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06MAT41

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Employ Taylor's series method to find an approximate solution correct to fourth decimal places for the following initial value problem at $x = 0.1$, $dy/dx = x - y^2$, $y(0)=1$. **(06 Marks)**

b. Using modified Euler's method to find $y(0.1)$ given $dy/dx = x^2 + y$, $y(0) = 1$ by taking $h=0.05$. Perform two iterations in each step. **(07 Marks)**

c. If $dy/dx = 2e^x - y$, $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.04$ and $y(0.3)=2.09$ find $y(0.4)$ correct to four decimal places. By using Milne's predictor-corrector method (Use corrector formula twice). **(07 Marks)**

2 a. Derive Cauchy-Riemann equations in Cartesian form. **(06 Marks)**

b. Find the analytic function $f(z) = u+iv$ whose real part is $e^{-x}(x\cos y + y\sin y)$. **(07 Marks)**

c. Find the bilinear transformation which maps the points $Z=0, i, \infty$ onto the points $w = 1, -i, -1$ respectively. Find the invariant points. **(07 Marks)**

3 a. State and prove Cauchy's integral formula. **(06 Marks)**

b. Expand $f(z) = \dfrac{1}{(z-1)(z-2)}$ in terms of Laurent's series

valid in the regions i) $|z-1| < 1$ ii) $|z-1| > 1$. **(07 Marks)**

c. Evaluate $\int_c \dfrac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)}$ using Cauchy's Residues theorem where c is the circle $|z| = 3$. **(07 Marks)**

4 a. Solve in series the equation $x\dfrac{d^2y}{dx^2} + \dfrac{dy}{dx} + xy = 0$ **(06 Marks)**

b. Solve Bessel's differential equation leading to $J_n(x)$. **(07 Marks)**

c. Express $x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre's polynomials. **(07 Marks)**

PART – B

5 a. The pressure and volume of a gas are related by the equation $PV^\nu = K$, where ν and K being constants. Fit this equation to the following set of observations. **(06 Marks)**

P (kg/cm^2)	0.5	1.0	1.5	2.0	2.5	3.0
V (litre)	1.62	1.00	0.75	0.62	0.52	0.46

b. Find the correlation coefficient and the regression lines of y on x and x on y for the following data: **(07 Marks)**

x	1	2	3	4	5
y	2	5	3	8	7

c. State and prove Baye's theorem. **(07 Marks)**

6 a. The probability density function of a variate X is

X:	0	1	2	3	4	5	6
P(X):	k	3k	5k	7k	9k	11k	13k

Find i) k ii) $P(X \geq 5)$ iii) $P(3 < X \leq 6)$ **(06 Marks)**

b. The number of telephone lines busy at an instant of time is a binomial variate with probability 0.1 that a line is busy. If 10 lines are choosen at random, what is the probability that i) no line is busy ii) at least 5 lines are busy iii) at most 3 lines are busy. **(07 Marks)**

c. Obtain the mean and standard deviation of the normal distribution. **(07 Marks)**

7 a. Explain the following terms:
i) Null hypothesis
ii) Confidence limits
iii) Type I & Type II errors. **(06 Marks)**

b. A die was thrown 9000 times and a throw of 5 or 6 was obtained 3240 times. On the assumption of random throwing, do the data indicate that the die is biased? **(07 Marks)**

c. The nine items of a sample have the following values: 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ significantly from the assumed mean of 47.5? (Given $t_{0.05}$ for 8 df = 2.31). **(07 Marks)**

8 a. The joint probability distribution of two random variables X and Y are given below.

X \ Y	-3	2	4
1	0.1	0.2	0.2
2	0.3	0.1	0.1

Determine i) E(X) and E(Y) ii) E(XY) iii) COU (X,Y) **(06 Marks)**

b. Every year, a man trades his car for a new car. If he has a Maruti, he trades it for an Ambassador. If he has an Ambassador, he trades it for a Santro. However, if he has a Santro, he is just as likely to trade if for a new Santro as to trade if for Maruti or an Ambassador. In 2000, he bought his first car, which was Santro. Find the probability that he has
i) 2002 Santro ii) 2002 Maruti. **(07 Marks)**

c. Define stochastic matrix. Find the unique fixed probability vector for the regular stochastic matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/4 & 1/4 \end{bmatrix}$ **(07 Marks)**

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06CS42

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Graph Theory and Combinatorics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Determine $|V|$ for the following graphs.

