

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ CSE/PEC-CS501D/ 2023-24
2023
Operation Research

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions

1. What do you mean by degeneracy in Transportation problem?
2. What is surplus variable?
3. What do you mean by dummy activity in a network?
4. What do you mean by unbalanced assignment problem? How will you solve the problem?
5. Explain dominance principle with an example

5x2=10

2

2

2

2

2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions

6. i) Use the graphical method to solve the following Linear programming problem
 Maximize $Z = 15x_1 + 10x_2$
 Subject to constraints

4x15 = 60

8

$$4x_1 + 6x_2 \leq 360$$

$$3x_1 \leq 180$$

$$5x_2 \leq 200$$

$$x_1, x_2 \geq 0$$

- ii) What do you mean by no feasible solution and unbounded solution when a LPP is solved using graphical method? Are they same?
- iii) Write the standard form of the following LPP
 Maximize $Z = 5x_1 + 3x_2$
 Subject to constraints

$$x_1 + x_2 \leq 2$$

$$5x_1 + 2x_2 \leq 10$$

$$3x_1 + 8x_2 \leq 12$$

$$x_1, x_2 \geq 0$$

7. i)

Solve the given transportation table using VAM and test whether the solution is optimal or not. If it is not optimal then find out the optimal solution

(5+7)

	1	2	3	4	Availability
A	21	16	25	13	11
B	17	18	14	23	13
C	32	17	18	41	19
Requirement	6	10	12	15	

- ii) Explain allocations in independent position in transportation problem

3

8. i) Use simplex method to solve the following LPP

$$\text{Maximize } Z = x_1 + x_2 + 3x_3$$

Subject to constraints

$$3x_1 + 2x_2 + x_3 \leq 3$$

$$2x_1 + x_2 + 2x_3 \leq 2$$

$$3x_1 + 8x_2 \leq 12$$

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

- ii) Following Payoff Matrix is given

Player A	Player B			
	B1	B2	B3	B4
A1	-2	0	0	5
A2	4	2	1	3
A3	-4	-3	0	-2
A4	5	3	-4	2

Determine the best strategies and also the value of the game. Is this game (i) fair (ii) strictly determinable?

9. i)

Tasks A,B,.....H,I constitute a project. The notation $X < Y$ means that the task must be completed before Y is started. With the notation

$A < D, A < E, B < F, D < F, C < G, C < H, F < I, G < I$

Completion time of each task is given below

Task	A	B	C	D	E	F	G	H	I
Time(days)	8	10	8	10	16	17	18	14	9

Draw the network diagram and find the minimum time of completion of the project. Also calculate total float of each non critical activity

- ii) State the similarities and distinction between PERT and CPM

10. i) Using the following cost matrix, determine (a) optimal job assignment (b) the cost of assignments

Mechanic		JOB				
		1	2	3	4	5
	A	20	15	18	20	25
	B	18	20	12	14	15
	C	21	23	25	27	25
	D	17	18	21	23	20
	E	18	18	16	19	20

- ii) Solve the following 2x2 game

Player A	Player B	
	2	5
	7	3

11. i) Use Big 'M' method to solve the following problem

$$\text{Maximize } z = -4x_1 - 3x_2$$

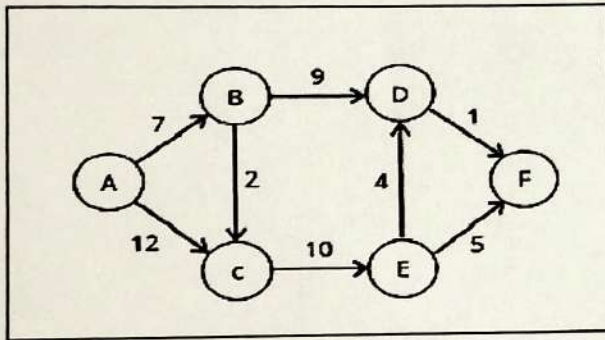
subject to the constraints :

$$2x_1 + x_2 \geq 10, \quad -3x_1 + 2x_2 \leq 6$$

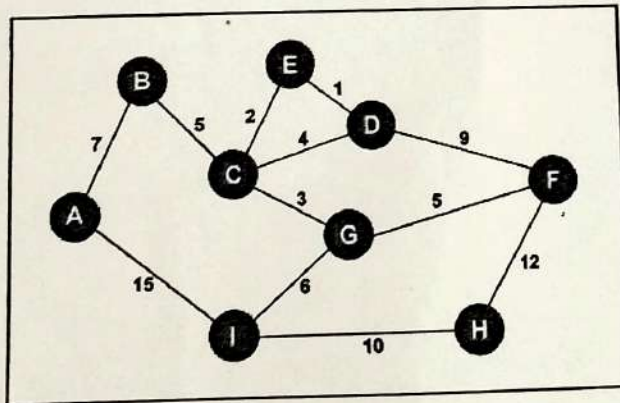
$$x_1 + x_2 \geq 6, \quad x_1 \geq 0 \text{ and } x_2 \geq 0.$$

