



University of Kerala

Discipline	Mathematics				
Course Code	UK3DSCMAT201				
Course Title	Differential Equations, Multiple Integrals and Vector Calculus				
Type of Course	DSC				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Differential calculus 2. Vectors 3. Integration				
Course Summary	The course enable the students to find the solutions of certain differential equations, identifying the applications of multiple integrals and to get a brief idea of vector calculus.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		First Order Ordinary Differential Equations	9
	1	Basic Concepts. Modeling, Separable ODEs. Modeling (exclude extended method : reduction to separable form), Exact ODEs. In tegrating factors, Linear ODEs. Bernoulli equation (exclude Population Dynamics). Sections 1.1,1.3,1.4,1.5 of Text [1]	
II		Second Order Linear Ordinary Differential Equations	9
	2	Homogeneous linear ODEs of second order, Homogeneous linear ODEs with constant coefficients (exclude derivation in case III- complex exponential function), Existence and uniqueness of solutions. Wronskian, solving non-homogeneous ODE via the method of undetermined coefficients. Statement of theorems only. Sections 2.1,2.2,2.6,2.7 of Text [1]	



Module	Unit	Contents	Hrs
III		Multiple Integrals	9
	3	Double Integrals, Double integrals over non rectangular regions, Double integrals in polar coordinates, Triple integrals (definition of a triple integral, properties of triple integrals and evaluating triple integrals over rectangular boxes). Chapter 14: Section 14.1, 14.2, 14.3, 14.5 of Text [2]	
IV		Vector Calculus	9
	4	Vector Fields (definition), Inverse square field, Gradient field, Conservative fields and potential function, Divergence and Curl, Δ operator, The Laplacian Δ^2 , line integrals (Integrating a vector field along a curve only), Independence of path ; conservative vector fields (exclude conservative vector fields in 3- Space, and conservation of Energy) Green's theorem and applications (with out proof).Chapter 15: Section 15.1, 15.2, 15.3, 15.4 of Text [2].	
V		Suggestions for teacher designed module	9
	5	Triple integrals in cylindrical and spherical coordinates, Defining and evaluating surface integrals, their applications, Orientation of surfaces, evaluating flux integrals, The divergence theorem, Gauss' Law, Stoke's theorem, applications of these theorems. Chapter 15: Section 15.5, 15.6, 15.7, 15.8 of Text [2]	

Practical sessions and examinations – 30 hours

All the topics mentioned above can be used for practical sessions using SageMath software. Some specific problems and useful resources for solving these problems using the SageMath software are given below.

1. Defining symbolic functions and evaluating them
2. Formation of differential equations eliminating constants
3. Solving differential equations using desolve
4. Evaluating multiple integrals
5. Conversion of points between cartesian and polar co-ordinates
6. Evaluating triple integrals
7. Computing gradient, curl, divergence of functions
8. Evaluating using Green's theorem
9. Evaluating using Divergence and Stoke's theorems



A record should be maintained with atleast 7 problems from the main topics/teacher designed topics. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbooks

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition Wiley, 2018.
2. Howard Anton, Irel Bivens, Stephens Davis, *Calculus* 10th Edition Wiley, 2012.

References

1. Ian Sneddon, *Elements of Partial Differential Equations*, Mc Graw- Hill, 2013.
2. Peter. V. O Neil, *Advanced Engineering Mathematics*, Thompson Publications, 2007.
3. M. D. Raisinghaniya, *Ordinary and Partial Differential Equations*, S Chand 18th Edition, 2008.
4. G. F. Simmons, *Differential Equations with Applications and Historical Notes*, Tata McGraw-Hill, 2003.
5. G. B. Thomas, R. L. Finey, *Calculus*, 9th Edition, Addison-Weseley Publishing Company, 2004.

Resources for practical sessions

1. SageMath Documentation - Solving ordinary differential equations
<https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/desolvers.html>
2. Sage Quickstart for Differential Equations <https://doc.sagemath.org/html/en/prep/Quickstarts/Differential-Equations.html>
3. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes*
https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf
4. Sagemath documentation – Symbolic variables <https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html>



5. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus <https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf>
6. Sagemath documentation – Sage Quickstart for Multivariable Calculus <https://doc.sagemath.org/html/en/prep/Quickstarts/Multivariable-Calculus.html>
7. Sagemath documentation – Parametric plots https://doc.sagemath.org/html/en/reference/plot3d/sage/plot/plot3d/parametric_plot3d.html#sage.plot.plot3d.parametric_plot3d.parametric_plot3d
8. SageMath documentation – 3D Graphics <https://doc.sagemath.org/html/en/reference/plot3d/index.html>

Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand the concepts of ordinary differential equations, integration over multi variables geometric and physical interpretations of vector integration	PSO1, 2, PO3, 6, 7, 8	U, Ap	F,C	L	
CO 2	Analyze the solutions of ordinary differential equations, Multiple Integrals and Vector Integration	PSO 2,3, PO1, 2, 3, 6, 7, 8	U, An	C,P	L	
CO 3	Develop problem-solving skills and application skills	PSO 1, 2, 3, 4, PO1, 2, 3, 6, 7, 8	An, E	P	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)



Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1					3	-	1	-	-	2	1	1
CO2		3	1				1	1	3	-	-	2	1	1
CO3	1	3	2	3	2		1	3	3	-	-	3	1	1

(- -Nil, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- End Semester Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	---	---	✓
CO2	✓	✓		✓
CO3	✓	✓		✓

