



VIT

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

REG.NO.:

SLOT: B2+TB2

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

Programme Name & Branch : B.Tech – CSE and Specializations
Course Code and Course Name : BCSE302L & Database Systems
Faculty Name(s) : Applicable to all B2 slots
Class Number(s) : VL2025260101386, 1326, 1349, 1360, 1379, 1344, 1377
 1389, 1335, 1383, 1370, 1330, 1366, 1353, 1402, 1374
 1406, 1372
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 (Type the CO statements covered in this question paper. Use the CO number as per the syllabus copy)
 CO2 - Develop a database project depending on the business requirements, considering various design issues.
 CO3 - List the concepts of indexing and accessing methods.
 CO4 -Explain the concept of a database transaction processing and comprehend the concept of database facilities including concurrency control, backup and recovery.

Q. No	Question	Module	Marks	CO	BL
1.	<p>a) Determine if the relations below are in BCNF. If the relation is not in BCNF, decompose it into BCNF relations. (5 marks)</p> <p>R2(A,B,C,D,E) with functional dependencies $D \rightarrow B$, $CE \rightarrow A$, $A \rightarrow E$.</p> <p>Ans: Key : {CDE} 2NF – R2a(B,<u>D</u>) , R2b(A,<u>C</u>,<u>E</u>), R2c(<u>C</u>,<u>D</u>,<u>E</u>) R2a, R2b & R2c are in 3NF R2b – Not in BCNF R2b1(A,E), R2b2(A,C)</p> <p>b) Evaluate if the functional dependencies given below are equivalent or not equivalent. (5 marks)</p> <p>R(A,B,C,D,E,F) F1:{ A->BC, AB->D, D->EF} F2:{A->B, D-F, AB->CD, D->E }</p>	3	10	CO2	BL5



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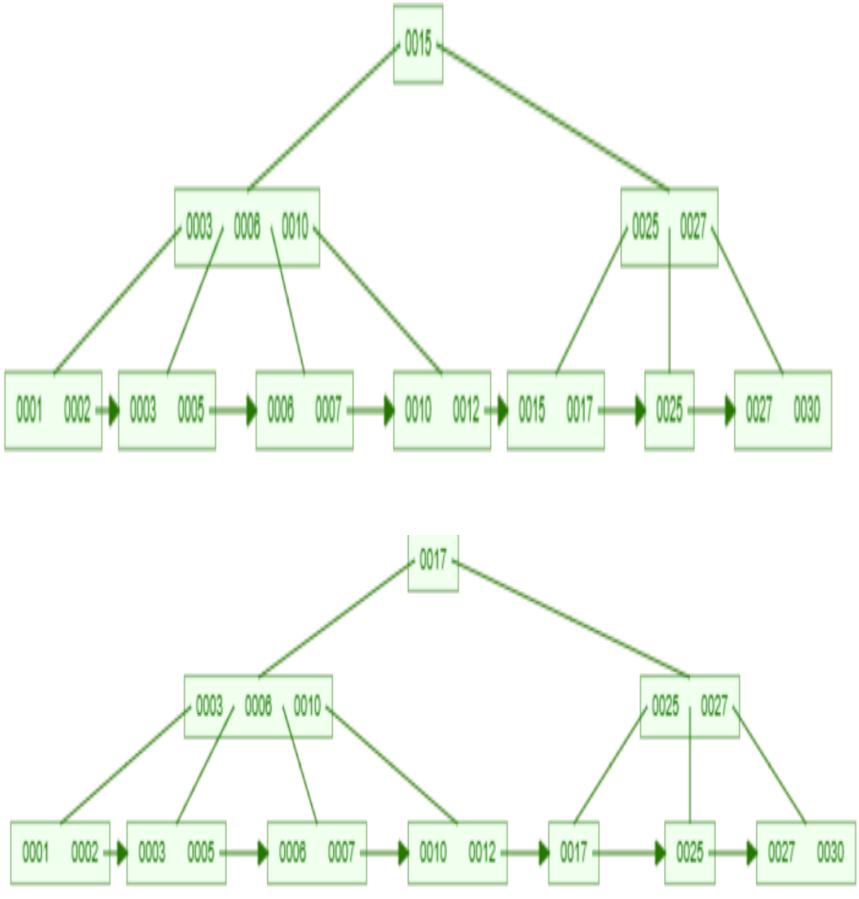
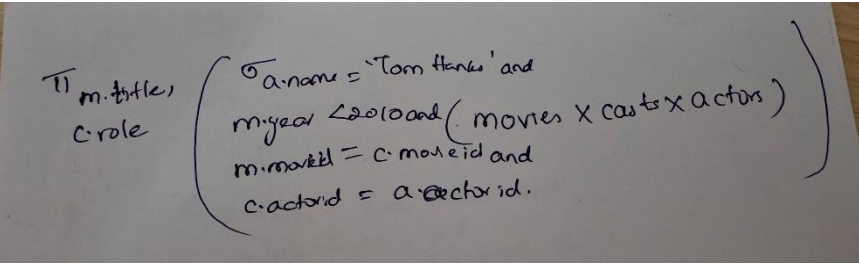
	<p>Show F1 covers F2</p> <p>$A^+ = \{A,B,C,D,E,F\}$</p> <p>$D^+ = \{D,E,F\}$</p> <p>$(AB)^+ = \{A,B,C,D,E,F\}$</p> <p>All the functional dependencies in F2 can be derived from F1. So F1 covers F2</p> <p>Show F2 covers F1</p> <p>$A^+ = \{A,B,C,D,E,F\}$</p> <p>$(AB)^+ = \{A,B,D,C,E,F\}$</p> <p>$D^+ = \{D,E,F\}$</p> <p>All the functional dependencies in F1 can be derived from F2. So F2 covers F1.</p> <p>Both F1 and F2 are equivalent.</p>				
2.	<p>For the following relations:</p> <p>Vehicles(<u>vehicle_id</u>,make, model,licence_plate,daily_rate, status)</p> <p>Branches(<u>branch_id</u>,name,address,city,phone_number)</p> <p>Renters(<u>renter_id</u>,name,email, licence_number)</p> <p>Rentals(<u>rental_id</u>, renter_id, vehicle_id, pickup_branchID, return_branchID)</p> <p>Write queries for the questions using relational algebra:</p> <p>a) List the make and model of all the vehicles manufactured in or after the year 2020.</p> <p>$\pi_{make,model}(\sigma_{Year \geq 2020}(Vehicles))$</p> <p>b) Find the average daily rate for all the vehicles.</p> <p>$G_{AVG}(daily_rate)(Vehicles)$</p> <p>c) List the name and email of all the renters who have rented a Toyota</p> <p>$\pi_{name,email}(Renters \bowtie_{renter_id} (\pi_{renter_id}(Rentals \bowtie_{vehicle_id} (\sigma_{make='Toyota'}(Vehicles))))))$</p>	4	10	CO3	BL3



