B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous Institute, Affiliated to VTU)
Computer Science & Engineering

INTERNALS-II

Course Code: 22CS3PCDBM	**Course Title: Database Management Systems**	
Semester: 3	**Maximum Marks: 40**	**Date: 8-2-24**
Faculty Handling the Course:	Dr.MDR, Dr. Sunil, Dr. UV, Dr. KVN, RGS	

Instructions: *Internal choice is provided in Part C.*

PART A

Total 5 Marks (No Choice)

No.	**Question**	Marks
1	Provide definitions and examples for the following : i. Attributes ii. Composite Attributes iii. Weak Entities iv.Identifying Relationships v. Partial Key. Each definition = 0.5 Marks * 5 = 2.5 Marks Each Examples = .5 Marks * 5 = 2.5 Marks	**5**

PART B

Total 15 Marks (No Choice)

<table>
<tr><th>No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>2a</td><td>
Consider the following relation instance
CourseRegistrations
<table>
<tr><th>StudentID</th><th>StudentName</th><th>CourseID</th><th>CourseName</th><th>Instructor</th></tr>
<tr><td>101</td><td>Priya Gupta</td><td>CS101</td><td>Introduction to Programming</td><td>Dr. Sharma</td></tr>
<tr><td>102</td><td>Arjun Singh</td><td>CS102</td><td>Data Structures</td><td>Prof. Iyer</td></tr>
<tr><td>103</td><td>Meera Patil</td><td>CS103</td><td>Web Development</td><td>Dr. Reddy</td></tr>
<tr><td>104</td><td>Rohit Kumar</td><td>CS104</td><td>Database Systems</td><td>Prof. Banerjee</td></tr>
<tr><td>105</td><td>Anjali Rao</td><td>CS105</td><td>Machine Learning</td><td>Dr. Joshi</td></tr>
</table>

Analyze the CourseRegistration Table and identify the different update anomalies present in the table. Justify your answers.

Solution : 5 Marks

Update Anomalies:
1. Redundancy: There is redundant data concerning CourseName and Instructor. Each course's name and assigned instructor are repeated with each student's registration. If a course name or instructor changes, you would have to update multiple rows, which leads to the next anomaly.

2. Update Anomaly: If you need to change the instructor for a course (say from Dr. Sharma to Dr. Kumar for CS101), this change would have to be made in every row where CS101 appears. If the change is not made uniformly, it could lead to inconsistencies where CS101 is listed with different instructors in different rows.

3. Deletion Anomaly: If you remove the student Priya Gupta from the table because she decided not to take any course, you would also lose the information about CS101 being Introduction to Programming and taught by Dr. Sharma. There's no row left to represent this course independently of the students.
</td><td>5</td></tr>
</table>

4. Insertion Anomaly: To insert a new course into the database, you must also have a student register for the course. You cannot have a course listed in the table without having at least one student enrolled in it, which is not practical.

2b Consider the relation scheme R(A, B, C, D, E,) and the set of functional dependencies:
A → B, BC → D, E → C , D → A
Identify at least three candidate keys for R **Candidate Keys= EA, ED, EBC (5 Marks)**

5

2c Consider below tables and write the output for the following relational algebra expression

5

Instructors

InstId	**InstName**	**DeptId**
1	Sharma	D1
2	Verma	D2
3	Thakur	D3
4	Raghavan	D1

Courses

CourseId	**CourseName**	**DeptId**
C1	Database Systems	D1
C2	Machine Learning	D2
C3	Operating Systems	D3
C4	Algorithms	D1

Departments

DeptId	**DeptName**
D1	Computer Science
D2	Data Science
D3	Software Engineering

1. Π_{DeptID}(Instructors) ∩ Π_{DeptId}(Courses) **(1 Marks)**

DeptId
D1
D2
D3

2. $\Pi_{InstName}(\sigma_{DeptId \neq 'D3'}(Instructors)) - \Pi_{InstName}(\sigma_{DeptName = 'Software\ Engineering'}(Departments \bowtie Instructors)))$ (2 Marks)

InstName
Sharma
Verma

3. $((\Pi_{CourseName}(\sigma_{DeptName = 'Computer\ Science'}(Departments \bowtie Courses))) \cup (\Pi_{CourseName}(\sigma_{DeptName = 'Data\ Science'}(Departments \bowtie Courses))))$ (2 Marks)

CourseName
Database Systems
Algorithms

PART C

Total 20 Marks (Choice between question 3a & 3b, choice between question 4a & 4b)[CO3-PO3]

No.	Question	Marks

3a	**Consider a relational schema with tables representing students, companies, job postings, and applications for Student Placement Cell database.** **Student** (sID, sName, sEmail, sMajor, sCGPA) **Company** (cID, cName, cLocation, cIndustry) **Job** (cID, jID, jTitle, jDescription, jLocation, minCGPA) **Application** (sID, jID, appDate, appStatus) In this schema, sID and cID represent the identifiers for students and companies, respectively. The Job table lists the job postings by various companies, where jID is a job identifier. The Application table records the applications sent by students to the jobs they are interested in. **Write a relational algebra expression for the following (2 Marks Each)** i. List distinct Company names that are accepting applications. $\pi_{cName}(Company \bowtie_{Company.cID=Job.cID} Job \bowtie_{Job.jID=Application.jID} Application)$ ii. List Company IDs which require a minimum CGPA of 8.0 for any job posting. $\pi_{cID}(\sigma_{minCGPA\geq 8.0}(Job))$ iii. List IDs of the Companies located in "Bangalore" that have not received any applications as of "2024". $(\pi_{cID}(\sigma_{cLocation='Bangalore'}(Company))) - (\pi_{cID}(Job \bowtie_{Job.jID=Application.jID} \sigma_{YEAR(appDate)\leq 2024}(Application)))$ iv. List IDs of the students from the "Computer Science" major who have applied for jobs with the title "Software Engineer". $\pi_{sID}(\sigma_{sMajor='ComputerScience' \wedge jTitle='SoftwareEngineer'}(Student \bowtie Application \bowtie Job))$ v. List the names of students who have applied to more than three jobs. $\pi_{sName}(\sigma_{count(jID)>3}(\gamma_{sID,COUNT(jID)\rightarrow jobCount}(Application) \bowtie Student))$	**10**
	OR	