i) G has nine edges and all vertices have degree 3.

ii) G is regular with 15 edges. **(06 Marks)**

b. Define isomorphism of graphs. Show that no two of the following three graphs as shown in Fig.1(b) are isomorphic. **(07 Marks)**

Fig.1(b).

c. Define Euler circuit. Discuss Konigsberg bridge problem. **(07 Marks)**

2 a. Define: i) Bipartite graph ; ii) Hamilton cycle and iii) Planar graph. Give one example for each. **(06 Marks)**

b. If G = (V, E) is a loop-free connected planar graph with $|V| = n$, $|E| = e > 2$, and r regions, then prove that : i) $e \geq \frac{3r}{2}$; ii) $e \leq 3n - 6$. Further, if G is triangle free, then iii) $e \leq 2n - 4$. **(07 Marks)**

c. Define chromatic number. Find the chromatic polynomial for the cycle of length 4. Hence find its chromatic number. **(07 Marks)**

3 a. Define a tree. Prove that in every tree $T = (V, E)$, $|V| = |E| + 1$. **(06 Marks)**

b. Define: i) Rooted tree ; ii) Complete binary tree and iii) Spanning tree. Give an example for each. **(07 Marks)**

c. Obtain an optimal prefix code for the message ROAD IS GOOD using labelled binary tree. Indicate the code. **(07 Marks)**

4 a. State Max-flow and Min-cut theorem. For the network as shown in Fi.4(a), determine the maximum flow between the vertices A and D by identifying the cut-set of minimum capacity. **(06 Marks)**

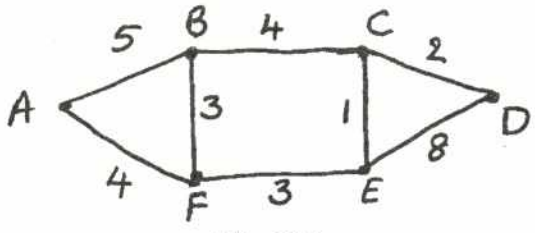

Fig.4(a).

b. State Kruskals algorithm. Apply Kruskal's algorithm to find a minimal spanning tree for the weighted graph as shown in Fig.4(b). **(08 Marks)**

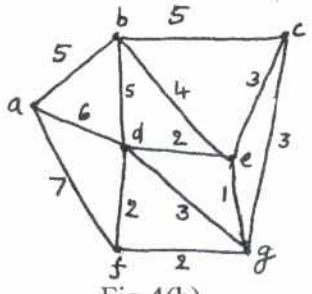

Fig.4(b).

c. Explain the steps in Dijikstra's shortest path algorithm. **(06 Marks)**

PART – B

5 a. i) How many distinct four digit integers can one make from the digits 1, 3, 3, 7, 7 and 8?
ii) Find the number of arrangements of the letters in TALLAHASSEE which have no adjacent A's **(06 Marks)**

b. In how many ways can 10 identical dime be distributed among five children if,
i) There are no restrictions
ii) Each child gets at least one dime
iii) The oldest child gets at least two dimes. **(07 Marks)**

c. Define Catalan number. In how many ways can one arrange three 1's and three – 1's so that all six partial sums (starting with the first summand) are nonnegative? List all the arrangements. **(07 Marks)**

6 a. Determine the number of positive integers n such that $1 \le n \le 100$ and n is not divisible by 2, 3 or 5. **(06 Marks)**

b. Define derangement. Find the number of derangements of 1, 2, 3, 4. List all the derangements. **(07 Marks)**

c. A girl student has sarees of 5 different colours: blue, green, red, white and yellow. On Mondays, she does not wear green; on Tuesdays, blue or red; on Wednesday, blue or green; on Thursdays red or yellow; on Fridays, red. In how many ways can she dress without repeating a colour during a week (from Monday to Friday)? **(07 Marks)**

7 a. Find a generating function for each of the following sequences:
i) $1^2, 2^2, 3^2, 4^2, \ldots\ldots$
ii) 8, 26, 54, 92, …… **(06 Marks)**

b. Using the generating function, find the number of ways of forming a committee of 9 students drawn from 3 different classes so that students form the same class do not have an absolute majority in the committee. **(07 Marks)**

c. If a leading digit 0 is permitted, using exponential generating function, find the number of r – digit binary sequences that can be formed using an even number of 0's and an odd number of 1's. **(07 Marks)**

