

Day: Friday
Date: 16/11/2018

W-2018-2990

Time: 02.30 PM TO 05.30 PM
Max. Marks: 80

N.B.

- 1) Q. No. 1 and Q. No. 5 are **COMPULSORY**. Out of the remaining attempt **ANY TWO** questions.
- 2) Answers the two sections should be written in **SEPARATE** answer books.
- 3) Use of electronic non-programmable calculator is allowed.
- 4) Assume suitable data if necessary.

SECTION - I

- Q.1**
- a) Give the corrections for Heat transfer coefficient in double pipe heat exchange. (05)
 - b) Calculate diameter, height and weight of shell material (SS - 316) for reactor handling of 6m^3 liquid with specific gravity 0.92. (05)
 - c) Elaborate the different types of blades in agitation with their significance. (04)
- Q.2** 1.8 kg/s of an organic liquid is to be cooled from 45°C to 20°C . The organic liquid is cooled by chilled water supplied from a refrigeration unit at a temperature of 5°C of can be heated up to 10°C properties of organic liquid of water are (13)

Properties	Organic liquid	Water
Specific heat J/kg K	2150	4180
Viscosity Ns/m^3	0.25×10^{-3}	0.8×10^{-3}
Density kg/m^3	716	1000
Thermal conductivity W/mK	0.132	0.61
Fouling Resistance $\text{m}^2 \text{k/W}$	0.0002	0.0004

Thermal conductivity of metal tube = 45 W/mK. Use triangular pitch. Given $k = 0.249$, $n = 2.207$ estimate, tube bundle diameter, no. of tubes and tube side heat transfer coefficient, use length of tube = 1.6m inside diameter (ID) = 12mm. Thickness = 2mm. Assume overall Heat Transfer coefficient to be $590 \text{ W/m}^2\text{K}$.

- Q.3**
- a) Describe various types of agitators. (05)
 - b) Design a shaft for anchor type agitator. (08)
Vessel diameter = 1000mm
Agitator diameter = 900mm.
Speed = 10rpm
Specific gravity of liquid in vessel = 1.6
Power number = 53
Shaft overhang = 1200mm.
Permissible shear stress for shaft material = 63 N/mm^2
Modulus of elasticity = $1.93 \times 10^5 \text{ N/mm}^2$
Estimate power requirement for agitator and diameter of shaft, use 0.5 hp Motor.
- Q.4**
- a) Give the detail design consideration for half coil jacket. (05)
 - b) How do you calculate power requirement of agitator for laminar and turbulent region. (08)

P.T.O

SECTION - II

- Q.5** a) Explain in detail about safety devices used in chemical process industry. (05)
- b) Explain the design procedure for absorber with sketch. (05)
- c) Write a short note on: (04)
- i) Reflux drum
 - ii) Knock out drum
- Q.6** a) How do you perform hydraulic design for sieve tray in distillation column? (07)
- b) Derive the correlation for optimum plate spacing in a distillation column. (06)
- Q.7** In the manufacturing of 2 ethyl hexanol by low pressure process, n-butyaldehyde is reacted with 2% by weight of sodium hydroxide solution. Approximately 90% of butyraldehyde is converted to 2 ethyl hexanol . The mixture of organic phase and aqueous phase is separated in a decanter, In the manufacture of 60ton/day of 2 ethyl hexanol the following conditions are involved. (13)
- Organic phase flow rate = 2883.5 kg/ hr.
Aqueous phase flow rate = 425.4kg/hr.
Density of organic phase = 830kg/m³
Density of aqueous phase = 1050 kg/m³
Viscosity of organic phase = 6.5×10^{-3} N s/m²
Viscosity of aqueous phase = 1.1×10^{-3} N s/m²
Assume aqueous phase is dispersed and assume a droplet size of 120 micron meter. Design a suitable separator.
- Q.8** Evaporative crystallizer has to be design for capacity of 500kg per batch (13) with product crystal size of 0.001m. max. Suspension density is 0.2 gm/cc. Density of crystal is 1380 kg/m³. Volume shape factor is 1 max. Allowable growth rate = 01×10^{-4} m/s. Seed size is 0.002m. Solubility at crystallizer temperature = 370 kg/m³ of solvent. Find size of crystallizer.

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