1. Rules and Guidelines
This section contains general rules and guidelines for completing and submitting your TMA.

20.1 General guidelines
The TMA requires that you demonstrate an understanding of course concepts and techniques, and an ability to apply these to sample problems. Your tutor will be following a detailed marking scheme, but he or she will particularly look for the following:

Using course concepts and terminology. It is not enough to give answers that simply rely on knowledge you may have gained about a topic from previous studies or from general reading. You must draw upon the content and terminology taught in M359 unless the question asks you to use other notations from external sources.

Using the e-library and other external sources. When asked to do so, you need to search the e-library and the internet to identify relevant material. In particular, you are urged to use the following sources, all of which are freely available to AOU students:
1. AOU’s subscribed e-library, accessible through the LMS which includes a number or other resources
2. Google books
3. Google scholar
4. Google knol

1.2 Submitting your TMA
You are required to submit your TMA through the Learning Management System (LMS) provided by your branch. In case there are additional files to be submitted together with your TMA, you need to put all the files in a single directory and compress it into one archive file and submit it by the Cut-off date. Submit your document as a single word document or as a compressed “.rar” archive in case it contains more than one file. Submit your TMA to the LMS system on (or preferably before) the cut-off date shown above. Your tutor will mark your script and post the grades to the LMS.

1.3 Answering SQL-based questions
You are required to use the course software (SQL Anywhere) to answer all SQL questions. It is not permitted to use other SQL environments for this course.
1.4 Plagiarism and quoting

Use your own words. All work you submit must be in your own words. Your tutor has tools available to him/her to allow the detection of plagiarism from the Internet as well as from other colleagues. If you copy material that is not your own and submit it as your own you are committing plagiarism. Plagiarism is a serious offence and if a case of plagiarism is detected, the Arab Open University will apply severe penalties and disciplinary procedures.

Quoting. If you wish to quote other materials, including from the M359 Blocks, then you must clearly acknowledge the source according to accepted rules of citation and referencing. It is not enough to simply post a reference at the end of the document without explicitly stating which parts of your document are being quoted. Proper citation of external sources must be included. Also, quoting is only used in limited fashion; to refer to a point using the words of a well recognized guru, for example. Large amounts of materials copied into your TMA will not be accepted, even if properly quoted. If you need to refer to large amount of external material, you can simply refer to the source.

Getting help and collaborating with colleagues. You can discuss the TMA with your tutor. Your tutor will help explain unclear points in the TMA and will direct you to useful and appropriate material in the course. However, you should not expect your tutor to supply you with answers to specific TMA questions. Remember that answering the TMA is ultimately your responsibility, not your tutor’s.

Sharing knowledge and information and holding discussions with your colleagues about the course material is called group learning and is encouraged by the Arab Open University. However, at the end, you should complete the TMA by yourself and answer the TMA, in your own words. Collaborating in answering TMA questions is not allowed, and is not the same as group learning. You are also not allowed to use the course forum to post answers to TMA questions or to collaborate on answering TMA questions.
Question 1 (10 marks)

This question covers Sections 1, 2 and 3 of Block 1. It assesses your understanding of various concepts covered in those sections and your ability to relate those concepts together.

a) Discuss what is meant by unproductive maintenance in the file systems approach. Give an example illustrating the difference between productive and unproductive maintenance. Discuss its negative effects, underlying cause and how it can be addressed by introducing the concept of data independence.

b) The Notlaw database supplied with the course materials contains a number of problems related to quality issues. Identify each of them and explain what could have been done to prevent such problems. To answer this question, you will need to do activities 2.1-2.8 in the text.

c) Using the e-library or other external sources, compare and contrast Multi Media Data Bases (MMDB) with text-only databases in the following respects:
   a. Content
   b. Types
   c. Design features
   d. Search features

   Arrange your answer in the table below. Give proper references.

