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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL UNIVERSITY, MANIPAL - 576 104

SECOND SEMESTER B.E DEGREE END SEMESTER EXAMINATION – 2007

SUB: ENGINEERING MATHEMATICS II (MAT –102)
(REVISED CREDIT SYSTEM)

Time : 3 Hrs. **Max.Marks : 50**

✍ **Note : a) Answer any FIVE full questions.**
b) All questions carry equal marks.

1A. Solve : $y'' - 2y' + y = e^{2x}\cos x$ by variation of parameter method.

1B. Change the order of integration and hence evaluate $\int_{-2}^{1}\int_{x^2}^{2-x} y\,dy\,dx$.

1C. Investigate the maximum and minimum values of $f(x,y) = x^4 + y^4 - 2x^2 + 4xy - 2y^2$.

(3 + 3+ 4)

2A. Solve : $ydx + (3x + 2 - yx)\,dy$.

2B. Find :

(i) $L\left[\dfrac{e^{-t}\sin^2 t}{t}\right]$ (ii) $L^{-1}\left\{\dfrac{\left(1-e^{-2s}\right)\left(1-3e^{-2s}\right)}{s^2}\right\}$

2C. Find the inverse of matrix using elementary row transformations

$$A = \begin{bmatrix} 8 & 4 & 3 \\ 2 & 1 & 1 \\ 1 & 2 & 1 \end{bmatrix}$$

(3 + 4 + 3)

3A. Solve :
$$\frac{dx}{dt} + x + 2\frac{dy}{dt} + y = e^t$$
$$\frac{dx}{dt} - x + \frac{dy}{dt} + y = 1$$

P.T.O

3B. Find :

(i) $L\{\cos t\cdot \cos 2t\cdot \cos 3t\}$ (ii) $L^{-1}\left\{\frac{e^{-4s}}{(s+1)^3}\right\}$

3C. Find the volume inside the cone $x^2 + y^2 = z^2$ bounded by the sphere $x^2 + y^2 + z^2 = a^2$.

(4 + 3+ 3)

4A. Solve :

(i) $x\,dx = y\,(x^2 + y^2 - 1)\,dy$

(ii) $y\,e^{x/y}dx = \left(x\,e^{x/y} + y^2\right)dy$

4B. Find the extreme values of $x^2 + y^2 + z^2$ subject to the conditions $\frac{x^2}{1}+\frac{y^2}{2}+\frac{z^2}{3}=2$ and $3x + 2y + z = 0$.

4C. Evaluate : $\int_a^b (x-a)^p (b-x)^q\,dx$ and hence find $\int_2^4 (x-2)^6 (4-x)^4\,dx$.

(4 + 3 + 3)

5A. Using Gram – Schmidt orthogonalisation process find an orthonormal basis from (1, 1, 1), (0, 1, 1), (1, 2, 3) in E^3.

5B. A circuit consists of resistance R, an induction L and a constant e.m.f E switch is closed at t = 0 and removed at t = T. Find current at any time t.

5C. Test for consistency. If consistent solve by Gauss Elimination

$4x - 2y + 6z = 8$

$x + y + 3z = -1$

$15x - 3y + 9z = 21$ (4+ 3 + 3)

6A. Solve : $\omega''(x) + 2\omega'(x) + \omega(x) = x$ $\omega(0) = -3$ and $\omega(1) = -1$ using Laplace transform method.

6B. Expand $f(x,y) = xy^2 + \cos xy$ about the point $\left(1, \frac{\pi}{2}\right)$ upto second degree terms.

6C. Solve : $2xy'' + 3y' - \frac{y}{x} = 5 - \frac{\sin(\log x)}{x^2}$. (4 + 3 + 3)

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✍ **Note : a) Answer any FIVE full questions.**
c) All questions carry equal marks.

1A. Solve the differential equation by variation of parameter method:
$y'' - 2y' + y = \left(1 + e^{-x}\right)^{-2}$.

1B. Evaluate : $\int_0^1 \int_x^{1/x} \frac{y}{(1+xy)^2(1+y^2)}\, dydx$.

1C. Find the stationary value of $a^3x^2 + b^3y^2 + c^3z^2$ where $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}=1$.

(3 + 3+ 4)

2A. Solve : $(2x + y - 3)\, dy - (x + 2y - 3)\, dx = 0$.

2B. Let $F(t) = \begin{cases} 3t, & 0 < t < 2 \\ 6 & 2 < t < 4 \end{cases}$ and $F(t+4) = F(t)$ for all t, find $L[F(t)]$.

2C. Using Gram – Schmidt orthogonalisation process find an orthonormal basis from (1, 1,1), (0, 1, 1) (1, 2, 3).

(3 + 3+ 4)

3A. Solve : $(3x+2)^2 y'' + 3(3x+2)y' - 36y = 3x^2 + 4x + 1$

3B. Evaluate : $L^{-1}\left\{\frac{1}{s^2(s+1)^2}\right\}$ using convolution.

3C. Find the volume of the ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$, using triple integration.

(3 + 3 + 4)

P.T.O.

4A. Solve :

(i) $ydx - x\,dy + 3x^2y^2e^{x^3}\,dx = 0.$

(ii) $dy - \sin(x + y)\,dx = 0$

4B. Expand $f(x, y) = \sin xy$ in powers of $(x - 1)$ and $\left(y - \frac{\pi}{2}\right)$ upto second degree terms.

4C. Prove that : $\gamma(m)\gamma\left(m + \frac{1}{2}\right) = \frac{\sqrt{\pi}}{2^{2m-1}}\gamma(2m).$

(4 + 3 + 3)

5A. A spring of stiffness k = 32 dynes / cm is suspended from a fixed point and carries a mass of 200 gm at the other end. The mass is pulled down from its neutral position to a depth of 10 cm and released from the rest. Find the displacement at any time t.

5B. Find the values of λ and μ for which the system $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$ has

(i) unique solution (ii) no solution (iii) infinite solution

5C. Define : (i) Basis (ii) orthonormal basis , for E^n.

Find the rank of $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 0 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$ using row transformations.

(3 + 3+ 4)

6A. Solve : $y''(x) + 2y'(x) + y(x) = x;\ y(0) = -3$ and $y(1) = -1$ using Lapalce transform method.

6B. Find the double integration the area inside the circle $r = a\sin\theta$ and outside the cardioid $r = a(1 - \cos\theta)$.

6C. Solve :

$$\frac{dx}{dt} + 2x + 3y = 0$$

$$\frac{dy}{dt} + 3x + 2y = 2e^{2t}$$

(3 + 3+ 4)

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