USN | | | | | | | | | | **17MAT41**

Fourth Semester B.E. Degree Examination, July/August 2021
Engineering Mathematics – IV

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions.*

1 a. Use Taylor's series method to find $y(1.5)$ from $y' = xy^{\frac{1}{3}}$, $y(1) = 1$, consider upto third order derivative term. **(06 Marks)**

 b. Find $y(0.2)$ by using modified Euler's method given that $y' = x + \left|\sqrt{y}\right|$, $y(0) = 1$. Take $h = 0.2$ and carry out two modifications at each step. **(07 Marks)**

 c. If $5xy' + y^2 = 2$, $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0143$ then find $y(4.4)$ by using Milne's method. **(07 Marks)**

2 a. Use Taylor's series method to find $y(1.02)$ from $y' = xy - 1$, $y(1) = 2$ consider upto fourth order derivative term. **(06 Marks)**

 b. Use Runge-Kutta method to find $y(0.2)$ from $y' = \dfrac{y^2 - x^2}{y^2 + x^2}$, $y(0) = 1$ taking $h = 0.2$. **(07 Marks)**

 c. Use Adam Bashforth method to find $y(0.4)$ from $y' = x + y^2$, $y(0) = 1$, $y(0.1) = 1.1$, $y(0.2) = 1.231$, $y(0.3) = 1.402$ **(07 Marks)**

3 a. Express $2x^3 - x^2 - 3x + 2$ in terms of Legendre polynomials. **(06 Marks)**

 b. Find $y(0.1)$ by using Runge-Kutta method given that $y'' = x^3(y + y')$, $y(0) = 1$, $y'(0) = 0.5$ taking step length $h = 0.1$. **(07 Marks)**

 c. If α and β are the roots of $J_n(\alpha) = 0$ then show that $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx = 0$ if $\alpha \neq \beta$. **(07 Marks)**

4 a. Prove that $J_{-\frac{1}{2}}(x) = \sqrt{\dfrac{2}{\pi x}}\cos x$. **(06 Marks)**

 b. Find $y(0.4)$ by using Milne's method given $y'' + y' = 2e^x$, $y(0) = 2$, $y'(0) = 0$, $y(0.1) = 2.01$, $y'(0.1) = 0.2$, $y(0.2) = 2.04$, $y'(0.2) = 0.4$, $y(0.3) = 2.09$, $y'(0.3) = 0.6$. **(07 Marks)**

 c. State and prove Rodrigue's formula. **(07 Marks)**

5 a. Derive Cauchy-Riemann equation in Cartesian form. **(06 Marks)**

 b. Find the analytic function $f(z) = u + iv$ in terms of z given that $U = \dfrac{2\sin 2x}{e^{2y} + e^{-2y} - 2\cos 2x}$. **(07 Marks)**

 c. Evaluate $\int_C \dfrac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)}$ where C is the circle $|z| = 3$. **(07 Marks)**

6 a. If $f(z)$ is analytic function then prove that, $\left[\dfrac{\partial |f(z)|}{\partial x}\right]^2 + \left[\dfrac{\partial |f(z)|}{\partial y}\right]^2 = |f'(z)|^2$. **(06 Marks)**

 b. Discuss the transformation $W = e^z$. **(07 Marks)**

 c. Find the bilinear transformation that maps the points $z = -1, i, 1$ onto the points $W = 1, i, -1$. Also find the invariant points. **(07 Marks)**

7 a. Find the value of K such that the following distribution represents a finite probability distribution. Hence find its mean and standard deviation. Also find

    (i) $P(x \leq 1)$ (ii) $P(x > 1)$ (iii) $P(-1 < x \leq 2)$

x	−3	−2	−1	0	1	2	3
P(x)	K	2K	3K	4K	3K	2K	K

                                                            (06 Marks)

  b. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students where marks will be

    (i) Less than 65   (ii) More than 75   (iii) Between 65 and 75 $(A(1) = 0.3413)$

                                                            (07 Marks)

  c. The joint probability distribution for two random variables X and Y as follows:

Y \ X	−2	−1	4	6
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Find : (i)   E(X)E(Y)   (ii)   E(XY)
       (iii)   Covariance of (XY)   (iv)   Correlation of X and Y.   **(07 Marks)**

8 a. Derive mean and variance of the exponential distribution.   **(06 Marks)**

  b. The joint probability distribution for two random variables X and Y as follows: **(07 Marks)**

    Find (i) E(X) and E(Y)
         (ii) E(XY)
         (iii) Covariance (X, Y)
         (iv) Correlation of X and Y.

