Faculty of Science and Humanities			
Ramaiah University of Applied Sciences			
Department	Mathematics	Programme	B. Tech.
Semester/Batch	1/2017		
Course Code	BSC101A	Course Title	Engineering Mathematics – 1
Course Leader(s)	Deepak A. S., Mahesha Narayana, Chandankumar S., Shekar M., Hemanthkumar B., and Meenakshi N.		

Assignment – 02			
Reg. No.		**Name of Student**	

Sections		Marking Scheme	Max Marks	First Examiner Marks	Moderator
Part-A	A.1	Description of computation of SVD of a matrix with an example	3		
	A.2	Comparison between the singular values and singular vectors with eigenvalues and eigenvectors	2		
	A.3	Geometrical description of SVD of a matrix	2		
	A.4	Application of SVD	2		
		Conclusion	1		
		Part-A1 Max Marks	10		
Part B 1	B1.1	Find and sketch the domain of heat loss as a function of the lengths of the sides	2		
	B1.2	Dimensions that minimize heat loss	4		
	B1.3	Discussion on design a building with even less heat loss	3		
	B1.4	Comment and conclude on the result	1		
		Part-B1 Max Marks	10		
	B2.1	To establish orthogonality at (x_0, y_0)	5		
	B2.2	Sketching of the level curves $u(x,y) = c_1$ and $v(x,y) = c_2$ for $f(z) = z^2$	4		
	B2.3	Conclusion	1		
		Part-B2 Max Marks	10		
Part B 3	B3.1	Sketch the diagram and find transition matrix	3		
	B3.2	MATLAB built-in function	2		
	B3.3	Diagonalizable matrix	2		
	B3.4	Number of leases at the end of 2, 4 and 6 years	2		
	B3.5	Steady state vector as $\lim_{n\to\infty} x_n$ and comment	2		
		Part-B3 Max Marks	10		
Part B 4	B4.1	Algorithm for Newton-Raphson method	2		
	B4.2	MATLAB function to implement Newton Raphson method	5		
	B4.3	Plot	2		
	B4.4	Comment	1		
		Part-B 4 Max Marks	10		
		Total Assignment Marks	50		

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Course Marks Tabulation				
Component-1 (B) Assignment	**First Examiner**	**Remarks**	**Moderator**	**Remarks**
A				
B.1				
B.2				
B.3				
B.4				
Marks (Max 50)				
Marks (out of 25)				
Signature of First Examiner				**Signature of Moderator**

Please note:

1. Documental evidence for all the components/parts of the assessment such as the reports, photographs, laboratory exam / tool tests are required to be attached to the assignment report in a proper order.
2. The First Examiner is required to mark the comments in RED ink and the Second Examiner's comments should be in GREEN ink.
3. The marks for all the questions of the assignment have to be written only in the **Component – CET B: Assignment** table.
4. If the variation between the marks awarded by the first examiner and the second examiner lies within +/- 3 marks, then the marks allotted by the first examiner is considered to be final. If the variation is more than +/- 3 marks then both the examiners should resolve the issue in consultation with the Chairman BoE.

Assignment – 02
Term - 2

Instructions to students:

1. The assignment consists of **5** questions: Part A – **1** Question, Part B- **2** Questions.
2. Maximum marks is **50**.
3. The assignment has to be neatly word processed as per the prescribed format.
4. The maximum number of pages should be restricted to **20**.
5. Restrict your report for Part-A to 3 pages only.
6. Restrict your report for Part-B to a maximum of 17 pages.
7. The printed assignment must be submitted to the course leader.
8. **Submission Date: 20/11/2017**
9. **Submission after the due date is not permitted.**
10. **IMPORTANT**: It is essential that all the sources used in preparation of the assignment must be suitably referenced in the text.
11. Marks will be awarded only to the sections and subsections clearly indicated as per the problem statement/exercise/question

Preamble

The course introduces students to the basic concepts and techniques in real and complex analyses, matrix algebra and numerical analysis. Students are taught the concepts of derivative, continuity, limits, series expansion, functions and integrals of real and complex variables. The utility of Cauchy's Integral and residue theorem in the evaluation of an integral is emphasized. The mathematical operations in Matrix theory, Eigen value and Eigen vector, Inversion and diagonalization of matrix and matrix solution for linear system of equations are discussed in this course. This course also deals with the underlying concepts of finding the roots, solving the linear systems in the context of numerical analysis and implementation of the schemes in MATLAB.