- ii) Describe Kendall's notation for representing Queuing models? Which model is called Birth and Death Model? How do you measure expected (average) queue length in a queuing system 4+1+1

12. i) Using Dijkstra's algorithm find the length of the shortest path from source A to each vertex 7



- ii) Find the minimum spanning tree calculate its duration using Prim's algorithm 6



- iii) Differentiate between Prim's and Kruskal's algorithm 2

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ CSE/ PCC-CS502/ 2023-24
2023
DISCRETE MATHEMATICS

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer **all** questions

1. If $A \cup B = A \cup C$ and $A \cap B = A \cap C$ for subsets A, B, C of a Universal Set S , Prove that $B = C$. 5x2=10
2. Show that $A \times B \neq B \times A$, when A and B are non empty sets unless $A = B$.
3. State the Konigsberg's seven bridge problem with suitable diagram.
4. Show that $p \rightarrow q$ and $\neg p \vee q$ are logically equivalent.
5. Find $f \circ g$ where $f: Z \rightarrow Z$ is defined by $f(n) = n^2, n \in Z$ and $g: Z \rightarrow Z$ is defined by $g(n) = 2n, n \in Z$

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any **four** questions

6. i) Construct the truth table of the following compound proposition $p \oplus (p \vee q)$ 4x15 = 60
3
 ii) Define partial order relation and Poset with suitable examples. 4
 iii) Find $f \cdot g, g \cdot f, f^{-1}$ and g^{-1} where 8

$$f = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 4 & 3 & 5 & 6 & 1 \end{pmatrix}, g = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 6 & 4 & 5 & 3 & 2 \end{pmatrix}$$

7.

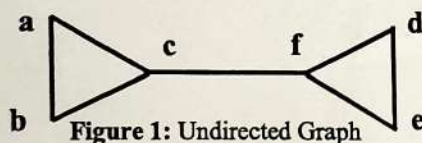


Figure 1: Undirected Graph

- i) Does the graph in the above Figure 1 has a Hamilton path? If so, find such a path. If it does not, give an argument to show why no such path exists. 5
- ii) Use mathematical induction to prove that $n^3 - n$ is divisible by 3 whenever n is a positive integer. 5
- iii) Define relation, binary relation, and equivalence relation with suitable examples. 5
8. i) A relation ρ is defined on the set Z by $a \rho b$ if and only if $ab > 0$, for $a, b \in Z$. Examine if ρ is reflexive, symmetric, iii) transitive. 5
 ii) Define complete bipartite graph. Draw $K_{2,6}$ and prove that $K_{2,6}$ is complete bipartite graph. 5
 iii) Find the solution to the following recursive relation 5

$$a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$$
 with initial conditions $a_0 = 2, a_1 = 5$, and $a_2 = 15$.
 9. i) Let S be the set of all possible divisors of 30. Define a relation \leq on S by $x \leq y$ if and only if x is a divisor of y , for $x, y \in S$. Prove that (S, \leq) is a Poset. Draw the covering diagram of the Poset. 6
 ii) Show that the given mapping f is bijection. Determine f^{-1} . 6

$$f: R \rightarrow R \text{ defined by } f(x) = 2x + 3, x \in R.$$

 iii) Define principle of mathematical induction and recursively defined function. 3

P.T.O.

10. i) Define a binary composition \circ on Z by $a \circ b = a + b + ab, \forall a, b \in Z$.
Examine if (Z, \circ) is a group or not. 6
- ii) Define injective, surjective, and bijective mapping with examples. 6
- iii) Define Boolean algebra. 3

11.

