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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2024 - 2025)

Subject: Engineering Mathematics-III

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

1-a. The order of Partial Differential equation $\frac{\partial^2 u}{\partial t^2} + 2\frac{\partial^2 u}{\partial x \partial t} + \frac{\partial^2 u}{\partial x^2} = 0$ is: (CO1,K1) 1

- (a) 1
- (b) 2
- (c) 3
- (d) 4

1-b. For this P.D.E $3Z_{xx} + BZ_{xy} + 3Z_{yy} + 4Z = 0$ to be classified as parabolic, the value of B must be..... (CO1,K2) 1

- (a) 3
- (b) 0
- (c) 2
- (d) 6

1-c. $Z(2^{k+2}) = \dots\dots\dots$ for $k \geq 0$: (CO2,K1) 1

- (a) $\frac{4z}{(z-3)}$
- (b) $\frac{2z}{(z-1)}$
- (c) $\frac{8z}{(z-e)}$
- (d)

$$\frac{4z}{(z-2)}$$

- 1-d. The inverse Z-transform of $F(z) = \frac{z}{(z-2)}$ is: (CO2,K1) 1
- (a) $2^{(k+1)}$
 (b) 3^k
 (c) $2^{(-k)}$
 (d) 2^k
- 1-e. A function which is analytic everywhere in a complex plane is known as: (CO3,K2) 1
- (a) Harmonic function
 (b) Differentiable function
 (c) Regular function
 (d) Entire function
- 1-f. $f(z)$ satisfies Cauchy Riemanns equations everywhere and differentiable then $f(z)$ is: (CO3,K1) 1
- (a) May be analytic everywhere
 (b) Analytic everywhere
 (c) Analytic except at origin
 (d) None of these
- 1-g. $f(z) = \frac{z}{(z-2)^3}$, then pole and order of the pole are: (CO4,K2) 1
- (a) 2 and 2 respectively
 (b) 0 and 3 respectively
 (c) 2 and 3 respectively
 (d) None of these
- 1-h. The residue of the function $f(z) = \frac{z+1}{z^2(z-2)}$ at $|z| = 2$ is: (CO4,K1) 1
- (a) $3/4$
 (b) 0
 (c) 1
 (d) None of these
- 1-i. Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $P = \{1, 2, 5\}$, $Q = \{6, 7\}$, then $P \cap Q'$ is : (CO5,K1) 1
- (a) P
 (b) Q
 (c) P'
 (d) Q'
- 1-j. The following two sets are equal: (CO5,K2) 1
- (a) $A = \{1, 2\}$ and $B = \{1\}$
 (b) $A = \{1, 2\}$ and $B = \{1, 2, 3\}$

(c) $A = \{1, 2, 3\}$ and $B = \{2, 1, 3\}$

(d) $A = \{1, 2, 4\}$ and $B = \{1, 2, 3\}$

2. Attempt all parts:-

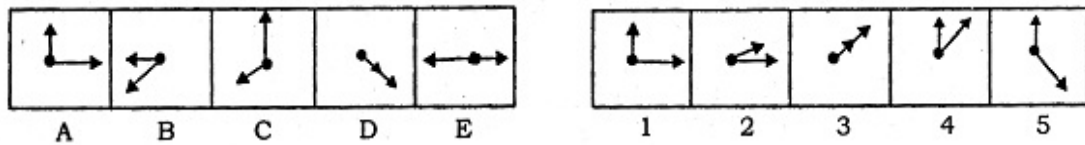
2.a. Classify the P.D.E: $\frac{\partial^2 u}{\partial t^2} + 2 \frac{\partial^2 u}{\partial x \partial t} + \frac{\partial^2 u}{\partial x^2} + 2 \frac{\partial u}{\partial x} + 6u = 0$. (CO1,K1) 2

2.b. Find the Fourier cosine transform of the function $F(x) = \begin{cases} k, & x < a \\ 0 & x > a \end{cases}$. (CO2,K2) 2

