Q. P. Code: 40017

Duration: 3 Hours Marks :80

N.B. (1) Question No. 1 is compulsory.
(2) Solve any three questions from remaining questions.
(3) Draw suitable diagrams wherever necessary.
(4) Assume suitable data, if necessary.

Q.1 Attempt any four sub-questions.

a) State and explain advantages and limitation of regular and context free grammar. 05

b) Design a Mealy machine for a binary adder. 05

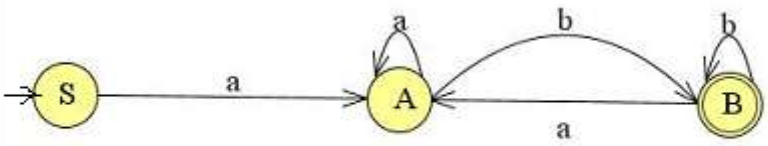
c) Give formal definition of PDA. 05

d) Construct the DFA that accept set of all strings over the alphabet ∑ = {a, b} containing either the substring 'aaa' or 'bbb'. 05

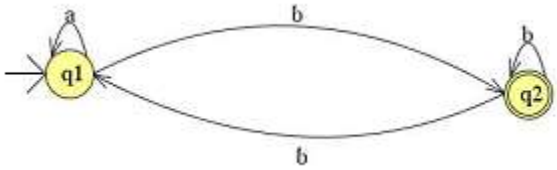
e) Find the CNF equivalent to
S→aAbB, A→aA | a, B→bB | b. 05

Q2. a) What is NFA? Design a NFA for a binary number where the first and last digit is same. 10

b) Write a necessary function for the given automata. 10



Q3.a) i) Find a regular expression RE corresponding to the following FA 10



ii) Give a regular expression for a language over the alphabet ∑ = {a, b} containing at most two a's

b) Construct a Mealy machine that accepts strings ending in '00' and '11'. Convert the same to Moore machine. 10

Q4.a) Design a PDA for CFL that checks the well formedness of parenthesis i.e the language L of all balanced string of two types of paranthesis "( )" and "[ ]". Trace the sequence of moves made corresponding to input string (([ ]) [ ]). 10

b) Construct a TM accepting palindromes over ∑= {a,b}. 10

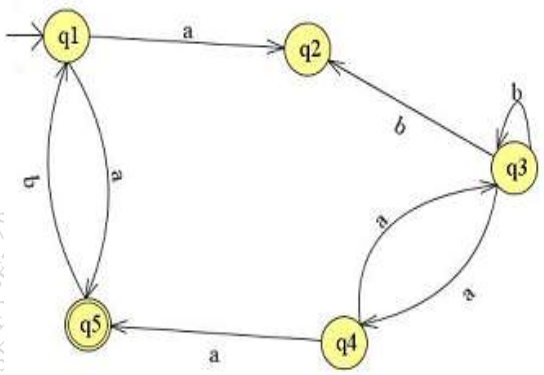
Q5. a) Let G be the grammar. Find the leftmost derivation, rightmost derivation and parse tree for the string 001222. 10

G: $S \rightarrow 0S \mid 1A \mid 2B \mid \varepsilon$

$A \rightarrow 1A \mid 2B \mid \varepsilon$

$B \rightarrow 2B \mid \varepsilon$

b) Design a NFA for accepting input strings that contain either the keyword 000 or the keyword 010 and convert it into an equivalent DFA. 10



Q6. Write short notes on (any four) 20

a) Variants of Turing Machines
b) Algorithm for CFG to CNF Conversion
c) Chomsky Hierarchy
d) Limitation of Finite Automata
e) Halting Problem.

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(3 Hours) **[Total Marks: 80]**

Note : Q1 is compulsory.
Attempt any THREE out of the remaining questions.
Assume suitable data if necessary.

