Reg. No. :

Question Paper Code: 12021

M.E. DEGREE EXAMINATION, DECEMBER 2013.

First Semester

Communication Systems

01PMA122 - APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Find the value of $J_0(x)$.

2. Write the orthogonal property of Bessel's function.

3. State singular value decomposition theorem.

4. Explain least square method.

5. Find the moment generating function of $f(x) = 1/4; -2 < x < 2$.

6. The mean and variable of a binomial distribution are 4 and $\frac{4}{3}$ respectively. Find $P(x \geq 1)$, if $n = 6$.

7. Find the value of K, if $f(x, y) = K(1-x)(1-y)$, for $0 < x, y < 1$, is to be a joint density function.

8. Prove that the correlation co - efficient is the geometric mean of the regression co - efficient.

9. What is the probability that a customer has to wait more than 15 minutes to get his service completed in a $M/M/1$ queuing system, if $\lambda = 6$ per hour and $\mu = 10$ per hour.

10. For $(M/M/1):(\infty/FIFO)$, write down the Little's formula.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Prove that $\frac{d}{dx}\left[x^n j_n(x)\right] = x^n j_{n-1}(x)$. (8)

(ii) Show that $J_{1/2}(x) = \sqrt{\frac{2}{\pi x}}\ \sin(x)$. (8)

Or

(b) (i) Express $\cos(x\sin\theta)$ and $\sin(x\sin\theta)$ as an infinite series of Bessel's function. (8)

(ii) Prove that $\int_{-1}^{1}(x^2-1)P_{n+1}P_n^1\,dx = \frac{2n(n+1)}{(2n+1)(2n+3)}$ (8)

12. (a) (i) Use Choleskey's decomposition method, to find A^{-1} where $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 4 \end{bmatrix}$. (16)

Or

(b) (i) Obtain singular value decomposition of A, where $A = \begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 1 & 3 \end{bmatrix}$. (16)

13. (a) (i) Find the mean and variance of a continuous random variable X if it has the following pdf

$$f(x) = \begin{cases} 2(x-1); 1 < x < 2 \\ 0 \ ; \text{otherwise} \end{cases}.$$ (8)

(ii) 6 dice are thrown 729 times. How many times do you expect at least three dice to show 5 (or) 6? (8)

Or

(b) (i) In an engineering examination, a student is considered to have failed, secured second class, first class and distinction, accordingly as he scores less than 45%, between 45% and 60%, between 60% and 75% and above 75% respectively. In a particular year 10% of the students failed in the examination and 5% of the students got distinction. Find the percentage of students who have got first class and second class (Assume normal distribution of marks). (8)

14. (a) If X and Y are two random variables having joint density function

$$f(x, y) = \begin{cases} \frac{1}{8}(6 - x - y); 0 < x < 2; \quad 0 < y < 4 \\ 0 \quad ; \text{otherwise} \end{cases}$$

Find (i) $P(x < 1 \cap y < 3)$

(ii) $P(x + y < 3)$

(iii) $P(x < 1 / y < 3)$. (16)

Or

(b) Calculate the co - efficient of correlation between x and y from the following table and write down the regression equation of y on x

Y \ X	0 – 40	40 – 80	80 – 120	120 – 160
10 – 30	9	4	1	-
30 – 50	47	19	6	-
50 – 70	26	18	11	-
70 – 90	2	3	2	2

(16)

15. (a) There are 3 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,

(i) What fraction of the time all the typists will be busy?

(ii) What is the average number of letters waiting to be typed?

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

(iv) What is the probability that a letter will take longer than 20 minute waiting to be typed and being typed?

Or

(b) A car wash facility operates with only one bay. Cars arrive according to a Poisson distribution with a mean of 4 cars per hour and may wait in the facility's parking lot if the bay is busy. The parking lot is large enough to accommodate any number of cars. Find the average number of cars waiting in the parking lot, if the time for washing and cleaning a car as follows.

(a) uniform distribution between 8 and 12 minutes.

(b) a normal distribution with mean 12 and SD 8 minutes.

(c) a discrete distribution with values equal to 4, 8 and 15 minutes and corresponding probabilities 0.2, 0.6 and 0.2.