8 a. The number of virus affected files in a system is 1000 (to start with) and this increases 250% every two hours. Use a recurrence relation to determine the number of virus affected files in the system after one day. **(06 Marks)**

b. Solve the following recurrence relations:
i) $a_n - 3\,a_{n-1} = 5\,(3^n)$, $n \ge 1$, $a_0 = 2$.
ii) $a_{n+2} + 4\,a_{n+1} + 4\,a_n = 7$, $n \ge 0$, $a_0 = 1$, $a_1 = 2$. **(08 Marks)**

c. Find the generating function for the recurrence relation:
$a_{n+2} - 2\,a_{n+1} + a_n = 2^n$, $n \ge 0$ with $a_0 = 1$, $a_1 = 2$. Hence solve it. **(06 Marks)**

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06CS43

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Part – A

1 a. Explain the various stages of algorithm design and analysis process using a flow chart. **(10 Marks)**

b. Define the following:
i) Special types of list.
ii) Paths and Cycles.
iii) Sets and Dictionaries. **(06 Marks)**

c. Write an algorithm to find the distance between two closest elements in an array of numbers. **(04 Marks)**

2 a. Prove that : If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$
then $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$ **(06 Marks)**

b. Write an algorithm to compute n! recursively. Set up a recurrence relation for the algorithm's basic operation count and solve it. **(08 Marks)**

c. Explain the method of comparing the order of the growth of 2 functions using limits. Compare order of growth of $\log_2 n$ and $\sqrt{n}$. **(06 Marks)**

3 a. Discuss how quick sort works to sort an array and trace for the following data set. Draw the tree of recursive calls made. 1, 1, 9, 9, 5, 5, 6, 6 **(10 Marks)**

b. What is stable algorithm? Is Quick Sort stable? **(02 Marks)**

c. Write the algorithm for binary search and find the average case efficiency. **(08 Marks)**

4 a. Explain the difference between DFS and BFS. Solve topological sorting problem using DFS algorithm, with an example. **(12 Marks)**

b. Show the steps in multiplying the following 2 integers using efficiency integer multiplication method: 5673 × 6342. **(08 Marks)**

Part – B

5 a. What is an AVL tree? Explain the need for rotation of AVL tree. Construct an AVL tree for the list 10, 20, 30, 25, 27, 7, 4 by successive insertion. **(10 Marks)**

b. Write an algorithm for comparison counting and show how comparison counting method sorts the list: 45, 2, 19, 10, 33, 22, 1, 23 **(10 Marks)**

6 a. Explain hashing and various collision resolution techniques. **(06 Marks)**

b. Solve the all pairs shortest path problem for the diagraph with the weight matrix. **(10 Marks)**

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

c. Using dynamic programming, solve the following knapsack instance:
$n = 3, [\omega_1, \omega_2, \omega_3] = [1, 2, 2]$ and $[P_1, P_2, P_3] = [18, 16, 6]$ and $M = 4$ **(04 Marks)**

7 a. Solve the following instances of the single source shortest path problem with vertex 'a' as the source. **(06 Marks)**

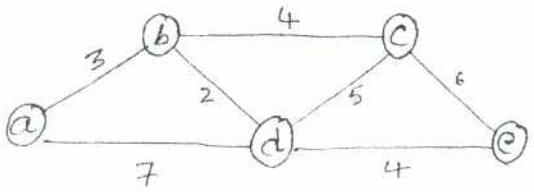

Fig. Q7 (a)

b. Write the Kruskal's algorithm to find the minimum cost spanning tree. Also trace the algorithm for the graph of figure Q7 (b). **(10 Marks)**

c. What are Huffman codes and trees? Discuss the advantage of Huffman's code. **(04 Marks)**

8 a. Discuss p and np problems. **(05 Marks)**

b. What is the central principle of back tracking? Taking n-queens problem as an example, explain the solution process. **(05 Marks)**

c. What is branch and bound? How is it different from back tracking? **(05 Marks)**

d. Draw the state space tree for the sum of subset problem of the instance: $S = \{5, 7, 8, 10\}$ and $d = 15$ **(05 Marks)**

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06CS44

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Object Oriented Programming with C++

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Part – A

1 a. What is cin and cout? Explain with examples. **(04 Marks)**

b. What is the function overloading? Write a program in C++ to overload the function add (S1, S2) where S1 and S2 are integers and floating point values. **(10 Marks)**

c. Explain the two different ways of defining member functions with example. **(06 Marks)**

