SCHEME OF COURSE WORK

Course Details:

Course Title	**Calculus and Linear Algebra**		
Course Code	**20BM1101**	**L T P C**	**3 0 0 3**
Program:	**B. Tech.**		
Specialization:	**Civil Engineering**		
Semester	**I Semester**		
Prerequisites	• Basic formulae of differentiation, product rule, and quotient rule. • Basic Integration formulae, integration by parts, definite integrals and properties • solve a linear system of equations analytically and compute eigen values and eigen vectors of a square matrix		
Courses to which it is a prerequisite	**: For all Engineering Courses**		

Course Outcomes (COs):

1	Test the convergence of an infinite series and express a function in terms of power series.
2	Apply the techniques of multivariable differential calculus to determine extrema and series expansions of a function of several variables.
3	Use the concept of integration of higher dimensions to solve the problems in engineering
4	Justify solutions of linear system of equations analytically and compute eigenvalues and eigenvectors of a square matrix
5	Classify the nature of a quadratic form

PROGRAM OUTCOMES:

1. Graduates will be able to apply the knowledge of mathematics, science, engineering fundamentals to solve complex civil engineering problems.
2. Graduates will attain the capability to identify, formulate and analyse problems related to civil engineering and substantiate the conclusions
3. Graduates will be in a position to design solutions for civil engineering problems and design system components and processes that meet the specified needs with appropriate consideration to public health and safety.
4. Graduates will be able to perform analysis and interpretation of data by using research methods such as design of experiments to synthesize the information and to provide valid conclusions.
5. Graduates will be able to select and apply appropriate techniques from the available resources and modern civil engineering and software tools, and will be able to predict and model complex engineering activities with an understanding of the practical limitations.
6. Graduates will be able to carry out their professional practice in civil engineering by appropriately considering and weighing the issues related to society and culture and the consequent responsibilities.
7. Graduates will be able to understand the impact of the professional engineering solutions on environmental safety and legal issues.
8. Graduates will transform into responsible citizens by resorting to professional ethics and norms of the engineering practice.

9. Graduates will be able to function effectively in individual capacity as well as a member in diverse teams and in multidisciplinary streams.
10. Graduates will be able to communicate fluently on complex engineering activities with the engineering community and society, and will be able to prepare reports and make presentations effectively.
11. Graduates will be able to demonstrate knowledge and understanding of the engineering and management principles and apply the same while managing projects in multidisciplinary environments.
12. Graduates will engage themselves in independent and life-long learning in the broadest context of technological change while continuing professional practice in their specialized areas of civil engineering.

Course Outcome versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3										
CO-2	3	2										
CO-3	3	3										
CO-4	3	3										
CO-5	3	3										

3 - Strongly correlated, *2* - *Moderately* correlated, *0* - *No correlation*

Program Specific Objectives (PSOs): The student must attain the knowledge and skills to

PSO-1	Collect, process and analyse the data from topographic surveys, remote sensing, hydrogeological investigations, geotechnical explorations, and integrate the data for planning of civil engineering infrastructure.
PSO-2	Analyse and design of substructures and superstructure for buildings, bridges, irrigation structures and pavements.
PSO-3	Estimate, cost evaluation, execution and management of civil engineering projects. With Regards

Course Outcome Versus Program Specific Outcomes:

COs	PSO1	PSO2	PSO3
CO-1	2	1	2
CO-2	2	1	2
CO-3	2	1	2
CO-4	2	1	2
CO-5	2	1	2

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

Assessment Methods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	**TOPIC / CONTENTS**	**Course Outcomes**	**Sample questions**	**TEACHING-LEARNING STRATEGY**	**Assessment Method & Schedule**
1	Sequence, infinite series tests for convergence: comparison test, ratio Test, root test.	**CO-1**	Test for the converge the series $\sum_{n=1}^{\infty}\left(\frac{n!3^n}{n^n}\right)$	Lecture / Problem solving	Assignment (Week 2 - 4) / Quiz-I (Week -8)/ Mid-Test 1 (Week 9)
2	Rolle's theorem, Lagrange's and Cauchy's mean value theorem	**CO-1**	Apply Lagrange's Mean Value theorem for $f(x)=(x-1)(x-2)(x-3)$ in [0,4]	Lecture / Problem solving	Assignment (Week 2 - 4)/ Quiz -I (Week -8)/ Mid-Test 1 (Week 9)
3	Expansions of functions: Taylor's and Maclaurin's series	**CO-1**	Use Taylor's series expansion for $\sin^{-1}x$ in powers of x and y up to third degree	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Assignment (Week 2 - 4)/ Quiz -I (Week -8)
4	Total derivative, change of variables, Jacobin's	**CO-2**	If $x=u(1-v),\ y=uv$, then determine $\frac{\partial(u,v)}{\partial(x,y)}$	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
5	Taylor's theorem for functions of two variables	**CO-2**	Determine the Taylor's series expansion of $e^x \sin y$ in powers of x and y	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz -I (Week -8)
6	Maxima and minima of functions of two variables, Lagrange method of undetermined multipliers	**CO-2**	In the plane triangle ABC, determine the maximum value of $\cos A \cos B \cos C$	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
7	Non Cartesian Coordinates, Double integrals, Change of order of integration.	**CO-3**	Evaluate $\int_{-1}^{2}\int_{x^2}^{x+2} dy\,dx$.	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz -I (Week -8)
8			**Mid-Test 1**	------	----------
9	Double integral in polar co-ordinates Triple integrals, Change of variables in double integral.	**CO-3**	Evaluate $\int_0^{\infty}\int_0^{\infty} e^{-(x^2+y^2)}\,dxdy$ by changing to polar coordinates.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
10	Double integral in polar co-ordinates	**CO-3**	Evaluate	Lecture /	Mid-Test 2

	Triple integrals, Change of variables in double integral.		$\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\, dxdy$ by changing to polar coordinates.	Problem solving	(Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
11	Change of variables in triple integral, Simple Applications of multiple integrals.	**CO-3**	Evaluate $\int_{x=0}^{1} \int_{y=0}^{x} \int_{z=0}^{x+y} x\, dzdydx.$	Lecture / Problem solving	Assignment (Mid-Test 2 (Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
12	Rank of a matrix (echelon form and normal form	**CO-4**	Determine the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
13	Consistency of linear system of equations	**CO-4**	Discuss the consistency of linear system of equations $4x-2y+6z=8,$ $x+y-3z=-1,$ $15x-3y+9z=21$	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
14	Eigen values and eigen vectors of a matrix, properties of eigen values	**CO-4**	Determine the eigen values and eigen vectors for the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$, Two eigen values of the matrix $A=\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ are equal to 1 each.Find the eigen value of A^{-1}	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
15	Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem	**CO-5**	Using Cayley –Hamilton theorem find the inverse of $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ 2 & -4 & -4 \end{bmatrix}$, find A^4	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
16	Reduction to diagonal form,	**CO-5**	Determine the eigen values and eigen vectors and hence reduce the matrix $A=\begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$ to a diagonal form	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)

17	Reduction of quadratic form to canonical form, nature of the quadratic form	**CO-5**	Discuss the nature of the quadratic form by reducing to canonical form $3x^2+5y^2+3z^2-2yz+2zx-2xy$	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
18	**Mid-Test 2**				
19/20	**END EXAM**				