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

SLOT: A1

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - I
WINTER SEMESTER 2025-2026

Programme Name & Branch	: B.Tech. Computer Sci. and Engineering and Business Systems
Course Code and Course Name	: **CBS1007** - Database Systems
Faculty Name(s)	: **Dr. RAJASEKAR V R**
Class Number(s)	: VL2025260502070
Date of Examination	: **27/01/2026**
Exam Duration	: **90 minutes**

General instruction(s): **Maximum Marks: 50**

- 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

CO1: Acquire a good understanding of the architecture and functioning of database management systems.
CO2: Ability to construct an ER model and derive relational schemas from the model.
CO3: Analyse and apply the principles and practices of good database design.
CO4: Use the concepts of data normalization to analyse, measure, and evaluate the performance of a database application.

Q. No	Question	Module	Marks	CO	BL
1.	Students, faculty, and administrators use a University Academic Management System. Each user group requires different views of the same data, while the database should remain independent of changes in storage structure or user requirements. The system must: Support multiple user views, hide physical storage details from users, and maintain logical and physical data independence. To achieve this, the database designers adopt a layered DBMS architecture. **Based on the above scenario, answer the following questions.** a) Identify the DBMS architecture used in this system. b) Draw a neat diagram representing this architecture, clearly showing all levels and their relationships. c) Briefly explain the purpose of each level.	1	10	CO1	BL-1
2.	A retail e-commerce management system is being developed to manage information related to products, customers, and customer orders. The system must store details of products available for sale, registered customers, and orders placed by customers, including the quantity of each product ordered and the date of purchase. The management frequently requires analytical queries, such as identifying products that were sold more than 100 times in the previous month. **Based on the above scenario, answer the following questions:** a) Identify and design all the necessary database tables required for the e-commerce management system. Clearly specify the attributes of each table.	1	10	CO1	BL 2

2+3+1+0 = 6

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	b) Specify the primary key for each table and justify why it is appropriate. 3 → 0 c) Identify all foreign keys in the designed tables and specify the tables they reference. 2 → 1 d) Write a SQL query that would allow the system to efficiently retrieve products sold more than 100 times in a given month. 2 → 0				
3.	Design an Enhanced Entity–Relationship (EER) diagram for the following scenario. Clearly represent all relevant entities, attributes, keys, specialization/generalization, weak entities, and relationships. Assume the role of a database designer and decide the appropriate relationships, cardinalities, and participation constraints on your own, strictly based on the problem scenario. A Smart Energy Distribution & Utility Management System is proposed to manage information related to power stations, utility employees, consumers, energy connections, and energy usage reports. Each PowerStation is uniquely identified by a StationID. It stores information such as StationName and Location, and may have multiple ContactNumbers. Each UtilityEmployee is uniquely identified by an EmployeeID. The employee's Name is a composite attribute consisting of FirstName, MiddleName, and LastName. Other attributes include EmailID, DateOfBirth, an optional AlternatePhoneNumber, and a derived attribute Age, which is calculated from DateOfBirth. UtilityEmployee is modeled as a superclass entity and is specialized into two subclasses: PermanentStaff, which includes attributes Salary and JobTitle and ContractStaff, which includes attributes ContractDuration and ServiceAgency Both subclasses inherit all attributes of UtilityEmployee. Each Consumer is uniquely identified by a ConsumerID. A consumer has a Name, multiple PhoneNumbers, and a composite Address consisting of HouseNo, Street, City, State, and Pincode. Each EnergyConnection is uniquely identified by a ConnectionID. It includes attributes such as ConnectionType, InstallationDate, and LoadCapacity. UsageReport is a weak entity that is dependent on an EnergyConnection for its existence. It is identified using a partial key ReportID and has attributes BillingMonth, UnitsConsumed, and BillAmount. UsageReport is related to EnergyConnection through an identifying relationship. The system supports various interactions among power stations, employees, consumers, energy connections, and usage reports, including supervision, maintenance, assistance, supply, and reporting activities.	2	10	CO2	BL 2
4.	A University Academic & Resource Management System is being developed to manage departments, students, faculty, library resources, research projects, and student clubs. In this system, a student may simultaneously belong to an academic department, access library services, participate in multiple research projects, and join various clubs.	2	10	CO3	BL 3

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	Similarly, a faculty member may teach in multiple departments, supervise several students, and be involved in different research projects. Library resources and research projects are shared across departments. The same student record must be accessible through multiple paths, such as Department → Student, Library → Student, and Project → Student. Hence, the database must support many-to-many relationships, multiple parent records, and efficient navigation of highly interconnected data. a) Identify the most suitable database model for representing the above scenario and justify your choice. b) Write about the features of the selected model. c) Discuss the advantages of using this model. d) Mention the limitations of this model.				
5.	A University Student Information System maintains academic records using a relational database. The relation STUDENT_RECORD stores information about students, courses, instructors, and grades with the following attributes: STUDENT_RECORD(StudentID, StudentName, CourseID, Course Name, InstructorID, InstructorName, Grade). Based on the system rules, the database administrator has identified the following functional dependencies: a) *StudentID → StudentName* b) CourseID → CourseName c) InstructorID → InstructorName d) CourseID → InstructorID e) (StudentID, CourseID) → Grade Questions a) Using Armstrong's Axioms, derive additional functional dependencies from the given set by applying the rules of Reflexivity, Augmentation, and Transitivity. Clearly mention the axiom used for each derivation.	3	10	CO4	BL 4