2.c. Check that the $\lim_{z \rightarrow 0} \frac{\bar{z}}{z}$ exist or not? (CO3,K1) 2

2.d. Write Cauchy's integral formula for complex integration. (CO4,K2) 2

2.e. Find the next of E selected from 1,2,3,4,5. (CO5,K1) 2



SECTION-B

30

3. Answer any five of the following:-

3-a. Solve the following PDE by method of separation of variables: $\frac{\partial u}{\partial x} = \frac{\partial u}{\partial y}$. (CO1,K1) 6

3-b. Solve: $(D - D' - 1)(D - D' - 2)z = \sin(2x + 3y)$. (CO1,K2) 6

3-c. Find the Fourier transform of the following function: (CO2,K2) 6
 $F(t) = \begin{cases} t, & t < a \\ 0, & t > a \end{cases}$

3-d. By residue method, find the inverse z transform of the given function: (CO2,K1) 6
 $\frac{8z^2}{(2z-1)(4z-1)}$

3.e. Show that $e^x \cos y$ is a harmonic function. Also find the corresponding analytic function whose real part is $e^x \cos y$. (CO3,K1) 6

3.f. Evaluate $\oint_C \frac{\cos \pi z}{(z-1)} dz$, where C is the circle $|z| = 3$. (CO4,K1) 6

3.g. If $A = \{4, 8, 12, 16, 20\}$, $B = \{2, 4, 6, 8, 10, 12, 14, 16, 18, 20\}$ and $C = \{a, b, c, d, e\}$. State, true or false for the following: (CO5,K2) 6
 (a) $n(A) = n(C)$
 (b) $n(A) = n(B)$
 (c) $n(B) - n(C) = n(A)$
 (d) $A \cup (B \cap C) = (A \cup B) \cap C$

SECTION-C

50

4. Answer any one of the following:-

4-a. Solve the following PDE: $(D^2 + D'^2)z = x^2 y^2$ (CO1,K1) 10

- 4-b. $(D - 2D' - 1)(D - 2D')z = e^{3x+4y}$ (CO1,K2) 10
5. Answer any one of the following:-
- 5-a. By residue method, find the inverse z transform of the given function: (CO2,K1) 10

$$\frac{3z^2 + 2}{(5z - 1)(5z + 2)}$$
- 5-b. Using Suitable Fourier transform to solve the equation $\frac{\partial u}{\partial t} = 2 \frac{\partial^2 u}{\partial x^2}$ under the conditions: (CO2,K3) 10
 (i) $u(0, t) = 0$ (ii) $u(x, 0) = e^{-x}$ (iii) $u(x, t)$ is bounded.
6. Answer any one of the following:-
- 6-a. Show that transformation $w = \frac{(2z + 3)}{(z - 4)}$ maps the circle $x^2 + y^2 = 4x$ onto straight line $4u + 3 = 0$. (CO3,K1) 10
- 6-b. If $u = e^x(x \cos y - y \sin y)$ is a harmonic function, find analytic function $f(z) = u + iv$ (CO3,K2) 10
 Such that $f(1) = e$.
7. Answer any one of the following:-
- 7-a. Evaluate : $\int_C \frac{1}{(z-3)(z-1)(z-2)} dz$, where C is the circle $|z| = 4$. (CO4,K1) 10
- 7-b. Determine poles and the residues at the each poles of the following function: (CO4,K1) 10

$$f(z) = \frac{z^2}{(z+1)^2(z-2)(z-3)}$$
8. Answer any one of the following:-
- 8-a. Justify Answer for the following Statements and conclusion: (CO5,K1) 10
 Statements: All the locks are keys. All the keys are bats. Some watches are bats.
 Conclusions:
 Some bats are locks.
 Some watches are keys.
 All the keys are locks.
- 8-b. Two cards are drawn from the pack of 52 cards. Find the probability : (CO5,K2) 10
 (a) one of them is king and the other is queen (b) both are either red or kings.