Code : 211202

B.Tech 2nd Semester Exam., 2018

MATHEMATICS—II

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct answer (any *seven*) : 2×7=14

(a) The Fourier series of the periodic function

$$f(x) = x + x^2, -\pi < x \le \pi$$

at $x = \pi$ converges to

(i) π

(ii) 2π

(iii) π^2

(iv) $\pi + \pi^2$

(b) The radius of convergence of the series

$$\sum_{n=0}^{\infty} (3+4i)^n z^n$$

is

(i) 5

(ii) $\frac{1}{5}$

(iii) $3+4i$

(iv) None of the above

(c) The Laplace transform of

$$3\cosh(5t) - 4\sinh(5t)$$

is

(i) $\frac{(3s-20)}{(s^2-25)}, s > 5$

(ii) $\frac{(3s-20)}{(s^2-25)}, s < 5$

(iii) $\frac{(3s-20)}{(s^2+25)}, s > 5$

(iv) $\frac{(3s-20)}{(s^2+25)}, s < 5$

(d) If $\delta(t)$ is the Dirac delta function, than $L(\delta t)$ is

(i) -1

(ii) 0

(iii) 1

(iv) None of the above

(e) If L is the Laplace operator, then $L^{-1}\left(s^{-\frac{3}{2}}\right)$ is

- (i) $\sqrt{\frac{t}{\pi}}$
- (ii) $\sqrt{\frac{\pi}{t}}$
- (iii) $2\sqrt{\frac{\pi}{t}}$
- (iv) $2\sqrt{\frac{t}{\pi}}$

(f) If $\varphi(x, y, z) = 3x^2y - y^3z^2$, then $\nabla\varphi$ at the point $(1, 1, -2)$ is

- (i) $12i - 9j - 16k$
- (ii) $6i - 9j + 4k$
- (iii) $6i - 9j - 4k$
- (iv) $-12i - 9j + 16k$

(g) If $a < b$, then $\int_a^b |(x-a)+(x-b)|\,dx$ is equal to

- (i) $\frac{(b-a)^2}{2}$
- (ii) $\frac{(b^2-a^2)}{2}$
- (iii) $\frac{(a^3-b^3)}{2}$
- (iv) $(b-a)^2$

(h) The value of $\iint x^2y^2\,dxdy$ over the region $x^2+y^2 \le 1$ is

- (i) $\frac{\pi}{6}$
- (ii) $\frac{\pi}{12}$
- (iii) $\frac{\pi}{24}$
- (iv) $\frac{\pi}{48}$

(i) If $A(2) = 2i - j + 2k$, $A(3) = 4i - 2j + 3k$, then $\int_2^3 A \cdot \frac{dA}{dt}\,dt$ is

- (i) 5
- (ii) 10
- (iii) 15
- (iv) 20

(j) If $\vec{A}, \vec{B}, \vec{C}$ are three mutually perpendicular vectors, each of magnitude unity, then $\left|\vec{A}+\vec{B}+\vec{C}\right|$ is equal to

- (i) $\sqrt{3}$
- (ii) 3
- (iii) $\sqrt{2}$
- (iv) 2

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2. (a) Test the convergence of

$$1+\frac{3}{7}x+\frac{3\cdot 6}{7\cdot 10}x^2+\frac{3\cdot 6\cdot 9}{7\cdot 10\cdot 13}x^3+\frac{3\cdot 6\cdot 9\cdot 12}{7\cdot 10\cdot 13\cdot 16}x^4+\cdots$$

(b) Examine the convergence of the series of which the general term is

$$\frac{2^2\,4^2\,6^2\ldots(2n-2)^2}{3\cdot 4\cdot 5\ldots(2n-1)\cdot 2n}x^{2n}$$ 7+7=14

3. (a) State and prove the convolution theorem for Laplace transform.

(b) Find

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

using the convolution theorem. 7+7=14

4. (a) Solve the differential equation

$$\frac{d^2y}{dx^2}+9y=\cos 2t,\quad y(0)=1,\quad y\left(\frac{\pi}{2}\right)=-1$$

using Laplace transform.

(b) Evaluate the integral

$$\int_0^\infty \frac{e^{-t}\sin t}{t}\,dt$$

using Laplace transform. 7+7=14

5. Expand in Fourier series

$$f(x)=\begin{cases}-x, & -4\le x\le 0\\ x, & 0\le x\le 4\end{cases}$$

and hence deduce that

$$\frac{\pi^2}{8}=1+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}+\frac{1}{9^2}+\cdots$$ 14

6. (a) Evaluate by changing the order of integration

$$\int_0^\infty\int_x^\infty \frac{e^{-y}}{y}\,dy\,dx$$

(b) Find the volume of the solid in the first octant bounded by the paraboloid

$$z=36-4x^2-9y^2$$ 7+7=14

7. (a) Find the mass of a plate in the form of a quadrant of an ellipse

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

whose density per unit area is given by $\rho = kxy$.

(b) Evaluate the following integral by changing to polar coordinates :

$$\int_0^1\int_0^{\sqrt{(2x-x^2)}}(x^2+y^2)\,dy\,dx$$ 7+7=14

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8. (a) Use divergence theorem to evaluate

$$\iint_S A \cdot d\vec{S},$$

where

$$A = 4xi - 2y^2 j + z^2 k$$

and S is the surface, $x^2 + y^2 = 4$, $z = 0$ and $z = 3$.

(b) Find the directional derivative of

$$\varphi(x, y, z) = x^2yz + 4xz^2$$

at $(1, -2, -1)$ in the direction $2i - j - 2k$.

7+7=14

9. (a) Evaluate

$$\oint_C (x^2 - 2xy)\,dx + (x^2y + 3)\,dy$$

around the boundary of the region defined by $y^2 = 8x$ and $x = 2$ using Green's theorem.

(b) Find (i) $A \times (\nabla\varphi)$ and (ii) $(\nabla \times A) \times B$, where $\vec{A} = x^2z\,i + yz^3 j - 3xyk$, $\vec{B} = 3xi + 4zj - xyk$ and $\varphi = xy^2z$.

7+7=14

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