CBCS SCHEME

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17MAT31

Third Semester B.E. Degree Examination, June/July 2019
Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Obtain the fourier series of the function $f(x) = x - x^2$ in $-\pi \le x \le \pi$ and hence deduce $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\ldots$ **(08 Marks)**

b. Obtain the Half Range Fourier cosine series for the $f(x) = \sin x$ in $[0, \pi]$. **(06 Marks)**

c. Obtain the constant term and the coefficients of first sine and cosine terms in the fourier expansion of y given

x :	0	1	2	3	4	5
y :	9	18	24	28	26	20

(06 Marks)

OR

2 a. Obtain the fourier series of $f(x) = \frac{\pi - x}{2}$ in $[0, 2\pi]$ and hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots\ldots$ **(08 Marks)**

b. Find the fourier half range cosine series of the function $f(x) = 2x - x^2$ in $[0, 3]$. **(06 Marks)**

c. Express y as a fourier series upto first harmonic given

x :	0	30	60	90	120	150	180	210	240	270	300	330
y :	1.8	1.1	0.30	0.16	1.5	1.3	2.16	1.25	1.3	1.52	1.76	2.0

(06 Marks)

Module-2

3 a. Find the fourier transform of $f(x) = \begin{cases} a^2 - x^2 ; & |x| \le a \\ 0 ; & |x| > a \end{cases}$ and hence deduce $\int_0^a \frac{\sin x - x\cos x}{x^3} dx = \frac{\pi}{4}$ **(08 Marks)**

b. Find the fourier sine transform of $e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{x \sin ax}{1+x^2} dx ; a > 0$ **(06 Marks)**

c. Obtain the z-transform of $\cos n\theta$ and $\sin n\theta$. **(06 Marks)**

OR

4 a. Find the fourier transform of $f(x) = xe^{-|x|}$. **(08 Marks)**

b. Find the fourier cosine transform of f(x) where

$$f(x) = \begin{cases} x ; & 0 < x < 1 \\ 2 - x ; & 1 < x < 2 \\ 0 ; & x > 2 \end{cases}$$

(06 Marks)

c. Solve $u_{n+2} + 6u_{n+1} + 9u_n = 2^n$ with $u_0 = u_1 = 0$ using z-transform. **(06 Marks)**

Module-3

5 a. Fit a straight line $y = ax + b$ for the following data by the method of least squares.

x :	1	3	4	6	8	9	11	14
y :	1	2	4	4	5	7	8	9

(08 Marks)

b. Calculate the coefficient of correlation for the data:

x :	92	89	87	86	83	77	70	63	53	50
y :	86	83	91	77	68	85	54	82	37	57

(06 Marks)

c. Compute the real root of $x\log_{10}x - 1.2 = 0$ by the method of false position. Carry out 3 iterations in (2, 3). **(06 Marks)**

OR

6 a. Fit a second degree parabola to the following data $y = a + bx + cx^2$.

x :	1	1.5	2	2.5	3	3.5	4
y :	1.1	1.3	1.6	2	2.7	3.4	4.1

(08 Marks)

b. If θ is the angle between two regression lines, show that

$\tan\theta = \left(\frac{1-r^2}{r}\right)\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}$; explain significance of $r = 0$ and $r = \pm 1$. **(06 Marks)**

c. Using Newton Raphson method, find the real root of the equation $3x = \cos x + 1$ near $x_0 = 0.5$. Carry out 3 iterations. **(06 Marks)**

Module-4

7 a. From the following table, estimate the number of students who obtained marks between 40 and 45.