Y \ X	−4	2	7
1	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
5	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$

  c. In a certain factory turning out razor blades there is a small chance of 0.002 for any blade to the defective. The blades are supplied in packets of 10. Using Poisson distribution find the approximate number of packets containing (i) No defective blade (ii) One defecting blade (iii) Two defective blades in a consignment of 10000 packets.   **(07 Marks)**

9 a. A coin was tossed 400 times and the head turned up 216 times. Test the hypothesis that the coin is unbiased at 5% level of significance.   **(06 Marks)**

  b. A certain stimulus administered to each of 12 patients resulted in the following increases of blood pressure 5, 2, 8, -1, 3, 0, -2, 1, 5, 0, 4, 6. Can it be concluded that the stimulus will in general be accompanied by an increase in blood pressure. $(t(11)_{00.05} = 2.2)$ **(07 Marks)**

  c. Find the unique fixed probability for the regular stochastic matrix :

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1/2 & 1/2 & 0 \end{bmatrix}.$$

                                                            (07 Marks)

10 a. Define the terms : (i) Null hypothesis   (ii) Type – I and Type II error.
                 (iii) Tests of significance.   **(06 Marks)**

  b. In experiments on pea breeding the following frequencies of seeds were obtained:

Round and Yellow	Wrinkled and Yellow	Round and Green	Wrinkled and Green	Total
315	101	108	32	556

Theory Predicts that the frequencies should be in proportions 9:3:3:1. Examine the correspondence between theory and experiment $\left(\psi^2_{0.05} = 7.815\right)$.   **(07 Marks)**

  c. A students study habits are as follows. If he studies one night, he is 30% sure to study the next night, on the other hand, if he does not study one night he is 60% sure not to study the next night as well. Find the transition matrix for the chain of his study. In the long run how often does he study?   **(07 Marks)**

USN | | | | | | | | | | 17CS42

Fourth Semester B.E. Degree Examination, July/August 2021
Object Oriented Concepts

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Bring out the differences between procedure oriented programming and object oriented programming. **(05 Marks)**
   b. Define function polymorphism. Write a program in C++ using function overloading area( ) to calculate area of circle (area = πr^2), area of triangle (1/2 * base * height) and area of rectangle (area = base * height) **(08 Marks)**
   c. What are static members of a class? Write and explain program to count the number of objects created. **(07 Marks)**

2 a. How do you space helps in preventing pollution of global namespace. **(06 Marks)**
   b. Write a C++ program that has a class names 'student' with data members name, USN and average and two member function read( ) to read students data and write( ) to display record on screen. Write main( ) function to read and display three students data. **(07 Marks)**
   c. What is reference variable? Write a C++ program to swap two integer numbers and display values before and after swapping. **(07 Marks)**

3 a. List and explain Java buzzword. **(08 Marks)**
   b. Explain (i) >>>   (ii) for each   (iii) Short circuit operator. **(06 Marks)**
   c. Write a Java program to find biggest and smallest element in an array of 'n' elements. **(06 Marks)**

4 a. Discuss with example how arrays are declared and initialized in Java. Write a Java program to demonstrate the use of array. **(08 Marks)**
   b. Write a Java program to perform arithmetic operation (+, −, *, /) based on user choice and display the result on screen. **(06 Marks)**
   c. Explain briefly type casting in Java. **(06 Marks)**

5 a. Explain the concept of inheritance and its classification. **(08 Marks)**
   b. What is an exception? Explain the usage of throw keyword with an example. **(06 Marks)**
   c. Discuss use of interface. Give its syntax with example in Java. **(06 Marks)**

6 a. Can constructor be overloaded in Java? Justify your answer. **(08 Marks)**
   b. With example program, explain two uses of super in Java inheritance. **(08 Marks)**
   c. Write a note on Garbage Collection. **(04 Marks)**

