[redacted]

GUIDELINES FOR THE PROJECT

NUMBER OF QUESTIONS AND TOPICS:

- Mandatory minimum requirement- Prepare 6 questions and their answers from the following topics
    - 2 questions and their answers from linear algebra
    - 2 questions and their answers from optimization
    - 2 questions and their answers from probability and statistics

MANDATORY QUESTIONS- DETAILS:

➔ Mandatory questions can be in one of the following categories

- ◆ Numeric type- Related to numerical calculations involving scalars, matrices, function values etc.
- ◆ Conceptual type- Related to concepts in MFDS represented in abstract form
- ◆ Symbolic type- Involves symbolic representations instead of numerical values

➔ 1 question out of the 2 questions from each of the three topics mentioned before, should be of Numeric type

- ◆ 1 Numeric type + 1 Numeric/ Conceptual/ Symbolic type from linear algebra
- ◆ 1 Numeric type + 1 Numeric/ Conceptual/ Symbolic type from optimization
- ◆ 1 Numeric type + 1 Numeric/ Conceptual/ Symbolic type from probability & statistics

➔ Each mandatory question and its answer should have variants generated using Matlab only. The code should run without any error in the latest online version of Matlab (Every student has access to online Matlab)

- Numeric type
  - Each variant of a given Numeric type question will take different numeric input values in the form of matrices or function values and generates corresponding answers containing different numeric output values
  - These different input and output values used in variants of a given Numeric type question should be randomly generated using Matlab program
  - The Matlab program should be able to generate any number of variants (e.g. 500) for a Numeric type question
- Conceptual and Symbolic types
  - Each variant of a given Conceptual or Symbolic type question and its answer should have enough number of variants generated using Matlab program
  - The number of variants is dependent on the nature of a particular Conceptual or Symbolic type question

➔ The final documents for submission should contain the following

- The computer program code in Matlab for generating questions and the corresponding answers
- The question and its required number of variants (e.g. 5- 10 variants)
- The corresponding answer for the question and its required number of variants (e.g. 5- 10 variants)
- This is required for each one of the 6 questions from 3 different categories mentioned earlier

SAMPLE PRINT FORMAT FOR THE QUESTION AND THE CORRESPONDING ANSWER

QUESTION-1

Which of the following sets of column vectors form a basis for R3?

A.[3 -3 4; -7 -4 -3; 9 -1 1]

B.[7 -6; 3 -2; 4 9]

C.[-6 8 -5 -9; 8 6 2 4; 2 3 3 -2]

D.[-5 -6 -9; 9 -6 -9; -9 -2 -3]

E.None of the other options

ANSWER: A

SOLUTION-1

A basis for R3 requires 3 independent vectors, each consisting of 3 elements.

The matrix P = [3 -3 4; -7 -4 -3; 9 -1 1] contain 3 column vectors, each consisting of 3 elements. The rank of this matrix is 3. It implies that there are 3 linearly independent column vectors. Therefore the column vectors of this matrix P forms a basis for R3.

The matrix Q = [7 -6; 3 -2; 4 9] contain 2 column vectors, each consisting of 3 elements. Since the number of column vectors are less than 3, these column vectors cannot span R3 and do not form a basis for R3.

The matrix R = [-6 8 -5 -9; 8 6 2 4; 2 3 3 -2] contain 4 column vectors, each consisting of 3 elements. The rank of this matrix is 3. It implies that there are 3 linearly independent column vectors. These 3 linearly independent column vectors of matrix R can form a basis for R3, but all 4 column vectors are not required to form a basis.

The matrix S = [-5 -6 -9; 9 -6 -9; -9 -2 -3] contain 3 column vectors, each consisting of 3 elements. The rank of this matrix is 2. It implies that there are only 2 linearly independent column vectors. Since the number of column vectors

are less than 3, these column vectors cannot span R3 and do not form a basis for R3.

QUESTION-2

Which of the following sets of column vectors form a basis for R3?

A.[7 5 9; 8 9 -1; -6 -3 -5]

B.[4 4; 5 1; -8 7]

C.[7 -1 -5 -2; -4 -3 2 8; 2 7 3 -6]

D.[-8 4 5; 2 2 2; 7 7 7]

E.None of the other options

ANSWER: A

SOLUTION-2

A basis for R3 requires 3 independent vectors, each consisting of 3 elements.

The matrix P = [7 5 9; 8 9 -1; -6 -3 -5] contain 3 column vectors, each consisting of 3 elements. The rank of this matrix is 3. It implies that there are 3 linearly independent column vectors. Therefore the column vectors of this matrix P forms a basis for R3.

The matrix Q = [4 4; 5 1; -8 7] contain 2 column vectors, each consisting of 3 elements. Since the number of column vectors are less than 3, these column vectors cannot span R3 and do not form a basis for R3.

The matrix R = [7 -1 -5 -2; -4 -3 2 8; 2 7 3 -6] contain 4 column vectors, each consisting of 3 elements. The rank of this matrix is 3. It implies that there are 3 linearly independent column vectors. These 3 linearly independent column vectors of matrix R can form a basis for R3, but all 4 column vectors are not required to form a basis.

The matrix S = [-8 4 5; 2 2 2; 7 7 7] contain 3 column vectors, each consisting of 3 elements. The rank of this matrix is 2. It implies that there are only 2 linearly independent column vectors. Since the number of column vectors are less than 3, these column vectors cannot span R3 and do not

form a basis for R3.

QUALITY SPECIFICATIONS:

- The questions should not be in the same pattern of any of the questions given for the exams already or the solved questions available in Moodle
- The questions should not be directly solvable using direct command lines of a computer program. There must be concepts involved in solving the questions just like the questions given in tests.
- The program should be able to run and generate questions on demand without display of any error
- If the codes/report submitted by any two or more groups are found to be the same, then the project marks will be made zero for all those groups
- If a group is found to have used the same questions given in tests or got the questions from previous year students, the marks will be made zero in that case too.

GROUPS FOR THE PROJECT:

- A group should consist of 4 members.
- Only one final report needs to be submitted by a group.
- Students are free to choose their group members
- If a group does not have 4 members or if a student is unable to find any team member, the list of those students will be collected and grouped together randomly.

GRADING SCHEME:

- A maximum of 20 points for the mandatory questions with each question having an equal weightage
- A maximum of 4 points for the optional questions, 1 point for each question
- The extra credits from the optional questions will be directly added to the final regular consolidated score
- The project will have a weightage of 20% in the final consolidated score
- The marks given out of 20 will depend upon the quality of the question, concept involved and also the number of unique variants the code is capable of generating.

FORMAT FOR SUBMISSION:

- The matlab code submitted should be named as Group_Number. For example, “Group_10.m”
- The report should be submitted in pdf format (either typed out or published from Matlab) named as Group_Number. For example, “Group_10.pdf”
- The group number for each group will be allocated and informed once grouping is finalized for all students.

SUBMISSION DEADLINE:

- [redacted]
- Submissions made after the deadline will not be considered for grading.
- Any kind of requests for extension of this deadline will not be entertained.