Marks :	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
No. of students	31	42	51	35	31

(08 Marks)

b. Use Newton's dividend formula to find f(9) for the data:

x :	5	7	11	13	17
f(x) :	150	392	1452	2366	5202

(06 Marks)

c. Find the approximate value of $\int_0^{\pi/2}\sqrt{\cos\theta}\,d\theta$ by Simpson's $\frac{1}{3}^{rd}$ rule by dividing $\left[0, \frac{\pi}{2}\right]$ into 6 equal parts. **(06 Marks)**

OR

8 a. The area A of a circle of diameter d is given for the following values:

d :	80	85	90	95	100
a :	5026	5674	6362	7088	7854

Calculate the area of circle of diameter 105 by Newton's backward formula. **(08 Marks)**

b. Using Lagrange's interpolation formula to find the polynomial which passes through the points (0, –12), (1, 0), (3, 6), (4, 12). **(06 Marks)**

c. Evaluate $\int_4^{5.2}\log_e x\,dx$ taking 6 equal parts by applying Weddle's rule. **(06 Marks)**

Module-5

9 a. If $\vec{F} = 3xy\,\hat{i} - y^2\,\hat{j}$, evaluate $\int_C \vec{F}.d\vec{r}$ where 'C' is arc of parabola $y = 2x^2$ from (0, 0) to (1, 2) **(08 Marks)**

b. Evaluate by Stokes theorem
$\oint_C (\sin z\,dx - \cos x\,dy + \sin y\,dz)$, where C is the boundary of the rectangle $0 \le x \le \pi$;
$0 \le y \le 1,\ z = 3$ **(06 Marks)**

c. Prove that the necessary condition for the $I = \int_{x_1}^{x_2} f(x, y, y')\,dx$ to be extremum is

$$\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$$ **(06 Marks)**

OR

10 a. Using Green's theorem evaluate $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$, where C is the boundary of the region bounded by the lines $x = 0$, $y = 0$, $x + y = 1$. **(08 Marks)**

b. Find the external value of $\int_0^{\pi/2} \left[(y')^2 - y^2 + 4y\cos x\right]dx$. Given that $y(0) = 0$, $y\left(\frac{\pi}{2}\right) = 0$. **(06 Marks)**

c. Prove that the shortest distance between two points in a plane is along a straight line joining them. **(06 Marks)**

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CBCS SCHEME

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17CS32

Third Semester B.E. Degree Examination, June/July 2019
Analog and Digital Electronics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. List any 4 differences between JFET and MOSFET. **(04 Marks)**

b. Explain with help of neat diagram the working of N-channel JFET and sketch its characteristics. **(08 Marks)**

c. With help of block diagram, explain the operation of a astable multivibrator using IC 555. **(08 Marks)**

OR

2 a. Sketch and explain the working of peak detector. **(06 marks)**

b. State and explain any four performance parameters of an operational amplifier. **(08 marks)**

c. Illustrate the various types of filters with neat diagram and defination. **(06 Marks)**

Module-2

3 a. Use a Karnaugh map to find minimum 80p form for the following Boolean function :
$f(a, b, c, d) = \Sigma m(0, 2, 3, 5, 6, 7, 8, 9) + d(10, 11, 12, 13, 14, 15)$.
Also draw the logic circuit diagram for the simplified SOP. **(10 Marks)**

b. Apply Quine Mc-clusky method to find essential prime implicants for the Boolean function $f(a, b, c, d) = \Sigma m(1, 3, 6, 7, 10, 12, 13, 14, 15)$.
Write prime implicant table. **(10 Marks)**

OR

4 a. There are 4 adjacent parking slots in Mega Inc. executive parking area. Each slot is equipped with sensor whose output is asserted high when a car is occupying the slot. Write a truth table so that the output is high if two or more vacant parking is available.
i) Write truth table
ii) Find the expression of the system that will signal the existence of two or more vacant slots
iii) Simplify the expression
iv) Draw the logic diagram for simplified expression. **(10 Marks)**

b. Briefly explain an HDL implementation models. And write the HDL program for the following circuit shown in using in figure Fig.Q4(b) using structural model. **(07 Marks)**

