**QUESTION 1 (10 POINTS)**

Primary keys - CourseNo, Phone , Sname

The following are the Functional Dependencies (FD):

* FD1 – Transitive functional dependency

{ CourseNo} -> { CourseName }

{ CourseName } -> { CourseSection }

Therefore, { CourseNo} -> { CourseSection } should hold, this means that if we have known the CourseNo we know the Course Section too.

* FD2 – Trivial functional dependency

{ CourseNo, CourseName , CourseSection } -> { CourseNo}

Since CourseNo is a subset of { CourseNo, CourseName , CourseSection }

* FD3 – Non-trivial functional dependency

{Instructor} -> {Phone}. If we know the Instructor, we know his/her phone. But his phone is not a subset of {Instructor}.

* FD4 – Multivalued functional dependency

{ SName } -> { Level }.

{ SName } -> { Grade }.

Level and Grade are independent of each other but dependent on SName

**QUESTION 2 (41POINTS)**

Below is our table now in the first normal form:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sname | Address | Level | CourseNo | CourseSection | CourseName | Instructor | Grade | Phone |
| John Smith | Columbus, OH | GR | COMP630 | Q1 | Database | Todd | C | 1230 |
|  |  |  | COMP501 | Q1 | Python | Tim | B | 2356 |
|  |  |  | ENG500 | U1 |  | Mike | A | 5647 |
| Bryon Duncan | Columbus, OH | GR | COMP630 | Q1 | Database | Todd | C | 1230 |
| Kirby Macdonald | Dublin, OH | UG | COMP201 | R1 | Hardware | Tim | A | 2356 |
|  |  |  | ISEC200 | U1 | Cybersecurity | Todd | A | 1230 |
| Aileen Reed | Columbus, OH | GR | COMP630 | R1 | Database | U | C | 9871 |
| Sharon Rodriguez | Dayton, OH | UG | COMP204 | R1 | Network | Tim | D | 2356 |
|  |  |  | ISEC200 | U1 | Cybersecurity | Todd | A | 1230 |

Below is our table now in the second normal form:

This is achieved by removing the partial dependency from the table

RELATION-1

Primary keys (pk) - Sname

|  |  |  |
| --- | --- | --- |
| Sname | Address | Level |
| John Smith | Columbus, OH | GR |
| Bryon Duncan | Columbus, OH | GR |
| Kirby Macdonald | Dublin, OH | UG |
| Aileen Reed | Columbus, OH | GR |
| Sharon Rodriguez | Dayton, OH | UG |

RELATION-2

Foreign Keys (fk) - Grade\_ID

Primary keys (pk) - Sname and CourseNo

|  |  |  |
| --- | --- | --- |
| Sname | CourseNo | Grade\_ID |
| John Smith | COMP630 | C |
| Bryon Duncan | COMP630 | C |
| Kirby Macdonald | COMP201 | A |
| Aileen Reed | COMP630 | C |
| Sharon Rodriguez | COMP204 | D |

RELATION-3

Primary keys (pk) - Phone and CourseNo

Schema - (Phone, CourseNo, CourseSection, Instructor, CourseName)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CourseNo | CourseSection | CourseName | Instructor | Phone |
| COMP630 | Q1 | Database | Todd | 1230 |
| COMP501 | Q1 | Python | Tim | 2356 |
| ENG500 | U1 |  | Mike | 5647 |
| COMP201 | R1 | Hardware | Tim | 2356 |
| ISEC200 | U1 | Cybersecurity | Todd | 1230 |
| COMP630 | R1 | Database | U | 9871 |
| COMP204 | R1 | Network | Tim | 2356 |

Below is our table now in the third normal form:

This is achieved by removing the transitive dependency from the tables.