Part A (10 Marks)

Write an essay on **"Singular Value Decomposition (SVD) of a Matrix"**. Your report should include the following points:

A.1 Computation of SVD of a matrix with an example.

A.2 Comparison of the singular values and singular vectors with eigenvalues and eigen vectors of a matrix.

A.3 Geometrical description of SVD of a matrix.

A.4 Application of SVD to solve an engineering problem and conclusion.

Part B (40 Marks)

B.1. **(10 Marks)**

A rectangular building is being designed to minimize the cost of construction material. The material used to construct east and west walls cost $Rs. 10\ /m^2$, the north and south walls cost Rs. $8\ /m^2$, the floor costs Rs. $1\ /m^2$, and the roof costs Rs. $5\ /m^2$. Each wall must be at least 30 meters long, the height must be at least $4\ m$, and the volume must be exactly $4000\ m^3$.

B.1.1 Find the domain of cost as a function of the lengths of the sides with a sketch.

B.1.2 Find the dimensions that minimize the cost of construction material.

B.1.3 Can you design a building with lesser cost if the restrictions on the lengths of the walls were removed? Justify.

B.1.4 Comment and conclude on the result.

B.2. **(10 Marks)**

Let the function $f\ (z)\ =\ u(x,y)\ +\ iv(x,y)$ be analytic in a domain D, and consider the families of level curves $u(x,y)\ =\ c_1$ and $v(x,y)\ =\ c_2$, where c_1 and c_2 are arbitrary real constants.

B.2.1. Prove that these families are orthogonal. More precisely, show that if $z_0\ =\ (x_0, y_0)$ is a point in D which is common to two particular curves $u(x,y)\ =\ c_1$ and $v(x,y)\ =\ c_2$ and if $f'(z_0) \neq\ 0$, then the lines tangent to those curves at (x_0,y_0) are perpendicular.

B.2.2. Illustrate the above result by sketching the level curves using MATLAB $u(x,y)\ =\ c_1$ and $v(x,y)\ =\ c_2$ for $f(z) = z^2$.

B.2.3. Observe that the curves $u(x,y)\ =\ 0$ and $v(x,y)\ =\ 0$ for $f(z) = z^2$ intersect at the origin and are not orthogonal to each other. Comment.

B.3. **(10 Marks)**

An automobile dealer leases four types of cars: Audi, BMW, Suzuki and Toyota. The term of the lease is $n = 2$ years. The automobile leasing can be viewed as a process with four possible outcomes. The probability of each outcome can be estimated by reviewing records of previous leases. The records indicate that 80% of the customers currently leasing Audi will continue the same, 10% of the customers will switch to BMW, 5% of the customers will switch to Suzuki and another 5% will switch to Toyota in the next lease. Furthermore, 10% of the customers currently leasing BMW will switch to Audi, 80% of the customers will continue the same BMW, 5% of the customers will switch to Suzuki and another 5% of the customer will switch to Toyota. In addition, 5% of the customers driving Toyota will switch to Audi, 5% of the customer will switch to BMW, 10% of the customer will switch to Suzuki and 80% of the customers will continue the same. Automobile dealer wants to predict the future leases.

B.3.1 Sketch the diagram for the above data and find the transition matrix A for the system.

B.3.2 Using MATLAB built-in function find eigenvalue and eigenvectors of the transition matrix A.

B.3.3 Check whether the matrix A is diagonalizable? If it is diagonalizable then find the diagonalization of A.

B.3.4 Suppose, initially there are 200 Audis and 100 each of the other three types leased. Determine the number of people who will lease each type of vehicle after 2, 4 and 6 years (**Hint:** $x_{n+1} = Ax_n, n = 1,2, \ldots$).

B.3.5 Find the steady state vector as $\lim_{n\to\infty} x_n$ and comment on the result.

B.4. **(10 Marks)**

A loan of d rupees is repaid by making n equal monthly payments of M rupees, from one month after the loan is released. It can be shown that if the monthly interest rate is r, then

$$Ar = M\left[1 - \frac{1}{(1+r)^n}\right].$$

A car of Rs. 600000 was repaid in 60 monthly payments of Rs. 15000. Use Newton Raphson method to find the monthly interest r.

B.4.1 Explain the steps involved in the algorithm.

B.4.2 Assuming initial guess $r_0 = 0.015$, write MATLAB function to implement Newton-Raphson method up to 4 decimal places.

B.4.3 Plot the given function and indicate the root in the same graph.

B.4.4 Comment on the result obtained.