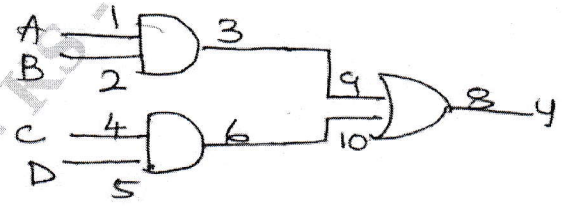

Fig.Q4(b)

c. What is hazards? List the types of hazards. **(03 Marks)**

Module-3

5 a. Implement the full adder outputs using 3 – 8 decoder. **(07 marks)**

b. Design one bit magnitude comparator and implement it using de-multiplexer **(08 Marks)**

c. Distinguish between combinational and sequential circuit. **(05 Marks)**

OR

6 a. Design a seven segment display using PLA. **(10 Marks)**

b. Show now 1 : 4 de-multiplexer is used to get 1 : 16 de-multiplexer. **(04 Marks)**

c. With the help of block diagram explain PAL and PLA. **(06 Marks)**

Module-4

7 a. The sequence 1011 is applied to the output of a 4 bit serial shift register that is initially cleared. With the help of diagram show how sequence is being entered serially into the register. **(08 Marks)**

b. Design a self correcting modulo-6 counter in which all the unused state leads to state ABC = 000. **(08 Marks)**

c. Draw the logic diagram, truth table and waveforms for a two flip-flop ripple counter. **(04 Marks)**

OR

8 a. Sketch a ring counter and Jonnson counter and write its truth table. **(08 Marks)**

b. Explain how toggle flip-flop is used as frequency divider circuit. Sketch the output waveforms. **(08 Marks)**

c. A 4-bit binary asynchronous counter is connected. With a clock of 500 KHz frequency. Find the time period of the wave forms at the o/p of all the flop-flops. **(04 Marks)**

Module-5

9 a. Design synchronous counter for the sequence 1 – 3 – 5 – 7 – 1 using J-K flip-flop. **(12 Marks)**

b. Explain digital clock with neat diagram. **(04 Marks)**

c. Explain the terms accuracy and resolution for D/A converter. **(04 Marks)**

OR

10 a. Explain with block diagram the operation of successive approximation ADC. **(08 Marks)**

b. Explain the binary ladder with digital input 1100. **(08 Marks)**

c. For a 5 bit resistive divider, determine the following :

i) Weight assigned to binary

ii) Weight assigned to second and third LSB

iii) The change in output voltage due to a change in the LSB, the second LSB and the third LSB

iv) The output voltage for a digital input of 10101.

Assume 0 = 0V and 1 = +10V.

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17CS33

Third Semester B.E. Degree Examination, June/July 2019
Data Structures and Applications

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Data structures. Give its classification. What are the basic operations that can be performed on data structure? **(08 Marks)**

b. Give the ADT for sparse matrix. Express the given sparse matrix in the triplet form and find its transpose.

$$A = \begin{bmatrix} 10 & 0 & 0 & 25 & 0 \\ 0 & 23 & 0 & 0 & 45 \\ 0 & 0 & 0 & 0 & 32 \\ 42 & 0 & 0 & 31 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 30 & 0 & 0 \end{bmatrix}$$ **(08 Marks)**

c. Consider the given 2 polynomials,
$A(x) = 4x^{15} + 3x^4 + 5$ and $B(x) = x^4 + 10x^2 + 1$
Represent the polynomials using Array of structures. **(04 Marks)**

OR

2 a. Explain the dynamic memory allocation functions in detail. **(08 Marks)**

b. Write a C program using pointers to (i) Concatenate two strings, (ii) reverse a string. **(06 Marks)**

c. Apply Knut-Morris-Pratt (KMP) pattern matching algorithm to search the pattern "abcdabcy" in the text "abcxabcdabxabcdabcdabcy". **(06 Marks)**

Module-2

3 a. Define stack data structure and give the ADT for stack. Write C functions for push( ) and pop( ) operations. **(08 Marks)**

b. Convert the given infix expressions to postfix and prefix expression.
(i) (a +b)* d + e / (f + g * h) + i
(ii) ((a / (b – c + d)) * (e – f) * g) **(06 Marks)**

c. Write an algorithm for evaluation of postfix expression. Trace the same for the expression ab/c – de * t ac * t where a = 6, b = 3, c = 1, d = 2, e = 4. **(06 Marks)**