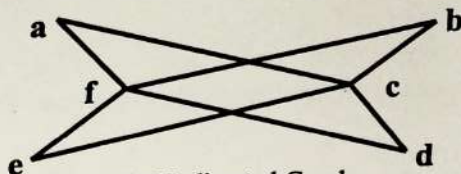


Figure 2: Undirected Graph

- i) Examine whether the given graph (Figure 2) is bipartite graph or not using a theorem that states: A simple graph is bipartite if and only if it is possible to assign one of two different colors to each vertex of the graph so that no two adjacent vertices are assigned the same color. 5
- ii) Find all solutions of the recursive relation $a_n = 2a_{n-1} + 3^n$ 6
- iii) Suppose that $A \times B = \emptyset$, where A and B are sets, what can you conclude? 4
12. i) Define group, ring, and field with suitable examples. 6
- ii) Prove that the set of matrices $\left\{ \begin{pmatrix} a & b \\ 3b & a \end{pmatrix} : a, b \in Q \right\}$ forms a field under matrix addition and matrix multiplication. 6
- iii) Define subgraph of a graph, and union of two simple graphs. 3

Jalpaiguri Govt. Engg. College
(A Govt. Autonomous College)
COE/B.Tech./CSE/PCC-CS504/2023-24
2023
OPERATING SYSTEM

FM: 70

Time Allotted: 3 hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group – A

[Objective Type Questions]

5 X 2 = 10

Answer all questions

1. In RAID level 2 if the no. of data disk is 6 then how many extra disks are required to provide reliability.
2. What are overlays?
3. Describe the system state when time quantum is zero in Round Robin scheduling.
4. "Switching is pure overhead to the system"- Explain.
5. What is Belady's anomaly?

Group – B

[Long Answer Type Questions]

4 X 15 = 60

Answer any four of the following

6. a. What is Process Control Block? What are the information stored here?
b. Write a C program using fork() system call that generates the Fibonacci sequence in the child process.
c. What are the purposes of process cooperation?

5+6+4
7. a. What is race condition? Explain with an example?
b. What are the requirements for solution to the critical section problem?
c. Write a solution for producer-consumer problem using semaphore. Describe all the semaphores used in the solution.

5+3+7
8. a. What are different types of address binding? Describe them.
b. "Compaction is not always possible"-Justify.
c. Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending request is: 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130
Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for the following disk scheduling algorithm?
i) SSTF
ii) SCAN

6 + 3 + 6
9. a. What is Load Balancing? In a Symmetric multiprocessing system how load balancing is done?
b. What is processor affinity?
c. Consider a logical address space of 64 pages of 1024 words each, mapped onto a physical memory of 32 frames.
i. How many bits are there in the logical address?
ii. How many bits are there in the physical address?

P.T.O

- d. A computer provides each process with 64K of address space divided into pages of 4K. A particular program has a text size of 32,768 bytes, a data size of 16,386 bytes, and a stack size of 15,870 bytes. Will this program fit in the address space? Explain.

5 + 3 + 4 + 3

10. a. Why page size is always a power of two? What is demand paging?
b. If a system uses FIFO policy for page replacement, and it has 4-page frames with no pages loaded to begin with. Also, the system first accesses 100 distinct pages in some order and then accesses the same 100 pages but now in the reverse order, then how many page faults will occur?
c. Explain the necessary and sufficient conditions for deadlock? Why are they called necessary and sufficient?

(2+3) + 4 + 6

11. a. What are the advantages of RAID level 3 over RAID level 1?
b. Consider a disk having 8 surfaces, each surface is having an outer diameter of 16 cm and inner diameter of 6 cm and inner track space is 0.2mm. There are 32 sectors in each track. If the disk addresses for reading a byte of a sector on any surface track of the disk is 27-bits
i) What is the sector size in bytes?
ii) If the disk rotates at 3600rpm, what is the effective data Transfer rate in bytes/sec?
c. Under which circumstances CPU-scheduling decisions takes place?
d. What is fragmentation? How it can be overcome?

3 + (3+3) + 2 + 4

12. a. What is thrashing and what is the cause of thrashing?
b. Explain how does working set window helps to avoid thrashing?
c. When a process has been allocated 3-page frames, none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1. Least Recently Used (LRU) page replacement policy is a practical approximation to optimal page replacement. For the above reference string, how many more page faults occur with LRU than with the optimal page replacement policy?

.....END.....

5 + 5 + 5

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CSE/ PEC-CS502C/2023-24
2023
ARTIFICIAL INTELLIGENCE

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5x2=10

Answer **all** questions

1. Define Artificial Intelligence. Write down the applications of AI.
2. Write down the characteristics of adversarial search.
3. Define Fuzzy set with example.
4. What is the difference between goal-based agent and utility-based agent?
5. Define heuristic function and write down its applications.

