Time: 3 hours **Max. Marks: 80**

N.B. (1) Question one is Compulsory.
(2) Attempt any 3 questions out of the remaining.
(3) Assume suitable data if required.

Q. 1

a) Consider a knapsack with a capacity of W = 50. There are 4 items with the following weights and profits: (P1, P2, P3, P4) = (60, 100, 120, 80) and weights (w1, w2, w3, w4) = (10, 20, 30, 40). Find the maximum profit and optimal using greedy method. **(05)**

b) Write algorithm for binary search and explain its working with an example. **(05)**

c) Explain how Graph coloring problem can be solved with backtracking using suitable example. **(05)**

d) Solve the following recurrence relations using Master's method. **(05)**

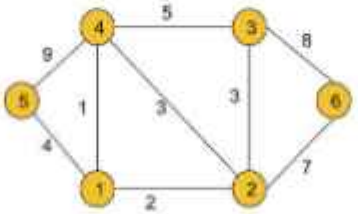
i. $T(n) = 4T(n/2) + n^2$

ii. $T(n) = 16T(n/4) + n$

Q. 2

a) What is an N-Queen problem? Give an algorithm to solve this problem using backtracking method. Explain its working with an example. **(10)**

b) Give step by step method to find the Minimum Spanning Tree of the given graph using Prim's Algorithm. Take vertex 1 as the root. **(10)**



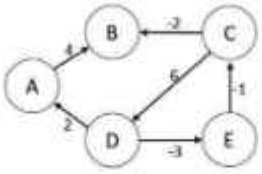
Q. 3

a) Write an algorithm for Quicksort. Derive and discuss its time complexity for all cases. Explain with an example **(10)**

b) What is the 15-puzzle problem? Explain with an example how this can be solved using Branch and Bound. **(10)**

Q. 4

a) Give an algorithm to solve the All-pairs shortest path problem using dynamic programming. What is its time complexity? Find the All-pairs shortest path for all the vertices for the following graph. **(10)**



b) Explain the KMP algorithm for string matching with a suitable example. What is the advantage of the KMP algorithm over other string-matching algorithms? **(10)**

Q. 5

a) Explain asymptotic notations in detail. **(10)**

b) Give an algorithm to find Longest Common Subsequence between two sequences using Dynamic Programming. Also, find the LCS for the following strings: X = "AMERICA" **(10)**

Y = "ARMENIA"

Q. 6

a) What is assembly line scheduling? Explain its solution using dynamic programming **(10)**

b) Write detailed notes on P, NP, NP-Hard and NP-Complete class of problems. **(10)**

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Duration: 3 Hours **[Max Marks:80]**

N.B.: (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1		**Solve any two out of three questions.**	**[20]**
	A	What is DDL and DML commands. Write syntax and examples for DDL and DML commands.	**[10]**
	B	Discuss with suitable example Extended E-R features Specialization, Generalization and aggregation.	**[10]**
	C	Explain any five relational algebra operators with suitable example.	**[10]**
2	A	Explain different types of users for database system and explain responsibilities of DBA.	**[10]**
	B	What is Normalization. Explain 1 NF,2 NF,3NF with suitable example.	**[10]**
3	A	i) Explain ACID properties of transaction. ii) In a Hospital Management System there are many departments and many patients. Doctors work in various departments and treat multiple patients. Patients undergo multiple tests, and each test is conducted by lab technicians under a specific department. Consider the above scenario and draw an E-R diagram. (Represent proper cardinalities)	**[10]**
	B	Explain types of joins with suitable example.	**[10]**
4	A	Define trigger. Explain syntax of trigger with suitable example.	**[10]**
	B	Discuss 2PL with its types	**[10]**
5	A	I) Write the SQL expression for the following. customer(cust_id, cname, caddress, ph_no, balance) i) Find the names of customers whose name starts with the letter 'A'. ii) Add one record with the values (105, 'Rakhi', 'Malad', 9826756045, 3400). iii) Remove the data of the customer whose name is 'Abhay' and phone number is 8890654312. iv) Find the total number of customers. II) Define view. Write syntax of creation of view considering suitable example.	**[10]**
	B	Explain conflict serializability with suitable example.	**[10]**
6	A	Write a note on Time stamp ordering protocol.	**[10]**
	B	Explain deadlock handling.	**[10]**