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	<p>d) List the name of all the renters who have picked up a Toyota from Chennai</p> <p>$\pi_{name}(Renters \bowtie_{renter_id}(\pi_{renter_id}((Rentals \bowtie_{vehicle_id}(\sigma_{make='Toyota'}(Vehicles))) \bowtie_{pickup_branchID=branch_id}(\pi_{branch_id}(\sigma_{city='Chennai'}(Branches))))))$</p>				
<p>3.</p>	<p>Create a self-balancing hierarchical index structure of order 4 for the given list of primary keys: (5 marks)</p> <p>10, 20, 5, 6, 12, 30, 7, 17, 3, 25, 2, 8, 15</p> <p>a) Show the tree after the following values are added: 27 and 1 (2 marks)</p> <p>b) Show the tree after deletion of each of the keys: 20, 8 and 15 (3 marks)</p>	<p>4</p>	<p>10</p>	<p>CO3</p>	<p>BL3</p>

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<p>4.</p>	<p>Consider the given database schema:</p> <p>Movies(movie_id, title, year, genre) Actors(actor_id, name, dob) Casts(movie_id, actor_id, role)</p> <p>From the given relations: find the titles of movies released before the year 2010 in which actor Tom Hanks has acted, and list the roles he played in those movies.</p> <p>Using detailed steps, demonstrate how a heuristic query optimizer optimizes your query.</p> 	<p>4</p>	<p>10</p>	<p>C03</p>	<p>BL3</p>

