**3 Hours**                                    **Total Marks: 80**

N.B.: 1) All Question carry equal Marks.
2) Solve any Four from the six questions.
3) Assume suitable data if necessary.
4) Figures to the right indicate full marks.

Q.1)    Answer the following questions:

a. What do you mean by Right-Linear and Left-Linear grammars?                [05]

b. What is Finite Automata (FA)? List the limitations of FA.                 [05]

c. Explain the need for normalization in grammars.                          [05]

d. Design Turing Machine to multiply two unary numbers.                     [05]

Q.2) a)    I.   Define the terms: Regular Expression, Regular Grammar and Regular   [06]
                Language.

        II.  Write down the regular expressions for the following language L:       [04]
             a) For all strings over $\{0, 1\}$ having no consecutive 1s.
             b) For all strings over $\{0, 1\}$ containing the sequence 011
             c) For all strings over $\{a, b\}$ whose length is a multiple of 3.
             d) For all strings over $\{0, 1\}$ containing no more than two 0s.

b)    What are Moore and Mealy machines. Design Moore and Mealy machines to         [10]
      convert each occurrence of aaa with bbb.

Q.3) a)    Design Push Down Automata (PDA) for the language                          [10]
           $L=\{a^{2n}ba^n \mid n \geq 0\}$

b)    What do you mean by Deterministic Finite Automata (DFA)?                       [10]
      Construct an automaton for binary numbers divisible by 5 excluding numbers
      with leading zeroes.

Q.4) a)    Consider the grammar $S \rightarrow aSa \mid bSb \mid SS \mid \lambda$.    [10]
           Given the string "babbabaaba", find a leftmost and rightmost derivations
           with corresponding parse trees.

b)    What is a compiler? Explain the different phases of a compiler.                [10]

Q.5) a)    Convert the following grammar into Chomsky Normal Form (CNF)              [10]
           $S \rightarrow aSa \mid bSb \mid A \mid \lambda$
           $A \rightarrow a \mid b \mid \lambda$

b)    Design a Turing machine over $\Sigma \{0,1\}$ to accept the language          [10]
           $L=\{0^{2m} 1^m \mid m > 0\}$

Q.6)    Write short notes on **(Any FOUR)**:                                         [20]
        a. Non-Deterministic Finite Automata
        b. Power and Limitations of PDA.
        c. Greibach Normal Form (GNF)
        d. Chomsky hierarchy
        e. Universal Turing Machine

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**66471**                        **Page 1 of 1**

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

**N.B.:**   (1) Question No.1 is compulsory.
       (2) Attempt any three questions from the remaining five questions.
       (3) Make suitable assumptions wherever necessary but justify your assumptions.

| | | |
|---|---|---:|
| **Q.1.** | a. Explain in detail TCP Timers. | 05 |
| | b. Compare Circuit-Switched Networks and Packet Switching Network. | 05 |
| | c. What is the difference between MAC address and IP address ? | 05 |
| | d. Explain Domain Name System (DNS). | 05 |
| | | |
| **Q.2.**a. | Explain in detail Link state routing. | 10 |
| **Q.2.**b. | Explain the OSI model of Computer Network with a neat diagram . | 10 |
| | | |
| **Q.3.**a. | Explain in detail Classful and Classless IP addresses | 10 |
| **Q.3.**b. | Explain in detail TCP header with diagram. | 10 |
| | | |
| **Q.4.**a. | Draw and explain guided and unguided transmission media. | 10 |
| **Q.4.**b. | An organization is granted the block 18.0.0.0/8. The administrator wants to create 511 fixed-length subnets. a. Find the subnet mask. b. Find the number of addresses in each subnet.c. Find the first and the last address in the first subnet. | 10 |
| | | |
| **Q.5.**a. | Explain in detail Go-Back-N protocol. | 10 |
| **Q.5.**b. | Explain in detail CSMA protocols. | 10 |
| | | |
| **Q.6.** | Write short notes on (Any Four) | 20 |

      a.   OSPF
      b.   SNMP
      c.   VLAN
      d.   RPC
      e.   Image Compression

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Time: 3 Hours                                                                    Max Marks: 80

N.B.    1. Question No 1 is compulsory.
        2. Solve any **three** questions out of the remaining five questions.
        3. Assume suitable data if necessary.
        4. Figures to the right indicate marks.

Q. 1. Solve **any four** out of five.                                            (4*5=20)
   a.  Explain Von-Neumann's architecture with diagram
   b.  Explain the working of JK flip-flop.
   c.  Convert $(- 10.125)_{10}$ in the IEEE 754 single precision standard.
   d.  Compare SRAM and DRAM.
   e.  Write a note on Amdahl's Law

Q. 2. a)  Construct flowchart for Booth's Algorithm and multiply (-8) and (5) using the same.   (10)
      b)  Explain Encoder and Decoder with one example.                          (10)

Q. 3. a)  Reduce given Boolean expression using K-Map method.
          $f(A,B,C,D) = \sum ( 0,1, 2 ,3,4,5,8,9,10,11,12,13)$                    (10)
      b)  Write an assembly language program for an 8086 microprocessor to find largest
          8 bit binary number.                                                   (10)

Q. 4. a)  Discuss various cache memory mapping techniques with diagram           (10)
      b)  Explain various pipeline hazards with example.                         (10)

Q. 5. a)  Discuss the various characteristics of Memory.                         (10)
      b)  Explain design of control unit w.r.t. micro programmed and hardwired approach.   (10)

Q. 6. a)  Explain different addressing modes of 8086 microprocessors with examples.   (10)
      b)  Describe DMA and explain its various data transfer techniques.         (10)

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**(Time : 3 Hours)**                                                    **(Total Marks : 80)**

**Note :**
1) Q. No. 01 is compulsory.
2) Solve any three from Q. No. 02 to 06.
3) Numbers to the right indicate full marks.
4) Use of statistical tables is allowed.