7 a. Define a thread. List the differences between multiprocess and multithreaded concepts. **(06 Marks)**
   b. Illustrate with an example, the use of isAlive( ) and join( ) method. **(08 Marks)**
   c. Discuss delegation event model with example. **(06 Marks)**

8   a.   Write a Java program to implement producer consumer problem using thread.   **(08 Marks)**

     b.   What is synchronization? Explain with an example how synchronization is implemented in Java.   **(06 Marks)**

     c.   Write a note on :
       (i) adapter class   (ii) inner class.   **(06 Marks)**

9   a.   List and explain two types of applet? Explain the skeleton of an applet.   **(06 Marks)**

     b.   Describe the steps to create JTable. Write a program to create a table with the column heading Name, USN, Marks, Grade and insert 5 records into the table and display on screen.   **(10 Marks)**

     c.   Write a note on components and containers.   **(04 Marks)**

10   a.   Demonstrate how to pass parameters for font name and font size in applet.   **(06 Marks)**

     b.   List and explain different forms of repaint method.   **(07 Marks)**

     c.   Create a swing applet that has two buttons named "Outline class" and "Offline class". When either of the button is pressed it should print "Online class is scheduled" or "Offline class is scheduled".   **(07 Marks)**

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USN ☐☐☐☐☐☐☐☐☐☐

17CS43

Fourth Semester B.E. Degree Examination, July/August 2021
Design and Analysis of Algorithms

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions.*

1   a. Define asymptotic notations with example. **(09 Marks)**
    b. Solve the following recurrence relation. Using backward substitution :
       $x(n) = 3x(n-1)$ for $n > 1$, $x(1) = 4$ **(03 Marks)**
    c. List and explain the basic asymptotic efficiency classes. **(08 Marks)**

2   a. Define the following terms :
       (i)   Graph
       (ii) Tree
       (iii) Set and Dictionaries. **(04 Marks)**
    b. Write an algorithm to find n^{th} Fibonacci number recursively. Set up a recurrence relation for Fibonacci number and solve it. **(08 Marks)**
    c. Consider the following algorithm :
       Algorithm Mystery (n)
       //Input : A nonnegative integer is
       S←0
       for i ← 1 to n do
          s←s + i * i
       return s
       (i)   What does this algorithm compute?
       (ii) What is its basic operation?
       (iii) How many time is the basic operation executed?
       (iv) What is the efficiency class of this algorithm? **(08 Marks)**

3   a. Write an algorithm to finding the maximum and minimum of the given set of elements,
       {a(i), a(i+1),.......a(j)} **(08 Marks)**
    b. Apply Quicksort algorithm to the following set of input values and draw a tree of recursive calls to quicksort with input values l and r of subarray bounds and split position P of a partition obtained.
       5, 3, 1, 9, 8, 2, 4, 7 **(12 Marks)**

4   a. Explain the Strassen's matrix multiplication algorithm to compute the product of 2×2 matrices. **(08 Marks)**
    b. Describe the advantages and disadvantages of divide and conquer technique. **(06 Marks)**
    c. Consider the following graph, apply the DFS-based algorithm to solve the topological sorting problem for the given digraphs : (Refer Fig. Q4 (c)) **(06 Marks)**
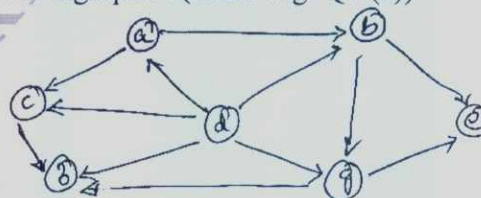

Fig. Q4 (c)

5 a. Write an algorithm of greedy method control abstraction for the subset paradigm. **(06 Marks)**

    b. What is spanning tree? Explain the Prim's algorithm for constructing a minimum spanning tree for the weighted connected graph. **(08 Marks)**

    c. Apply the dijkstra's algorithm for single source shortest paths for the given graph and assume vertex 'A' as source (Fig. Q5 (c)) **(06 Marks)**
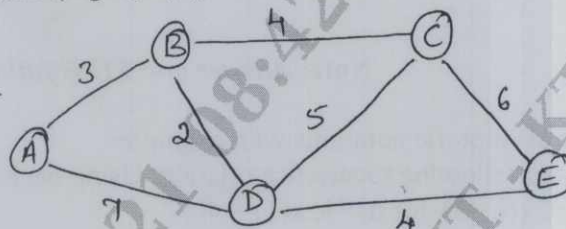