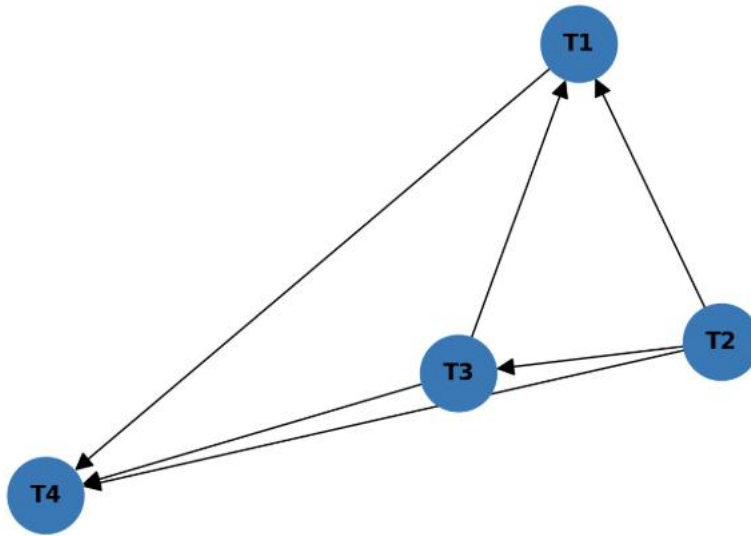


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5.	<p>Consider the following schedules for an e-commerce website. The transactions indicate the consumers performing one of the following actions: Cart Service (adding products to the cart), Purchase service, Payment service and shipping service. The schedules S1 and S2 show the different ways these transactions are interleaved. Of these schedules, identify the schedule that can be called an equivalent to a serial schedule of transactions. Explain and justify your answer.</p> <p>S1: R2(X)R3(X)W3(X)R1(X)W1(X)R2(Y)W2(Y)R2(Z)R4(Y)R4(X)</p> <p>S2-> R1(X)W1(X)R4(Z)W4(X)R2(X)R3(Y)R3(Z)W3(Z)R1(Z)W2(X)</p> <p>S1</p> <p>Conflicting Operations</p> <ul style="list-style-type: none"> T2 → T3 (from R2(X) before W3(X)) T2 → T1 (from R2(X) before W1(X)) T3 → T1 (from R3(X) / W3(X) before R1(X) / W1(X)) T3 → T4 (from W3(X) before R4(X)) T1 → T4 (from W1(X) before R4(X)) T2 → T4 (from W2(Y) before R4(Y)) <p>Precedence Graph</p>	5	10	CO4	BL3



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Example Equivalent Serial Schedule:

T2 → T3 → T1 → T4

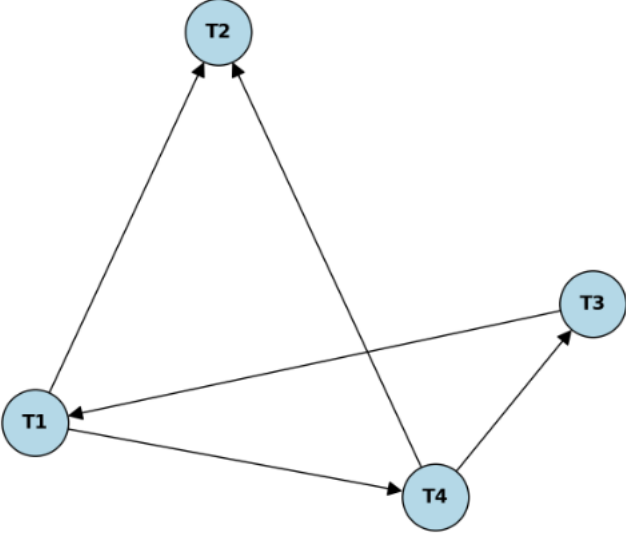
S2:

Conflicts

- W1(X) (op 2, T1) → W4(X) (op 4, T4) ⇒ edge T1 → T4 (write–write).
- W1(X) (op 2, T1) → R2(X) (op 5, T2) ⇒ edge T1 → T2 (write–read).
- W1(X) (op 2, T1) → W2(X) (op10, T2) ⇒ edge T1 → T2 (write–write)
— same edge as above.
- W4(X) (op 4, T4) → R2(X) (op 5, T2) ⇒ edge T4 → T2 (write–read).
- W4(X) (op 4, T4) → W2(X) (op10, T2) ⇒ edge T4 → T2 (write–write)
— same edge repeated.
- (R1(X) op1 before W4(X) op4 produces T1 → T4 as well — duplicate edge.)
- R4(Z) (op 3, T4) → W3(Z) (op 8, T3) ⇒ edge T4 → T3 (read–write).
- W3(Z) (op 8, T3) → R1(Z) (op 9, T1) ⇒ edge T3 → T1 (write–read).



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<p>Precedence Graph</p>  <pre>graph TD; T1((T1)) --> T2((T2)); T1 --> T4((T4)); T4 --> T2; T4 --> T3((T3)); T3 --> T1;</pre> <p>The precedence graph is cyclic. Therefore, this schedule is not conflict-serializable.</p>				
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