<table>
<thead>
<tr>
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<th>Text-only databases</th>
<th>MMDB</th>
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References:
Question 2 (10 marks)

This question assesses your understanding of Conceptual Data Model (CDM) and the occurrence diagrams and the notation of Entity-Relationship diagrams as presented in Section 5 of Block 1.

Give a the CDM and the simplest possible representative occurrence diagram for each of the following situations; Include all 5 components of the CDM, making sure not to miss any parts of the CDM.

(a) Represent part of the military command structure of the armies of the world. It is desired to represent every command unit and all army personnel, along with their ranks and personal details. Each country has one army who has a Commander-In-Chief. Each army is divided into a number of field armies. Each field army has between 80,000 - 200,000 soldiers and is headed by a General. There is only one Field Marshall in each army. Not all generals head a field army.

(b) A sports club wants to maintain a sign-up list for its activities. Each club member may sign-up for multiple activity sessions, and each activity session may be booked by many members. Each activity has several sessions. A coach is assigned to supervise each activity session. An activity is described by a name and a brief description.

Question 3 (10 marks)

This question assesses your understanding of the Conceptual Data Model (CDM) presented in section 5 of Block 1.

It was decided to upgrade the M359 Hospital database due to changing requirements. Referring to the Hospital database scenario, the Conceptual Data Model (CDM) and the University relational headings in your database cards pack, Answer the following questions:

Note: You will need to read thoroughly the M359 Hospital scenario and relate it to both the Hospital CDM and the Hospital relational headings before you start answering this question.

a) Modify the CDM to accommodate the following new requirement. Make sure that you include any changes in any of the five components of the CDM:
a. The E-R diagram  
b. The Entity types  
c. The Additional constraints  
d. The Assumptions  
e. The Limitations

New requirement: Each nurse can be assigned to different wards on different days of the week. A nurse must be supervised by another nurse who is assigned to the same ward on the same day of the week as the nurse. So, a nurse may be supervised by different nurses on different days of the week, but both the nurse and the supervisor nurse must be assigned to the same ward on the same day in which the supervision takes place.

Question 4 (20 marks)

This question assesses your knowledge of Block 2, Sections 2 and 4, and in particular your understanding of the relational representations and the rules used to transform E-R fragments into a corresponding relational representation.

When converting an E-R relationship between two entity types to a relational representation, when would you have to use each of the following methods (list all cases that apply)? Give reasons in each case.

a) Using a relation to represent the relationship.  

b) Posting the primary key of one entity type as a foreign key into the other.  

c) Posting the primary key of one entity type as a foreign key in the other entity type and declaring it as an alternate key in the receiving relation.  

d) Posting the primary key of one entity type as a foreign key in the other entity type and adding a constraint on the values of the foreign key.
Question 5 (20 marks)

This question assesses your understanding of manipulating relations, and constraints as discussed in Sections 3-4 of Block 2.

Consider the University Data Summary given in the database cards pack that you received with the learning materials for this course. Write relational algebra expressions to answer the following questions. Show the result in each case.

a) Find the Names and IDs of all students in region number 3.

b) Find all staff numbers, staff names and the telephone numbers of the regions with which they are contracted.

c) Find the ids and names of all students in region number 1 together with the titles of the courses they are currently enrolled in.

d) Find all student Ids for students not enrolled in any course.

e) Find the Ids of students who are enrolled in all 30-credit courses.

Question 6 (20 marks)

This question tests your knowledge and understanding of normal forms as presented in Unit 5 of Block 2. You may refer to the reference sheet at the end of this TMA.

The table Signup depicts a one-table database recording the enrolment information of sports club members in sports activities. The information recorded are the member id, the member name, the activity id, the activity name, a session id that is unique within the same activity, the day, start and end times of the activity session enrolled, and the id and name of the coach supervising the activity session. Each session must be supervised by only one coach and the duration of all activity sessions is one hour.

