3RD SEM./ELECT/ETC/AE&I/MECH/AUTO/CSE/IT 2020(W)OLD

BST301-ENGINEERING MATHEMATICS –III

Full Marks: 80 Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10

1. a. Determine the rank of the matrix

$$\begin{bmatrix} 1 & 0 & 1 \\ -1 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix}$$

b. Derive a partial differential equation by eliminating arbitrary constants from $z = ax + by + ab$.

c. Find $L(e^{-2t}t)$.

d. Find a_0 if $f(x) = x^2$ in $(-\pi, \pi)$.

e. Find $L^{-1}\left(\frac{s^3-3s^2+4}{s^4}\right)$.

f. State Newton's Backward interpolation formula to interpolate a function.

g. Define even and odd function with examples.

h. Evaluate $\Delta \cos 2x$.

i. Solve $\frac{d^2y}{dx^2} - y = 0$.

j. Write down the formula for Simpson's $\frac{1}{3}$rd rule for Numerical integration.

2. Answer **Any Six** Questions 6 x 5

a. Find the approximation of a real root of the equation $x^3 - 4x - 9 = 0$ using Bisection method correct upto two decimal places.

b. Find $L\left\{\frac{\cos 2t - \cos 3t}{t}\right\}$..

c. Solve $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = e^{2x}$.

d. Find the fourier coefficients a_0, a_n and b_n for the function $f(x) = x$ in $(-\pi, \pi)$.

e. Evaluate $\int_0^5 \frac{dx}{1+x^2}$ using Trapezoidal rule taking h=1.

f. Estimate the missing value in the following table

x :	0	1	2	3	4
f(x):	1	3	9	-	81

g Apply Langrage's method to find he value of f(10) from the following table

x :	5	6	9	11
f(x) :	12	13	15	17

3 Solve $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$ 10

4 Using Newton's Interpolation formula find f(1.6) from the following table 10

x :	1	1.4	1.8	2.2
f(x) :	3.49	4.82	5.96	6.5

5 Find the $L^{-1}\left\{\frac{2s^2-4}{(s-1)(s-2)(s-3)}\right\}$. 10

6 Solve $(D^2+2)y = x^2 + \cos 3x$. 10

7 Test for consistency of the following system of linear equations and solve . 10

$$2x - 3y + 7z = 5$$
$$3x + y - 3z = 13$$
$$2x + 19y - 37z = 32$$

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1. Answer **All** questions 2 x 10

a. Define the rank of a matrix. Find the rank of the matrix $\begin{pmatrix} 1 & 2 \\ 2 & 4 \end{pmatrix}$

b. Find the complementary function if the roots of the auxiliary equation are 0,-2,-2,-2.

c. Derive a partial differential equation for the following:
$z = xy + f(x^2 + y^2)$

d. Define gamma function. Evaluate $\Gamma(-\frac{1}{2})$.

e. Define Numerical Integration and state Trapezoidal rule.

f. Define even and odd functions with example.

g. Find Laplace Transform of $sin^2 t$.

h. Find the value of Fourier co-efficient 'a_0' if
$$f(x) = x + x^2 \ in \ (-\pi, \pi)$$

i. *Evaluate* $\Delta\ (\tan^{-1} x\ )$

j. Change into $a + ib \ form \ \frac{2i}{3+4i}$

2. Answer **Any Six** Questions 6 x 5

a. Find the real roots of the equation
$$x^3 - 3x + 1 = 0$$
By Newton's Raphson method correct to two decimal places.

b. Find the Particular Integral (P.I) of the differential equation
$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x\, e^x \sin x$$

c. Show that
$$L(t \cos at) = \frac{s^2 - a^2}{(s^2 + a^2)^2}$$

d. Express $f(x) = |x|$as a Fourier series in $-\pi < x < \pi$

e. Use Lagrange's Interpolation formula to fit a polynomial to the given data:

x	0	1	3
f(x)	1	3	55

f. Find the square root of $-8+\sqrt{-1}$

g. Using Simpson's $\frac{1}{3}$ rd rule and taking $h=1$, evaluate

$$\int_0^6 \frac{dx}{1+x}$$

3 a. Investigate for what value of λ and μ the simultaneous equations 7
x +y+ z=6, x+2y+3z=10, x+2y+λz=μ have
(i)No solution
(ii)a unique solution
(iii)an infinite number of solution

