

NATIONAL INSTITUTE OF TECHNOLOGY PATNA
MID SEMESTER EXAMINATION, March 2024

Program: DD-M.S.E

Semester: 4

Department: Physics

Course Code: PH48103

Course Name: Introduction to Bioscience and Technology

Full Marks: 30

Duration of Examination: 2 Hours

Answer all questions.

- Q1.** Discuss the notions of discrete and continuous distributions. Explain in detail the significance of mean and variance. Consider the distribution function $P(x)$, evaluate the variance where, [15]

$$P(x) = \begin{cases} \frac{1}{a}, & 0 \leq x < a \\ 0, & \text{otherwise} \end{cases}$$

- Q2.** Explain in detail why the Poisson-Boltzmann theory is called the theory of length scales. Write a note on activation energy in a two-state model. [15]

NATIONAL INSTITUTE OF TECHNOLOGY, PATNA
MID SEMESTER EXAMINATION- March 2024

Program: BT-MT (DD-PH-MSE)
Course Code: PH48101
Full Marks: 30

Semester: 4
Course Name: Phase diagrams & transformations
Duration of Examination: 2 hours

Department: Physics

Attempt all questions. Please assume missing data suitably, if any.

- Q.1. (a) Briefly explain equilibrium and non-equilibrium cooling with development of microstructure in the copper-nickel phase diagram. 6
- (b) A copper-nickel alloy of composition 60 wt% Ni-40 wt% Cu is slowly heated from a temperature of 1300 °C. 4
- (i) At what temperature does the first liquid phase form?
- (ii) What is the composition of this liquid phase?
- (iii) At what temperature does complete melting of the alloy occur? *W*
- (iv) What is the composition of the last solid remaining prior to complete melting?
- Q.2. (a) Derive the Lever rule and explain in detail. 4
- (b) Describe briefly Gibb's Phase rule with suitable example. 3
- (c) Describe briefly lead-tin phase diagram. Calculate the relative amount of each phase present in terms of mass and volume fractions. At 150°C, take the densities of lead and tin to be 11.23 and 7.24 g/cm³, respectively. 3
- Pb Sn*
- Q.3. (a) Define solubility limit and discuss Hume-Rothery criteria for solid solution. 3
- (b) Define the terms eutectic, eutectoid and peritectic reactions by taking suitable examples. 3
- (c) Discuss **time-temperature transformation (TTT) diagram** with suitable example. 4
- W*
W

National Institute of Technology Patna

Department of Mathematics

Mid Semester Examination : March 2024

MA48101 : Numerical Methods for Engineers

Branch: B. Tech + M.Tech (Dual Degree)

Maximum Marks: 30

Semester: 4th

Time: 02.00 hours

Answer Any Six Questions

1. Show all the steps involved in the computation.

(a) Using 5-digit rounding, compute $42500 + 25.874 - 37679$.

(b) Let $a = 0.00656$, $b = 0.133$, $c = 0.129$. Using 3-digit rounding, compute $(a + b) + c$, and $a + (b + c)$.

2. Instead of using the true values $x_T = 0.71456371$ and $y_T = 0.71456238$ in calculating $z_T = x_T - y_T (= 0.133 \times 10^{-5})$, if we use the approximate values $x_A = 0.71456414$ and $y_A = 0.71456103$, and calculate $z_A = x_A - y_A (= 0.311 \times 10^{-5})$, then find the loss of significant digits in the process of calculating z_A when compared to the significant digits in x_A .

3. Find the condition number at a point $x = c$ for the following functions

(a) $f(x) = a^x$

(b) $f(x) = 1 + x + x^2$.

4. Use the Doolittle's factorization to solve the system

$$4x_1 + x_2 + x_3 = 4$$

$$x_1 + 4x_2 - 2x_3 = 4$$

$$3x_1 + 2x_2 - 4x_3 = 6.$$

5. Consider the matrix $A = \begin{bmatrix} 1 & -2 \\ -3 & 4 \end{bmatrix}$. Find the norm of A_∞ , A_2 and A_1 . Also verify that $\|Ax\| \leq \|A\|\|x\|$ for the any of the two norm defined above (The vector norm is understood in the sense that the matrix norm is subservient to it.).

6. Solve the system $Ax = b$ by Gauss-Jacobi method with $A = \begin{bmatrix} 10 & 3 & 1 \\ 2 & -10 & 3 \\ 3 & 3 & 10 \end{bmatrix}$, $b = \begin{bmatrix} 14 \\ -5 \\ 14 \end{bmatrix}$, and

$x^{(0)} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$. Tabulate the results upto first 5 iteration.

7. Find the minimum number iterations needed to approximate the root of the equation $e^x - 3x^2 = 0$ in $(3, 4)$ such that the absolute error is less than or equal to 10^{-3} . Also find the corresponding approximate solution.

— All the Best —

$$e^x - 3x^2 = 0.$$

$$n - n_A = 10^3$$

$$9 \times 9 + \frac{1}{2} + \frac{1}{2} = 9$$

$$K(A) = A^{-1} \|A\|_2$$

$$4 - \frac{1}{4} = \frac{16-1}{4} = \frac{15}{4}$$

$$-2 - \frac{1}{4} = -\frac{8-1}{4} = -\frac{7}{4}$$

$$3 - \frac{2}{8} = \frac{24-2}{8} = \frac{22}{8} = \frac{11}{4}$$