OR

4 a. Define recursion. Write C recursive functions for the following :
(i) Tower of Hanoi (ii) Factorial of a give number. **(07 Marks)**

b. Write C functions for insertcq( ) and deletecq( ) operations on a circular queue. **(05 Marks)**

c. Explain in detail multiple stacks, with relevant functions in C. **(08 Marks)**

Module-3

5 a. Define linked lists. Explain in detail, the primitive operations performed on Supply Linked List (SLL). List the different types of linked lists. **(12 Marks)**

b. Write C functions for the following operations on Doubly Linked List (DLL).
(i) Concatenation of two DLL.
(ii) Search the DLL for the given key element. **(08 Marks)**

OR

6 a. Write a C program to implement linked stacks. **(08 Marks)**

b. Write an algorithm to add 2 polynomials using circular simply linked list (SLL). And also represent the given polynomial using CSLL.
$P(x, y, z) = 6x^2y^2z - 4yz^5 + 3x^3yz + 2xy^5z - 2xyz^3$ **(08 Marks)**

c. For the given sparse matrix give the linked list representation.

$$A = \begin{bmatrix} 0 & 0 & 4 & 0 & 0 \\ 6 & 5 & 0 & 0 & 0 \\ 0 & 3 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$ **(04 Marks)**

Module-4

7 a. Define tree data structure. Represent the tree given in Fig.Q7(a) using (i) List representation (ii) Left-Child Right-Sibling representation (iii) Degree-two or Binary tree representation.

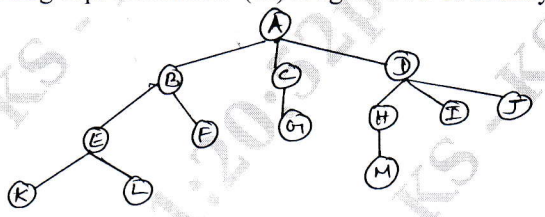

Fig.Q7(a) **(08 Marks)**

b. Write recursive C functions for in-order, pre-order, post-order traversals of binary tree (BT). Also give the 3 traversals for the BT shown in Fig.Q7(b). **(12 Marks)**

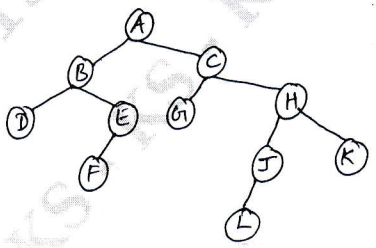

Fig.Q7(b)

OR

8 a. Define Binary Search Tree (BST). Construct BST for the element step-by-step,
100, 85, 45, 55, 110, 20, 70, 65, 113, 145, 132, 96 **(08 Marks)**

b. Define threaded binary trees. Given in-order sequence: DJGBHEAFKIC and post-order sequence : JGDHEBKIFCA, construct BT for the same. **(08 Marks)**

c. Write an algorithm for deleting a key element from BST. **(04 Marks)**

Module-5

9 a. Define the terminologies with example for graph data structure.
(i) Graph (ii) Multigraph (iii) Complete graph. **(06 Marks)**

b. Give the adjacency matrix and adjacency list representation for the weighted graph given in Fig.Q9(b). **(06 Marks)**

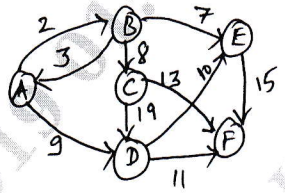

Fig.Q9(b)

c. Write an algorithm for BFS and DFS graph traversal methods. **(08 Marks)**

OR

10 a. Apply insertion sort technique for the following elements : 77, 33, 44, 11, 88, 22, 66, 55. **(08 Marks)**

b. Explain Hashing and collision. What are the methods used to resolve collision. **(08 Marks)**

c. What are the basic operations that can be performed on a file? List the methods used for file organization (any 2). **(04 Marks)**