2 a. Explain constant member function and mutable data members with example. **(06 Marks)**

b. What are friend classes? Explain with example. **(04 Marks)**

c. Write a C++ program to define a class called TIME with hour, minute and second as data member and read ( ), display ( ) and add ( ) as member functions. **(10 Marks)**

3 a. Explain how new and delete operators manage memory allocation and deallocation for arrays. **(05 Marks)**

b. Is overloading of constructor possible? Justify your answer with an example. **(10 Marks)**

c. How set-new-handler ( ) function is used to handle out of memory condition. **(05 Marks)**

4 a. What is the function over riding? Explain with a suitable example. **(05 Marks)**

b. What is inheritance? Explain the different kinds of inheritance with examples. **(10 Marks)**

c. In inheritance, explain the order of invocation of constructors and destructors with example. **(05 Marks)**

Part – B

5 a. Explain virtual function and write a C++ program to demonstrate dynamic polymorphism. **(08 Marks)**

b. Differentiate between virtual function and pure virtual function. **(04 Marks)**

c. Explain text and binary Input/Output. **(04 Marks)**

d. With general form, explain the following functions: i) getline ( ) ii) read ( ). **(04 Marks)**

6 a. Explain the following functions:
i) seekp ( ) ii) tellp ( ) iii) setw ( ) iv) setprecision ( ). **(08 Marks)**

b. Write a C++ program to create a class called a STACK using array of integers as data member. Implement the following operations by overloading + and – – operators:
i) S1 = S1+ element; where S1 is an object of the class STACK and element is an integer no to be push.
ii) S1 = – – S1; where S1 is an object of class STACK and – – operator pops the element.
Handle STACK EMPTY and STACK FULL conditions. Also display contents of stack, after each operation. **(12 Marks)**

7 a. What is operator overloading? Write a C++ program to compare two values representing distances in feet and inches, using overloading the operator >. **(10 Marks)**

b. Explain how to overload subscript [ ] and pointer-to-member –> operator. **(10 Marks)**

8 a. What is a class template? Explain with an example. **(08 Marks)**

b. What is exception handling? Explain try, throw and catch constructs in C++. **(08 Marks)**

c. Explain any four template class of Standard Template Library (STL). **(04 Marks)**

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06CS45

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Microprocessors

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Part – A

1 a. Sketch neat block diagram of internal architecture of 8086 microprocessor. Explain functions of following in brief: i) BIU ii) Queue iii) AX iv) IP v) CX vi) CS **(12 Marks)**

b. Calculate physical address of memory to access OP code and stack. IP = C846H, CS = 8480 H, SS = C800H, SP = FFFFH. **(04 Marks)**

c. Identify memory addressing mode in the following instructions and calculate effective offset address: i) MOV AX, 1000 H ii) MOV CX, [1000H] iii) MOV al, [SI+05] iv) ADD AX, BX **(04 Marks)**

2 a. State and explain instruction format for MOV instruction to transfer data between register and memory. Also generate opcode for following instructions assuming the opcode for mov as 1 0 0 0 1 0 0 1.
i) MOV AL, BL ii) MOV AX, [BX]
iii) MOV AL, [SI+05] iv) MOV CX, [1000H] **(10 Marks)**

b. Explain following assembler directives with examples of each:
i) PROC and ENDP ii) MACRO and ENDM iii) DW, DD
iv) EVEN v) PUBLIC and EXTRN. **(10 Marks)**

3 a. Explain instructions with example of each:
i) DAA ii) XLAT iii) DIV iv) AAA v) CMP **(10 Marks)**

b. Differentiate between short, near and far jump instructions with two examples of each. **(10 Marks)**

4 a. Write an ALP which reads the user password through keyboard and check with stored correct password. Display the result as 'Valid' or 'Not valid' password on monitor by using DOS function 07 interrupt 21 H. **(08 Marks)**

b. Write an ALP to calculate delay of 100 milliseconds by using 8086 MP working at 10 MHz clock frequency. Assume the states for the instructions used. **(06 Marks)**

c. Write an ALP to compute the value of function $f(x) = 4x^2 + 8x - 20$ where x is 8 bit unsigned binary number. **(06 Marks)**

Part – B

5 a. Write an ALP to compute factorial of single digit positive number using recursive procedure. For N = 4 show the stack operations. **(08 Marks)**

b. Write procedure to unpack BCD digits from packed two digit BCD number and store the result in memory locations. **(06 Marks)**

c. List the instructions to process the flags in flag register. **(06 Marks)**

6 a. Explain with block diagram minimum mode configuration of 8086 MP. How de-multiplexing of address bus is obtained? **(10 Marks)**

b. Draw and explain the timing diagram for opcode fetch memory read cycle with one wait state for 8086 MP. **(10 Marks)**