Fig. Q5 (c)

6 a. (i) Construct a Huffman code for the following data:

Character	A	B	C	D	-
Probability	0.4	0.1	0.2	0.15	0.15

      (ii) Encode the text ABACABAD using the code of Q(i).

      (iii) Decode the text whose encoding is 100010111001010 in the code of Q(i). **(10 Marks)**

    b. Construct a heap for the list 2, 9, 7, 6, 5, 8 by bottom up algorithm and how efficient is this algorithm in the worst case? **(10 Marks)**

7 a. Apply the dynamic programming algorithm for constructing an optimal binary search-tree for the following data set :

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

(10 Marks)

    b. Solve the all pairs shortest path problem for the diagram with the following weight matrix:

$$\begin{bmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix}$$

(10 Marks)

8 a. Compute the optimal tour of the given directed graph using dynamic programming techniques of TSP. (Refer Fig. Q8 (a)). **(10 Marks)**
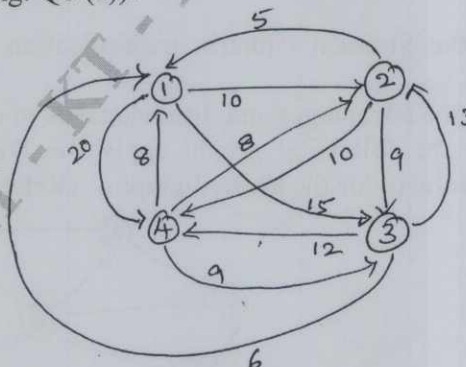

Fig. Q8 (a)

b. Apply the bottom-up dynamic programming algorithm to the following instance of the knapsack problem.

Item	Weight	Value
1	2	$12
2	1	$10
3	3	$20
4	2	$15

Capacity W = 5

(10 Marks)

9   a. Explain how the board's symmetry can be used to find the second solution to the 4-Queen problems.   (06 Marks)

  b. Apply backtracking to the problem of finding a Hamiltonian circuit in the following graph (Fig. Q9 (b))   (08 Marks)
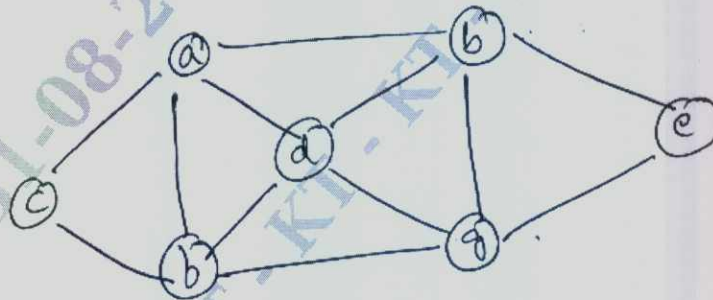

Fig. Q9 (b)

  c. Write a pseudocode of the backtracking algorithm.   (06 Marks)

10 a. Construct and draw the state space tree of the backtracking algorithm applied to the instance A={3, 5, 6, 7} and d = 15 of the subset problem.   (10 Marks)

  b. Solve the following instance of the knapsack problem by FIFOBB algorithm.

  n = 4   (P₁, P₂, P₃, P₄) = (10, 10, 12, 18)
          W₁, W₂, W₃, W₄ = (2, 4, 6, 9)   M = 15

(10 Marks)

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐   17CS44

Fourth Semester B.E. Degree Examination, July/August 2021
Microprocessors and Microcontrollers

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions.