b. $(1-\omega+\omega^2)^5+(1+\omega-\omega^2)^5=32$ 3

4 a. Obtain the Fourier series for $f(x)=\begin{cases}-k & if \ -\pi<x<0\\ k & if \ 0<x<\pi\end{cases}$ 5

b. Find the Laplace transform of $\frac{sin2t}{t}$ 5

5 a. Obtain the fourier series of f(x) defined by 7

$f(x)=\begin{cases}0, -\pi<x<0\\ x^2, 0<x<\pi\end{cases}$

b. Estimate the missing term in the following table : 3

X:	0	1	2	3	4
Y:	2	4	10	_	78

6 a. $x^2(y-z)p+y^2(z-x)q=z^2(x-y)$ 7

b. Determine the rank of the matrix: 3

$$\begin{bmatrix}1 & 0 & 1\\ -1 & 1 & 0\\ 0 & -1 & 1\end{bmatrix}$$

7 a. Find the inverse Laplace transform of 5

$$\frac{3s+7}{s^2-2s-3}$$

b. Using Trapezoidal rule and taking $h=\frac{1}{2}$, evaluate 5

$$\int_0^2 \frac{dx}{1+x}$$

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   a. Find the value of $(\omega + \omega^2)^{97}$ *where* ω *is the cube root of unity.*

   b. Find the value of $A + 2B$, *where* $A = \begin{bmatrix} 2 & -1 \\ 1 & 0 \end{bmatrix}$ *and* $B = \begin{bmatrix} 1 & 3 \\ 1 & -2 \end{bmatrix}$

   c. Write down the formula for Simpsons $\frac{1}{3}$ rule having space width is h

   d. Form a partial differential equation by eliminating arbitrary constant of $Z = ax + by$

   e. Find C.F if $D^2y + 5Dy + 6y = 0$

   f. Explain Interpolation with an example.

   g. State Linearity property of Laplace Transforms

   h. Define even function with an example

   i. Evaluate $\Delta(x + \cos x)$

   j. Find $L(e^{3t}t^2)$

2. Answer **Any Six** Questions 5 X 6

   a. Find Rank of matrix $\begin{bmatrix} 1 & 3 & 4 & 3 \\ 3 & 9 & 12 & 3 \\ 1 & 3 & 4 & 1 \end{bmatrix}$

   b. Solve $\frac{d^3y}{dx^3} - y = 0$

   c. Find the Laplace transforms of $tcos^2t$

   d. Find root of equation $x^3 - 2x - 5 = 0$ upto 4 stages which lies between 2 and 3 by using Bisection method.

   e. If $x + \frac{1}{x} = 2\cos\theta$, *then show that* $x^n + \frac{1}{x^n} = 2\cos n\theta$

   f. Prove that $\Delta\{\log f(x)\} = \log\left\{1 + \frac{\Delta f(x)}{f(x)}\right\}$

g Using Inverse Lagrange's Interpolation formula , find the value of x *when* $y = 15$ *from the following data*

x	5	6	9	11
y	12	13	14	16

3 Expand $F(x) = |x|$ *as a fourier series in the interval* $-\pi \leq x \leq \pi$, *Hence deduce that* $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} \ldots\ldots = \frac{\pi^2}{8}$ 10

4 a) Applying Newton's Forward Interpolation formula, find a cubic polynomial from the following data. 5

x	0	1	2	3
y	1	2	1	10

b) Find the square root of $3 + 4i$ 5

5 a) Solve $(D^2 - 3D + 2)y = e^{3x} + \sin 2x$ 5

b) Find the value of y *when* $x = 10$ *from following data* 5

x	5	15	25	35
y	9	30	35	42

6 a) Integrate Numerically $\int_0^6 \frac{dx}{1+x^2}$, using Trapezoidal Rule taking $h = 1$ 5

b) Find $L^{-1}\left(\log \frac{s+1}{s+2}\right)$ 5

7 Solve $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$ 10

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$(\frac{1}{2})(\frac{y}{x})$ $\tan^{-1}\frac{1}{3}$ rule

$\theta = \tan^{-1}(\frac{1}{3})$

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i.e. A function $f(x)$ is said to be even (or symmetric) function if $f(-x) = -x$.

e.g. let $f(t)$ be a function of t defined for all positive values of t then the laplace transforms of $f(t)$ denoted by $L\{f(t)\}$ is defined by $L\{f(t)\} = \int e^{-st} f(t)\,dt$.

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