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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E.(Full Time) - END SEMESTER EXAMINATIONS NOV/DEC 2024

Material Science Engineering
VII SemesterML5010-Computational Methods for Materials Engineering
(Regulation 2019)

Time: 3hrs

Max. Marks: 100

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

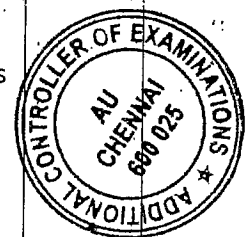
PART- A (10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	BL
1	What is Newton's 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 $x_0 = 0$ and $y_0 = 0$ 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 $x_0 = 0$ and $y_0 = 0$ and perform iteration.	2	L3
9	A metal rod of length $L = 1\text{m}$ expands due to temperature rise $\Delta T = 50\text{K}$ if the coefficient of thermal expansion is 12×10^{-6} . Find change in length.	2	L3
10	The resistivity of a material is $1.6 \times 10^{-8} \Omega\text{m}$ 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 Jordan Method $x+y-z=7$, $x-y+2z=3$, $2x+y+z=9$	13	<u>L4</u>															
11 (b)	Find the value of y at $x=21$ and $x=28$ from the following data using the Newton Forward Interpolation Method: <table><tr><td></td><td>20</td><td>23</td><td>26</td><td>29</td></tr><tr><td>x</td><td></td><td></td><td></td><td></td></tr><tr><td>y</td><td>0.3430</td><td>0.3907</td><td>0.4384</td><td>0.4848</td></tr></table>		20	23	26	29	x					y	0.3430	0.3907	0.4384	0.4848	13	<u>L4</u>
	20	23	26	29														
x																		
y	0.3430	0.3907	0.4384	0.4848														
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 4×5 , with the known points labeled 1, 2, 3, 4, and 5. The unknown points are labeled P, Q, R, and S.	13	<u>L4</u>															
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: $u(0,t) = u(4,t) = 0$ for all t $u(x,0) = (x/3)(16-x^2)$ for $0 \leq x \leq 4$ and $t \geq 0$	13	<u>L4</u>															
13 (a)	Monte Carlo Method for simulation of nucleation and growth of grains in materials	13	<u>L4</u>															
13 (b)	Estimate the integral of the function, i. $f(x)=x^3$ ii. $f(x) = x^4+ 5$ over the interval $[0,1]$ using Monte Carlo integration with 4 random samples.	13	<u>L4</u>															
14 (a)	Given the stiffness matrix for 2D anisotropic material $K = \begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$ Calculate the strain vector and when stress vector σ is $\sigma = \begin{bmatrix} 6 \\ 8 \end{bmatrix}$	13	<u>L4</u>															
14 (b)	Find the largest eigen value of the matrix $A = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$	13	<u>L4</u>															



	Using the power method with an initial guess vector $v_0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$. Perform 2 iteration		
15 (a)	A cylindrical rod of diameter $d=20\text{mm}$ and length $L=2500\text{mm}$ is subjected to a tensile load $F=5\text{kN}$. The material has young's modulus $E=200\text{GPa}$. Calculate strain, stress and elongation ΔL , Bulk modulus and shear modulus when poisson's ratio $\nu=0.27$	13	<u>L4</u>
15 (b)	A composite wall consists of two layers in series. The first layer has thermal conductivity $k_1=2\text{W/mK}$ and thickness $t_1=0.02\text{m}$. The second layer has thermal conductivity $k_2=3\text{W/mK}$ and thickness $t_2=0.03\text{m}$. The temperature difference across the entire wall is $\Delta T=50\text{K}$. 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	<u>L4</u>

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 or Gauss Seidel method $4x - y + z = 5$ $-2x + 6y = -9$ $x + y + 5z = 6$ Use an initial guess : $x_0 = 0; y_0 = 0; z_0 = 0$	15	<u>L5</u>

