPa is flowing over a plate at a velocity of 3 m/s. If the plate is 30 cm wide and at a temperature of 60°C, calculate the following quantities at $x = 0.3$. **07**
(1) Velocity boundary layer thickness
(2) Thermal boundary layer thickness
(3) Heat transfer from the plate.
- Q.4 (a)** With usual notations derive generalized two dimensional steady state heat conduction equation in semi-infinite plate when two boundaries are at zero temperature. **07**
- (b)** What are Heisler charts? Explain the significance of Heisler charts in solving transient conduction problems. **07**
- OR**
- Q.4 (a)** Explain the fluid flow along a flat plate **07**
1) Temperature distribution in thermal boundary layer
2) Velocity distribution in hydrodynamic boundary layer
3) Variation of local heat coefficient along the flow
- (b)** What are the criteria of thermodynamic equilibrium? What are different types of equilibriums? Discuss in detail. **07**

- Q.5 (a)** What is shape factor? Discuss the salient features of the shape factor for analysis of radiant heat exchange between surfaces. **06**
- (b)** Explain the term absorptivity α , reflectivity ρ and transmissivity τ of $\alpha + \rho + \tau = 1$ radiant energy. How are they related to each other for a black body and an opaque body? Establish the expression and comment on the statement. **08**
- OR**
- Q.5 (a)** Derive necessary Von-Karman's expression for convective heat transfer. **07**
- (b)** Explain the following : **07**
- (1) Emissivity (2) Lambert's cosine law
 - (3) Wein's displacement law of radiation
