

JK LAKSHMIPAT UNIVERSITY, JAIPUR
INSTITUTE OF ENGINEERING AND TECHNOLOGY
End Term Examination (Regular/Backlog), April-May 2018
B. Tech/ M. Tech (as applicable) in Chemical Engineering, Semester Sixth

Roll No.....

COURSE CODE: CHE621

Time: 3 hours

Max. Marks: 100

COURSE TITLE: Process Design Decisions

Instructions to students:

1. Do not write anything other than your roll number on question paper.
 2. Assume suitable data wherever required and mention it clearly.
 3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
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Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. If P represents the principal, n the number of interest periods, and i the interest rate based on the length of one interest period, the amount of simple interest during n interest periods is
(a) $P(1+in)$ (b) $P(1+i)^n$ (c) $P i n$ (d) $P[(1+i)^n-1]$
- ii. The nominal and effective interest rates are equal when the interest is compounded
(a) monthly (b) continuously (c) semi-annually (d) annually
- iii. Select the correct statement
(a) Payout period is the length of time over which the earnings on a project equal investment.
(b) Payout period is not important for business decision making
(c) Payout period is affected by the variations in earnings after the recovery of the investment
(d) Payout period and economic life of a project are the same
- iv. For most chemical plants the ratio of working capital to total capital investment varies from
(a) From 10 to 20 % (b) from 80 to 90 %
(c) from 51 to 65 % (d) from 1 to 2 %
- v. Select the wrong statement
(a) Depreciation is the unavoidable loss in the value of plant, equipment and materials with lapse in time.
(b) Depreciation is a cash expense
(c) Depreciation does figure in the computation of the income tax liability on cash flows from an investment.
(d) Annual depreciation costs are constant when the straight-line method is used.
- vi. The correlation between sales, administration, research, and engineering to revenue with the following factors
(a) 0.025 (b) 2.5 (c) 0.25 (d) 0.0025
- vii. The economic life of a small chemical plant is

- (a) usually more than a large chemical plant
 (b) usually much more than a large chemical plant
 (c) usually much less than a large chemical plant
 (d) always equal to a large chemical plant
- viii. Select the correct statement for offsite cost
 (e) 7.3 to 26% of FCI or 35 to 45% PEC (b) 2.5 to 7.0% of FCI or 6 to 30% PEC
 (c) 6 to 20% of FCI or 10 to 70% PEC (d) 3 to 15% of FCI of 6 to 30% PEC
- ix. Which of the following is a component of working capital investment?
 (a) Process equipment (b) maintenance and repair inventory
 (c) utilities plants (d) depreciation
- x. Select the correct statement for engineering and supervision cost
 (a) 1 to 2% of FCI or 4 to 8 PEC (b) 4 to 21% of FCI of 5 to 15% DC
 (c) 3 to 15% of FCI or 10 to 80% PEC (d) 2.5 to 7.0% of FCI or 6 to 30% PEC
- Q.2 Short answer type questions (4 questions @ 2.5 marks) (10)
- A. What are the heads of the direct production cost with their contributions?
 B. Which heads comes in the inside of the battery limits, write their contribution.
 C. What are the heads of construction expenses with their contributions?
 D. What are the heads of outside battery limit with their contributions?
- Q.3A What are the decisions for the determination of the recycle structure explain in 05 details.
- Q.3B The component list and the destinations codes for the anhydride process are 05 given in below in the order of their normal boiling points. Find out the number of product stream and recycle streams with stream name and prepare a recycle structure of acetic anhydride process.

Components	Destinations	NBP, °F
CO	Fuel by-product	-312.6
CH ₄	Fuel by-product	-258.6
C ₂ H ₄	Fuel by-product	-154.8
Ketone	Unstable reactant-completely converted	-42.1
Acetone	Reactant-recycle to R1-liquid	133.2
Acetic acid	Reactant-recycle to R2-liquid	244.3
Acetic anhydride	Primary product	281.9

- Q.4A What are the input information required to undertake a design problems. 05
- Q.4B Develop the overall material balances for the HDA process. The production rate 05 of benzene is 265 mol/hrs. Product purity is 99.97%. The reaction inlet temperature 1150°C, the raw materials pure toluene at ambient conditions, hydrogen stream containing 95% H₂, 5% CH₄ at 550 psia, 100°F
- Q.5A What are the decisions for the input-output structure of the flowsheet? Make an 05 input-output structure of flowsheet alternatives.
- Q.5B We have the 10 components listed in order of their boiling point with 05 destination codes indicated. How many product streams will there be?

Component	Destination	Component	Destination
A	Waste	F	Primary product
B	Waste	G	Recycle
C	Recycle	H	Recycle
D	Fuel	I	Valuable by-product 1
E	Fuel	J	Fuel

Q.6A What are the general structure of the separation system explain in details with suitable diagram. 05

Q.6B1 What are the best location of vapour recovery system? Explain the decision methods for vapour recovery system location with suitable diagram. 05

OR

Q.6B2 Prepare the flowsheet for separation system recycle loop for combining the vapour recovery system with the liquid separation system, explain in details. 05

Q.7A What are the economic decision for design a solvent recovery system explain with suitable examples? 05

Q.7B1 What are the rule of thumb for solvent recovery? Explain the Kremser equation is used to calculate the theoretical trays required in the gas absorber. 05

OR

Q.7B2 What are the systematic procedure for the process retrofits? 05

Q.8A What are the engineering methods for process design with suitable example? 05

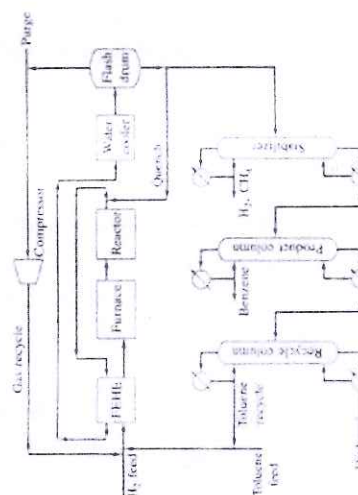
Q.8B1 What are the economic decision for among the process alternative. 05

OR

Q.8B2 Define and derive the correlation for effective interest. 05

Q.9A The original optimum design variables existing plant are listed in table for the flowsheet given below. Explain the steps in the systematic procedure for retrofitting of an HAD process. 10

Design variables	Value
Reactor conversion	0.75
Hydrogen purge composition	0.46
Inlet temperature to partial condenser	428 K
Outlet temperature from partial condenser	311 K
Benzene recovery in the product column	0.99
Reflux ratio in product column	1.2
Toluene recovery in recycle column	0.986
Diphenyl recovery in recycle column	0.807
Recycle ratio in recycle column	1.0



Q.9B1 Write the application of the cost diagrams in terms of conventional approach, process alternatives, cost distribution, infer structural modifications and identify the significant design variable. 10

OR

Q.9B2 Derive the correlation /cost model for total product cost with suitable example. 10

*****Good Luck*****