2
2
2
2
2

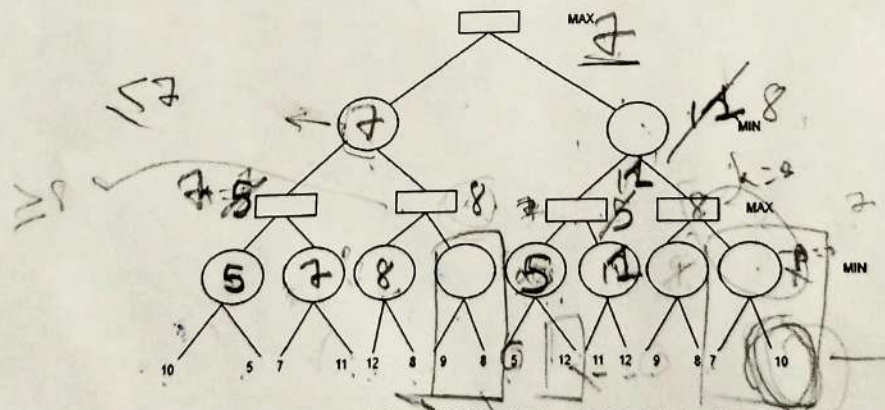
GROUP-B
[LONG ANSWER TYPE QUESTIONS]

4x15 = 60

Answer any **four** questions

6. i) What do you mean by AI Agent and Environment? Define ideal rational agent. Explain the following features of AI environment with examples: (a) Static vs Dynamic (b) Deterministic vs Stochastic (c) Single agent vs Multi agent environment
- ii) Explain Learning Agent with proper block diagram.
7. i) What is the importance of searching in AI? Explain the properties of searching algorithm. Write down the differences between uninformed search and informed search.
- ii) Write down the algorithm of Greedy Search and explain it with example.
8. i) Write down the features of optimization problem. Explain Hill Climbing Algorithm and write down its limitations.
- ii) Apply Alpha-Beta pruning algorithm for the given graph and show the pruned vertices. Calculate the best case and worst case time complexity of the algorithm.

2+1+6
6
2+2+5
6
2+(3+3)
5+2



9. i) Define Constraint Satisfaction Problem (CSP). Using CSP Solve the following cryptarithmic problem: $TO + GO = OUT$
- ii) What is reasoning? Explain the different types of reasoning with examples.
10. i) What do you mean by Learning? Compare the different types of learning techniques.
- ii) Explain the different steps of Natural Language Processing along with their difficulties.
- iii) Explain an Expert system with proper block diagram.

2+5
2+6
1+6
5
3

11. i) Write down the significance of knowledge in AI. Explain the different approaches for representing knowledge. 2+5

ii) Represent the following statements using FOPL:

2x4=8

(a) Some girls like football

(b) Anyone who loves some candy is a nutrition fanatic

(c) All children like candy

(d) Every person who buys a policy is smart

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
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JGEC/B.TECH/ CSE/ PCC-CS501/ 2023-24
2023
SOFTWARE ENGINEERING

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5x2=10

Answer *all* questions

1. What do you mean by size of a software product? How project size can be estimated?
2. Why software configuration management is crucial towards the successful completion of a project?
3. Write down the importance of SRS document.
4. Define cosmetic failure and transient failure.
5. What do you mean by system testing?

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

4x15 = 60

Answer any *four* questions

6. i) What do you mean by software life cycle model? Why it is required? Explain the different phases of classical waterfall model. Is the classical waterfall model useful at all? Give suitable reasons. Which phase consumes the maximum effort for developing a typical software product? 1+1+5+2+1
 ii) Write down the differences between prototyping model and evolutionary model. What is the significance of *phase containment of errors*? 3+2
7. i) Write down the different activities for project planning. According to Boehm, explain the different types of software product with examples. 3+3
 ii) Draw and explain the characteristic curve of Effort with respect to project size. 3
 iii) Assume the following regarding the development of a software system: 6
 - Estimated lines of code: 33,480 LOC
 - Average productivity : 620 LOC per person-month
 - Number of software developers : 6
 - Average salary of a software developer : Rs. 50,000 per month
 Calculate the estimated development effort, estimated development time and estimated development cost
8. i) Using Putnam's method show how project effort relates with development time. Write down the differences between PERT chart and Gantt chart. Compare project-based organization structure and functional-based organization structure. 3+3+3
 ii) What is software risk? Explain the different steps of risk management. 2+4
9. i) What is context diagram? Write down the limitations of DFD model. Explain balancing DFD with example. What is data dictionary why it is required? 1+2+2+3
 ii) What is independent module? Write down its importance. Explain different types of coupling with examples. 1+1+5
10. i) Write down the differences between software verification and software validation. Explain the different levels of testing and their goals. Write down the importance of code walkthrough and code inspection. 3+3+3
 ii) Define McCabe's cyclomatic complexity. Write a C function to calculate the gcd of two integers using while loop and find the value of McCabe's cyclomatic complexity. 2+4
11. i) What do you mean by software maintenance? Explain the different types software maintenance. 1+3
 ii) What do you mean by reliability of a software product? Explain the following reliability metrics: 2+6