**Q. 1.**    Solve.

a)  If $A = \begin{bmatrix} -1 & 2 & 38 \\ 0 & 2 & 37 \\ 0 & 0 & -2 \end{bmatrix}$ find the Eigen values of $A^3 + 5A + 8I$.    **05**

b)  Integrate the function $f(z) = x^2 + i\,xy$ from A(1, 1) to B(2, 4) along $y = x^2$    **05**

c)  Find the Z-Transform of $f(k) = a^{-k}$ , $k \geq 0$.    **05**

d)  If a random variable X follows Poisson distribution such that P (x = 1) = 2 P (x = 2).    **05**
    Find mean and variance of the distribution.

**Q. 2.**

a)  Find the Eigenvalues and Eigenvectors of the matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$.    **06**

b)  Find the Z-Transform of $\cos\left(\frac{\pi}{4} + k\alpha\right)$ $k \geq 0$.    **06**

c)  Use the dual simplex method to solve the LPP
    Min. Z = 2 X₁ – X₂ + 3 X₃ ,    **08**
    $3X_1 - X_2 + 3X_3 \leq 7$, $2X_1 - 4X_2 \geq 12$, $X_1, X_2, X_3, \geq 0$

**Q. 3.**

a)  Evaluate $\int_C \frac{z+8}{z^2+5z+6}\, dz$ Where C is a circle $|z|=5$ .    **06**

b)  Verify Caley-Hamilton theorem and hence find $A^{-1}$ and $A^4$ where $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$.    **06**

c)  Solve the LPP by Big -M method
    Max. Z = X₁ + 2X₂ +3X₃ - X₄    **08**
    X₁ +2X₂ +3X₃ = 15 , 2X₁ + X₂ + 5X₃ = 20, X₁ +2X₂ +X₃ + X₄ = 10  X₁, X₂, X₃ , X₄
    ≥ 0

**Q. 4.**

a)  Find inverse Z transform of $F(z) = \frac{1}{(z-2)(z-3)}$ for i) $|z| < 2$, ii) $|z| > 3$.    **06**

b)  A certain drug administered to 12 patients resulted in the following change in their
    blood pressure. 5, 2, 8, - 1, 3, 0, 6, - 2, 1, 0, 4,5 Can we conclude that the drug    **06**
    increases the blood pressure?

**67953**                                  **Page 1 of 2**

c) Find all possible Laurent's series expansions of the function $f(z) = \frac{1}{(z+1)(z-2)}$ about $z = 0$ indicating the region of convergence in each case. **08**

**Q. 5.**

a) Determine all basic solutions to the following problem
$\text{Max} = x_1 - 2x_2 + 4x_3$,
$x_1 + 2x_2 + 3x_3 = 7,\ 3x_1 + 4x_2 + 6x_3 = 15,\ x_1, x_2, x_3 \geq 0$. **06**

b) If X is a Normal variate with mean 10 & s.d. 4, find i) P(5≤X≤18), ii) P(X≤12). **06**

c) Solve the NLPP
Optimize $Z = 12x_1 + 8x_2 + 6x_3 - x_1{}^2 - x_2{}^2 - x_3{}^2 - 23$
Subject to $x_1 + x_2 + x_3 = 10,\ x_1, x_2,\ x_3 \geq 0$. **08**

**Q. 6.**

a) Show that the given matrix is diagonalizable and hence find diagonal form and transforming matrix where $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$. **06**

b) Based on the following data if there is a relation between literacy and smoking. **06**

|  | Smoking | Non-smoking |
|---|---|---|
| Literacy | 83 | 57 |
| Illiteracy | 45 | 68 |

c) Max. $Z = 12x_1 x_2 + 2x_1{}^2 - 7x_2{}^2$, Subject to $2x_1 + 5x_2 \leq 98,\ x_1, x_2 \geq 0$ by K-T condition. **08**

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Time: 3hours                                                                                    Max. Marks: 80

N.B.: 1) Question No.1 is compulsory.
       2) Attempt any THREE questions out of remaining FIVE questions.
       3) Figures to the right indicates full marks.
       4) Assume suitable data if necessary.

| Q1 | **Answer any FOUR** | 20 |
|---|---|---|
| a | Explain process state model. | |
| b | Describe the implementation of file allocation techniques? | |
| c | What is difference between physical address and virtual address? | |
| d | Explain memory fragmentation. | |
| e | Explain about IPC. | |

**Q.2**
| a | What is an Operating System? Explain structure of Operating System. | 10 |
|---|---|---|
| b | What is thread in OS? Compare user level and kernel level threads. | 10 |

**Q.3**
| a | What is process scheduling? List process scheduling algorithms and explain anyone scheduling algorithm with example. | 10 |
|---|---|---|
| b | What is a deadlock? Explain necessary conditions for deadlock. | 10 |

**Q.4**
| a | What is a process? Explain Process control block in detail. | 10 |
|---|---|---|
| b | What is redundant array storage? Explain RAID levels. | 10 |

**Q.5**
| a | Explain objectives and characteristics of modern operating system. Explain Network OS. | 10 |
|---|---|---|
| b | What is page replacement? Explain any one page replacement algorithms with example. | 10 |

| Q.6 | **Write short notes on any FOUR** | 20 |
|---|---|---|
| a | Segmentation | |
| b | Memory Allocation | |
| c | Deadlock avoidance | |
| d | Network OS | |
| e | Memory fragmentation | |
| f | Cache memory | |

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