(03 HOURS) **(MAX. MARKS : 80)**

Note:

1. Question **No. 1** is compulsory.
2. Attempt **any three** questions out of remaining **five** questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

Q.1 Answer the following **(Any four)** **Marks**

a. If $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ Find the characteristic roots of $A^3 + I$. **05**

b. Evaluate $\int f(z)\,dz$ along the parabola $y = 2x^2$ from $z = 0$ to $z = 3 + 18i$ Where $f(z) = x^2 - 2iy$. **05**

c. Determine all basic solutions and optimal basic feasible solution to the following problem. **05**

Max. $z = x_1 + 3x_2 + 3x_3$

Subject to $x_1 + 2x_2 + 3x_3 = 4$,

$2x_1 + 3x_2 + 5x_3 = 7$,

$x_1, x_2, x_3 \geq 0$.

d. Find the z-transform of $f(k) = 3^k$, $k \geq 0$. **05**

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

b. The heights of six randomly chosen sailors are in inches: 63, 65, 68, 69, 71 and 72. The heights of ten randomly chosen soldiers are: 61, 62, 65, 66, 69, 69, 70, 71, 72, and 73. discuss in the light that these data throw on the suggestion that the soldiers on an average are taller than sailors. **06**

c. Use the dual simplex method to solve the L.P.P. **08**

Maximize $z = -3x_1 - 2x_2$

Subject to $x_1 + x_2 \geq 1$;

$x_1 + x_2 \leq 7$;

$x_1 + 2x_2 \geq 10$;

$0x_1 + x_2 \leq 3$;

$x_1, x_2 \geq 0$

Q.3 a. Find the relative maximum or minimum of the function $Z = x_1^2 + x_2^2 + x_3^2 - 8x_1 - 10x_2 - 12x_3 + 100$.. **06**

b. If $f(k) = 4^k U(K)$ and $g(k) = 5^k U(k)$, then find the Z-transform of $\{f(k) * g(k)\}$. **06**

c. Find all possible Laurents expansion of $f(z) = \frac{z}{(z-1)(z-2)}$ about $z = -2$. **08**

Q.4 a. Verify Cayley-Hamilton theorem for the matrix A and hence find the matrix represented by **06**

by $A^6 - 6A^5 + 9A^4 + 4A^3 - 12A^2 + 2A - I$ where $A = \begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$.

b. In a survey of 200 boys of which 75 were intelligent ,40 had educated fathers, while 90 of the unintelligent boys had uneducated fathers. Do these figures support the hypothesis that educated fathers have intelligent boys. **06**

c. Using the Kuhn –Tucker conditions to solve the N.L.P.P **08**

Maximize $z = 8x_1 + 10x_2 - x_1^2 - x_2^2$

Subject to $3x_1 + 2x_2 \leq 6;$

$x_1, x_2 \geq 0$

Q.5 a. Evaluate $\oint \frac{3z^2+z}{z^2-1}$ dz using Cauchy's residue theorem, **06**

where C is the circle $|z| = 2$.

b. Using the method of Lagrange's multiplier solve the N.L.P. **06**

Optimize $z = 10x_1 + 8x_2 + 6x_3 + 2x_1^2 + x_2^2 + 3x_3^2 - 100.$

Subject to $x_1 + x_2 + x_3 = 20.$

$x_1, x_2, x_3 \geq 0.$

c. The marks obtained by 1000 students in an examination are found to be normally **08**

Distributed with mean 70 and s. d. 5. Estimate the number of students whose marks Will be (i) between 60 and 75 (ii) more than 75.