3b

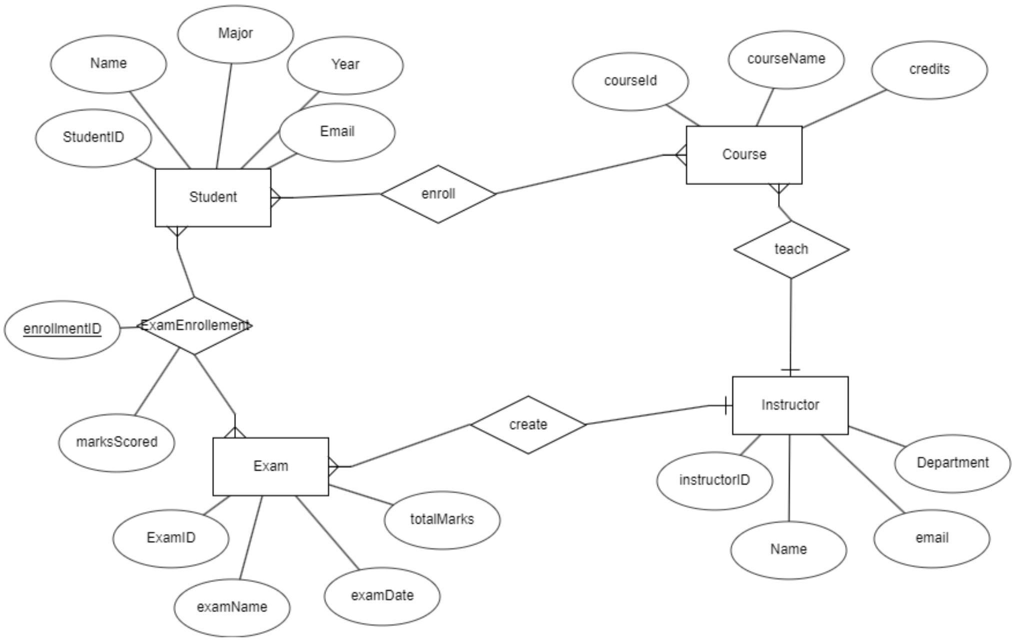
Consider a requirement for a new Student Internal Exam Conduction System at a Dept.of CSE, BMSCE. The system needs to manage information about students, courses, instructors, and the exams that students take. The Students have a unique StudentID, a Name, an Email, a Major, and a Year. Courses are uniquely identified by a CourseID and have a CourseName, an assigned Instructor, and Credits. Exams are identified by an ExamID and have an ExamName, ExamDate, and TotalMarks. Instructors have an InstructorID, a Name, an Email, and belong to a Department. ExamEnrollments are records that tie students to the exams they take and include the MarksScored.

Students can enroll in multiple courses, and a course can have multiple students. An instructor can teach multiple courses, but each course is taught by one instructor. A course can have multiple exams, but each exam is associated with only one course. A student can take multiple exams, and an exam can be taken by multiple students. An instructor can create multiple exams, but each exam is created by one instructor. Design an ER diagram that captures the above requirements. Your diagram should include the following:

1. Properly labeled entities with all relevant attributes. 5 Marks
2. Correct identification of primary keys. 2 Marks
3. Representation of all relationships, including cardinalities. 2 Marks
4. Identification of any weak entities and their supporting relationships. 1 Marks
5. Notation of any participating constraints and key constraints.

10

Solution :



1.

4a

Given a relation R(P, Q, R, S, T, U, V, W, X, Y) and Functional Dependency set FD = { PQ → R, P → ST, Q → U, U → VW, and S → XY},

a. Identify the candidate key(s) for R. **PQ (2 Marks)**

b. Identify the highest normal form that R satisfies (1NF, 2NF, 3NF). **(1 NF) (6 Marks)**

c. If R is not in 3NF, decompose it into a set of 3NF relations that preserve the dependencies. R1-> (PQR)

R2(P ST)

R3(QU)

R4(UVW)

R5(SXY)

10

OR

4b	Consider the relation ***PLAYER*** with relational schema *PLAYER (Player-no, Player-name, Team, Team-color, Coach-no, Coach-name, Player-position, Team-captain)* and set of functional dependencies as follows; ***F = {Player-no → Player-name, Player-no → Player-position, Player-no → Team, Coach-no → Coach-name, Team → Team-color, Team → Coach-no, Team → Team-captain}*** a. Identify the candidate key(s) for R. (2 Marks) Solution : **Player-no** b. Identify the highest normal form that R satisfies (1NF, 2NF, 3NF). (6 Marks for identification and justification) Solution : 2NF c. If R is not in 3NF, decompose it into a set of 3NF relations that preserve the dependencies. (2 Marks) Solution : R1(***Player-no,Player-name, Player-position,Team)*** R2(***Team*** ,***Team-color Coach-no, Team-captain)*** R3(***Coach-no*** ,***Coach-name)***	**10**