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17CS34

Third Semester B.E. Degree Examination, June/July 2019
Computer Organization

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Write the basic performance equation. Explain the role of each of the parameters in the equation of the performance of the computer. **(04 Marks)**

b. Draw and explain the connections between the processor and the main memory. **(08 Marks)**

c. Write a program to evaluate the arithmetic statement Y = (A + B) * (C + D) using three – address, two-adderss, one–adderss and zero – address instructions. **(08 Marks)**

OR

2 a. What is an addressing mode? Explain any four addressing modes with examples. **(08 Marks)**

b. Explain the concept of stack frames, when subroutines are nested. **(06 Marks)**

c. Explain the shift and rotate operations with examples. **(06 Marks)**

Module-2

3 a. Give comparison between memory mapped I/O and I/O mapped I/O. **(04 Marks)**

b. Explain the following methods of handling interrupts from multiple devices.
i) Interrupt nesting /priority structure
ii) Daisy chain method. **(08 Marks)**

c. What is bus arbitration? Explain distributed arbitration with a neat diagram. **(08 Marks)**

OR

4 a. Draw neat timing diagrams and explain :
i) Multicycle synchronous bus transfer for a read operation.
ii) Asynchronous bus transfer for a write operation. **(12 Marks)**

b. Explain the following with respect to USB.
i) USB architecture
ii) USB addressing. **(08 Marks)**

Module-3

5 a. With a neat diagram, explain the internal organization of a 2M × 8 dynamic memory chip. **(08 Marks)**

b. Distinguish between SRAM and DRAM. **(04 Marks)**

c. Describe any two mapping functions in cache. **(08 Marks)**

OR

6 a. What is virtual memory? With a diagram, explain how virtual memory address is translated? **(08 Marks)**

b. Define the following :
i) Memory latency ii) Memory bandwidth iii) Hit-rate iv) Miss-penalty. **(04 Marks)**

c. Describe the working principle of a typical magnetic disk. **(08 Marks)**

Module-4

7 a. Convert the following pairs of decimal numbers to 5-bit signed 2's complement binary numbers and add them. State whether overflow has occurred.
i) –5 and 7 ii) –10 and –13 iii) –14 and 11. **(06 Marks)**

b. Draw 4-bit carry-look ahead adder and explain. **(06 Marks)**

c. Explain Booth's algorithm, multiply +15 and – 6 using Booth's multiplication. **(08 Marks)**

OR

8 a. Explain the concept of carry-save addition for the multiplication operation $M \times Q = P$ for 4-bit operands, with diagram and suitable example. **(08 Marks)**

b. Explain IEEE standard for floating – point numbers. **(06 Marks)**

c. Perform the non-restoring division for $8 \div 3$ by showing all the steps. **(06 Marks)**

Module-5

9 a. Draw and explain multiple bus organization of CPU. And write the control sequence for the instruction Add R_4, R_5, B_6 for the multiple bus organization. **(10 Marks)**

b. Explain with block diagram the basic organization of a micro programmed control unit. **(10 Marks)**

OR

10 a. With block diagram, explain the working of a microwave oven. **(10 Marks)**

b. Explain the structure of general-purpose multiprocessors with diagrams. **(10 Marks)**

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CBCS SCHEME

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Third Semester B.E. Degree Examination, June/July 2019
UNIX and Shell Programming

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With a neat diagram, explain the architecture of UNIX operating system. **(08 Marks)**

b. Differentiate between internal and external commands in UNIX with suitable examples. **(05 Marks)**

c. Write down the key combinations for managing the non-uniform behavior of key board and termina! for the following :
i) Backspacing doesn't work
ii) Killing a line
iii) Interrupting a command
iv) Terminating commands input
v) Keyboard is locked
vi) [Enter] key doesn't work
vii) Terminal behaves in eratic manner (command). **(07 Marks)**

