Course Code & Name	26CAPC7001 Mathematical Foundations for Computing		
Teaching Hours /week (L: T:P: R)	3:1:0:0	Credits	4
CIE Marks	40	ESE Marks	60
Course Type	Theory(PCC)	Exam Hours	3
Prerequisites (if any)	26CAPCC103		

Course Objectives:

1. Develop a comprehensive understanding of advanced mathematical concepts and their applications, including the recurrence relations, linear systems and solve problems in computer science, information theory, and related fields

2. Develop a strong foundation in applied mathematics, including the use of correlation and regression for data analysis, and the application of graph theory to solve problems in a wide range of fields.

Course Outcomes (COs)

At the end of the course students should be able to:

CO#	Course Outcomes	Bloom's Knowledge Level (KL)
CO 1	Solve the linear system of equations and Calculate the eigen values and eigen vectors of matrices.	K3
CO 2	Demonstrate the ability to derive, simplify, and interpret solutions of recurrence relations in various mathematical and applied contexts.	K3
CO 3	Apply the principles of correlation and regression in practical problems.	K3
CO 4	Apply the fundamental concepts of graph theory and solve problems in almost every conceivable discipline using graph models.	K3

Note: *K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

CO #	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	2	-	-	-	-
CO 2	3	-	-	2	-	-	-	-
CO 3	3	2	2	2	-	-	-	-
CO 4	3	3	2	-	-	-	-	-

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), - : No Correlation*

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE)

Attendance	Assignment/ Micro-project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
8	12	10	10	40 Marks

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

PART A	PART B	TOTAL
■ 2 Questions from each module. ■ Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	■ Each question carries 9 marks. ■ Two questions will be given from each module, out of which 1 question should be answered. ■ Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60 Marks**

SYLLABUS

Module #	Syllabus Description	Hours
1	Linear system of equations, coefficient matrix, augmented matrix, Gauss elimination method and back substitution, elementary row operations, row equivalent systems, Gauss elimination- three possible cases, Row Echelon form, Linear independence- rank of a matrix. Matrix eigenvalue problem- determination of eigenvalues and eigenvectors.	12
2	First Order Linear Recurrence Relation, Second Order Linear Homogeneous Recurrence Relations with Constant coefficients, Non Homogeneous Recurrence Relation.	12
3	Bivariate data – Scatter Diagram – Interpretation of the nature and degree of relation using scattered diagram - Curve fitting – Principle of least squares – fitting a straight line – fitting a parabola – linear correlation and regression – Karl's Pearson's Coefficient of Correlation – Spearman's rank correlation coefficient (problems based on the formula)	12
4	Graph Theory- Introduction to Graphs, Types of Graphs (simple, directed, weighted, etc.), Subgraphs, Degree of Vertex, Paths and Cycles, Connected and Disconnected Graphs, Representation of Graphs, Euler and Hamiltonian Paths, Trees and Properties Trees, concept of spanning tree, Shortest-Path Problems, Directed Graph, Multigraph, Planar and Non-planar Graphs	12

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition & Year
1	Elementary Number Theory	David M. Burton,	McGraw-Hill,	7th Edition 2012
2	Discrete and Computational Mathematics-an applied introduction	Ralph P Grimaldi	Pearson Education	2007

3	Advanced Engineering Mathematics	Erwin Kreyszig	Wiley.	10th Edition
4	Fundamentals of Mathematical Statistics	Gupta S.C and Kapoor V .K	Sultan Chand & Sons	11th Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition & Year**
1	Discrete Mathematical Structures with applications to Computer Science	Jean-Paul Tremblay	McGraw-Hill	1st Edition 2001
2	Elements of Discrete Mathematics: A Computer Oriented Approach	C. Liu	McGraw-Hill	4th Edition 2012
3	Discrete mathematics and its applications	Kenneth H. Rosen	McGraw-Hill,	7th Edition
4	Elementary Number Theory with Programming	Marty Lewinter, Jeanine Meyer	Wiley-Blackwell	2015
5	Introduction to practice of statistics	David S. Moore and George P. McCabe	W.H. Freeman & Company	5th Edition 2005
6	Applied Statistics and Probability for Engineers	Douglas C. Montgomery and George C. Runger	Wiley India	5th Edition 2012

Web References/ Video Links (NPTEL, SWAYAM…)	
Sl.No	**Link ID**
1	https://www.youtube.com/watch?v=Lj9Awpd5ltc&t=15s
2	https://nptel.ac.in/courses/106106183
3	https://nptel.ac.in/courses/106106183
4	https://www.digimat.in/nptel/courses/video/111107112/L01.html
5	https://nptel.ac.in/courses/111108066
6	https://nptel.ac.in/courses/111105043
7	https://onlinecourses.nptel.ac.in/noc22_ma10/preview

Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Find the eigenvalues and eigenvectors of $\begin{bmatrix} -4 & 2 & 2 \\ 2 & 5 & 0 \\ 0 & 3 & 2 \end{bmatrix}$