1   a. Define Microprocessor. Recall the various registers of 8086 with diagram. **(08 Marks)**
    b. With neat diagram explain flag register of 8086. **(08 Marks)**
    c. Write a note on different memory segments of 8086. **(04 Marks)**

2   a. Explain with example various addressing modes of 8086. **(08 Marks)**
    b. Write an ALP to find the Fibonacci series of first seven numbers. **(08 Marks)**
    c. Write the four differences between Com and Exe file. **(04 Marks)**

3   a. Explain the following instruction with syntax :
      (i) DAA   (ii) RCR   (iii) CLC. **(03 Marks)**
    b. Write an ALP with algorithm to calculate the sum of (13h − 23h) using sub instructions and store the result at offset address 0010h. **(09 Marks)**
    c. With the help of ADC instruction write a program to calculate the total sum of 5 bytes of data. The decimal data are 125, 235, 197, 91, 48. **(08 Marks)**

4   a. Explain the following instruction with example :
      (i) SBB   (ii) RCL   (iii) SHL **(03 Marks)**
    b. Write an ALP to
      (i) Convert ASCII NO '23' to packed BCD.
      (ii) ADD the BCD Number 23 with 45
      (iii) Convert the Result of above addition to ASCII. **(09 Marks)**
    c. Write an ALP to
      (i) To clear the screen
      (ii) To set the cursor at center of screen
      (iii) To Display a string "VTU WELCOMES YOU" on the screen. **(08 Marks)**

5   a. Explain the following instruction with syntax :
      (i) IMUL   (ii) CLD   (iii) STOSB   (iv) SCASB **(06 Marks)**
    b. Write an ALP to check whether a given string is a palindrome or not? **(07 Marks)**
    c. Find the control word if PA = out, PB = in, $PC_0 - PC_3$ = in, $PC_4 - PC_7$ = out and write the program to get the data from port B and send it to port A. Use port address of 300H-303H for 8255 chip. **(07 Marks)**

6   a. Explain the following instruction with syntax:
      (i) IDIV   (ii) STD   (iii) OUT   (iv) LODSB **(06 Marks)**
    b. Write an ALP to check whether two strings are equal or not and display the corresponding message such as "STRINGS ARE EQUAL"...... etc. **(07 Marks)**
    c. Design a memory interface which uses 8 numbers of 2764 EPROM chip for 64×8 memory for the address range between F0000H to FFFFFH. **(07 Marks)**

7	a.	With neat diagram explain ARM core data flow model.	(07 Marks)
	b.	With neat diagram, summarize the complete set of Registers of ARM.	(07 Marks)
	c.	With neat diagram outline the various functional block of embedded system.	(06 Marks)

8	a.	Compare the difference between RISC and CISC design philosophy.	(07 Marks)
	b.	With neat diagram explain the various fields of CPSR.	(07 Marks)
	c.	With neat diagram summarize the pipeline mechanism in RISC processor.	(06 Marks)

| 9 | a. | Explain Branch and Data processing Instruction of ARM processor with example. | (10 Marks) |
| | b. | Explain logical instruction of ARM processor, with syntax and example. | (10 Marks) |

| 10 | a. | With neat diagram explain the functions of Barrel shifter in ARM. | (10 Marks) |
| | b. | Explain different compare and multiply instructions of ARM with examples. | (10 Marks) |

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17CS45

Fourth Semester B.E. Degree Examination, July/August 2021
Software Engineering

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions.*

1	a.	What are the essential attributes of good software?	(05 Marks)
	b.	Discuss spiral model with its block diagram.	(08 Marks)
	c.	With a diagram, explain the Rational Unified Process.	(07 Marks)
2	a.	Why the understanding of requirements from stake holder is difficult task? Explain the requirements elicitation and analysis process.	(10 Marks)
	b.	Explain the IEEE standard structure of Software Requirement Document.	(05 Marks)
	c.	Explain the different checks to be carried out during requirement validation process.	(05 Marks)
3	a.	With a neat diagram, explain the 2 approaches to interaction modeling.	(10 Marks)
	b.	Explain class diagram and generalization.	(05 Marks)
	c.	Explain data driven modeling with example.	(05 Marks)
4	a.	What are the things to be done for a design of Object Oriented System? Discuss how the objects are identified and design models.	(10 Marks)
	b.	What is design pattern? Explain 4 elements of design pattern.	(05 Marks)
	c.	Explain 3 general models of Open Source Licensing.	(05 Marks)
5	a.	Explain development testing, with 3 levels of granularity in testing.	(10 Marks)
	b.	Explain the benefits of test driven development process.	(05 Marks)
	c.	Explain the stages of acceptance testing process.	(05 Marks)
6	a.	List and explain Lehman's law.	(06 Marks)
	b.	Explain the software reengineering process with suitable diagram.	(10 Marks)
	c.	Explain the legacy system assessment with example.	(04 Marks)

7   a.   Draw the activity bar chart and staff allocation chart for the following set of tasks shown below.

