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M.E DEGREE EXAMINATIONS: JAN 2015

(Regulation 2014)

First Semester

COMMUNICATION SYSTEMS

P14MAT107: Applied Mathematics for Electronics Engineers

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Consider the following statements [K_2]

1) Sum, product and scalar multiple of upper triangular matrices is upper triangular.
2) Every square echelon matrix is lower triangular.
3) Any matrix w[ith a zero row or zero column is invertible.
4) The rows and columns of A will be linearly dependent if determinant not equal to zero.

Which of these statements are false?

a) 1,3 b) 3,4
c) 3,2 d) 2,4

2. If two rows of a matrix A are interchanged to produce B, the det(B) is

a) 0 b) A^2
c) -A d) - det(A)

3. For two different sets A and B, $A\cup(B-A)=$ [K_1]

a) A b) B
c) $A\cap B$ d) $A\cup B$

4. Assertion (A) : For a function, every element of a domain set must be associated with some element of the codomain set. [K_2]

Reason (R) : For a relation, any element of the first set must be associated with any element of the second set.

a) both A and R are individually true and R is the correct explanation of A
b) both A and R are individually true but R is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true.

5. Match the following [K_3]

A) When $AA^T = I$	1) One of the eigen value of A is zero.
B) A is a square matrix of order 2	2) Eigen values of A are 1,1.
C) Eigen values of A^{-1} are 1,1	3) Characteristic Equation of A is quadratic
D) A is a singular matrix	4) A is an orthogonal matrix.

Codes	A	B	C	D
a)	3	4	2	1
b)	4	3	2	1
c)	3	4	1	2
d)	4	3	1	2

6. The steps involved in diagonalising a matrix A [K_3]
   1. Obtain the characteristic equation.of A
   2. Find the latent roots and latent vectors.
   3. Check the vectors are linearly independent and pairwise orthogonal.
   4. Diagonalise and $D = M^T AM$,

a) 1-2-3-4 b) 2-3-4-1

c) 3-4-1-2 d) 4-1-2-3

7. If a random variable X has the following probability distribution [K_2]

Values of X = x	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
$p(x)$	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

Then the value of a is

a) 1/81 b) 81

c) 1 d) 1/10

8. The pdf of a distribution is f(x) = Ce^{-x}, $0 \le x < \infty$ then C is [K_3]

a) 3 b) -1

c) 2 d) 1

9. A queuing system is composed of the following components of which is described orderly as : [K_1]

1) Service process or mechanism 2) Serviced customers or departure
3) Input source or population 4) Waiting area or queue

The correct sequence of the components is

a) 1-2-3-4 b) 2-3-4-1

c) 3- 4-1-2 d) 4-1-3-2

10. Match list I with list II and select the correct answer using the codes given below: [K_2]

List I	List II
A. Lq	1. Wq
B. $Ws - \frac{1}{\mu}$	2. $Ls - \frac{\lambda}{\mu}$
C. λWs	3. Lq
D. λWq	4. Ls

Codes:

	A	B	C	D
a)	2	1	3	4
b)	3	4	2	1
c)	2	1	4	3
d)	3	1	2	4

PART B (10 x 2 = 20 Marks)

11. Use the inverse of the matrix to solve the system $3x_1 + 4x_2 = 3; \quad 5x_1 + 6x_2 = 7.$ [K_3]

12. Verify $\det AB = (\det A)(\det B)$ for $A = \begin{pmatrix} 6 & 1 \\ 3 & 2 \end{pmatrix}$ *and* $B = \begin{pmatrix} 4 & 3 \\ 1 & 2 \end{pmatrix}$. [K2]

13. For any 3 sets A, B and C, prove that $A\times(B\cap C)=(A\times B)\cap(A\times C)$. [K3]

14. Show that the functions $f(x)=x^3$ and $g(x)=x^{\frac{1}{3}}$ for $x\in R$ are inverses of one another. [K4]

15. Identify the rank of the matrix $A=\begin{bmatrix} 1 & 2 & -1 & 3 \\ 3 & -1 & 2 & 1 \\ 2 & -2 & 3 & 2 \\ 1 & -1 & 1 & -1 \end{bmatrix}$ [K4]

