University of Kerala

Discipline	Mathematics				
Course Code	UK3DSCMAT200				
Course Title	Integral Calculus and Foundations of Vector Calculus				
Type of Course	DSC				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3		2	5
Pre-requisites	1.Awareness of Differential Calculus and Integral Calculus				
	2. Knowledge of various co-ordinate systems in 2-dimension				
Course Summary	The course deal with identifying the applications of integration and vector valued functions				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Integral Calculus I**	**9**
	1	Area between two curves, Volume by Slicing (Exclude other axes of revolution), Volume by cylindrical shells (Exclude variations of the method of cylindrical shells). Chapter 5: Section 5.1, 5.2, 5.3 of Text [1]	
II		**Integral Calculus II**	**9**
	2	Length of the plane curve (exclude finding arc length by numerical methods) Area of surface of revolution, Work (Exclude calculating work from basic principles and the work energy relationship) Chapter 5: Section 5.4, 5.5, 5.6 of Text [1]	
III		**Vector Valued Functions I**	**8**

Module	Unit	Contents	Hrs
	3	Projections, Parametric equations of lines, Planes in 3-space, Cylindrical and spherical Coordinates (exclude spherical coordinates in navigation). Chapter 11: Section 11.3, 11.5, 11.6, 11.8 of Text [1]	
IV	**Vector Valued Functions II**		**10**
	4	Introduction to Vector-Valued Functions, Calculus of Vector-Valued Functions, Arc Length (arc length from the vector view point only), Unit Tangent, Normal Vectors, Curvature. Chapter 12: Section 12.1 to 12.5 of Text [1]	
V	**Suggestions for Teacher designed Module**		**9**
	5	Volume by Slicing-other axes of revolution, volume by cylindrical shells - variations of the method of cylindrical shells,Rectangular Coordinates in 3-Space; Spheres; Cylindrical Surfaces, spherical coordinates in navigation, Motion along a curve, Vectors, Dot Product, Cross Product, Binormal vectors Chapter 5: Sections 5.2, 5.3, Chapter 11: 11.1, 11.2, 11.3, 11.4, Chapter 12: 12.4, 12.6 of Text [1]	

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. Finding area between curves
2. Representation of a point in different co-ordinate systems (rectangular, polar, spherical)
3. Computing length of a plane curve
4. Finding area of surface of revolution
5. Defining vectors, computing their sum, difference, norm
6. Dot and cross products of vectors
7. Computing parametric equations of planes
8. Computing arc length
9. Computing unit tangent vector, normal vector, curvature

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.

Textbook

1. H Anton, I Bivens, S Davis. Calculus, 10th Edition, John Wiley & Sons, 2012.

References

1. Joel Hass, Maurice D. Weir, Thomas' Calculus Early Transcendentals, 12th Edition, Addison-Weseley Publishing Company, 2004.
2. J Stewart, Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited, 2008.
3. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. 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

P3. Sagemath documentation – Symbolic variableshttps://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

P5. Sagemath documentation – Sage Quickstart for Multivariable Calculus https://doc.sagemath.org/html/en/prep/Quickstarts/Multivariable-Calculus.html

P6. 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

P7. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P8. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P9. 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	Demonstrate applications of Integration	PSO3, PO1, 2, 3, 4, 5, 6, 7, 8	U,E	F,P	L	
CO 2	Computing area and volume using Integration	PSO2, PO1, 2, 3, 4, 5, 7, 8	U,An	F, P		
CO 3	Analysing geometry of curves and surfaces using Vector Calculus	PSO2, PO1, 2, 3, 4, 5, 6, 7, 8	U, E	F, P		
CO 4	Distinguish cylindrical and spherical co-ordinates	PSO4, PO1, 2, 3, 4, 5, 6, 7, 8	R, An	F, P		

(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				3	3	2	2	1	2	2	1
CO2		3					3	3	1	1	2		2	1
CO3		3					3	2	1	1	2		2	1
CO4				3			3	2	1	1	1	2	3	1

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

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1		✓		
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