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**Question Paper Code: 94021**

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

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)

- How many "T" are occurred in  $(P \vee Q)$  CO1-U  
(a) 4 (b) 3 (c) 1 (d) 2
- $\neg(P \rightarrow Q)$  is equivalent to CO1-U  
(a)  $\neg P \wedge Q$  (b)  $P \wedge \neg Q$  (c)  $\neg(P \wedge Q)$  (d)  $P \vee Q$
- How many ways can letters of the word "KSKQK" be arranged CO2-App  
(a) 16 (b) 120 (c) 60 (d) 20
- The particular integral of  $a_n - 4a_{n-1} + 7a_{n-2} = 12$  CO2-App  
(a) 4 (b) 3 (c) 7 (d) 0
- A subgroup of the group  $\{1, i, -i, 1\}$  where  $i^4 = 1$  under the multiplication CO3- App  
is  
(a)  $\{1, i\}$  (b)  $\{1, -i\}$  (c)  $\{-i, i\}$  (d) None of the above
- The order of the element [7] in a group  $(Z_8, \oplus_8)$  CO3- App  
(a) 4 (b) 3 (c) 2 (d) None of the above
- 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  $\neg(P \wedge \neg Q)$  and  $P$  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. Determine the Z – Transform of  $z(a^n)$  CO5-U

PART – C (5 x 16= 80Marks)

16. (a) (i) Calculate PCNF and PDNF for  $(\neg P \rightarrow R) \wedge (Q \leftrightarrow P)$  CO1-App (8)

(ii) Using the rules of inference derive & using CP Rule. CO1- App (8)

$$P \rightarrow (Q \rightarrow S), \neg R \vee P, Q \Rightarrow R \rightarrow S$$

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 CO2-App (8)

$$1.1! + 2.2! + 3.3! + \dots + n.n! = (n+1)! - 1$$

(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 that are divisible by 2, 3, 5 or by 7 CO2 -App (8)
- (ii) Using generating functions Solve  $a_n = 3a_{n-1} + 5^n, a_0 = 4$  CO2 -App (8)
18. (a) (i) State and prove Lagrange's theorem. CO3-U (10)
- (ii) The binary operation  $*$  is defined on  $\mathbb{R}$  such that  $a * b = a + b + 3ab, a, b \in \mathbb{R}$ , Verify  $(\mathbb{R}, *)$  is a Group. CO3-App (6)
- Or
- (b)  $S = \mathbb{Q} \times \mathbb{Q}$ , 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  $\int_0^{\infty} \left(\frac{\sin x}{x}\right)^2 dx$  and  $\int_0^{\infty} \left(\frac{\sin x}{x}\right)^4 dx$
- 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) Obtain Fourier Transform of  $e^{-a^2 x^2}$  CO4-App (8)
20. (a) (i) Solve the difference equation  $y_{n+2} - 6y_{n+1} + 8y_n = 3^n$  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  $y_{n+2} + 3y_{n+1} - 10y_n = 6^n$  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)