OR

2 a. Explain the salient features of UNIX operating system. **(08 Marks)**

b. Differentiate between 'more' and 'less' page programs in UNIX. **(04 Marks)**

c. List and describe the mandatory and optional sections of man page in UNIX operating system. **(08 Marks)**

Module-2

3 a. Illustrate with a neat diagram typical UNIX file system and explain different types of files supported in UNIX. **(08 Marks)**

b. Assume you are in /home/Kumar, which of these commands will work when executed in sequence? Explain the proper reasons.
mkdir a/b/c → mkdir a a/b
mkdir a a/b a/b/c → rmdir a/b/c → rmdir a a/b → mkdir a/p a/q a/p/r
Draw the final tree structure for directory 'a'. **(07 Marks)**

c. Explain the following commands with an example. i) cd ii) pwd iv) rmdir v) wc. **(05 Marks)**

OR

4 a. Which command is used for listing file attributes? Explain the significance of each field in the output. **(08 Marks)**

b. Explain the following commands with an example for each.
i) cp ii) rm iii) mv iv) cat. **(04 Marks)**

c. Current file permissions of a regular file "unix" are rw_ _w_ _ _x. Write chmod expressions required to change it to the following :
i) _wxrwxr_x ii) _ _ _r _ xrw_ iii) rwx_ _x _ _ _ iv) r _ _ _ wx _ _ _.
Using both relative and absolute methods of assigning permissions. **(08 Marks)**

Module-3

5 a. Explain the three modes of vi. Indicate clearly how can you switch form one mode to another. Explain the following input mode commands : i, I, a A, r, R, o, O, s, S. **(10 Marks)**

b. Explain what these wild-card pattern match
i) [A – Z]???? ∗ ii) ∗[! 0 – 9]∗ iii) ∗.[!t][!x][!t] **(06 Marks)**

c. Explain the navigation keys for the following types of navigations in vi editor.
i)Movement in four directions
ii)Word navigation. **(04 Marks)**

OR

6 a. With suitable examples, explain the 'grep' command with its various options. **(06 Marks)**

b. Briefly explain Basic Regular Expression (BRE) and Extended Regular Expression (ERE) metacharacters. **(10 Marks)**

c. Write a regular expression to match the following i) a decimal number which is non negative and floating point number ii) A valid 'C' variable. **(04 Marks)**

Module-4

7 a. Explain the following commands with an example for each. i) head ii) tail iii) cut iv) paste. **(08 Marks)**

b. What is shell programming? Write a shell program to create a simple calculator which can perform basic arithmetic operations like addition, subtraction, multiplication or division, depending upon the user input. **(10 Marks)**

c. Write the syntax for if-else-fi statement in shell programming. **(02 Marks)**

OR

8 a. Write a shell program to get the following details of the student. Name, age, USN and gender. Output all the details to the terminal. And also output whether the student is eligible to vote or not with suitable messages. **(08 Marks)**

b. Distinguish between hard links and soft links. **(04 Marks)**

c. Write and explain the syntax of 'while' and 'for' loops in shell programming. **(08 Marks)**

Module-5

9 a. Write a Perl script to determine whether the given year is a leap year or not. **(08 Marks)**

b. What is the difference between a job and a process? How do you i) suspend the foreground job ii) move a suspended job to the background iii) bring back a suspended job to the foreground? **(06 Marks)**

c. Explain the mechanism of process creation. **(06 Marks)**

OR

10 a. Explain the following string handling functions of PERL with example :
i) length ii) index iii) substr iv) reverse. **(08 Marks)**

b. Explain the following commands :
i) at ii) cron iii) nice iv) nohup. **(08 Marks)**

c. With suitable examples, explain 'split' and 'join' functions in PERL. **(04 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **17CS36**

Third Semester B.E. Degree Examination, June/July 2019
Discrete Mathematical Structures

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define tautology. Verify that $[p \to (q \to r)] \to [(p \to q) \to (p \to r)]$ is a tautology. **(06 Marks)**

b. If statement q has truth value 1, determine all truth value assignments for the primitive statements p, r, s for which the truth value of the statement :

