VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

REG.NO.: 24MI0027

SLOT: B1

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

Programme Name & Branch	: M. Tech Integrated (MIC and MID)
Course Code and Course Name	: CSI1001 - Principles of Database Systems
Faculty Name(s)	: DIVIYA M, HARINI N, SUDHAKAR P, NAGESHWAR RAO RAGI
Class Number(s)	: 1640, 1634, 1637, 2027
Date of Examination	: 06/10/2025
Exam Duration	: **90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
  Course Outcomes:
  3. Analyze and improve a database design by normalization.
  5. Analyze the basics of query evaluation and heuristic query optimization techniques.

Q. No	Question	Module	Marks	CO	BL
1.	Consider the following relation: ENROLL (StudentID, StudentName, Program, Courses = {(CourseCode, CourseTitle, Credits)}, Advisors = {(AdvisorID, AdvisorName)}) Sample Tuples: (S101, "Kavya Nair", "B.Tech-CS", Courses = {(CS201,"DSA",4), (CS235,"DBMS",3)}, Advisors = {(A11,"Dr. Rao"), (A18,"Dr. Mehta")}) (S114, "Rahul Sen", "B.Tech-IT", Courses = {(IT210,"Networks",3)}, Advisors = {(A18,"Dr. Mehta")}) (S127, "Mira Shah", "B.Tech-CS", Courses = {(CS235,"DBMS",3), (CS260,"OS",4)}, Advisors = {(A11,"Dr. Rao")}) Functional Dependencies: StudentID → StudentName, Program CourseCode → CourseTitle, Credits AdvisorID → AdvisorName (i)Normalize the relation so that it satisfies Boyce-Codd Normal Form (BCNF). (ii)Identify the candidate keys at each stage and verify whether the decomposition is lossless.	3	10	3	3
2.	a) Given a relational schema R (W, X, Y, Z) and two sets of functional dependencies: P = {W → X, WX → Y, Z → WY} Q = {W → XY, Z → WX} Check whether P and Q are equivalent. Justify your answer.	3	5	3	2
	b) Let G = {A → BCD, BC → AD, D → E, E → AF} be a set of functional dependencies. Find the minimal cover of G.	3	5		
3.	a) Consider the following relational algebra expression over schema: Student (sid, sname, major, dept_id)	4	6	5	3

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	Enroll (sid, cid, grade) Course (cid, cname, credits, dept_id) Dept (dept_id, dname, campus) Expression: πsid,sname(σmajor='AI'∧ grade∈{'A','S'} ∧ credits≥4 ∧ campus= 'South'(Student×Enroll×Course×Dept)) Construct the initial query tree for the given relational algebra expression. Then, by applying heuristic optimization techniques, transform it step by step into an optimized query tree.				
	b) Translate the following SQL query into extended relational algebra expressions for each query block, and draw the corresponding query tree: SELECT sname FROM Student WHERE sid IN (SELECT e.sid FROM Enroll e, Course c WHERE e.cid = c.cid AND c.credits >= 4);	4	4		
4.	Transactions: T1: $r_1(A)$; $w_1(B)$; $r_1(C)$; $w_1(C)$ T2: $r_2(B)$; $w_2(A)$; $r_2(C)$; $w_2(C)$ T3: $r_3(A)$; $r_3(B)$; $w_3(B)$ Schedules: S1: $r_1(A)$; $r_3(A)$; $r_2(B)$; $w_1(B)$; $r_3(B)$; $w_3(B)$; $r_2(C)$; $w_2(A)$; $r_1(C)$; $w_1(C)$; $w_2(C)$ S2: $r_3(A)$; $r_1(A)$; $r_2(B)$; $r_3(B)$; $w_2(A)$; $w_1(B)$; $r_2(C)$; $r_1(C)$; $w_3(B)$; $w_2(C)$; $w_1(C)$ For each schedule S1 and S2, construct the precedence (conflict) graph to determine conflict-serializability (state an equivalent serial order if serializable, otherwise justify why not) and determine whether it is recoverable with a brief justification referencing the relevant conflicting reads/writes and the commit order.	4	10	5	3
5.	a) Build the S/X lock compatibility matrix and, for the request sequence below on item A, indicate at each step whether the lock is granted or blocked and state if the overall schedule is allowed: T1: lock-S(A) T2: lock-X(A) T3: lock-S(A) T1: unlock(A) Re-evaluate pending requests in queue order.	4	4	5	3
	b) Three transactions interact with items A, B, and C under 2PL: T1 holds X(A) and requests S(B) T2 holds X(B) and requests X(C) T3 holds S(C) and requests X(A) Construct the wait-for graph, determine whether a deadlock exists, and if so, identify the cycle in the graph.	4	6		

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