SCHEME OF COURSE WORK

Course Details:

Course Title	**ODE and Vector Calculus**		
Course Code	**20BM1103**	**L T P C**	**3 0 0 3**
Program:	**B.Tech.**		
Specialization:	**Civil Engineering**		
Semester	**II Semester**		
Prerequisites	• Basic formulae of differentiation and integrations.. • Vectors, differentiation and integrations		
Courses to which it is a prerequisite	**: For all Engineering Courses**		

Course Outcomes (COs):

1	Solve first order differential equations arising in various engineering fields
2	Evaluate linear differential equations of higher order and use the knowledge to study certain problems that arise in engineering
3	Illustrate the techniques of Laplace transform to solve problems that arise engineering.
4	Summarize various concepts of vector differentiation
5	Use calculus to vector functions and interpret vector integral theorems

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	Assignment / Quiz / Seminar / Case Study / Mid-Test / End

Teaching-Learning and Evaluation

Teaching-Learning and Evaluation

Week	**TOPIC / CONTENTS**	**Course Outcomes**	**Sample questions**	**TEACHING-LEARNING STRATEGY**	**Assessment Method & Schedule**
1	Linear and Bernoulli differential equations.	CO-I	Solve $\frac{dy}{dt}\sin t+2y\cos t=\cos^2 t$ Solve $\frac{dy}{dx}+8x^6y=e^xy^3$	Lecture / Problem solving	Assignment (Week 2 - 4) / Mid-Test 1 (Week 9)
2	Orthogonal trajectories exact differential equations.	CO-I	Determine the orthogonal trajectories of $y=cx^3+2$	Lecture / Problem solving	Assignment (Week 2 - 4) / Mid-Test 1 (Week 9)
3	Equations reducible to exact equations.	CO-I	Solve $\left(\frac{y}{x}+6x\right)dx+(\ln x-2)dy=0$	Lecture / Problem solving	Assignment (Week 2 - 4) / Mid-Test 1 (Week 9)
4	simple electric circuits, Newton's law of cooling.	CO-I	A body originally at 80^0C cools down to 60^0C in 20 minutes, the temperature of the air being 40^0C. Determine the temperature of the body after 40 minutes from the original?	Lecture / Problem solving	Assignment (Week 2 - 4) / Mid-Test 1 (Week 9)
5	Linear differential equations of higher order with constant coefficients,	CO-II	Solve $2y'''+19y''+39y'+9y=0$	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz
6	Complete solution, operator D, rules for finding the complementary function,	CO-II	Solve $2y'''+19y''+39y'+9y=0$.	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz
7	Inverse operator, rules for finding the particular integral, method of variation of parameters Cauchy's linear equation, L-C-R circuit problems.	CO-II	Solve $2x^3y'''+19x^2y''+39xy'+9y=0$	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz
8	**Mid Exam-I**				
9	Definition of Laplace transform, existence conditions, properties of Laplace transform, periodic functions,	CO-III	Determine Laplace transform of	Lecture / Problem solving	Mid-Test 2 (Week 18) / Assignment (12-14)

			$g(t)=\begin{cases} 1, & 0 \le t \le a, \\ \dfrac{(b-t)}{(b-a)}, & a<t \le b, \\ 0, & \text{if } t>b \end{cases}$		
10	Transforms of derivatives, transforms of integrals, multiplication by t, division by t, evaluation of integrals by Laplace transforms,	CO-III	Solve $y''(t)+y(t)=g(t)$, $y(0)=0, y'(0)=0$, $g(t)=\begin{cases} t & \text{if } 0 \le t<5 \\ 0 & \text{if } 5 \le t<\infty. \end{cases}$	Lecture / Problem solving	Mid-Test 2 (Week 18) / Assignment (12-14)
11	Inverse Laplace transforms, convolution theorem (without proof), unit step function, unit impulse function, applications to ordinary differential equations.	CO-III	Show that $L^{-1}\left[\dfrac{(s-a)}{(s-a)^2+b^2}\right]=e^{at}\cos bt$	Lecture / Problem solving	Mid-Test 2 (Week 18)/ Quiz
12	Scalar and vector point functions, gradient, directional derivative, divergence and curl.	CO-IV	Determine the gradient of the following function at the given point $h(x,y)=5500-0.001x^2-0.004y^2$ and p=$(200,800,900)$	Lecture / Problem solving	Mid-Test 2 (Week 18)/ Quiz
13	vector identities: del applied twice to point functions, del applied to products of point functions	CO-V	Show that $Curl(gra\ f)=0$	Lecture / Problem solving	Mid-Test 2 (Week 18)/ Quiz
14	Line integral - circulation, work done, surface integral-flux, volume integral.	CO-V	Determine work done if F=$\langle 5xy, 2y^2 \rangle = 5xyi+2y^2 j$ and given path $y=6x^2$ from $(0,0)$ to $(1,6)$.	Lecture / Problem solving	Mid-Test 2 (Week 18)/ Quiz
15	Green's theorem in the plane, Stoke's theorem and the Divergence theorem (without proof).	CO-V	Using Green'theorem evaluate $\int_C (ax+2y)dx+(bx+3y)dy$ where C is the unit circle $x^2+y^2=1$	Lecture / Problem solving	Mid-Test 2 (Week 18)
16	**Mid Exam-II**				
17/18	**END EXAM**				