$(q \to [(\neg p \vee r) \wedge \neg s]) \wedge [\neg s \to (\neg r \wedge q)]$ is 1. **(04 Marks)**

c. Establish the following logical equivalence :

i) $p \vee q \vee (\neg p \wedge \neg q \wedge r) \Leftrightarrow p \vee q \vee r$

ii) $[(\neg p \vee \neg q) \to (p \wedge q \wedge r)] \Leftrightarrow p \wedge q$. **(10 Marks)**

OR

2 a. Establish the validity of following arguments :

i)
$$\begin{array}{l} (\neg p \vee \neg q) \to (r \wedge s) \\ r \to t \\ \neg t \\ \hline \therefore p \end{array}$$

ii)
$$\begin{array}{l} u \to r \\ (r \wedge s) \to (p \vee t) \\ q \to (u \wedge s) \\ \neg t \\ q \\ \hline \therefore p \end{array}$$
(08 Marks)

b. Let p(x), q(x) and r(x) be the following open statements :

$p(x) : x^2 - 7x + 10 = 0$ $q(x) : x^2 - 2x - 3 = 0$ $r(x) < 0$.

Determine truth or falsity of following statements, where universe is all integers. If a statement is false, provide a counter example.

i) $\forall x[p(x) \to \neg r(x)]$ ii) $\forall x[q(x) \to r(x)]$

iii) $\exists x[q(x) \to r(x)]$ iv) $\exists x[p(x) \to r(x)]$. **(08 Marks)**

c. Prove that for all integers 'k' and 'ℓ', if 'k' and 'ℓ' are both even, then $k + \ell$ is even and $k\ell$ is even by direct proof. **(04 Marks)**

Module-2

3 a. Define well ordering principle and prove the following by mathematical induction :

i) $1^2 + 3^2 + 5^2 + ----- + (2n-1)^2 = \dfrac{n(2n-1)(2n+1)}{3}$

ii) $1 * 3 + 2 * 4 + 3 * 5 + ----- + n(n+2) = \dfrac{n(n+1)(2n+7)}{6}$. **(12 Marks)**

b. Find the coefficients of :

i. x^9y^3 in the expansion of $(2x - 3y)^{12}$

ii. $a^2b^3c^2d^5$ in the expansion of $(a + 2b - 3c + 2d + 5)^{16}$. **(08 Marks)**

OR

4 a. A women has 11 close relatives and she wishes to invite 5 of them to dinner. In how many ways can she invite them in following situations,
   i. There is no restriction on the choice
   ii. Two particular persons will not attend separately
   iii. Two particular persons will not attend together. **(06 Marks)**

b. How many arrangements are there for all letters in word SOCIOLOGICAL? In how many of these arrangements all vowels are adjacent. **(06 Marks)**

c. For the Fibonacci sequence $F_0, F_1, F_2 \ldots$ prove that $F_n = \frac{1}{\sqrt{5}}\left[\left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{2}\right)^n\right]$. **(08 Marks)**

Module-3

5 a. Let A = {1, 2, 3, 4} and B = {1, 2, 3, 4, 5,6}.
   i. How many functions are there from A to B?
   ii. How many of these are one to one?
   iii. How many are onto?
   iv. How many functions are there from B to A?
   v. How many of these are onto?
   vi. How many are one to one? **(06 Marks)**

b. A computer operator is given a magnetic tape that contains 500,000 words of four or fewer lowercase letters. Can it be that the 500,000 words are all distinct? **(06 Marks)**

c. Let f, g, h : R → R where $f(x) = x^2$, $g(x) = x + 5$ and $h(x) = \sqrt{x^2 + 2}$. Show that (hog) of = ho(gof). **(08 Marks)**

OR

6 a. Let A = {1, 2, 3, 6, 9, 18} and define R on A by xRy if "x divides y", Draw the Hasse diagram for the poset (A, R). Also write the matrix of relation. **(08 Marks)**

b. Consider Poset whose Hasse diagram is given below. Consider B = {3, 4, 5}. Find upper and lower bounds of B, least upper bound and greatest lower bound of B. **(04 Marks)**
(Ref. Fig.Q6(b)).