MTTF, ROCOF, MTBF

iii) How we can define the quality of a software product? Write down the different factors of software quality. 1+2

3x5=15

12. Write short note on any *three*

1. Data Flow-based Testing
 2. Project scheduling
 3. UML diagrams
 4. Integration Testing
 5. SEI CMM
-

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CSE/PCC-CS503/2023-24
2023

DATABASE MANAGEMENT SYSTEMS

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer all questions

5x2=10

1. What is system log in recovery system and what are the various entries that are inserted into that log?
2. What is physical data independence? Give example.
3. What is data mining?
4. What is foreign key? Give one Example.
5. With an example describe ternary relationship in ER diagram.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any four questions

4x15=60
6x2.5

6. Consider the following relations where primary key is underlined in every relation.
Employee (EmpId, Ename, LivingCity)
WorksIn(EmpId, CompId, Salary, JoinDate)
Company (CompId, LocationCity, CompName,).

Express the following queries as specified.

- a) Create the Table WorksIn with a primary key and two foreign keys. (SQL)
- b) Give the names of employees living in the same city where their company is located. (SQL)
- c) Make a list of names of employees working in the same company where 'Ratul Pal' is working. (Relational algebra)
- d) List Employee Ids living in the city 'Kolkata' but the company in which he/she works does not have any branch in 'Kolkata'. (Relational algebra)
- e) List all the person's name, living city with salary who joined 'TCS' before 5th September, 2020. (Relational algebra)
- f) Find those companies whose employees earn a higher salary, on average, than the average salary at 'CTS'. (Relational algebra)

7.
 - i) Explain 3 schema architecture with example and diagram. 4
 - ii) Discuss the conversion rules that are followed when an ER diagram is converted to a collection of tables. 5
 - iii) Construct an ER diagram for a vehicle insurance company. The diagram should contain at least 5 entities, type and proper cardinality of each relationship should be clearly shown. 6
8.
 - i) What is meant by the statement "Armstrong's axioms are sound and complete". 3
 - ii) Find a canonical cover of the following Functional Dependency Set, $F = \{A \rightarrow BC, B \rightarrow C, AB \rightarrow C\}$ 5
 - iii) Consider the following relation and functional dependency set.
 $R(ABCDEFGH)$
 $F = \{ABC \rightarrow DE, E \rightarrow BCG, F \rightarrow AH\}$ 7
Decompose the relation into 3NF using dependency preserving, lossless decomposition algorithm (Synthesis algorithm). Consider that the given functional dependency set, F is itself a minimal/canonical cover.

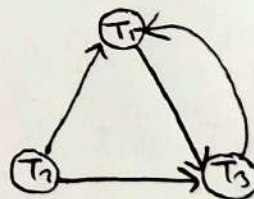
9.
 - i) Prove union, decomposition and pseudo transitivity rule using only Armstrong's 3 inference rules. 5

- ii) Show that two functional dependency sets E and F are equivalent, where $E = \{A \rightarrow C, C \rightarrow B, B \rightarrow A\}$ and $F = \{A \rightarrow C, B \rightarrow C, C \rightarrow AB\}$. 5
- iii) Let a relation be R (Student, Subject, Private_Tutor) with two functional dependencies $\{ \text{Student, Subject} \} \rightarrow \text{Private_Tutor}$ and $\text{Private_Tutor} \rightarrow \text{Subject}$. 5

Find a lossless join decomposition of R and explain why it is lossless.

10. i) Consider the following relation S(EFGH) with functional dependencies $\{EG \rightarrow H, E \rightarrow F\}$. Decompose S into 2NF, BCNF with explanation. 5
- ii) Give the condition of lossless join decomposition and explain it with an example. 5
- iii) What are the roles of the Analysis, Redo and Undo phases in the recovery algorithm 'ARIES'? 5
11. i) What is checkpoint and describe log-based recovery mechanism with example. 4
- ii) Describe two phase locking protocol with suitable example. Justify How 2 Phase locking protocol is guaranteed to maintain conflict serializability. 5
- iii) Describe Wait-Die and Wound-Wait deadlock prevention scheme. Prove that both of the methods avoid starvation. Which method has fewer rollbacks and why? 6
12. i) Draw the state diagram of a transaction and clearly explain what events trigger the transaction to change from one state to other. 4
- ii) Consider the following Schedule. 5

T1	T2	T3
R(A)		
	R(A)	
		W(A)
W(A)		



Check whether the given schedule is conflict serializable or not.

- iii) Explain recoverable schedule, cascade less schedule and conflict serializable schedule with examples. 6