2. Find the rank of the matrix $\begin{bmatrix} -3 & 0 & -5 \\ -4 & 5 & 0 \\ 0 & 3 & 4 \end{bmatrix}$

3. Solve the following Equations using Gauss elimination method

   x+2y-z =3, 3x-y+2z=1, 2x-2y+3z =2, x- y+ z=-1

Course Outcome 2 (CO2):

1. Solve the recurrence relation $a_n-5a_{n-1}+6a_{n-2}=3^n+n$, given $a_0=0$ and $a_1=1$.

2. Solve the recurrence relation $a_n-5.a_{n-1}+6.a_{n-2}=3^n+n$; $a_0=0$, $a_1=1$

Course Outcome 3 (CO3):

1. Show that a connected graph G is Euler if and only if all the vertices of G are of even degree.

2. Define Hamiltonian cycle and Euler circuit with example.

3. Show that the maximum number of edges in a simple graph with n vertices is nC_2.

Course Outcome 4 (CO4):

1. Fit a parabola by the method of least squares, to the following data. (K3)

x:	1	2	3	4	5
y:	5	12	26	60	97

2. Compute the correlation coefficient from the following data. (K3)

x:	77	54	27	52	14	35	90	25	96	60
y:	35	58	60	40	50	40	35	56	34	42

Focus on Excellence

Model Question Paper

Reg No.:_____ Name:_____

FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY

MCA S17 (R,S) Examination ---------- (2026 Scheme)

Course Code: 26CAPC7001

Course Name: Mathematical Foundations for Computing

Max. Marks: 60 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

		CO	Marks
1	Determine the rank of $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 2 & 5 \end{bmatrix}$	CO1	(3)
2	How to convert a matrix into row echelon form? What is the information obtained from this form?	CO1	(3)
3	Explain First Order Linear Recurrence Relation	CO2	(3)
4	Solve the following recurrence relation $a_n = 5a_{n-1} + 6a_{n-2}$	CO2	(3)
5	Explain the principle of least square.	CO3	(3)
6	Two lines of regressions are x+2y-5=0 and 2x+3y-8=0. Find the mean of x and y.	CO3	(3)
7	Define complete Bipartite graph. Draw the graph $K_{2,4}$.	CO4	(3)
8	Prove that the sum of the degrees of all vertices of a graph G is twice the number of edges in it.	CO4	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module I

9	a)How to convert a matrix into row echelon form? What is the information obtained from this form?	CO1	(3)
	b) Solve the following Equations using Gauss elimination method x+2y-z =3, 3x-y+2z=1, 2x-2y+3z =2, x- y+ z=-1		(6)

OR

10 a)State the fundamental theorem for linear systems. (3)

b)Find the eigenvalues and eigenvectors of CO1

$$\begin{bmatrix} 4 & 1 & -1 \\ 2 & 5 & 2 \\ 1 & 1 & 2 \end{bmatrix}$$ (6)

Module II

11 a)Explain Non Homogeneous Recurrence Relation (3)

b)Differentiate between homogeneous and non-homogeneous recurrence relations. CO2 (6)

$a_{n+2} + 3.a_{n+1} + 2.a_n = 3^n$; $a_0 = 0$, $a_1 = 1$

OR

12 a)Explain Second Order Linear Homogeneous Recurrence Relations (3)

b)Solve the recurrence relation CO2 (6)

$a_{n+2} = 4a_{n+1} - 4a_n$, $a_0 = 1$, $a_1 = 3$

Module III

13 a)In a partially destroyed laboratory record, only lines of regression y on x and x on y are available as $4x - 5y + 33 = 0$, $20x - 9y = 107$ respectively. Calculate the coefficient of correlation between x and y. (3)

b)Fit a parabola to the following data. CO3 (6)

X:	1.0	1.5	2.0	2.5	3.1	4.0
Y:	1.1	1.3	1.6	2.0	3.4	4.2

OR

14 a)Fit a straight line y=a+bx to the following data by the principle of least squares: (4)

x:	0	1	3	6	8
y:	1	3	2	5	4

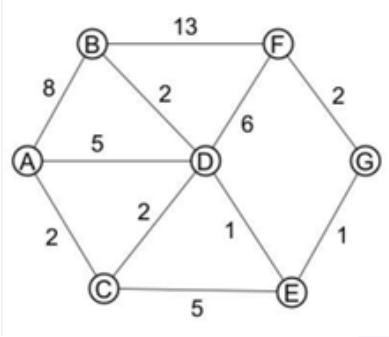
b)The marks secured by 9 students in Mathematics, English are as given below. Calculate the rank correlation coefficient. CO3 (5)

X:	10	15	12	17	13	16	24	14	22
Y:	30	42	45	46	33	34	40	35	39

Module IV

15 a)Define a planar graph with examples. CO4 (3)

b)Use Dijkstra's Algorithm to calculate the shortest path between the vertices A and F in the weighted graph given below. (6)



OR

16 a) Define Hamiltonian cycle and Euler circuit with example. (4)

CO4

b)Prove that a non-empty connected graph G is Eulerian if and only if its vertices are all of even degree (5)

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