

Exam Seat No: _____



A Charutar Vidya Mandal's Institution
V.P. & R.P.T.P. SCIENCE COLLEGE

(AUTONOMOUS) (Grant – in – Aid)
Affiliated to Sardar Patel University
VALLABH VIDYANAGAR – 388120



Bachelor of Science (Semester – 4) External Examination – 2026

US04MAICV01: Fluid Flow and Heat Transfer Operations

Date: 24th March 2026

Time: 01:45 P.M. TO 04:15 P.M.

Day: Tuesday

Total Marks: 50 Marks

Note: The figure to the right indicates the full marks for each question.

Q – 1 Answer the following Multiple-Choice Questions. (All are compulsory)

[10]

1. The SI unit of viscosity is
 - (A) Pascal
 - (B) Pascal – second
 - (C) Newton
 - (D) Joule
2. The instrument used to measure fluid pressure is
 - (A) Thermometer
 - (B) Hygrometer
 - (C) Manometer
 - (D) Calorimeter
3. Heat transfer through a solid without bulk motion of the material is called
 - (A) Convection
 - (B) Radiation
 - (C) Conduction
 - (D) Evaporation
4. Thermal conductivity is a property of a material that indicates
 - (A) Ability to conduct heat
 - (B) Ability to store heat
 - (C) Ability to absorb heat
 - (D) Ability to radiate heat
5. A wall made of several layers of different materials is called
 - (A) Hollow Wall
 - (B) Cylindrical Wall
 - (C) Composite Wall
 - (D) Insulated Wall
6. Fins are provided in heat exchangers to:
 - (A) Reduce pressure drop
 - (B) Decrease temperature
 - (C) Increase surface area
 - (D) Increase fluid velocity
7. In a shell and tube heat exchanger, baffles are used to:
 - (A) Reduce heat transfer
 - (B) Increase shell-side turbulence
 - (C) Block flow
 - (D) Reduce surface area
8. In a distillation column, the top product is called:
 - (A) Bottoms
 - (B) Residue
 - (C) Distillate
 - (D) Slurry
9. Evaporation is a process used to
 - (A) Remove solvent as vapor
 - (B) Convert vapor into liquid
 - (C) Remove solids
 - (D) Increase pressure
10. The reactant that is completely consumed in a reaction is called
 - (A) Excess reactant
 - (B) Limiting reactant
 - (C) Catalyst
 - (D) Inert reactant



❖ Answer The Following Long Questions

Q – 2 [A] Define viscosity. Differentiate between Newtonian and Non-Newtonian fluids with examples. [05]

[B] Write a note on different types of manometers: (a) U-tube Manometer (b) Inclined Tube Manometer [05]

OR

Q – 2 [A] State and explain the continuity equation and discuss its significance in fluid flow analysis. [05]

[B] Write a note on Reynold's Experiment and describe its significance. [05]

Q – 3 [A] Derive the equation for heat flow through a cylinder under steady-state conditions. [05]

[B] Derive the equation for Individual and Overall heat transfer coefficient for heat transfer through convection. [05]

OR

Q – 3 [A] Describe different flow arrangements in heat exchangers – parallel flow, counter flow and cross flow and compare their performance. [05]

[B] Explain the concept of log mean temperature difference (LMTD) and its significance in heat exchanger design and analysis. [05]

Q – 4 [A] Describe the construction and working of double-pipe heat exchangers and discuss their advantages and limitations. [05]

[B] Explain the design of shell and tube heat exchanger with a neat sketch, highlighting their different parts. [05]

OR

Q – 4 [A] Write a difference between Single pass and Multi pass shell and Tube heat exchanger. [05]

[B] Describe Extended-surface (Finned) heat exchanger and explain how fins enhance heat transfer performance. [05]

Q – 5 [A] List different steps which should be followed while solving material balance problems. [05]

[B] The waste acid from a nitrating process containing 20% HNO_3 , 55% H_2SO_4 , 25% H_2O by weight is to be concentrated by addition of concentrated H_2SO_4 containing 95% H_2SO_4 and concentrated HNO_3 containing 90% HNO_3 to get desired mixed acid containing 26% HNO_3 & 60% H_2SO_4 . Calculate quantities of waste & concentrated acids required for 1000 kg of desired mixed acid. [05]

OR

Q – 5 [A] 10000 kg/h of solution containing 20% methanol is continuously fed to a distillation column. Distillate is found to contain 98% methanol and waste solution from column carries 1% methanol. All percentages are by weight. Calculate the mass flow rates of distillate and bottom product and the percent loss of methyl alcohol. [05]

[B] Phosphorus is prepared by heating a mass of calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$, sand SiO_2 and charcoal. The reaction takes place as: $\text{Ca}_3(\text{PO}_4)_2 + 3\text{SiO}_2 + 5\text{C} \rightarrow 3\text{CaSiO}_3 + 5\text{CO} + 2\text{P}$ The amount of sand used is 15-weight percent excess and charcoal used is 35-weight percent excess of that theoretically required. Calculate (a) the percentage composition of the originally charge and (b) the amount of phosphorus produced if the reaction is 75% complete per 100 kg of calcium phosphate charged. [05]

