EMAT 102

B.Tech. (II[nd] SEMESTER) EXAMINATION, 2025-26

BACHELOR OF TECHNOLOGY

(IT, ME, CSE & ECE)

Engineering Mathematics-II

2404

Time : Three Hours] [Maximum Marks : 75

Note: There are **three** sections (A, B and C) and candidate has to attempt questions from all sections. Marks are indicated against each section.

Section-A

1. Attempt **all** parts of the following : 5×3=15

(a) Evaluate $L[e^{at}]$.

(b) Find order and degree of the differential equation : $\rho^2 = \frac{\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^3}{\left(\frac{d^2y}{dx^2}\right)^2}$.

(c) Write Euler formula with the value of a_o, a_n and b_n.

(d) Solve the differential equation :

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0.$$

(e) If $L^{-1}[f(s)] = F(t)$ then prove that $L^{-1}[f(as)] = \frac{1}{a}F\left(\frac{t}{a}\right), a > 0$.

Section-B

Note: Attempt all questions : 4×5=20

2. (a) State and prove Linearity property of Laplace transform.

Or

(b) Find the inverse Laplace Transform of :

(i) $\frac{s^2-a^2}{(s^2+a^2)^2}$ (ii) $\frac{2as}{(s^2+a^2)^2}$

3. (a) Find the Fourier series to represent e^{ax} in the interval $-\pi < x < \pi$.

Or

(b) Expand $f(x) = x$ as a half range cosine series in $0 < x < 2$.

4. (a) Form partial differential equation of the following function :

(i) $az + b = a^2x + y$

(ii) $z = f(x^2 - y^2)$

Or

(b) Solve $(y^2 + z^2 - x^2)p - 2xyq + 2xz = 0$

5. (a) Solve $x^3\frac{d^3y}{dx^3} + 2x^2\frac{d^2y}{dx^2} + 2y = 10\left(x + \frac{1}{x}\right)$.

Or

(b) Solve the simultaneous differential equation :

$\frac{d^2x}{dt^2} - 4\frac{dx}{dt} + 4x = y$ and $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = 25x + 16e^t$.

Section-C

Note: Answer any **two** questions of the following : 2×20=40

6. (a) State initial and final value theorem and also solve if $L[F(t)] = \frac{1}{s(s+\beta)}$, then :

   (i) $\lim_{t\to\infty} F(t)$ (ii) $\lim_{t\to 0} F(t)$

   (b) Solve the differential equation :

   $\frac{d^3y}{dt^3} + 2\frac{d^2y}{dt^2} - \frac{dy}{dt} - 2y = 0.$ Where $y = 1, \frac{dy}{dt} = 2, \frac{d^2y}{dt^2} = 2$ at $t = 0$.

7. (a) Solve $(D^2 - 3D + 2)y = e^{3x}$:

   (b) Solve the following differential equation by variation of parameters :

   $\frac{d^2y}{dx^2} + a^2y = \sec ax.$

8. (a) Define partial differential equation, and also solve :

   $\frac{\partial^2 z}{\partial x^2} + 3\frac{\partial^2 z}{\partial x \partial y} + 2\frac{\partial^2 z}{\partial y^2} = x + y.$

   (b) Use the method of separation of variable to solve the partial differential equation.

   $\frac{\partial^2 U}{\partial x^2} - \frac{\partial U}{\partial y} + 2U = 0.$s

9. (a) Find the Fourier series to represent the function $f(x)$ given by :

$$f(x) = \begin{cases} x \text{ for } 0 \leq x \leq \pi \\ 2\pi - x \text{ for } \pi \leq x \leq 2\pi \end{cases}$$

(b) Obtain the Fourier series for $y = x^2$ in $-\pi < x < \pi$ and hence show that :

$$\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} + \cdots = \sum_{n=1}^{\infty} \frac{1}{n^4} = \frac{\pi^4}{90}.$$

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EMAT 102

B.Tech. II[nd] SEMESTER EXAMINATION, 2024-25

BACHELOR OF TECHNOLOGY

(IT, ME, CSE & ECE)

Engineering Mathematics II

Time : Three Hours] [Maximum Marks : 75

Note: There are **three** sections (A, B and C) and Candidate has to attempt questions from all sections. Marks are indicated against each section.

Section-A

1. Attempt all questions. Each question carries equal marks : 3×5=15

(a) Define order of differential equations and find the order and degree of –

$$\frac{d^2y}{dx^2} = \left(1 + \frac{dy}{dx}\right)^{4/5}$$

(b) Solve : $\frac{dx}{x} = \frac{dy}{y} = \frac{dz}{z}$.

(c) State first and second shifting properly of Laplace transform.

(d) Find inverse Laplace transform of $\frac{1}{s(s+1)}$.

(e) Solve : $\sqrt{p} + \sqrt{q} = 1$.

Section-B

Note : Attempt all questions. Each questions carries equal marks : 5×4=20

2. (a) Solve : $(D^2 - 2D + 3)4 = x^3 + \sin x$.

Or

(b) Solve : $(D^2 + 2D + 10)4 + 37 \sin 3x = 0$.

3. (a) Solve : $\frac{dx}{1} = \frac{dy}{3} = \frac{dz}{5z + \tan(4 - 3x)}$.

Or

(b) Evaluate : $\int_0^\infty \frac{e^{-2t} \sin 2t}{t} dt$.

4. (a) If $L[F(t)] = f(s)$, then prove that :

$L[F'(t)] = sf(s) - F(0)$

Or

(b) Find inverse Laplace transform of $\frac{1}{s^2+s+1}$

5. (a) Find the Fourier series of the function :

$f(x) = |x|, -\pi < x < \pi$.

Or

(b) Find the Fourier series of :

$f(x) = x^2, -2 \le x \le 2$.

Section-C

Note : Answer any two questions of the following : 2×20=40

6. Using variation of parameter, to solve

$$\frac{d^2y}{dx^2} + a^2 y = \sec ax .$$

7. Using Laplace transform to solve the differential equation :

$y''(t) + 25\ y(t) = 10 \cos 5t\ , y(0) = 2\ , y'(0) = 0$

8. Solve the equation by using separation of variables.

$\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u\ ,\ given\ \ u(x, 0) = 6e^{-3x}$

9. Find the Fourier series expansion of -

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

Hence find the sum of series :

$$1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + ------ .$$

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