Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: 140403 Date: 14-06-2013

Subject Name: Principles of Process Engineering - I

Time: 10:30am – 01:00pm 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)** Stating the assumptions and limitations, derive corrected form of Bernoulli's equation. **07**

(b) Classify heat exchangers based on flow of fluids and contact between fluids. **07**

Q.2 **(a)** Derive an equation to find local velocity (u) as a function of radius (r) in a circular pipe. **07**

(b) Classify pressure measuring devices in detail and discuss any one with neat diagram. **07**

OR

(b) Describe with neat diagram Shell and Tube heat exchanger with all its components involved. **07**

Q.3 **(a)** Differentiate between Natural Convection and Forced Convection with suitable examples. **07**

(b) Derive an equation for log mean temperature difference (LMTD) in heat exchanger. **07**

OR

Q.3 **(a)** Schematically show temperature profiles for counter flow and parallel flow condenser. **07**

(b) Explain the principle, working and uses of centrifugal pump with neat diagram. **07**

Q.4 **(a)** Give the significance of Dimensional Analysis, stating its different methods. **04**

(b) State and explain general laws of heat transfer for each mode of it. **06**

(c) Define: **04**

i) Black body
ii) Gray body
iii) Emissivity (e)
iv) Monochromatic emissive power (E_λ)

OR

Q.4 **(a)** State and explain different types of flow measuring devices with its specific use. **06**

(b) State and derive Wien's displacement law for black body radiation using Planck's law. **08**

Q.5 **(a)** Derive equation for heat transfer rate per unit length of cylinder for steady state simultaneous heat conduction and convection through cylindrical tube of shell and tube heat exchanger. **07**

(b) A steel pipe 25 mm i.d. and 33 mm o.d. and insulated with rockwool carries steam at 178^{o}C. If the surrounding air temperature is 21^{o}C, calculate the rate of heat loss from one meter length of pipe. The thickness of insulation is 38 mm. Thermal conductivity of steel and rockwool are 10.74 and 0.0418 cal/sec-m-^{o}C respectively. The inside and outside heat transfer coefficients are 1356.17 & 2.7133 cal/sec-m^{2}-^{o}C respectively. Contact resistance between the pipe and insulation may be neglected. **07**

OR

Q.5 **(a)** With neat sketch, explain the concept of critical insulation thickness and also derive the equation for critical radius for simultaneous heat conduction and convection through cylindrical geometry. **07**

(b) Derive the governing equation for unsteady state heat conduction with neat diagram. **07**

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