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B.Tech/M.Tech(Integrated) DEGREE EXAMINATION, NOVEMBER 2023

Third Semester

21MAB209T - TRANSFORMS AND COMPUTATIONAL TECHNIQUES

(For the candidates admitted during the academic year 2022-2023 onwards)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

	Question	Marks	BL	CO
1.	Which of the following is not true with respect to the Fourier Series (A) $f(x)$ is piecewise continuous (B) $f(x)$ has at at most a finite number of discontinuities within the period (C) $f(x)$ has an infinite number of maxima and minima in any one period (D) $f(x)$ is a single-valued and finite in any interval	1	1	1
2.	The Fourier Transform of the derivatives is given by: (A) $F\{f'(x)\} = -isF(s)$ (B) $F\{f'(x)\} = sF(s)$ (C) $F\{f'(x)\} = is^2F(s)$ (D) $F\{f'(x)\} = is^4F(s)$	1	1	2
3.	How many initial and boundary conditions are required to solve $u_t = \alpha^2 u_{xx}$ (A) One (B) Two (C) Three (D) Four	1	2	3
4.	The error in the Simpson's $\frac{1}{3}$-rule is of the order (A) h^3 (B) h^4 (C) h^2 (D) h	1	1	4
5.	The given PDE $z_{xx} - z_{yy} = 0$ is (A) Hyperbolic (B) Elliptic (C) Parabolic (D) Deterministic	1	2	5
6.	Which one of the following function is neither even nor odd? (A) |Cosx| (B) xSinx (C) $1 + x^3$ (D) x^4	1	2	1
7.	Let $F(s)$ is the Fourier Transform of $f(x)$, then Parseval Identity is (A) $\int_{-\infty}^{\infty} f(x)^2 dx = \int_{-\infty}^{\infty} f(s) ds$ (B) $\int_{-\infty}^{\infty} f(x) dx = \int_{-\infty}^{\infty} f(s) ds$ (C) $\int_{-\infty}^{\infty} f(x) dx = \int_{-\infty}^{\infty} \frac{f(s)}{2} / ds$ (D) $\int_{-\infty}^{\infty} \|f(x)\|^2 dx = \int_{-\infty}^{\infty} \|f(s)\|^2 ds$	1	1	2
8.	Solve the PDE $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} + 2\frac{\partial^2 z}{\partial x \partial y} = 0$ (A) $z = \phi_1(y-x) + \phi_2(y-2x)$ (B) $z = \phi_1(y-x) + \phi_2(y-x)^2$ (C) $z = \phi_1(y-x) + x\phi_2(y-x)$ (D) $z = x^2\phi_1(y-x) + x\phi_2(y-x)$	1	2	3
9.	Which of the following methods is used to solve an ordinary differential equation (A) Runge-Kutta Method (B) Bender - Schmidt Method (C) Crank-Nicholson Method (D) Simpson $\frac{3}{8}$ Method	1	1	4

10. The numerical solution of the one-dimensional Heat Equation can be obtained through 1 1 5

(A) Simpson $\frac{3}{8}$ Method
(B) Runge-Kutta Method
(C) Weddle's Method
(D) Crank-Nicholson Method

11. The condition for a partial differential equation $A(x,y)\frac{\partial^2 z}{\partial x^2} + B(x,y)\frac{\partial^2 z}{\partial x \partial y} + C(x,y)\frac{\partial^2 z}{\partial y^2} + F(x,y,z,\frac{\partial z}{\partial x},\frac{\partial z}{\partial y})$ =0 is elliptic 1 2 5

(A) $B^2 - 4AC < 0$
(B) $B^2 - 4AC > 0$
(C) $B^2 - 4AC = 0$
(D) $B = 0$

12. The error in the trapezoidal rule is of the order 1 1 4

(A) h^3
(B) h^2
(C) h^4
(D) h^5

13. If $Z(f_n) = F(z)$ then $Z(a^n f_n)$ is 1 1 3

(A) $F(f_n F(z))$
(B) $F(z + a^{-n})$
(C) $F(\frac{z}{a})$
(D) $F(a\frac{z}{n})$

14. Consider the two statements: 1 1 4

(i) Euler and Runge-Kutta methods are used for computing y over a limited range of $x - values.$
(ii) Milne and Adams methods may be applied for finding y over a wider range of $x - values.$

(A) Only (i) is correct
(B) Only (ii) is correct
(C) Both (i) and (ii) are correct
(D) Both (i) and (ii) are incorrect

15. The Laplace equation and the Poisson's equation are the examples of 1 1 5

(A) Hyperbolic partial differential equation
(B) Elliptic partial differential equation
(C) Parabolic partial differential equation
(D) Spherical partial differential equation

16. If a function is even in $(-\pi, \pi)$, the value of b_n in Fourier series is 1 2 1

(A) 0
(B) $-\iota$
(C) 1
(D) $1 + \iota$

17. The Z transform of 1 is: 1 2 3

(A) $\frac{z+1}{z-1}$
(B) z
(C) z^2
(D) $\frac{z}{z-1}$

18. If $f(x)$ is a periodic function of T, then $f(T + x)$ is 1 1 1

(A) $nf(x)$
(B) $f(x+n)$
(C) $f(x/n)$
(D) $f(x)$

19. Find the Particular Integral of $(D^2 - a^2 D'^2) = x$. 1 1 3

(A) $\frac{x^2}{6}$
(B) $\frac{x^3}{6}$
(C) $\frac{x^3}{36}$
(D) $Ax + B$

20. The Schmidt explicit formula is valid only for 1 1 5

(A) $0 < \alpha \leq \frac{1}{2}$
(B) $\frac{-1}{2} < \alpha \leq \frac{1}{2}$
(C) $0 < \alpha \leq 1$
(D) $-1 < \alpha \leq 1$

PART - B (4 × 10 = 40 Marks)
Answer **any 4** Questions

Marks BL CO

		Marks	BL	CO
21.	Evaluate $\int_0^6 \frac{dx}{1+x^2}$ taking step length $h = 1$ by using (i) Trapezoidal rule (ii) Simpson's $\frac{1}{3}$ rule (iii) Simpson's $\frac{3}{8}$ rule	10	1	4
22.	Find the Fourier Series of $f(x) = x^2$ in $(0, 2l)$.	10	1	1
23.	A uniform string is stretched and fastened to two points l apart. Motion is started by displacing the string into the form of the curve $y = kx(l - x)$ and then releasing it from this position at time $t = 0$. Find the displacement of the point of the string at a distance x from one end at time t.	10	1	3
24.	Use the Convolution Theorem of the Fourier Transform to find $F^{-1}\left(\frac{1}{6+5is-s^2}\right)$	10	1	2
25.	Using Modified Euler's method, find an appropriate value of y when $x = 0.3$, given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$.	10	1	4
26.	Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ in $0 < x < 5, t \geq 0$ given that $u(x,0) = 20, u(0,t) = 0, u(5,t) = 100$. Compute u for the time-step with $h = 1$ by Crank-Nicholson method.	10	1	5

PART - C (1 × 15 = 15 Marks)

Answer **any 1** Questions

		Marks	BL	CO
27.	A uniform bar of length l through which heat flows is insulated at its sides. The ends are kept at zero temperature. If the initial temperature at the interior point of the bar is given by $kSin^3(\frac{\pi x}{l})$ for $0 < x < l$, find the temperature distribution in the bar after time t.	15	3	3
28.	For the $Z - Transform$, Deduce the identity $Z(n^p) = -z\frac{d}{dz}Z(n^{p-1})$, and hence find the $Z(n^3)$.	15	4	2

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