University of Kerala

Discipline	Mathematics				
Course Code	UK2DSCMAT103				
Course Title	Integral Calculus and Vectors				
Type of Course	DSC				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Integral of elementary functions 2. Vectors				
Course Summary	This course enable the students to find the integrals and know about the vector valued functions				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Definite Integral**	**9**
	1	Integration by Substitution, The Definite Integral *(Chapter 4: Sections 4.3, 4.5 of Text [1])*	
	2	Evaluating Definite Integrals by Substitution *(Chapter 4: Sections 4.9 of Text [1])*	
II		**Evaluation of Integrals**	**9**
	3	Integration by Parts *(Chapter 7: Section 7.2 of Text [1])*	
	4	Integrating Trigonometric Functions *(Chapter 7: Section 7.3 of Text [1])*	
III		**Vector Algebra**	**9**
	5	Three dimensional space, vectors, Cylindrical surfaces, algebra of vectors, norm of a vector, vectors determined by length and angle, vectors determined by length and a vector in the same direction, resultant of two Concurrent forces. *(Chapter 11: Sections 11.1, 11.2 of Text [1])*	

Module	Unit	Contents	Hrs
	6	Dot Product, Projections, Algebraic properties of dot product, Angle between vectors, Direction angles *(Chapter 11: Section 11.3 of Text [1])*	
IV	**Cross product and Vector Valued Functions**		**9**
	7	Cross product - Algebraic and geometric properties of cross product, scalar triple product, Algebraic and geometric properties of scalar triple product *(Chapter 11: Section 11.4 of Text [1])*	
	8	Introduction to vector valued Functions, Parametric Curves in 3-Space - The parametric equations (introduction only) vector valued functions (introduction only) vector form of a line segment (introduction only) *(Chapter 12: Sections 12.1 of Text [1])*	
V	**Suggestions for teacher designed module**		**9**
	For internal assessment examinations only.		
	9	Average Value of a Function and its Applications Trigonometric Substitutions Calculus of vector-valued Functions Limits and Continuity, Geometric interpretations of limits Derivatives, Geometric interpretation of the derivative, derivative rules Derivatives of dot and cross products (fundamentals only) Integrals of vector valued functions and integral rules (fundamentals only) Unit Tangent, Normal and Binormal vectors (introduction only) Normal and Tangential Components of Acceleration	
	These topics can be found in Chapter 4: Section 4.8, Chapter 7: Section 7.4, Chapter 12: Sections 12.2, 12.4 of Text [1].		

Topics for Practical sessions – 30 hours

1. Introducing the SAGEMATH interface, SAGE cell server; basic arithmetic involving operators $+, -, /$, exponentiation; functions like `sin, cos, tan,e,log, sqrt`, constant π
   Ref: P1, or section 2.3 of P2

2. Defining and using lists, dictionaries, sets, and accessing elements in lists and dictionaries
   Ref: section 5.1, 5.3, 5.4 of P3

3. Defining variables using `var`, defining polynomials, polynomial functions, evaluating them
   Ref: P3 or section 1.4 of P4

4. `diff` command to find derivatives of standard functions, polynomials, including higher order derivatives

Ref: Section 3.1 of P4

5. Sketching graphs of curves using `plot`
   Ref : Section 6.1 of P2

6. Defining vectors, finding their dot and cross products, scalar triple product, finding norm of vectors, find angle between them
   Ref: Section 3.3.5 of P2

7. Defining parametric functions, sketching the graphs
   Ref: P5, Section 6.1 of P2

8. Find arc length of parametric curves

9. Computing unit tangent and normal vectors, sketching the curve and plotting these vectors
   Ref : P6

10. Plotting in polar co-ordinates
    Ref: Section 3.3 of P7

11. Plotting cylindrical surfaces
    Ref: Section 7.1 of P2

Problems for the practical examination

1. Computing indefinite and definite integrals of standard functions (trigonometric, log, e, polynomials)

2. Demonstrate the plot command with various options (line style, color, thickness etc)

3. Defining and solving polynomial equations, evaluating them

4. Defining vectors, finding their dot product, norm

5. Finding angle between vectors

6. Defining vectors, finding their cross products

7. Defining vectors finding scalar triple product

8. Computing unit tangent vectors plotting them on the vector curves

9. Polar co-ordinate plotting

10. Plotting cylindrical surfaces

A record should be maintained with atleast 7 problems from the above. 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 10 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	Understand the concept of integration	PSO 1	U	F, C	L	
CO 2	Describe the integration of a function and learn its physical interpretation through various examples.	PSO 2, 4	Ap, An	P	L	
CO 3	Understand the concepts of three dimensional space, vectors, different vector operations, vector valued functions and calculus of vector valued functions	PSO 1	U	F, C	L	
CO 4	Able to find limits, derivatives of vector valued functions	PSO 2	Ap	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	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	3	2	3	-	-	-	3	2	-	-	-	-	-
CO3	3	-	-	-	-	-	3	-	-	-	-	-	-	-
CO4	-	3	3	-	-	-	3	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	✓	✓		✓