B.Tech Sem – IV (2007 Course) (Civil Engg.) : WINTER - 2018

SUBJECT: ENGINEERING MATHEMATICS – III

Day: Tuesday
Date: 13/11/2018

W-2018-2743

Time: 02.30 PM TO 05.30 PM
Max. Marks: 80

N.B.:

1) **Q. No. 1** and **Q. No. 5** are **COMPULSORY**. Out of the remaining attempt **ANY TWO** questions from Section – **I** and Section – **II**.
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in **SEPARATE** answer books.
4) Use of non programmable **calculator** is **ALLOWED**.
5) Draw neat and labeled diagrams **WHEREVER** necessary.
6) Assume suitable data, if necessary.

SECTION - I

Q.1 **a)** Solve by method of variation of parameters: $\left(D^2-1\right)y = e^{-x}\sin e^{-x} + \cos e^{-x}$ **(05)**

b) Solve: $\dfrac{dx}{2x} = \dfrac{dy}{-y} = \dfrac{dz}{4xy^2-2z}$ **(04)**

c) Apply factorization method to solve the equations (LU-decomposition Method) **(05)**

$$3x+2y+7z=4$$
$$2x+3y+z=5$$
$$3x+4y+z=7$$

Q.2 Solve any three of the following: **(13)**

i) $\left(D^2-4\right)y = x\sinh x$

ii) $\left(D^2-2D+1\right)y = xe^x \sin x$

iii) $\left(D^2+3D+2\right)y = e^{e^x}$

iv) $x^2\dfrac{d^2y}{dx^2} - x\dfrac{dy}{dx} + y = \log x$

v) $(2x-1)^2\dfrac{d^2y}{dx^2} + (2x-1)\dfrac{dy}{dx} - 2y = 8x^2-2x+3$

Q.3 **a)** The whirling speed of a short of length l is given by $\dfrac{d^4y}{dx^4} - m^4y = 0$ where $m^4 = \dfrac{W\omega^2}{gEI}$ and y is the displacement at distance x from one end. If the ends of the shafts are constrained in long bearings, show that the shaft will whirl when $\cos ml \cosh ml = 1$ **(06)**

b) A tightly stretched flexible string has its ends fixed at x = 0 and x = l . At time t = 0, the string is given a shape defined by $F(x) = \mu x(l-x)$, where μ is constant, and then released. Find the displacement of any point x of the string at any time $t > 0$. **(07)**

P.T.O.

Q.4 **a)** Apply Runge Kutta method to find an approximate value of y for x = 0.2 in steps of 0.1, if $\frac{dy}{dx} = x + y^2$, given that y = 1, where x = 0 **(07)**

b) Apply Gauss seidel iteration method to solve the equations **(06)**

$20x + y - 2z = 17$

$3x + 20y - z = -18$

$2x - 3y + 20z = 25$

SECTION - II

Q.5 **a)** A problem in mechanics is given to the three students A, B and C whose chances of solving it are $\frac{1}{2}, \frac{3}{4}, and \frac{1}{4}$ respectively. What is the probability that the problem will be solved? **(04)**

b) For the curve $x = \cos t + t\sin t, y = \sin t - t\cos t,$ find the tangential and normal components of acceleration at any time t. **(05)**

c) If $\bar{F} = (2xy + 3z^2)\hat{i} + (x^2 + 4yz)\hat{j} + (2y^2 + 6xz)\hat{k},$ evaluate $\int_c \bar{F}.d\bar{r}$ where C is the curve $x = t,\ y = t^2,\ z = t^3$ joining the points $(0, 0, 0)\ and (1, 1, 1)$. **(05)**

Q.6 **a)** Determine the equations of regression lines for the following data: **(08)**

x:	1	2	3	4	5	6	7	8	9
y:	9	8	10	12	11	13	14	16	15

And obtain on estimate of y for x = 4.5

b) The mean weight of 500 students is 63 kgs and the standard deviation is 8 kgs. Assuming that the weights are normally distributed, find how many students weigh 52 kgs. The weights are recorded to the nearest kg. **(05)**
$(Given: z_1 = 1.44,\ A_1 = 0.4251,\ z_2 = 1.31,\ A_2 = 0.4049)$

Q.7 **a)** Find the directional derivative of the function $\phi = e^{2x-y-z}$ at $(1,\ 1,\ 1)$ in the direction of the tangent to the curve **(05)**
$x = e^{-t},\quad y = 2\sin t + 1,\quad z = t - \cos t\ \ at\ \ t = 0.$

b) Prove that : **(08)**

i) $\nabla\left(\frac{\bar{a}.\bar{r}}{r^n}\right) = \frac{\bar{a}}{r^n} - \frac{n(\bar{a}.\bar{r})}{r^{n+2}}\bar{r}$

ii) $\nabla^4 e^r = e^r + \frac{4}{r}e^r$

Q.8 **a)** Evaluate: $\iint_s 2x^2ydydz - y^2dzdx + 4xz^2dxdy$ over the curved surface of the cylinder $y^2 + z^2 = 9,$ bounded by $x = 0\ and\ x = 2$. **(06)**

b) Verify stokes theorem when $\bar{F} = (2x - y)\hat{i} - yz^2\hat{j} - y^2z\,\hat{k},$ where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1,$ and C is the boundary. **(07)**

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