RELATION-0NE

Primary keys (pk) - Sname

Schema - (Sname, Address, Level)

|  |  |  |
| --- | --- | --- |
| Sname | Address | Level |
| John Smith | Columbus, OH | GR |
| Bryon Duncan | Columbus, OH | GR |
| Kirby Macdonald | Dublin, OH | UG |
| Aileen Reed | Columbus, OH | GR |
| Sharon Rodriguez | Dayton, OH | UG |

RELATION-TWO

Foreign Keys (fk) - Grade\_ID

Primary keys (pk) - Sname and CourseNo

Schema - (Sname, CourseNo, Grade\_ID)

|  |  |  |
| --- | --- | --- |
| Sname | CourseNo | Grade\_ID |
| John Smith | COMP630 | 3 |
| Bryon Duncan | COMP630 | 3 |
| Kirby Macdonald | COMP201 | 1 |
| Aileen Reed | COMP630 | 3 |
| Sharon Rodriguez | COMP204 | 4 |

RELATION-THREE

Primary keys (pk) - Phone and CourseNo

Schema - (Phone, CourseNo, CourseSection, Instructor, CourseName)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CourseNo | CourseSection | CourseName | Instructor | Phone |
| COMP630 | Q1 | Database | Todd | 1230 |
| COMP501 | Q1 | Python | Tim | 2356 |
| ENG500 | U1 |  | Mike | 5647 |
| COMP201 | R1 | Hardware | Tim | 2356 |
| ISEC200 | U1 | Cybersecurity | Todd | 1230 |
| COMP630 | R1 | Database | U | 9871 |
| COMP204 | R1 | Network | Tim | 2356 |

RELATION-FOUR

Primary keys (pk) - Grade\_ID

Schema - (Grade\_ID, Grade)

|  |  |
| --- | --- |
| Grade\_ID | Grade |
| 3 | C |
| 1 | A |
| 2 | B |
| 4 | D |

# QUESTION 3

## SQL CODE FOR DATABASE SCHEMA CREATION

CREATE TABLE RELATION-0NE (

Sname varchar(255) NOT NULL,

Address varchar(255),

Level varchar(255),

PRIMARY KEY (`Sname`),

);

CREATE TABLE RELATION-THREE (

CourseNo varchar(255),

CourseSection varchar(255),

CourseName

varchar(255),

Instructor

varchar(255),

Phone

varchar(255),

PRIMARY KEY (`Phone`, `CourseNo`),

);

CREATE TABLE RELATION-FOUR (

Grade\_ID INT,

Grade varchar(255),

PRIMARY KEY (`Grade\_ID`)

);

CREATE TABLE RELATION-TWO (

Sname varchar(255) NOT NULL,

CourseNo varchar(255) NOT NULL,

Grade\_ID varchar(255) NOT NULL,

PRIMARY KEY (`Sname`, `CourseNo`),

FOREIGN KEY (Grade\_ID)

REFERENCES RELATION-FOUR(Grade\_ID)

ON DELETE CASCADE

);

## SQL CODE INSERTION

INSERT INTO RELATION-FOUR VALUES(1,”A”);

INSERT INTO RELATION-FOUR VALUES(2,”B”);

INSERT INTO RELATION-FOUR VALUES(3,”C”);

INSERT INTO RELATION-FOUR VALUES(4,”D”);

INSERT INTO RELATION-ONE VALUES(”John Smith”, “Columbus”, OH”, “GR”);

INSERT INTO RELATION-ONE VALUES(”Bryon Duncan”, “Columbus”, OH”, “GR”);

INSERT INTO RELATION-ONE VALUES(”Kirby Macdonald”, “Dublin”, OH”, “UG”);

INSERT INTO RELATION-ONE VALUES(”Ailien Reed”, “Columbus”, OH”, “GR”);

INSERT INTO RELATION-ONE VALUES(”Sharon Rodriguez”, “Dayton”, OH”, “UG”);

INSERT INTO RELATION-THREE VALUES(”COMP630”, “Q1”, “Database”, “Todd”, 1230);

INSERT INTO RELATION-THREE VALUES(”COMP501”, “Q1”, “Python”, “Tim”, 2356);

INSERT INTO RELATION-THREE VALUES(”ENG500”, “U1”, “Mike”, 5647);

INSERT INTO RELATION-THREE VALUES(”COMP201”, “R1”, “Hardware”, “Tim”, 2356);

INSERT INTO RELATION-THREE VALUES(”ISEC200”, “U1”, “Cybesecurity”, “Todd”, 1230);

INSERT INTO RELATION-THREE VALUES(”COMP630”, “R1”, “Database”, “U”, 9871);

INSERT INTO RELATION-THREE VALUES(”COMP204”, “R1”, “Network”, “Tim”, 2356);