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BTECH
(SEM IV) THEORY EXAMINATION 2023-24
MATHEMATICS-III

TIME: 3 HRS

M.MARKS: 70

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 7 = 14

a	Integrate $f(z) = x^2 + ixy$ from A(1,1) to B(2,4) along the curve $x = t, y = t^2$.
b	In a certain distribution, the first four moments about the point $x = 4$ are -1.5, 17, -30 & 308. Find the moment about mean.
c	Explain diagonally dominant system of linear equations and rewrite the following into diagonally dominant form $9x + 4y + z = -17$ $x - 2y - 6z = 14$ $x + 6y = 4$
d	Apply Euler's method to solve $\frac{dy}{dx} = e^x + xy, y(0) = 0$ to compute $y(0.1)$ for $h=0.1$
e	Prove that $hD = -\log(1 - \nabla)$.
f	Evaluate $\int_1^2 e^{\frac{x}{2}} dx$ using four intervals.
g	If Fourier Transform of $e^{-x^2} = \sqrt{\pi} e^{-(p^2/4)}$ then find Fourier Transform of $e^{-x^2} \cos 4x$.

SECTION B

2. Attempt any three of the following:

7 x 3 = 21

a	Find the Taylor's and Laurent's series which represent the function $f(z) = \frac{z^2 - 1}{(z + 2)(z + 3)}$ when (i) $ z < 2$ and (ii) $2 < z < 3$.												
b	The following results were obtained from marks in mechanics and engineering mathematics in an examination <table><tr><td></td><td>Mechanics(x)</td><td>Engg. Mathematics(y)</td></tr><tr><td>Mean</td><td>47.5</td><td>39.5</td></tr><tr><td>S.D.</td><td>16.8</td><td>10.8</td></tr></table> Given that $r = .95$. Find both the regression equations. Also estimate value of y for $x = 30$.		Mechanics(x)	Engg. Mathematics(y)	Mean	47.5	39.5	S.D.	16.8	10.8			
	Mechanics(x)	Engg. Mathematics(y)											
Mean	47.5	39.5											
S.D.	16.8	10.8											
c	Use Newton Raphson method to find a root of the equation $x^3 - 3x - 5 = 0$.												
d	Find the interpolating polynomial for the following data. <table><tr><td>x</td><td>-3</td><td>-1</td><td>0</td><td>3</td><td>5</td></tr><tr><td>f(x)</td><td>-30</td><td>-22</td><td>-12</td><td>330</td><td>3458</td></tr></table>	x	-3	-1	0	3	5	f(x)	-30	-22	-12	330	3458
x	-3	-1	0	3	5								
f(x)	-30	-22	-12	330	3458								
e	Solve by Z-transform: $y_{k+1} = 7y_k + 10x_k$ $x_{k+1} = y_k + 4x_k \ ; \ y_0 = 3, x_0 = 2$												



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SECTION C

3. Attempt any one part of the following:

7 x 1 = 7

- | | |
|-----|--|
| (a) | Evaluate $\oint_C \frac{3z^2 + z}{z^2 - 1} dz$, where C is the circle $ z = 2$. |
| (b) | Evaluate $\int_0^{2\pi} \frac{\cos 3\theta d\theta}{5 + 4\cos \theta}$ |

4. Attempt any one part of the following:

7 x 1 = 7

- | | | | | | | | | | | | | | |
|-----|---|------|------|------|------|---|---|---|------|------|------|------|------|
| (a) | Fit a second degree parabola to the following data by Least Squares method: | | | | | | | | | | | | |
| | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr> <td>y</td><td>1090</td><td>1220</td><td>1390</td><td>1625</td><td>1915</td></tr> </table> | x | 1 | 2 | 3 | 4 | 5 | y | 1090 | 1220 | 1390 | 1625 | 1915 |
| x | 1 | 2 | 3 | 4 | 5 | | | | | | | | |
| y | 1090 | 1220 | 1390 | 1625 | 1915 | | | | | | | | |
| (b) | Define level of significance. Show that in a poisson distribution with unit mean, mean deviation about mean is $(2/e)$ times the standard deviation. | | | | | | | | | | | | |

5. Attempt any one part of the following:

7 x 1 = 7

- | | |
|-----|---|
| (a) | Using Lagranges interpolation formula, find polynomial which takes the values 3, 12, 15, -21 when x has the values 3, 2, 1, -1. |
| (b) | Using Newton-Raphson method, find real root of equation $3x = \cos x + 1$ correct to four decimal places. |

6. Attempt any one part of the following:

7 x 1 = 7

- | | |
|-----|---|
| (a) | Solve the following system of linear equations by Crout's method:
$2x + 3y + z = 9$
$x + 2y + 3z = 6$
$3x + y + 2z = 8$ |
| (b) | Find an approximate value of the $\log_e 5$ by calculating to four decimal places by Simpson's (1/3) rd rule $\int_0^5 \frac{dx}{4x+5}$ dividing the range into 10 equal parts. |

7. Attempt any one part of the following:

7 x 1 = 7

- | | |
|-----|--|
| (a) | Using Fourier sine integral, show that $\int_0^\infty \frac{(1 - \cos \pi \lambda) \sin x \lambda d\lambda}{\lambda} =$
$\begin{cases} \frac{\pi}{2} & \text{when } 0 < x < \pi \\ 0 & x > \pi \end{cases}$ |
| (b) | Describe Fourier Sine transform of the function $F(x) = \frac{b^{-ax}}{x}$, $a > 0$. Hence evaluate Fourier Sine transform of the function $F(x) = \frac{1}{x}$. |