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Code No. : 21812

VASAVI COLLEGE OF ENGINEERING (Autonomous), HYDERABAD
M.E. (Mech. Engg.: CBCS) I-Semester Main Examinations, January-2018

(Advanced Design & Manufacturing)

Mathematical Methods for Engineers

Time: 3 hours

Max. Marks: 60

Note: Answer ALL questions in Part-A and any FIVE from Part-B

Q. No	Stem of the Question	M	L	CO	PO
Part-A (10 × 2 = 20 Marks)					
1.	Find the directional derivative of $\phi = x^2yz + 4xz^2$ at (1,-2,1) in the direction of $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$.	2	1	1	10
2.	If $u\mathbf{F} = \nabla v$ where u and v are scalar fields and \mathbf{F} is a vector field, show that $\mathbf{F} \cdot \text{curl } \mathbf{F} = 0$.	2	2	1	10
3.	Define Solenoidal and Irrotational vectors.	2	1	2	10
4.	Express the relationship between the associated tensors \bar{A}^{ikl} and A_{pqr}	2	2	2	10
5.	Write the mathematical formula for Cramer's Rule.	2	1	3	10
6.	Briefly explain LU decomposition.	2	2	3	10
7.	Compute the Laplace transform of $e^{4t} \sin 2t \cos t$.	2	2	4	10
8.	Find the Laplace transform of $\sin at$ using basic definition.	2	1	4	10
9.	Find the Fourier series of the function defined by $f(x) = \pi, -\pi \leq x \leq \pi$	2	2	5	10
10.	Find the Fourier series for the function defined by $f(x) = 0, -\pi \leq x < 0$ $f(x) = \sin x, 0 \leq x \leq \pi$	2	2	5	10
Part-B (5 × 8 = 40 Marks)					
11. a)	Show that $\nabla \times (\nabla \times \bar{A}) = \nabla(\nabla \cdot \bar{A}) - \nabla^2 \bar{A}$	5	2	1	10
b)	Find the unit normal vector to $x^2 + y^2 + z^2 = 5$ at (0,1,2)	3	1	1	10
12. a)	Let A_{rst}^{pq} be a tensor. Find the rank of A_{rst}^{pq} when $p = t$ and $q = s$	5	2	2	10
b)	Using tensor notation show that $\text{curl grad } \phi = 0$	3	3	2	5
13. a)	Solve the system of equations by Gauss-Seidal method for $x^{(1)}, y^{(1)}, z^{(1)}, w^{(1)}, x^{(2)}, y^{(2)}, z^{(2)}, w^{(2)}$ for the following system of equations $3.49x - 0.25y + 9.21z + 0.05w = 1.32$ $5.25x - 1.77y + 8.97z + 0.1w = 4.35$ $1.73x - 2.1y + 3.37z + 7.23w = 12.49$ $1.23x - 6.54y + 2.87z + 2.41w = 11.32$ Superscripts indicate iterations.	5	4	3	5
b)	Find a, b and c so that the linear system $x + 2y - 3z = a$ $2x + 3y + 3z = b$ $5x + 9y - 6z = c$ is consistent.	3	3	3	5

Contd...2

14. a)	Solve the initial value problem $y'' + 4y' + 3y = e^{-t}$, $y(0) = y'(0) = 1$ by using Laplace transforms.	5	3	4	5
b)	Find the inverse Laplace transforms of $\frac{4s + 5}{(s-1)^2 (s+2)}$	3	2	4	10
15. a)	A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially at rest in its equilibrium position. If it is vibrating by giving to each of its end points a velocity $\lambda x(l - x)$, find the displacement of the string at any distance x from one end at any time t .	5	5	5	12
b)	Expand $f(x)$ in a Fourier series on the interval $-2 \leq x < 2$ if $f(x) = 0$ for $-2 \leq x < 0$ and $f(x) = 1$ for $0 \leq x < 2$	3	4	5	5
16. a)	Prove that $\text{curl curl } F = \text{grad div } F - \Delta^2 F$	4	1	1	10
b)	Verify the identity $A \cdot (B \times C) = B \cdot (C \times A)$ using tensor notation.	4	2	2	10
17.	Answer any <i>two</i> of the following:				
a)	Find the Eigen values and corresponding Eigen vectors of matrix	4	6	3	12
	$A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 4 \end{bmatrix}$				
b)	Find $L^{-1} \left\{ \frac{\frac{s}{2} + \frac{5}{3}}{s^2 + 5s + 6} \right\}$	4	3	4	5
c)	Given the non-orthogonal basis $a_1 = i - j - k$, $a_2 = i + j + k$, $a_3 = -i + 2k$, use the Gram-Schmidt orthogonalization process to find the orthonormal basis.	4	2	5	10

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome

S. No.	Criteria for questions	Percentage
1	Fundamental knowledge (Level-1 & 2)	58.75
2	Knowledge on application and analysis (Level-3 & 4)	30.00
3	*Critical thinking and ability to design (Level-5 & 6) (*wherever applicable)	11.25

