# R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
### *(An Autonomous College U/s UGC Act 1956)*

### B.Tech. SEMESTER-I, SEMESTER END EXAMINATION - WINTER 2024

**Subject Code: 1CH101**                              **Date: 16-12-2024**
**Subject Name: FUNDAMENTALS OF CHEMICAL ENGINEERING**
**Time: 11:00 AM to 01:30 PM**                    **Total Marks: 70**

**Instructions**
1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Bloom's Taxonomy Levels (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

## SECTION A

|  |  | **Marks** | **BL** | **CO** |
|---|---|---|---|---|

**Q.1    Objective-Type Questions**                              **[05]**

**(a)** In which of the following systems does mass transfer occur across the system boundary?    **1    U    4**

| (i) Isolated system | (ii) Closed system |
|---|---|
| (iii) Open system | (iv) None of these |

**(b)** Zeroth law of thermodynamics helped in the creation of which scale?    **1    R    4**

| (i) Temperature | (ii) Heat energy |
|---|---|
| (iii) Pressure | (iv) Internal energy |

**(c)** First law of thermodynamics is based on?    **1    R    4**

| (i) Conservation of energy | (ii) Conservation of mass |
|---|---|
| (iii) Conservation of momentum | (iv) Conservation of work |

**(d)** Which of the following is the rate of heat transfer unit?    **1    R    5**

| (i) Watt | (ii) Pascal |
|---|---|
| (iii) Joule | (iv) Newton |

**(e)** Thermal diffusivity of a substance is      1    R    5

    **(i)** Directly proportional to the thermal conductivity      **(ii)** Inversely proportional to density of substance

    **(iii)** Inversely proportional to specific heat      **(iv)** All of the these

**Q.2**    **Attempt Any Two**      **[10]**

    **(a)** Explain importance of chemical engineering thermodynamics.      5    U    4

    **(b)** Distinguish between system and surrounding.      5    R    4

    **(c)** A gas absorbs 500 Joules of heat and 200 Joules of work. What is the change in internal energy of gas?      5    A    4

**Q.3**    **Attempt Any Two**      **[10]**

    **(a)** Explain the importance of mass transfer operation in chemical industry.      5    U    5

    **(b)** Explain modes of heat transfer also write various law's applicable to it.      5    U    5

    **(c)** Explain Fick's law and Raoult's law,      5    U    5

**Q.4**    **Attempt Any Two**      **[10]**

    **(a)** Explain the importance of heat transfer operation in chemical industry.      5    U    5

    **(b)** Explain classification of mass transfer operations.      5    U    5

    **(c)** Write basic difference between evaporation, boiling, cooling, and condensation.      5    R    5

# SECTION B

| | | Marks | BL | CO |
|---|---|---|---|---|

**Q.5** **Objective-Type Questions** **[05]**

**(a)** The specific gravity of liquid fluid is      **1**   R   1

    **(i)** Dimensionless quantity      **(ii)** fundamental quantity

    **(iii)** Ratio of density of fluid to the density of water      **(iv)** Both (i) and (iii)

**(b)** The conversion of 760 mm Hg equals to      **1**   U   2

    **(i)** 14.7 $kgf/cm^2$      **(ii)** 14.7 psi

    **(iii)** 14.7 MPa      **(iv)** 14.7 Torr

**(c)** Filtration is      **1**   R   1

    **(i)** Unit operation      **(ii)** Unit Process

    **(iii)** Heat treatment process      **(iv)** None of these

**(d)** Potential flow is      **1**   R   1

    **(i)** Cross flow      **(ii)** Rotational flow

    **(iii)** Irrotational flow      **(iv)** None of these

**(e)** The relation between calorie and joule is      **1**   U   2

    **(i)** 1J = 4.187 Cal      **(ii)** 1 Cal = 4.187 J

    **(iii)** 1 J = 4.187 kCal      **(iv)** 1 kCal = 1 J

**Q.6** **Attempt Any Two** **[10]**

**(a)** Discuss the importance and role of chemical engineer in industries.      **5**   U   1

**(b)** A caustic flake obtained from manufacturer are found to contain 70 ppm silica ($SiO_2$). Convert this impurity into wt. %.      **5**   A   2

**(c)** Convert 31000 lit/hr volumetric flow rate into mass flow rate in kg/sec.      **5**   A   2
**Data:** Density = 783 $kg/m^3$

**Q.7** **Attempt Any Two** **[10]**

**(a)** Differentiate between batch, semi batch and continuous process/operations with suitable examples.      **5**   R   3
**(b)** Write a brief explanation of Newton's Law of Viscosity.

**(c)** Compare and contrast Newtonian fluids and non-Newtonian fluids, highlighting their key differences in terms of viscosity and flow behavior.    **5   U   3**

**Q.8** **Attempt Any Two**      **[10]**

**(a)** Explain the different types of fluid classifications based on their properties and flow behavior.    **5   R   3**

**(b)** The analysis of gas sample from municipal waste treatment plant is 72 % Methane ($CH_4$), 23 % Carbon dioxide ($CO_2$) and 5% Ammonia ($NH_3$) on volume basis. Determine:    **5   A   2**

**A.** The average molar mass (Average molecular weight) of the gas.

**B.** Density of the gas mixture at 20 ⁰C and atmospheric pressure.

**(c)** Differentiate between unit process and unit operation.    **5   U   1**

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