Register No: …………………….   Name: ....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)
(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)
EIGHTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2024
B. Tech. Chemical Engineering
(2020 SCHEME)

Course Code	: 20CHT402	
Course Name	: **Chemical Process Equipment Design II**	
Max. Marks	: **100**	**Duration:3 Hours**

Instructions to Candidates

Apart from scientific calculators (including programmable) the following books and data books are permitted for the exam:

1. *Steam tables*
2. *Perry's Chemical Engineering Handbook*
3. *IS codes*
4. *Attested copies of Dühring's charts, Nomographs, charts and data tables used in design taken from TEMA standard/ Other editions of Handbook*
5. *Attested copy of Sieve tray hydraulics and sieve tray mass transfer for liquid extraction from 'Mass Transfer Operations' by Robert E.Treybal,Page 532-538*

Missing data may be assumed suitably
Graph sheets may be provided

Answer any one full question from each module. Each full question carries 50 marks
MODULE I

1. A packed tower is used for the absorption of ethylene oxide (5 mole %) from a gas stream at a total pressure of 1 atm and 30°C. The feed gas rate is 12600 kg/h and the solute concentration in the exit gas must not exceed 0.05 mole %. The solvent is pure water. The carrier gas has properties like air and has negligible solubility in water. The ceramic rashig rings are used as tower packing. The solubility of ethylene oxide in water at such a low concentration is described by Henry's law at the given pressure and temperature, obeying $y = 1.07x$. Design the packed tower for this operation.   **50**

    Diffusion coefficient of ethylene oxide in air: 1.587×10^{-6} m^2/s

    Diffusion coefficient of ethylene oxide in water: 1.553×10^{-9} m^2/s

OR

2. Design a sieve tray distillation column employing a partial condenser and total reboiler, which is used to separate 100 kmol/hr of an equimolar mixture of benzene and toluene. The feed enters the column at its bubble point and it is desired that the distillate composition be 95 mole% of benzene and the residue contains 95 mole % of toluene. The relative volatility is 2.5 and the reflux ratio employed is 1.5 times the minimum. The temperature of the rectifying section is maintained at 81°C and the stripping section temperature is maintained at 108°C.   **50**

MODULE II

3. (a) A process vessel has to be designed for a maximum operating pressure of 501 kN/m^2. An understanding between the purchaser and manufacturer indicates that the vessel should be over-designed considering 5% extra to maximum working pressure. The vessel has an outer diameter of 1.5 m. The vessel is made of IS 2002-1962 grade 2B and its design temperature is 435°C. A corrosion allowance of 2 mm is suggested for the expected life of vessel. It is fabricated according to class 1 of Indian Standard specification where a single welded butt joint with backing strip is used. What will be the standard plate thickness to fabricate the vessel for cylindrical as well as spherical   **20**

vessels?

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(b) Determine the parameters for the design of a torispherical top head and a conical bottom (apex angle is 120ºC) to be employed for the above cylindrical vessel.

OR

4. A wet solid at 27ºC with 8% moisture (wet basis) is to be dried to a final moisture content of 0.5% in a direct heat counter-current rotary drier. Hot air at 175ºC containing 0.01 kg moisture/kg dry air is available and an output of 500 kg dry solid/hr at 150ºC is required. The heat capacity of the solid is 0.85 kJ/kg.K. The velocity of the gas must not exceed 1.5m/s. Estimate the diameter, length and other parameters of the drier. Particle size of the solid, dp = 0.5 mm.

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