23/2/23

Reg. No.												

Question Paper Code	21310

M.E. / M.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022

First Semester

M.E. - Communication Systems

20PCOMA103 - APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS

(Regulations 2020)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level,CO
1.	Calculate $\langle X,Y \rangle$ when $X=\begin{bmatrix} i \\ 1 \end{bmatrix}$ and $Y=\begin{bmatrix} i \\ -i \end{bmatrix}$.	*K2,1,CO1*
2.	Define Singular value decomposition of a matrix.	*K1,1,CO1*
3.	The feasible region of a LPP is bounded by O(0,0), A(20,0), B(2.5,35)and D(0,36). Find an optimal solution for maximization problem with the objective function Z=3x+4y.	*K2,2,CO2*
4.	Solve the following LPP using graphical method, Maximize$Z = 2x + 3y$ Subject to $x - y \le 2, x + y \ge 4, x, y \ge 0$	*K3,2,CO2*
5.	State the interval of absolute stability for fourth order Runge Kutta Method.	*K1,3,CO3*
6.	Solve the boundary value problem $y'' + 50 = 0, 0 \le x \le 10$ by point collocation method.	*K3,3,CO3*
7.	The cumulative distribution function of a random variable X is $F(x) = 1 - (1 + x)e^{-x},\ x > 0$. Find the probability density function of X.	*K3,4,CO4*
8.	A box contains 4 bad and 6 good tubes. Two tubes are drawn out from the box at a time. One is tested and found to be good. What is the probability that the other one is also good?	*K3,4,CO4*
9.	Write the condition for the queue to explode in a Queueing model.	*K1,5,CO5*
10.	Prove that the inter arrival time of a Poisson process with parameter λ has an exponential distribution with mean $1/\lambda$	*K2,5,CO5*

PART - B (5 × 16 = 80 Marks)

Answer ALL Questions

11. a) Construct QR decomposition for the matrix $A = \begin{bmatrix} -4 & 2 & 2 \\ 3 & -3 & 3 \\ 6 & 6 & 0 \end{bmatrix}$ 16,K3,CO1

OR

b) Construct a singular-value decomposition for the matrix $A = \begin{bmatrix} 2 & 2 & -2 \\ 2 & 2 & -2 \\ -2 & -2 & 6 \end{bmatrix}$. 16,K3,CO1

12. a) Use two phase method to solve the LPP. 16,K3,C

Minimize $z = -2x_1 - x_2$

Subject to $x_1 + x_2 \geq 2$

$x_1 + x_2 \leq 4$

$x_1, x_2 \geq 0.$

OR

b) Solve the following transportation problem 16,K3,CO2

Destination Source	A	B	C	D	Supply
1	6	1	9	3	70
2	11	5	2	8	55
3	10	12	4	7	70
Demand	85	30	50	45	

13. a) Apply Runge Kutta method of fourth order to find $y(0.1)$ given $y'' + xy' + y = 0, y(0) = 1, y'(0) = 0$. 16,K3,CO3

OR

b) Apply Runge Kutta method to find y (0.1), y (0.2), y(0.3) for $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$, and hence obtain $y(0.4)$ using Adams method. 16,K3,CO3

14. a) Two random variables X and Y have joint density function $f(x, y) = 2 - x - y, 0 < x < 1, 0 < y < 1$. Find the regression equations of Y on X and X on Y. 16,K3,CO4

OR

b) If X and Y are independent random variables with probability density functions $f(x) = e^{-x}$, $x \geq 0$ and $f(y) = e^{-y}$, $y \geq 0$, respectively, find the density functions of $U = \frac{X}{X+Y}$ and $V = X + Y$. Are U and V independent? 16,K3,CO4

15. a) (i) There are three typists in an office Each typist can type an average of 6 letters per hour. If letters arrive for being typed at the rate of 15 letters per hour, *10,K3,CO5*

(a) What fraction of time all the typist will be busy?

(b) What is the average number of letters waiting to be typed.

(c) What is the average time a letter has to spend for waiting and for being typed?

(d) What is the probability that a letter will take longer than 20 minutes waiting to be typed and being typed.

(ii) Suppose that customers arrive at a bank according to Poisson process with mean rate of 3 per minute. Find the probability that during a time interval of two minutes *6,K3,CO5*

(i) exactly 4 customers arrive

(ii) greater than 4 customers arrive

(iii) fewer than 4 customers arrive.

OR

b) Arrivals at a telephone booth are considered to be Poisson with an average time of 12 minutes between one arrival and the next .The length of a phone call is assumed to be distributed exponentially with mean 4 minutes *16,K3,CO5*

(a) Find the average number of persons waiting in the system.

(b) What is the probability that a person arriving at the booth will have to wait in the queue?

(c) What is the probability that it will take him more than 10 min altogether to wait for the phone and complete his call?

(d) Estimate the fraction of the day when the phone will be in use

(e) The telephone department will install a second booth, when convinced that an arrival has to wait on the average for at least 3 min. for phone .By how much the flow of arrivals should increase in order to justify a second booth?

(f) What is the average length of the queue that forms from time to time?