Reg. No. :

Question Paper Code : 70753

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

First Semester

Applied Electronics

MA5152 – APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS

(Common to : M.E. Electronics and Communication Engineering/M.E. VLSI Design)

(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Statistical Tables may be permitted

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Prove that $(a \vee b) \vee \bar{b}$ is a tautology.
2. Write down the truth values of the primitives $\Rightarrow$, $\Leftrightarrow$ for the 3-valued logic with truth values $0, \frac{1}{2}, 1$.
3. State Cholesky's algorithm.
4. Define least square solution.
5. If X follows uniform distribution in (–3, 3), find $P\{|X-1| < 2\}$.
6. Given the random variable X with density function $f(x) = \begin{cases} 2x, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$, find the pdf of $Y = 4X^2$.
7. Define dynamic programming problem.
8. State Bellman's principle of optimality.
9. Determine the utilization factor for the queuing (M/M/1) : (∞/FIFO) system if the customers arrive at the rate of 12 per hour and are serviced at the rate of 30 per hour.
10. The number of messages to a communication channel in an interval of duration t seconds is a Poisson process with mean rate $\lambda = 0.3$. Compute the probability that exactly 3 messages will arrive during a 10 second interval.

PART – B (5×13=65 Marks)

11. a) Explain each of the following Fuzzy propositions with an example : (13)
   i) Unconditional and unqualified propositions.
   ii) Unconditional and qualified propositions.

(OR)

b) Explain the two different types of fuzzy quantifiers with examples. (13)

12. a) i) Find the canonical basis for the matrix $A = \begin{pmatrix} 5 & 1 & 0 \\ 0 & 5 & 1 \\ 0 & 0 & 5 \end{pmatrix}$. (6)

   ii) Obtain the QR decomposition of the matrix $A = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{pmatrix}$. (7)

(OR)

b) Obtain the singular value decomposition of the matrix $A = \begin{pmatrix} -1 & 1 \\ 1 & 0 \\ 1 & 1 \end{pmatrix}$. (13)

13. a) i) Find the moment generating function of Poisson distribution and hence find its mean and variance. (6)

   ii) The marks obtained by a number of students in a certain subject are approximately normally distributed with mean 65 and standard deviation 5. If 3 students are selected at random from the group, what is the probability that at least 1 of them would have scored above 75 ? (7)

(OR)

b) i) Derive the MGF of Gamma distribution and hence find its mean and variance. (6)

   ii) A continuous random variable X has pdf. $f(x) = \begin{cases} \frac{x}{4}e^{-x/2} & x > 0 \\ 0 & \text{otherwise} \end{cases}$. Find the r^{th} moment about the origin and hence find the first four moments about the origin. (7)

14. a) Use dynamic programming to solve Maximize $z = 3x_1 + 5x_2$ subject to the constraints : $x_1 \leq 4$, $x_2 \leq 6$, $3x_2 + 2x_2 \leq 18$ and $x_1, x_2 \geq 0$. (13)

(OR)

b) A vessel is to be loaded with stocks of 3 items. Each unit of item i has a weight w_i and value r_i. The maximum cargo weight the vessel can take is 5 and the details of the three items are as follows : **(13)**

i	w_i	r_i
1	1	30
2	3	80
3	2	65

Develop the recursive equation for the above case and find the most valuable cargo load without exceeding the maximum cargo weight by using dynamic programming.

15. a) A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distributions for both deposits and withdrawals are exponential with mean service time of 3 min per customer. Depositors are found to arrive in a Poisson fashion throughout the day with mean arrival rate of 16 per hour. Withdrawers also arrive in a Poisson fashion with mean arrival rate of 14 per hour. What would be the effect on the average waiting time for the customers if each teller could handle both withdrawals and deposits. **(13)**

(OR)

b) Patients arrive at a clinic according to Poisson distribution at a rate of 30 per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate of 20 per hour.
   i) Find the effective arrival rate at the clinic.
   ii) What is the probability that an arriving patient will not wait ?
   iii) What is the expected waiting time until a patient is discharged from the clinic ? **(13)**

PART – C **(1×15=15 Marks)**

16. a) The mileage that car owners get with a certain kind of radial tire is a random variable having an exponential distribution with mean 40,000 km. Find the probabilities that one of these tires will last (i) at least 20,000 km (ii) at most 20,000 km (iii) more than 30,000 km and (iv) less than 30,000 km. **(15)**

(OR)

b) A group of engineers has 2 terminals available to aid in their calculations. The average computing job requires 20 minutes of terminal time and each engineer requires some computation about once every half an hour. Assume that these are distributed according to an exponential distribution. If there are 6 engineers in the group, find (a) the expected number of engineers waiting to use one of the terminals and in the computing centre and (b) the total time lost per day. **(15)**