7 a. Explain the action taken by 8086 MP when an interrupt occurs. Describe Interrupt Vector Table (IVT). **(08 Marks)**

b. Explain with neat diagram how NMI pin of 8086 MP is used to read ASCII characters through keyboard? Also write instructions to initialize IVT for NMI interrupt. **(06 Marks)**

c. Interface IC 8259 to 8086 MP with a base address of FF10H. Write initialization sequence for IC 8259 with edge triggered input, only one 8259 IC, 8086 MP, interrupt type 40 H corresponds to IR_O input, normal EOI, non buffered mode, not SFNM, IR and IR_3 are unmasked. **(06 Marks)**

8 a. With neat timing diagram explain the different types of parallel data transfer from 8255. **(06 Marks)**

b. Describe internal block diagram of IC 8255 PPI. **(08 Marks)**

c. Explain control word format for IC 8255 PPI. Write initialization sequence for IC 8255 PPI in mode 'O' with A port, B port as output and C port as input with address of A port FFOOH. **(06 Marks)**

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06CS46

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Computer Organization

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. With a neat diagram, explain in detail the functional units of a computer. **(10 Marks)**

b. How the performance of a computer is measured? Assuming that the reference computer is Ultra SPARCIO workstation with 300MHz Ultra SPARC-IIi processor. A company has to purchase 500 new computers, hence ordered testing of a new computer with SPEC2000 (run on reference as well as new computer). Following observations were made.

Programs	Runtime on reference computer	Runtime in new computer
1	50 Minutes	5 Minutes
2	75 Minutes	4 Minutes
3	60 Minutes	6 Minutes
4	30 Minutes	3 Minutes

The company's system manager will place the orders for purchasing new computers only if the overall SPEC rating is at least 12.00. After the said test, will the system manager place order for the purchase of new computers? **(10 Marks)**

2 a. Convert the following pairs of decimal numbers to 5 bit signed 2's complement binary numbers and add them. Also state whether overflow occurs in each case.
i) -5 & 7 ii) -3 & -8 iii) -10 & -13. **(06 Marks)**

b. Write a program which evaluates the expression A×B+C×D in a single accumulator processor. Assume that processor has load, store, multiply and add instructions and all the values fit in the accumulator. **(05 Marks)**

c. Explain how the parameters are passed to a subroutine? Write a program to multiply a list of 'n' numbers stored in memory, which calls a subroutine namely, LISTMUL and trace the program with suitable example. **(09 Marks)**

3 a. In modern computers, why interrupts are required? Support your claim with a suitable example. **(06 Marks)**

b. In the interrupt mechanism, how the simultaneous arrivals of interrupts from various (multiple) devices (I/O) are handled? **(06 Marks)**

c. With neat sketches, explain the various approaches to bus arbitration. **(08 Marks)**

4 a. With a neat sketch, explain the individual input and output interface circuits. Also elicit their salient features. **(10 Marks)**

b. In a computer system, why a PCI Bus is used? With a neat sketch, explain how the read operation is performed, along with the role of IRDY# / TRDY#, on the PCI Bus. **(10 Marks)**

PART – B

5 a. Draw a diagram and explain the working of a 16 mega bit DRAM chip configured as 2M×8. Also explain as to how it can be made to work in fast page mode. **(10 Marks)**

b. Assume that a computer has L1 and L2 caches. The cache blocks consist of 8 words. Assume that the hit rate is same for both caches and that it is equal to 0.95 for instructions and 0.90 for data. Assume also that the times needed to access an 8-word block in these caches are C_1=1 cycle and C_2 = 10 cycles, then answer the following:

i) What is the average access time experienced by the processor if the main memory uses interleaving where the memory access parameters have usual meaning (M=17 with interleaving & M=38 without interleaving, assume that 30% of the instructions in a typical program perform a read or write operations). **(04 Marks)**

ii) What is the average access time if the main memory is not interleaved? **(04 Marks)**

iii) What is the improvement obtained through interleaving? **(02 Marks)**

6 a. Explain in detail, the working principle of a magnetic hard disk. **(10 Marks)**

b. A disk unit has 24 recording surfaces. It has a total of 14,000 cylinders. There are an average of 400 sectors per track. Each sector contains 512 bytes of data. Answer the following questions.