16. Define a vector space. [K1]

17. In a class of 10 students 4 are boys and rest are girls. Find the probability that a student selected will be a girl? [K3]

18. A continuous random variable X follows the probability law $f(x)=Ax^2$; $0\le x\le 1$, determine A and find the probability of X lies between 0.2 and 0.5 [K2]

19. Given $\lambda = 0.5$, $\mu = 0.67$ find W_q in the $(M/M/1):(\infty/FIFO)$ model. [K1]

20. What is the effective arrival rate for $(M/M/1):(4/FIFO)$ queuing model when $\lambda = 2$ *and* $\mu = 5$. [K3]

PART C (6 x 5 = 30 Marks)

21. Find the inverse of the matrix $A=\begin{bmatrix} 2 & 0 & 1 \\ 3 & 2 & 5 \\ 1 & -1 & 0 \end{bmatrix}$ [K3]

22. If $f: Z \to N$ is defined by f(x)=2x-1 when x>0 and f(x)= -2x when x<0, then prove that f is bijection and also find f^{-1}. [K3]

23. Test the dependency of the vectors (1,-1,-2,-4), (2,3,-1,-1), (3,1,3,-2), (6,3,0,-7). [K4]

24. Is $\begin{bmatrix} 1 \\ -2 \\ 1 \end{bmatrix}$. an Eigen vector of $\begin{bmatrix} 3 & 6 & 7 \\ 3 & 3 & 7 \\ 5 & 6 & 5 \end{bmatrix}$. If so find the corresponding Eigen value. [K3]

25. The chances of three candidates A, B and C to become the manager of a Company are in the ratio 3: 5: 4. The probability that a special bonus scheme was introduced by them if selected are 0.6, 0.4 and 0.5 respectively. If the bonus scheme is introduced, what is the probability that B has become the manager. [K3]

26. A petrol pump station has 2 pumps. The service times follow the exponential distribution with mean of 4 minutes and cars arrive for service is a Poisson process at the rate of 10 cars per hour. Find the probability that a customer has to wait for services. What is the probability that the pumps remain idle? Find the average number of customers in the queue and in the system. [K5]

PART D (4 x 10 = 40 Marks)

27. (i) Determine an LU factorization of $\begin{pmatrix} 2 & -4 & -2 & 3 \\ 6 & -9 & -5 & 8 \\ 2 & -7 & -3 & 9 \\ 4 & -2 & -2 & -1 \\ -6 & 3 & 3 & 4 \end{pmatrix}$ [K_5]

(ii) Show that the relation R on Z x Z defined by (a,b)R(c,d) iff a+d=b+c is an equivalence relation. [K_5]

28. Diagonalise the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ [K_4]

29. (i) A discrete random variable X has the probability function given below: (K5) [K_4]

Values of X, x	0	1	2	3	4	5	6	7
P(X)	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2 + k$

Find (i) The value of k (ii) $P(X < 6)$, $P(X \geq 6)$ & $P(0 < X < 4)$ [K_4]

(ii) In a continuous distribution whose p.d.f is given by $f(x) = kx(2-x)$, $0 \leq x \leq 2$

find (i)k (ii) mean (iii) variance (iv) r^{th} moment.

30. (i) Customers arrive at a one-man barber shop according to a Poisson process with a mean inter-arrival time of 20 minutes. Customers spend an average of 15 minutes in the barber's chair. If an hour is used as the unit of time, then [K_5]

a) What is the probability that a customer need not wait for a hair cut?

b) What is the expected number of customers in the barber shop and in the queue?

c) How much time can a customer expect to spend in the barbershop? [K_5]

(ii) A supermarket has 2 girls attending to service. The customers arrive in a Poisson fashion at the rate of 10/hr. The average service time for each customer is 4 min. Find (a) P (customer has to wait for the service) (b) Average time spent by the customer in queue. (c) Average queue length.

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