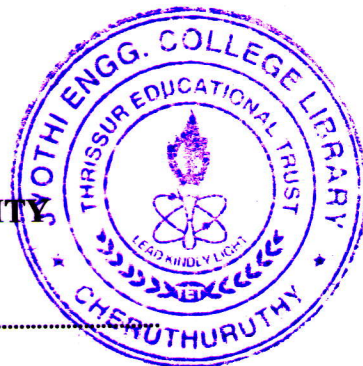


APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY

08 PALAKKAD CLUSTER



Q. P. Code : CESP0820111-I

(Pages: 3)

Name:

Reg. No:.....

FIRST SEMESTER M.TECH. DEGREE EXAMINATION MARCH 2021

Branch: Electronics & Communication Engineering

Specialization: Communication Engineering & Signal Processing

08EC6211/08EC6511 Mathematics for Communication Engineering

(Common to CESP and ECE)

Time: 2 hour 15 minutes

Max. Marks: 60

Answer all six questions.

Modules 1 to 6: Part 'a' of each question is compulsory and answer either part 'b' or part 'c' of each question.

Q. No. Module 1 Marks

1.a Determine whether the vectors $(1,3,2,-2)$, $(4,1,-1,3)$, $(1,1,2,0)$ and $(0,0,0,1)$ are linearly independent or not. 3

Answer b or c

b Find the basis and dimension of the subspace W of R^4 generated by $(1,2,-1,3)$, $(2,1,-1,1)$ and $(-1,4,5,11)$. 6

c Using Gram Schmidt orthogonalization process find an orthonormal basis for the subspace spanned by the vectors $(1, 1, 1)$, $(-1, 0, -1)$, $(-1, 2, 3)$ of R^3 . 6

Q. No. Module 2 Marks

2.a Show that the map $T:R^2 \rightarrow R^3$ defined by $T(a,b) = (a+b, a-b, b)$ is a linear Transformation. 3

Answer b or c

b Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$. 6

c Find a basis for the range of the linear transformation $T:R^3 \rightarrow R^3$ defined by $T(x_1, x_2, x_3) = (x_1 + x_2 + 2x_3, x_1 + 2x_2 + 5x_3, 5x_1 + 3x_2 + 4x_3)$. 6

Q. No. **Module 3** **Marks**

3.a Let X be a random variable with m.g.f $M_X(t)$ then show that **3**

$$M_{ax+b}(t) = e^{bt} M_X(at).$$

Answer b or c

b The random variables X and Y have joint distribution function **6**

$$f(x,y) = \begin{cases} x^2 + \frac{xy}{3} & , 0 < x < 1, 0 < y < 2 \\ 0, & \text{elsewhere} \end{cases}$$

Find 1) Marginal density function of X and Y 2) Are X and Y independent?

c The density function of a two dimensional random variable (X,Y) is given by **6**

$F(x,y) = \{e^{-(x+y)}, x > 0, y > 0\}$. Check whether X and Y are independent.

Q. No. **Module 4** **Marks**

4.a A student study habits are as follows. If he studies one night, he is 70% sure not to study next night. On the other hand, the prob. that he does not study 2 nights in succession is 0.6. In the long run, how often does he study? **3**

Answer b or c

b A Markov chain on state space {1,2,3} has initial distribution $p(X_0=i)=1/3$ and TPM = **6**

$$\begin{bmatrix} .1 & .5 & .4 \\ .6 & .2 & .2 \\ .3 & .4 & .3 \end{bmatrix}$$

Find a) $P(X_2=3)$ b) $P(X_4=2/X_2=1)$ c) $P(X_1=1, X_2=2, X_3=3)$

c A message transmission system is found to be Markovian with the transition probability of current message to next message is given by the matrix **6**

$$\begin{bmatrix} 0.2 & .0.3 & 0.5 \\ 0.1 & 0.2 & 0.7 \\ 0.6 & 0.3 & 0.1 \end{bmatrix}$$

The initial probabilities of the states are $p_1(0)=0.4, p_2(0)=0.3, p_3(0)=0.3$.

Find the probabilities of the next message

Q. No.	Module 5	Marks
5.a	If people arrive at a book stall in accordance with a Poisson Process with a mean rate of 3 per minute, find the probability that the interval between two consecutive arrivals is 1) more than 1 minute 2) between 1 min and 2 min 3) 4 min or less.	4
Answer b or c		
b	A random process $X(t)$ is defined as $X(t) = 2\cos(5t + \theta)$ where θ is uniformly distributed in $[0, 2\pi]$. Find mean and autocorrelation.	8
c	A man either drives a car or catches a train to go to office each day. He never goes 2 days in a row by train but if he drives one day then the next day he is just as likely to drive again as he is to travel by train. Now suppose that on the first day of the week the man tossed a fair die and drove to work if 6 appeared. Find (i) The probability that he takes a train on the 3 rd day. (ii) The probability that he drives to work in the long run	8

Q. No.	Module 6	Marks
6.a	Find the power spectral density of the WSS random process with autocorrelation function $2e^{-T} + 4e^{-4T}$.	4
Answer b or c		
b	Consider the random process $X(t) = \cos(t + \theta)$ where θ is a random variable with density function $f(\theta) = 1/\pi, (-\pi/2 < \theta < \pi/2)$. Check whether the process is stationary or not.	8
c	Given a random variable y with characteristic function $\phi(\omega) = E[e^{i\omega y}]$ and random process defined by $X(t) = \cos(\lambda t + y)$. Show that $X(t)$ is a stationary in wide sense of $\phi(1) = \phi(2) = 0$.	8