Q1. Attempt any 4 sub questions

a) Explain six stage instruction pipeline with suitable diagram. 5
b) Write a note on 8288 bus controller. 5
c) Explain memory hierarchy. 5
d) Draw the flowchart of unsigned binary restoring division algorithm.
e) Explain any five instructions of 8086 microprocessor with suitable examples. 5

Q2. a) What is DMA? Explain working of DMA. 10
b) List and explain key characteristics of computer memory. 10

Q3 a) Draw the flowchart of Booths algorithm and multiply (-3)*(4) using Booths algorithm. 10
b) Explain micro-programmed control unit with suitable diagram. 10

4 a) Explain addressing modes of 8086 microprocessor with suitable examples. 10
b) Explain single and double precision IEEE 754 binary floating point representation formats. 10

Q5. a) Explain with suitable diagram maximum mode of operation of 8086 Micro processor. 10
b) Write 8086 Assembly Language Program to count number of 0's and 1's in a given 8 bit number. 10

Q6 Write notes on (any two) 20
a) Cache memory mapping techniques.
b) Flynn's classification of parallel computers.
c) Programmed I/O.

[Time: Three Hours] **[Marks:80]**

Note:

1) **Question 1 is compulsory.**
2) **Solve any three questions out of the remaining questions**

Q1

(a) Discuss and compare various types of networks. **05**

(b) The size option field of an IP datagram is 20 bytes. What is the value of HLEN? What is the value in binary? **05**

(c) Compare connectionless and connection-oriented services. **05**

(d) The received string of bits is 110011001100. Is it acceptable? If so, what is the data bit sequence? Consider the divisor is 10101. **05**

Q2 (a) What is routing in a network? Explain the shortest path routing protocol. **10**

Q2 (b) Explain the different transmission media in networking. **10**

Q3 (a) Explain OSI reference model and the services and functions of each layer. **10**

Q3 (b) Construct Huffman code for the given symbols $\{x_1, x_2, \ldots\ldots, x_8\}$ with probabilities P(x) = {0.07, 0.08, 0.04, 0.26, 0.14, 0.09, 0.07, 0.25}. Find the coding efficiency. **10**

Q4 (a) Explain TCP segment header format in detail. **10**

Q4 (b) Explain ALOHA and Slotted ALOHA. **10**

Q5 (a) What is congestion and what are the causes of congestion? Explain token bucket algorithm of congestion control. **10**

Q5 (b) Explain CSMA/CD. **10**

Q6 Write short notes on the following (any four): **20**

a. SMTP
b. HDLC
c. ARP, RARP
d. Traditional Ethernet frame
e. Hubs, switches, bridges

(Hours: 3 hrs) **[Total Marks: 80]**

Note: 1. Question no**. 1** is compulsory.
2. Attempt any **three** questions out of remaining **five** questions.

Q.1.[a] Given two lines of regression lines $x + 2y - 5 = 0$, $2x + 3y + 8 = 0$. Find (i) $\bar{x}$, $\bar{y}$ (ii) correlation coefficient r. [5]

[b] Show that $97 \mid (2^{48} - 1)$. [5]

[c] The probability density function of a random variable x is zero except at x =0, 1, 2 and $p(0) = 3k^3$, $p(1) = 4k - 10k^2$, $p(2) = 5k - 1$. Find (i) k (ii) $p(0 < x \leq 2)$. [5]

[d] Give an example of a graph which has [5]
(i) Eulerian circuit but not a Hamiltonian circuit
(ii) Hamiltonian circuit but not an Eulerian circuit

Q.2.[a] Find gcd (2947, 3997) using Euclidean Algorithm. Also find x and y such that $2947x + 3997y = \gcd(2947, 3997)$. [6]

[b] The four roots of unity 1, -1, i, -i forms a group under multiplication. [6]

[c] Find whether the following graphs G = (V,E) and G' = (V', E') are isomorphic ? Justify. [8]
(1) V = {a,b,c,d} ,E ={(a,b),(a,d), (b,d), (c,d),(c,b),(c,d)}
(2) V' ={1,2,3,4} ,E' = {(1,2),(2,3) ,(3,1),(3,4),(4,1), (4,2)}

Q.3.[a] Show that $(D_8, \leq)$ is a lattice. Draw its Hasse diagram. [6]

[b] The local authorities in a certain city install 10,000 electric lamps in the streets of the city. If these lamps have an average life of 1000 burning hours with a standard deviation of 200 hours, how many lamps might be expected to fail i) in the first 800 burning hours? ii) Between 800 and 1200 burning hours? [6]

[c] **(i)** Find inverse of $2^{-1} \pmod{31}$ using Fermat's theorem. [8]
(ii) Find the Legendre's symbol of $\left(\frac{19}{23}\right)$.

