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Question Paper Code: 94021

B.E./B.Tech. DEGREE EXAMINATION, MAY 2024

Fourth Semester

Computer Science and Engineering

19UMA421 - Transforms and Discrete Mathematics

(Common to Information Technology)

(Regulations 2019)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The truth value "If 7 is prime then 2 is even", The truth value "1 > 3 and 3 is a positive integer"
(a) T,F (b) F,T (c) T,T (d) F,F CO1-U
2. $\neg(P \rightarrow Q)$ is equivalent to
(a) $\neg P \wedge Q$ (b) $P \wedge \neg Q$ (c) $\neg(P \wedge Q)$ (d) $P \vee Q$ CO1-U
3. Calculate how many integers between 1 to 100 are divisible by 2 and 10
(a) 41 (b) 16 (c) 82 (d) 10 CO2-App
4. The particular integral of $a_n - 4a_{n-1} + 7a_{n-2} = 12$
(a) 4 (b) 3 (c) 7 (d) 0 CO2-App
5. A subgroup of the group $\{1, i, -i, 1\}$ where $i^4 = 1$ under the multiplication is
(a) $\{1, i\}$ (b) $\{1, -i\}$ (c) $\{-i, i\}$ (d) None of the above CO3- App
6. The order of the element [7] in a group (Z_8, \oplus_8)
(a) 4 (b) 3 (c) 2 (d) None of the above CO3- App

7. Fourier transform of $\sqrt{2\pi}$, $-1 < x < 1$. CO4-App
- (a) $\frac{\cos s}{s}$ (b) $\sqrt{2\pi} \frac{\cos s}{s}$ (c) $\sqrt{2\pi} \frac{\sin s}{s}$ (d) $\frac{2 \sin s}{s}$
8. If $F[f(x)] = F(s)$, then $F[ax]$, $a > 0$ CO6-U
- (a) $aF\left(\frac{a}{s}\right)$ (b) $\frac{1}{a}F\left(\frac{s}{a}\right)$ (c) $aF\left(\frac{s}{a}\right)$ (d) $\frac{1}{a}F\left(\frac{a}{s}\right)$
9. The Z-transform of $\frac{a^n}{n!}$ CO5-U
- (a) e^{aZ} (b) $\frac{Z}{e^a}$ (c) e^Z (d) $\frac{a}{e^Z}$
10. The Z transform of $4(-1)^n$ is CO5-U
- (a) $\frac{z}{z-1}$ (b) $\frac{z}{z+4}$ (c) $\frac{4z}{z-1}$ (d) $\frac{4z}{z+1}$

PART – B (5 x 2= 10Marks)

11. Simplify the premises $\neg(\neg P \rightarrow Q)$ and $\neg P$ CO1-App
12. Derive the complementary function of $a_n + 2a_{n-1} + a_{n-2} = 25$ CO2-App
13. Define Monoid and give an example. CO3-U
14. Define Fourier transform pair CO4-App
15. State Initial value theorem of Z transform CO5-R

PART – C (5 x 16= 80Marks)

16. (a) (i) Calculate PCNF and PDNF for $(P \wedge \neg Q) \vee (P \wedge R) \vee (Q \wedge R)$ CO1-App (8)
- (ii) Show that the following premises are inconsistent: CO1- App (8)
- a. If Vijay misses many classes, then he fails in M.E
 - b. If Vijay fails in M.E, then he is unemployed.
 - c. If Vijay appears for lot of interviews, then he is not unemployed.
 - d. Vijay misses many classes and appears for lot of interviews

Or

- (b) (i) Prove the following by Indirect method. CO1- App (8)

$$(x)(P(x) \vee Q(x)) \Rightarrow (x)P(x) \vee (\exists x)Q(x)$$
- (ii) Prove the following by direct method CO1- App (8)

$$(\exists x)(P(x) \wedge Q(x)) \Rightarrow (\exists x)P(x) \wedge (\exists x)Q(x)$$
17. (a) (i) Using mathematical induction show that CO2-App (8)
 $n^3 + 2n$ is a multiple of 3..
- (ii) Solve $a_n - 4a_{n-1} + 4a_{n-2} = 2^n, a_0 = 1, a_1 = 1$ CO2-App (8)
- Or
- (b) (i) Calculate the number of positive integers not exceeding 250 CO2 -App (8)
that are divisible by 2, 3, 5 or by 7
- (ii) Using generating functions Solve $a_n = 3a_{n-1} + 5^n, a_0 = 4$ CO2 -App (8)
18. (a) (i) Let G be a finite group of order 'n' and H be any subgroup of CO3-U (10)
G. Then Show that the order of H divides the order of G. (i.e)
 $O(H) / O(G)$
- (ii) The binary operation * is defined on Q^+ such that CO3-App (6)
 $a * b = \frac{ab}{3}, a, b \in Q^+, \text{ Show that } (Q^+, *) \text{ is an abelian Group.}$
- Or
- (b) $S = Q \times Q$, such that binary operation defined by CO3-U (16)
 $(a, b) * (x, y) = (ax, ay + b)$
- (i) Prove that $(S, *)$ is a semi group
- (ii) Is it commutative
- (iii) Find the identity Element
- (iv) Find the inverse of $(1,3)*(2,1)$ and $(2,1)*(1,3)$

19. (a) Compute the Fourier Transform of $f(x) = \begin{cases} a - |x| & \text{if } |x| \leq a \\ 0 & \text{if } |x| > a \end{cases}$ CO4-App (16)

and hence evaluate (i) $\int_0^{\infty} \left(\frac{\sin x}{x}\right)^4 dx$ (ii) $\int_0^{\infty} \left(\frac{\sin x}{x}\right)^2 dx$

Or

- (b) (i) Find Fourier sine & cosine transform x^{n-1} and hence Show CO4-App (8)
that $\frac{1}{\sqrt{x}}$ is self reciprocal under Fourier sine & cosine transform

- (ii) Determine the Fourier sine transform of e^{-4x} and hence CO4-App (8)
determine the value of $\int_0^{\infty} \frac{x \sin 5x}{16 + x^2} dx$

20. (a) (i) Solve the difference equation $y_{n+2} - 6y_{n+1} + 8y_n = 5^n$ given CO5-App (8)
that $y_0 = 0, y_1 = 0$

- (ii) Using Convolution theorem find $Z^{-1} \left[\frac{10z^2}{(5z-2)(2z+1)} \right]$ CO5-App (8)

Or

- (b) (i) Solve the difference equation $y_{n+2} + 3y_{n+1} - 10y_n = 3^n$ given CO5- U (8)
that $y_0 = 0, y_1 = 0$

- (ii) Using Convolution theorem find $Z^{-1} \left[\frac{14z^2}{(7z+3)(2z-1)} \right]$ CO5- U (8)