Signup (MemberID, MemberName, ActivityID, ActivityName, SessionID, Day, From, To, CoachID, CoachName)
a) Write down a set of functional dependencies that covers all the non-trivial dependencies in this scenario. You need to be especially careful in this step.

b) Determine all the candidate keys for the relation Signup and choose a primary key.

c) What is the highest normal form to which the relation Signup conforms? Why?

d) Normalize the relation Signup to the next higher normal form. Indicate to which normal form(s) the resulting relations now conform? And why?

Question 7 (20 marks)

This question assesses your understanding of SQL as discussed in Sections 2-3 of Block 3. In this question you will re-implement the queries of question 5 in SQL. This will allow you to verify your answers in question 5.

Consider the University Data Summary given in the database cards pack that you received with the learning materials for this course. Write SQL statements to answer the following questions. Show the result in each case.

a) Find the Names and IDs of all students in region number 3.

b) Find the staff numbers, names of all staff along with the telephone numbers of the regions with which they are contracted.

c) Find the ids and names of all students in region number 1 together with the titles of the courses they are currently enrolled in.

d) Find all student Ids for students not enrolled in any course.

e) Find the Ids of students who are enrolled in all 30-credit courses.
Properties of Functional Dependencies:

Property 1: combining functional dependencies

If \( A \rightarrow B \) and \( A \rightarrow C \), then \( A \rightarrow B, C \)

Property 2: extending determinants

If \( A \rightarrow C \) and \( A \) is a subset of \( B \), then \( B \rightarrow C \)

Property 3: transitivity

If \( A \rightarrow B \) and \( B \rightarrow C \) then \( A \rightarrow C \)

Property 4: augmentation

If \( A \rightarrow B \), then \( A, C \rightarrow B, C \)

Normal Forms:

- **1NF**: A relation is in first normal form (1NF) if and only if it has no duplicate tuples and in each tuple, each value of every attribute is a single value.
- **2NF**: A relation is in second normal form (2NF) if and only if every non-primary key attribute is fully functionally dependent on the primary key.
- **3NF**: A relation is in third normal form (3NF) if and only if it is in 2NF and no nonprimary key attribute is transitively dependent on the primary key.

Definition:

An attribute \( A \) is transitively dependent (TD) on a set of attributes \( X \) in a relation \( R \) if there is a set of attributes \( Y \) such that all the following properties hold:

- **TD(i)**: \( X \rightarrow Y \) and \( Y \rightarrow A \).
- **TD(ii)**: It is not true that \( Y \rightarrow X \).
- **TD(iii)**: \( A \) is not an attribute of either \( X \) or \( Y \).

We included **TD(ii)** to rule out the situation where \( Y \) is an alternate key.

- **BCNF**: A relation is in Boyce–Codd normal form (BCNF) if and only if each irreducible determinant of a non-trivial FD is a candidate key.

Definitions:

A determinant \( A \) in \( A \rightarrow B \) is irreducible if there is no proper subset \( S \) of \( A \) such that \( S \rightarrow B \)

A trivial FD is one in which the right hand side is a subset of the left hand side

Definition:

**Weak Entity type:**

Weak entity types are those entity types that have a mandatory relationship with another entity type where the identifier of that entity type is the same as, or a subset of, the weak entity type, and that entity type is at the :1 end of this relationship.
General forms of relational algebra expressions:

select:
select <relation> where <selection condition>

project:
project <relation> over <attribute list>

combining select and project:
project (select <relation> where <selection condition>) over <attribute list>

alias:
<alias name> alias (<relational algebra expression>)

join:
<relation1> join <relation2>

rename:
<relation> rename (<old attribute1 name> as <new attribute1 name>, <old attribute2 name> as <new attribute2 name>, ... )

join with renaming:
<relation> join (<relation> rename (<old attribute1 name> as <new attribute1 name>, <old attribute2 name> as <new attribute2 name>, ... ))

divide:
divide <relation1> by <relation2>

union:
<relation1> union <relation2>

intersection:
<relation1> intersection <relation2>

difference:
<relation1> difference <relation2>

times:
<relation1> times <relation2>

general constraint:
constraint <condition>