i) What is the maximum no. of gigabytes that can be stores in this unit? **(04 Marks)**

ii) What is the data transfer rate in bytes/sec at a rotational speed of 7200 rpm? **(03 Marks)**

iii) Using a 32-bit word, suggest a suitable scheme for specifying the disk address, assuming that there are 512 bytes/sector. **(03 Marks)**

7 a. Draw circuit diagram for binary division. Explain the restoring and non-restoring division algorithms with suitable examples. **(10 Marks)**

b. Explain the concept of carry save addition for the multiplication operation, M×Q=P for 4-bit operands, with diagram & suitable example. **(10 Marks)**

8 a. Explain the process of fetching a word from memory using timing diagram of memory read operation. Also give an example for the same. **(10 Marks)**

b. Write the control sequence of execution of the instruction ADD (R3), R1. For this sequence of instructions the processor is driven by a continuously running clock such that each control step is 2 ns in duration. How long will the processor have to wait in steps 2 & 5, assuming that a memory read operation takes 16 ns to complete? Also compute the percentage of time for which the processor is idle during the execution of this instruction. **(10 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. If (l, m, n) be the direction cosines of a line then prove that $l^2 + m^2 + n^2 = 1$. **(06 Marks)**

b. Find the value of K if the angle between the lines with direction ratios -2, 1, -1 and 1, -K, -1 is $\frac{2\pi}{3}$. **(07 Marks)**

c. Find the projection of the line segment AB on CD, where A = (3, 4, 5), B = (4, 6, 3), C = (-1, 2, 4), D = (1, 0, 5) **(07 Marks)**

2 a. Find the angle between the planes $x-y+2z = 9$ and $2x+y+z = 7$. **(06 Marks)**

b. Find the equation of the plane passing through the line of intersection of the planes $x+2y-3z-1=0$ and $3x-y+4z-5=0$ and perpendicular to the plane $3x-y-3z+4=0$. **(07 Marks)**

c. Find the point of intersection of the lines, $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$ and $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$. **(07 Marks)**

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

b. For any three vectors $\vec{a}$, $\vec{b}$, $\vec{c}$, prove that $\left(\vec{a}\times\vec{b}\right)\times\vec{c} = \left(\vec{a}\cdot\vec{c}\right)\vec{b} - \left(\vec{b}\cdot\vec{c}\right)\vec{a}$ **(07 Marks)**

c. Prove that the four points $4i+5j+k$, $-(j+k)$, $(3i+9j+4k)$ and $4(-i+j+k)$ are coplanar. **(07 Marks)**

4 a. A particle moves along the curve $x = 1-t^3$, $y = 1+t^2$ and $z = 2t-5$ where t is the time. Find the velocity and acceleration at t = 1. **(06 Marks)**

b. Find the unit vector normal to the surface $x^2y - 2xz + 2y^2z^4 = 10$ at (2, 1, -1). **(07 Marks)**

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

5 a. If $\vec{F} = (3x^2y - z)i + (xz^3 + y^4)j - 2x^3z^2k$ find grad(div $\vec{F}$) at (2, -1, 0). **(06 Marks)**

b. Find curl(curl $\vec{A}$) given that $\vec{A} = xyi + y^2zj + z^2yk$. **(07 Marks)**

c. Show that $\vec{F} = \frac{xi+yj}{x^2+y^2}$ is both solenoidal and irrotational. **(07 Marks)**

6 a. Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$. **(05 Marks)**

b. Find $L(t^n)$ where n is a positive integer. **(05 Marks)**

c. Find $L[t\cos at]$. **(05 Marks)**

d. Find $L\left[\frac{\cos at - \cos bt}{t}\right]$. **(05 Marks)**

7 Find the inverse Laplace transform for the following:

a. $\frac{(s+2)^3}{s^6}$ **(05 Marks)**

b. $\frac{2s-1}{s^2+4s+29}$ **(05 Marks)**

c. $\frac{2s^2+5s-4}{s^3+s^2-2s}$ **(05 Marks)**

d. $\log\left(1-\frac{a^2}{s^2}\right)$ **(05 Marks)**

8 a. Use Laplace transform method to solve, $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$; $y(0)=0$, $y'(0)=0$ **(10 Marks)**

b. Find the inverse Laplace transformation of $\frac{s^2}{(s-2)^3}$ **(10 Marks)**

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