Task	Duration (days)	Dependencies
T_1	10	–
T_2	15	–
T_3	15	$T_1(M_1)$
T_4	10	–
T_5	10	$T_2, T_4(M_3)$
T_6	5	$T_1, T_2(M_4)$
T_7	20	$T_1(M_1)$
T_8	25	$T_4(M_2)$
T_9	15	$T_3, T_6(M_5)$
T_{10}	15	$T_7, T_8(M_6)$
T_{11}	10	$T_9(M_7)$
T_{12}	10	$T_{10}, T_{11}(M_8)$

                                                                                              (10 Marks)
    b.   Explain the COCOMO – II estimation model.   (06 Marks)
    c.   List and explain the factors affecting software pricing.   (04 Marks)

8   a.   Explain how reviews and inspections are used to check the quality of project delivery.
                                                                                              (10 Marks)
    b.   List and mention the importance of product and process standards.   (06 Marks)
    c.   Explain the process of product measurement.   (04 Marks)

9   a.   Explain the practices involved in the extreme programming.   (10 Marks)
    b.   State the principles of agile methods.   (05 Marks)
    c.   Write a note on pair programming.   (05 Marks)

10 a.   How the agile methods are scaled. How they cope with large systems engineering and the difficulties to introduce agile methods into large companies.   (10 Marks)
    b.   Explain plan-driven and agile development approach for software development.   (05 Marks)
    c.   Explain the scrum process.   (05 Marks)

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CBCS SCHEME

USN [   ]   **17CS46**

Fourth Semester B.E. Degree Examination, July/August 2021
Data Communication

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. What is data communication? Explain four fundamental characteristics. **(05 Marks)**
   b. With a neat diagram, explain the four basic topologies. **(10 Marks)**
   c. Write a short note on Wide Area Network. **(05 Marks)**

2 a. Explain circuit switched network and packet switched network with neat diagram. **(10 Marks)**
   b. With a diagram explain the layers in the TCP/IP protocol suite in brief. **(10 Marks)**

3 a. Explain Pulse Code Modulation in brief by highlighting the components of PCM encoder with supporting diagram. **(10 Marks)**
   b. Explain different data transmission modes with the diagram. **(10 Marks)**

4 a. List different categories of multiplexing and explain FDM and TDM with supporting diagrams. **(10 Marks)**
   b. Explain the following:
      (i) Frequency Hopping Spread Spectrum
      (ii) Direct Sequence Spread Spectrum **(10 Marks)**

5 a. Explain in brief process of error detection in block coding. **(10 Marks)**
   b. Write a short note on checksum with appropriate sketches. **(06 Marks)**
   c. Define: (i) Hamming distance   (ii) Burst error **(04 Marks)**

6 a. Distinguish between connectionless and connection oriented with respect to a DLC protocol. **(06 Marks)**
   b. Explain simple protocol. **(06 Marks)**
   c. Explain transition phases in a PPP connection. **(08 Marks)**

7 a. Distinguish between pure ALOHA and slotted ALOHA. **(05 Marks)**
   b. Calculate the throughput S for a pure ALOHA network if the offered traffic 'G' is 0.75. **(03 Marks)**
   c. Explain 1-persistent, non-persistent and p-persistent CSMA with flow diagrams. **(12 Marks)**

8 a. Explain three controlled access methods. **(12 Marks)**
   b. What is channelization? Explain frequency division multiple access. **(08 Marks)**

9 a. Distinguish between fixed WiMAX and mobile WiMAX. **(08 Marks)**
   b. Explain the three categories of satellites. **(12 Marks)**

