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VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. (CBCS : Mech. Engg.) I-Semester Make up Examinations, March-2017

(Advanced Design & Manufacturing)

Mathematical Methods for Engineers

Time: 3 hours Max. Marks: 70

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

Part-A (10 × 2 = 20 Marks)

1. If $F = (x^2y^3 - z^4)i + 4x^5y^2z\, j - y^4z^6\, k$, find curl F and div (curl F).
2. Find the directional derivative of $f(x,y,z) = xy^2 - 4x^2y + z^2$ at $(1,-1,2)$ in the direction of $6i + 2j + 3k$.
3. All vectors are not tensors, although all tensors of rank 1 are vectors. Give two examples.
4. Define contravariant, covariant tensors with one example each.
5. What is the condition under which the system of equations have unique solution? Give an example.
6. What are the Eigen values of an Upper triangular matrix?
7. Find the Laplace transform of $(1 - t^2)e^{-t}$
8. Find $L\left\{t^{\frac{3}{2}}\right\}$
9. Find the Fourier sine series of $f(x) = x, -\pi \le x \le \pi$.
10. Determine whether the given function $x^2 \sin x$ is even or odd or neither. If so write the corresponding Fourier coefficient.

Part-B (5 × 10 = 50 Marks)
(All bits carry equal marks)

11. a) If $F(x,y,z) = xyi + yzj + z^2k$ and $G(x,y,z) = xi + yj - zk$, find curl(FxG).

 b) If $u = x^3 + 3y^3 - 2z^3$ and $V = xi - 2yj + 3zk$, find the value of div(uV).

12. a) Write $\overline{A}_{rs} = \frac{\partial x^p}{\partial \overline{x}^r}\frac{\partial x^q}{\partial \overline{x}^s} A_{pq}$ for N = 1, 2 in terms of Matrix notation.

 b) Show that $\overline{A} \times (\nabla \times \overline{A}) = \frac{1}{2}\nabla A^2 - (\overline{A}.\nabla)\overline{A}$ by using Kronecker delta and permutation symbol.

13. a) Test for consistency and hence solve.
 $2x - 3y + 7z = 5, 3x + y - 3z = 13, 2x + 19y - 47z = 32.$

 b) Solve $5x + 2y + z = 12, x + 4y + 2z = 15, x + 2y + 5z = 20$ by Gauss-Seidel method.

14. a) Evaluate $L^{-1}\left[\frac{1}{s(s^2+5s-6)}\right]$ using convolution theorem.

 b) Solve the differential equation
 $y'' + y' + y = 0;\quad y(0) = 1\ and\ y'^{(0)} = 2$ using Laplace transforms

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15. a) Find the solution of wave equation $\frac{\partial^2 u}{\partial t^2} = C^2 \frac{\partial^2 u}{\partial x^2}$ under the conditions.
$u(0, t) = 0 = u(l, t), u(x,0) = 0$ and $\left(\frac{\partial u}{\partial t}\right)(x,0) = \lambda x(1-x)$, λ being a constant.

b) Find the fourier series for the function $x - x^2$ from $x = -\pi$ to π

16. a) Prove that $\nabla \times (\nabla \times \bar{V}) = \nabla(\nabla.\bar{V})$

b) A covariant tensor has components xy, $3y - z^2$, 3xz in Cartesian coordinates. Find its covariant component in spherical co-ordinates.

17. Answer any *two* of the following:

a) Determine Eigen values and the Eigen vectors of the given matrix. $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$

b) Find the inverse Laplace transform of $L^{-1}\left\{\frac{s^2-3s+4}{s^3}\right\}$

c) Solve $\frac{\partial^2 u}{\partial t^2} = C^2 \frac{\partial^2 u}{\partial x^2}, 0 < x < l, t > 0$ under the following conditions
$u(0,t) = u(l,t) = 0, t > 0, u_t(x,0) = 0, 0 < x < l, u(x,0) = x(1-x).$

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