CONTROLLER OF EXAMINATIONS ADDITIONAL AU CHENNAI 600 025

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**ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)**

**B.E.(Full Time) - END SEMESTER EXAMINATIONSNOV/DEC 2024**

Material Science Engineering
VII Semester
**ML5010-Computational Methods for Materials Engineering**
(Regulation2019)

Time:3hrs Max.Marks: 100

**BL – Bloom's Taxonomy Levels**
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

## PART- A(10x2=20Marks)
(Answer all Questions)

| Q.No. | Questions | Marks | BL |
|---|---|---|---|
| 1 | What is Newtons Raphson method? | 2 | L1 |
| 2 | What is Secant method? | 2 | L2 |
| 3 | What are the mass transport in materials | 2 | L1 |
| 4 | What are the advantages of the Dufort-Frankel method? | 2 | L1 |
| 5 | How does Monte Carlo integration work, and why is it particularly effective for high-dimensional problems? | 2 | L1 |
| 6 | How are thermodynamic averages, such as energy or magnetization, calculated in Monte Carlo simulations, and what insights do they provide about materials in equilibrium | 2 | L1 |
| 7 | Use the Jacobian Method to solve the following system: 3x-y=1; x+2y=4. Start with an initial guess of x0=0 and y0=0 to perform iteration | 2 | L3 |
| 8 | Use the gauss seidel method to solve the following system of linear equations: 4x--y =3 ; 2x+3y =10. Start with an initial guess of x0 = 0 and y0 = 0 and perform iteration | 2 | L3 |
| 9 | A metal rod of length L= 1m expands due to temperature rise delT=50K if the co-efficient of thermal expansion is is 12 *10^-6. Find change in length | 2 | L3 |
| 10 | The resistivity of a material is 1.6 *10^-8 Ωm and the length and cross sectional area are 2m and 0.5mm^2 respectively. Find the resistance R. | 2 | L3 |

## PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

| Q.No. | Questions | Marks | BL |
|---|---|---|---|

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|---|---|---|---|
| 11 (a) | Solve using Gauss Jordon Method x+y-z=7, x-y+2z=3,2x+y+z=9 | 13 | L4 |
| 11 (b) | Find the value of y at x=21 and x=28 from the following data using the Newton Forward Interpolation Method:<br><br>x: 20, 23, 26, 29<br>y: 0.3430, 0.3907, 0.4384, 0.4848 | 13 | L4 |
| 12 (a) | The question is to solve the elliptic partial differential equation for the following square mesh using the five-point difference formula by setting up linear equations at the unknown points P, Q, R, and S.The square mesh has dimensions 4x5, with the known points labeled 1, 2, 3, 4, and 5. The unknown points are labeled P, Q, R, and S. | 13 | L4 |
| 12 (b) | Solve the one- dimensional equation $du/dt = d^2u/dt^2$ using the Dufort- Frankel method at second-time level subject to the conditions:<br>$u(0,t) = u(4,t) = 0$ for all $t$<br>$u(x,0) = (x/3)(16-x^2)$ for $0 <= x <= 4$ and $t >= 0$ | 13 | L4 |
| 13 (a) | Monte Carlo Method for simula ng nuclea on and growth of grains in materials | 13 | L4 |
| 13 (b) | Estimate the integral of the func on,<br>i. $f(x)=x^3$<br>ii. ii. $f(x) = x^4+5$<br>over the interval [0,1] using Monte Carlo integra on with 4 random samples. | 13 | L4 |
| 14 (a) | Given the stiffness matrix for 2D anisotropic material<br>$K = \begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$<br>Calculate the strain vector and when stress vector sigma is<br>$\sigma = \begin{bmatrix} 6 \\ 8 \end{bmatrix}$ | 13 | L4 |
| 14 (b) | Find the largest eigen value of the matrix<br>$A = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$ | 13 | L4 |

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| | Using the power method with an initial guess vector $v_0 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$. Perform 2 iteration | | |
| 15 (a) | A cylindrical rod of diameter d=20mm and length L=2500mm is subjected to a tensile load F=5kN. The material has youngs modulus E=200GPa. Calculate strain, stress and elongation dell, Bulk modulus and shear modulus when poisson modulus =0.27 | 13 | L4 |
| 15 (b) | A composite wall consist of two layers in series. The first layer has thermal conductivity k1=2W/mK and thickness t1=0.02m.The second layer has thermal conductivity k2=3W/mK and thickness t2=0.03m. The temperature difference across the entire wall is delT=50K. The system is in steady state heat conduction with no heat generation and assumes 1-D heat transfer. Find Total thermal resistance, total heat flux, heat transfer rate per unit area, temperature drop across layer, temperature drop across second layer | 13 | L4 |

## PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

| Q.No. | Questions | Marks | BL |
|---|---|---|---|
| 16. | Solve the system of linear equations using one iteration of Jacobi Method of Gauss Seidel method<br><br>$4x - y + z = 5$<br>$-2x + 6y = -9$<br>$X + y + 5z = 6$<br>Use an initial guess : x0 =0; y0 = 0; z0 = 0 | 15 | L5 |

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