10 a. Explain IPv6 datagram. **(10 Marks)**
   b. Explain the three strategies which are devised for transition from IPv4 to IPv6. **(10 Marks)**

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Fourth Semester B.E. Degree Examination, July/August 2021

Advanced Mathematics – II

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

1 a. Find the angle between any two diagonals of a cube. **(06 Marks)**

  b. Find the equation of the plane which passes through the points $(0, 1, 1)$, $(1, 1, 2)$ and $(-1, 2 -2)$. **(07 Marks)**

  c. Show that the lines $\dfrac{x-5}{4} = \dfrac{y-7}{4} = \dfrac{z+3}{-5}$ and $\dfrac{x-8}{7} = \dfrac{y-4}{1} = \dfrac{z-5}{3}$ are coplanar and find their common point. **(07 Marks)**

2 a. Find the angle between the planes $x + y + 2z - 3 = 0$ and $2x + 3y + 3z - 4 = 0$. **(06 Marks)**

  b. Find the shortest distance between the lines $\dfrac{x-1}{2} = \dfrac{y-2}{3} = \dfrac{z-3}{4}$ and $\dfrac{x-2}{3} = \dfrac{y-4}{4} = \dfrac{z-5}{5}$ **(07 Marks)**

  c. Find the image of the point $(1, 6, 3)$ in the line $\dfrac{x}{1} = \dfrac{y-1}{2} = \dfrac{z-2}{3}$. **(07 Marks)**

3 a. If $\vec{A} = 2\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{B} = \hat{i} + 4\hat{j} - 2\hat{k}$, find the angle between the vectors $\vec{A}$ and $\vec{B}$. **(06 Marks)**

  b. If $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$, evaluate (i) $[\vec{a}\ \vec{b}\ \vec{c}]$ (ii) $\vec{a} \times (\vec{b} \times \vec{c})$ **(07 Marks)**

  c. Find the constant λ such that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} + \lambda\hat{j} + 5\hat{k}$ are coplanar. **(07 Marks)**

4 a. A particle moves on the curve $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$, where t is the time. Find the components of velocity and acceleration at $t = 1$ in the direction of $\hat{i} - 3\hat{j} + 2\hat{k}$. **(06 Marks)**

  b. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $r = |\vec{r}|$, show that $\nabla r^n = nr^{n-2}\ \vec{r}$. **(07 Marks)**

  c. Find a unit vector normal to the surface $x^3 + y^3 + 3xyz = 3$ at $(1, 2, -1)$. **(07 Marks)**

5 a. If $\vec{A} = \text{grad}(x^3 + y^3 + z^3 - 3xyz)$, find $\text{div}\,\vec{A}$ and $\text{curl}\,\vec{A}$. **(06 Marks)**

  b. Find the constant a, b, c so that $\vec{F} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$ is irrotational. **(07 Marks)**

  c. Find angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $x = z^2 + y^2 - 3$ at $(2, -1, 2)$. **(07 Marks)**

6   Find the Laplace transform of:

  a. $e^{-3t}(2\cos 5t - 3\sin 5t)$ **(05 Marks)**

  b. $\sin 3t \sin 2t + t \cos t$ **(05 Marks)**

  c. $\dfrac{\cos at - \cos bt}{t}$ **(05 Marks)**

  d. $e^{2t} + 4t^3 - 2\sin 3t + 3\cos 3t + 2^{-t}$ **(05 Marks)**

7   Find the inverse Laplace transform of

a. $\dfrac{s^2 - 3s + 4}{s^3}$ (05 Marks)

b. $\dfrac{2}{(s-1)(s-2)(s-3)}$ (05 Marks)

c. $\log\left[\dfrac{s^2+1}{s(s+1)}\right]$ (05 Marks)

d. $\dfrac{2s-3}{s^2+4s+13}$ (05 Marks)

8   a.   Solve using Laplace transformation method $y'' + 2y' - 3y = \sin t$, $y(0) = y'(0) = 0$. (10 Marks)

b.   By Laplace transform method solve the equation $\dfrac{d^2y}{dt^2} + 4\dfrac{dy}{dt} + 3y = e^{-t}$ with $y(0) = 1$,

$y'(0) = 1$.   (10 Marks)

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