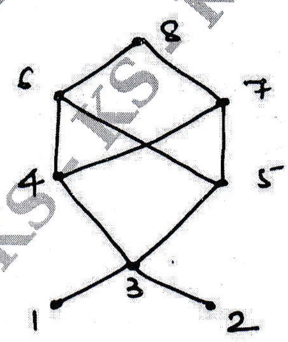

Fig.Q6(b)

c. Let A = {1, 2, 3, 4, 5} × {1, 2, 3, 4, 5} and define R on A by (x_1, y_1) R (x_2, y_2) if $x_1 + y_1 = x_2 + y_2$.
   i. Verify that R is an equivalence relation on A
   ii. Determine equivalence classes [(1, 3)], [(2, 4)] and [(1, 1)]
   iii. Determine partition of A induced by R. **(08 Marks)**

Module-4

7 a. In how many ways can the 26 letters of English alphabet be permuted so that none of the patterns CAR, DOG, PUN or BYTE occurs? **(08 Marks)**

b. There are eight letters to eight different people to be placed in eight different addressed envelops. Find the number of ways of doing this so that atleast one letter gets to right person. **(04 Marks)**

c. Four persons P_1, P_2, P_3, P_4 who arrive late for a dinner party find that only one chair at each of five table T_1, T_2, T_3, T_4 and T_5 is vacant. P_1 will not sit at T_1 or T_2, P_2 will not sit at T_2, P_3 will not sit at T_3 or T_4 and P_4 will not sit at T_4 or T_5. Find the number of ways they can occupy the vacant chairs. **(08 Marks**

OR

8 a. Find the recurrence relation and the initial condition for the sequence 0, 2, 6, 12, 20, 30, 42, ... Hence find the general term of the sequence. **(10 Marks)**

b. If $a_0 = 0$, $a_1 = 1$, $a_2 = 4$ and $a_3 = 37$ satisfy the recurrence relation $a_{n+2} + ba_{n+1} + ca_n = 0$ for $n \geq 0$, determine the constants b and c and then solve the relation for a_n. **(10 Marks)**

Module-5

9 a. Merge sort the list –1, 7, 4, 11, 5, –8, 15, –3, –2, 6, 10, 3. **(06 Marks)**

b. Determine whether the following graphs are isomorphic or not. **(06 Marks)**

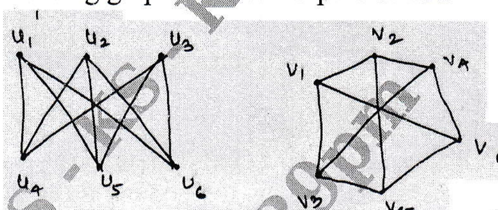

Fig.Q9(b)

c. Define the following with an example to each.

i) Simple graph ii) Complete graph iii) Regular graph iv) Spanning sub graph v) Induced subgraph vi) Complete Bipartite graph vii) Tree viii) Complement of graph. **(08 Marks)**

OR

10 a. Define trail, circuit, path, cycle. In the graph shown below determine : [Ref.Q10(a)]

i. a walk from b to d that is not a trail
ii. b-d trail that is not a path
iii. a path from b to d
iv. a closed walk from b to b that is not a circuit
v. a circuit from b to b that is not cycle
vi. a cycle form b to b. **(10 Marks)**

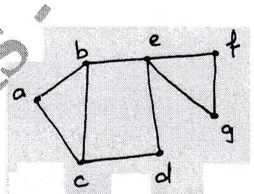

Fig.Q10(a)

b. Define optimal tree and construct an optimal tree for a given set of weights {4, 15, 25, 5, 8, 16}. Hence find the weight of optimal tree. **(06 Marks)**

c. Prove that in a graph. The sum of degrees of all vertices is an even number and is equal to twice the number of edges in the graph. **(04 Marks)**

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