Q.6 a. Find the inverse z- transform of $F(z) = \frac{1}{(z-3)(z-2)}$ if ROC is $2 < |z| < 3$. **06**

b. Show that the matrix $A = \begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$ is diagonalisable. find the diagonal form D and diagonalizing matrix M. **06**

c. Solve the L.P.P by simplex method. **08**

Maximize $z = 4x_1 + 3x_2 + 6x_3$

Subject to $2x_1 + 3x_2 + 2x_3 \leq 440;$

$4x_1 + 0x_2 + 3x_3 \leq 470;$

$2x_1 + 5x_2 + 0x_3 \leq 430;$

$x_1, x_2, x_3, \geq 0.$

Duration: 3hrs **[Max Marks:80]**

Q.1 (a) Design 8086 microprocessor-based on following Specifications: 10
1. MP 8086 working at 8MHz minimum mode.
2. 64 KB EPROM using 32 KB Devices
3. 64 KB SRAM using 16KB device

(b) Explain Addressing modes of 8086 microprocessor. Explain Programming Model of 8086. 10

Q.2 (a) Explain the Initialization command words (ICWs) and Operational command words(OCWs) of the 8259 PIC. 10

(b) Explain the interrupt structure of the 8086 processor(IVT) and differentiate between Hardware and Software interrupts 10

Q.3 (a) Comparison 80386 ,Pentium 1 ,Pentium 2 and Pentium 3 Processor 10

(b) Write an assembly language program for searching a Character in a Given String.(Consider your own String) and Explain the following instructions: LODSB, NOP,,RCR,CLR related to 8086. 10

Q.4 (a) List the features of Pentium 4 processor. Explain Net burst microarchitecture. 10

(b) Explain MESI Protocol 10

Q.5 (a) Draw and explain architecture of 8086. 10

(b) Differentiate between real Mode , Virtual Mode and Protected Mode of 80386 Processor .Explain the Floating point Pipeline of Pentium Processor 10

Q.6 (a) Explain Modes of 8259. 10

(b) Write an ALP for 8086 to transfer the block of data. 10

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Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

Q. 1 Attempt any FOUR [20]

a Explain the types of Multiprocessor Systems [5]

b Differentiate between context switching and interrupt handling [5]

c A counting semaphore S is initialized to 10. Then, 6 P operations and 4 V operations are performed on S. What is the final value of S? [5]

d Calculate the effective memory access time in nanoseconds if the hit ratio to a TLB is 80%, and it takes 15 nanoseconds to search the TLB, and 150 nanoseconds to access the main memory. [5]

e What is file? Explain File attributes [5]

Q. 2 a Explain Producer Consumer Problem with solution using Semaphore [10]

b Explain one system call of each type of system calls with an example [10]

Q. 3 a Draw a Gantt Chart and Calculate average waiting time and average turnaround time for FCFS, Pre-emptive Priority, SJF Pre-emptive and Round Robin algorithm (Time Quantum=2) for the following set of processes with arrival time (in milliseconds) and CPU burst time (in milliseconds). [10]

Process	Arrival Time	Burst Time	Priority
P1	3	2	1
P2	1	1	2
P3	3	3	0
P4	4	5	3
P5	5	4	4

b Consider the following snapshot of a system. [10]

Processes	Allocation		
	A	B	C
P0	0	1	0
P1	2	0	0
P2	3	0	3
P3	2	1	1
P4	0	0	2

Request		
A	B	C
0	0	0
2	0	2
0	0	0
1	0	0
0	0	2

Available		
A	B	C
0	0	0

Answer the following questions using the Deadlock Detection algorithm:

i. Check if the system is in a safe state? If Yes find out safe sequence state 5

ii. If a request from process P2 arrives for (0,0,1), can the request be granted immediately? 3

iii. Determine the total instances of each type of resource. 2

Q. 4	a	Explain Belady's Anomaly with an example and how to solve it. Calculate Hit Ratio and Miss Ratio for the page replacement policy of LRU's Counter implementation method and LRU's Stack implementation method for given reference string 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1. Assuming three frame size for counter method and Five frame size for Stack method.	[10]
	b	Explain Disk scheduling criteria with example	[10]
Q. 5	a	Explain steps for handling page fault in virtual memory.	[10]
	b	Explain the Five state process model with two suspended state	[10]
Q. 6		Write short notes on Following	[20]
	a	Multithreading Models	[5]
	b	Resource Allocation Graph	[5]
	c	File Allocation Methods	[5]
	d	Virtual Memory Paging Vs Virtual Memory Segmentation	[5]