University of Kerala

Discipline	Mathematics				
Course Code	UK3DSCMAT204				
Course Title	Applications of Integration 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. Differentiation 2. Integration 3. Vectors				
Course Summary	This course enable the students to gain a thourough understanding of applications of integration and vector calculus				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Applications of Integration**	**9**
	1	Area Between Two Curves, Volumes by Slicing; Disks and Washers (Chapter 5: Sections 5.1, 5.2 of Text[1])	
	2	Length of a Plane Curve, Area of revolution (Chapter 5: Sections 5.4, 5.5 of Text[1])	
	3	Work (Exclude calculating work from basic principles and the work energy relationship)(Chapter 5: Section 5.6 of Text[1])	
II		**Vector Differentiation and Vector Integration**	**11**
	4	Vector fields (Definition; graphical representation of vector fields excluded), inverse square fields, Gradient fields, Conservative Fields and potential functions, Divergence and Curl, the ∇ operator, the Laplacian ∇^2(Chapter 15: Section 15.1 of Text[1])	

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Module	Unit	Contents	Hrs
	5	Line integrals - Exercise Set 15.2- problems 15-30, 33-36, 41-46, Green's Theorem (Exclude Green's Theorem for multiply connected regions) (Chapter 15: Section 15.2, 15.4 of Text[1])	
	6	Independence of Path; Conservative Vector Fields (Exclude conservation of energy), (Chapter 15: Sections 15.3 of Text[1])	
III		**Surface Integrals and Applications**	**8**
	7	Surface integrals (Chapter 15: Section 15.5 of Text[1])	
	8	Applications of surface integrals; Flux (evaluating flux integrals for parametric and non-parametric surfaces) (Chapter 15: Section 15.6 of Text[1])	
IV		**Divergence theorem and Stoke's Theorem**	**8**
	9	The divergence theorem (without proof), using the divergence theorem to find flux (Chapter 15: Sections 15.7 of Text[1])	
	10	Stoke's theorem (without proof), using Stoke's Theorem to calculate work (Chapter 15: Section 15.8 of Text[1])	
V		**Teacher Designed Module - Suggested Topics**	**9**
	11	Moments, Centers of Gravity, and Centroids (Chapter 5: Section 5.7 of Text[1])	
	12	Volumes by Cylindrical Shells (Chapter 5: Section 5.3 of Text[1])	
	13	Relationships between Green's theorem and Stoke's theorem (Chapter 15: Section 15.8 of Text[1])	

Practical sessions and examinations – 30 hours

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

1. Finding area between curves

2. Computing length of a plane curve

3. Sketching the vector fields

4. Computing the gradient, curl, and divergence of functins

5. Verifying Green's theorem for selected functions

6. Computing surface integrals

7. Computing flux

8. Verifying the Divergence, Stoke's theorems

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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

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

2. 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

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

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

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

6. Tutorial: Vector Calculus in Euclidean Spaces https://doc.sagemath.org/html/en/thematic_tutorials/vector_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

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

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

10. 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 various applications of integration	PSO 1, PO1, 6	U	F, C	L	
CO 2	Compute tangent lines to polar curves, arc length and area	PSO 2, 4, PO6	Ap, An	P	L	
CO 3	Describe the concepts Vector fields, Gradient fields, potential functions and vector integrals	PSO1, PO1, 6	U	F, C	L	
CO 4	Apply vector integrals to find areas	PSO 3, 4, PO1, 6	Ap, An	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	-	-	-	-	2	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	2	-	-
CO3	3	-	-	-	-	-	2	-	-	-	-	2	-	-
CO4	-	-	3	3	-	-	2	-	-	-	-	2	-	-

(- -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	✓	✓		✓

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