Q.4.[a] Calculate the coefficient of correlation between x and y from the following data [6]

x	12	9	8	10	11	13	7
y	14	8	6	9	11	12	3

[b] (i) Draw a connected graph for which every edge isa cut edge. [6]
(ii) Show that any connected graph with 'n-1' edges is a tree.

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[c] **(i)** Can it be concluded that the average lifespan of an Indian is more than 70 years if a random sample of l00 Indians has an average lifespan of 71.8 years with standard deviation of 8.9 years? [8]
(ii) Ten individuals are chosen at random from a population and their heights are found to be in inches 63, 63, 64, 65, 66,69, 69, 70, 70,71. Discuss the suggestion that the mean height of the universe is 65 inches.

Q.5.[a] Solve $x \equiv 5 \pmod 6$, $x \equiv 4 \pmod{11}$, $x = 3 \pmod{17}$. [6]

[b] Theory predicts that the proportion of beans in the four groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans the numbers in the four groups were 882, 313, 287 and 118. Using Chi-Square verify does the experimental results support the theory? [6]

[c] Let G be a group of all permutations of degree 3 on 3 symbols 1, 2 & 3. Let H ={I, (1 2)} be a subgroup of G. find all the distinct left cosets of H in G and hence index of H. [8]

Q.6.[a] Show that $53^{103} + 103^{53}$ is divisible by 39. [6]

[b] Given L = {1, 2, 4, 5, 10, 20}with divisibility relation. Verify that $(L, \leq)$ is a distributive but not complimented Lattice. [6]

[c] **(i)** Write the following permutation as the product of disjoint cycles [8]
$f = (1\ \ 2)\ (1\ 2\ 3)\ (1\ 2)$.
(ii) Express the expression (x +y) (x + z) (x'y)' in the sum-of-product form.

(3 hours) [80 marks]

NOTE: Question No 1 is compulsory. Attempt any three questions from remaining.
Assume suitable data if necessary.
Draw neat labelled diagrams wherever needed.

Q.1. a) Explain the two main categories of services and functions of operating system. Compare and contrast them. **10M**

b) What is context-switch? Describe the actions taken by a kernel to context-switch between processes. **10M**

Q.2. a) Explain the differences in how much the following scheduling algorithms discriminate in favor of short processes: **10M**
a. FCFS
b. RR
c. Multilevel feedback queues

b) Describe the differences among short-term, medium-term, and long-term scheduling. **10M**

Q.3. a) Explain the timestamp based protocols to ensure serializability with the help of example. **10M**

b) Consider the following set of processes, with the length of the CPU burst given in milli seconds. The processes are assumed to have arrived in order P_1, P_2, P_3, P_4, P_5 all at time 0. **10M**

Process	*Burst Time*	*Priority*
P_1	10	3
P_2	1	1
P_3	2	3
P_4	1	4
P_5	5	2

Calculate the average turnaround time and maximum waiting time for pre-emptive priority scheduling algorithm.

Q.4. a) Compare and contrast paging and segmentation. **10M**

b) What is address translation? Consider a logical address space of 32 pages with 1,024 words per page, mapped onto a physical memory of 16 frames. **10M**
a. How many bits are required in. the logical address?
b. How many bits are required in the physical address?

Q.5 a) Describe how the Swap () instruction can be used to provide mutual exclusion that satisfies the bounded-waiting requirement. **10M**

b) What is deadlock? What are the essential conditions for deadlock to occur? **10M**

Q.6. Write Short Notes on: **(Any four)** **20M**
a) Linked Allocation.
b) Memory segmentation
c) Deadlock detection.
d) Translation Lookaside Buffer
e) Open() and Close () operations.
f) Page replacement algorithms

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