University of Kerala

Discipline	Mathematics				
Course Code	UK2DSCMAT102				
Course Title	Integration and Applications of differentiation				
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. Integration of elementary functions 2. Differentiation				
Course Summary	This course enables the student to understand the applications of differentiation and evaluate the integrals				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Applications of Derivatives**	**9**
	1	Related Rates, Analysis of functions - Increasing, Decreasing and Concavity, Relative Extrema excluding analysis of polynomials, Relative Maxima and minima, first derivative test, second derivative test, geometric implications of multiplicity	
	Chapter 2: Section 2.8 and Chapter 3: Section 3.1, 3.2 of Text[1]		
II		**Maximum Minimum Problems**	**9**
	2	Absolute maxima and minima (for finite closed intervals only), Applied maximum minimum problems (excluding application to economics), Mean value theorem, Rolle's Theorem	
	Chapter 3: Section 3.4, 3.5 and 3.8 of Text[1]		

Module	Unit	Contents	Hrs
III		**Definite Integral**	**9**
	3	Integration by Substitution, The Definite Integral	
	Chapter 4: Sections 4.3, 4.5 of Text [1]		
	4	Evaluating Definite Integrals by Substitution	
	Chapter 4: Sections 4.9 of Text [1]		
IV		**Evaluation of Integrals**	**9**
	5	Integration by Parts	
	Chapter 7: Section 7.2 of Text [1]		
	6	Integrating Trigonometric Functions	
	Chapter 7: Section 7.3 of Text [1]		
V		**Suggestions for teacher designed module**	**9**
	For internal assessment examinations only.		
	7	The following topics are suggested: Absolute maxima and minima on infinite intervals, absolute maxima and minima on open intervals, problems involving intervals that are not both finite and closed, Average Value of a Function and its Applications,Trigonometric Substitutions	
	These topics can be found in Chapter 3: Sections 3.4, 3.5, Chapter 4 Section 4.8, Chapter 7: Section 7.4 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. Solving polynomial equations and equations involving standard functions
   Ref : Section 2.2 of P7

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

7. Finding maxima, minima using first and second derivative tests.
   Ref : Section 4.2 of P4

8. Finding points of inflection and sketching them
   Ref : Section 4.2 of P4

9. Mean value theorem – verification and demonstration via sketching the curve and tangent
   Ref : P9

10. Using `integrate` command to compute indefinite and definite integrals
    Ref : Section 3.3.4 of P2

11. Finding average value of a function over an interval, sketch it to demonstrate its relation with the MVT
    Ref : Section 6.2 of P4

Problems for the practical examination

1. Defining polynomials, polynomial functions, evaluating them
2. Solving polynomial equations and equations involving standard functions
3. Sketching graphs of curves using plot with various styling options (thickness, line style, color etc)
4. Finding maxima, minima using first and second derivative tests.
5. Determine if the curve is concave up or down, sketch it.
6. Finding points of inflection and sketching them
7. Plotting tangent of a curve at specified point on the curve
8. Mean value theorem verification, and sketching
9. Integrate various standard functions (indefinite and definite)
10. Finding avarage value of function

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.

Textbooks

1. H Anton, I Bivens, S Davis, *Calculus*, 10^{th} Edition, John Wiley & Sons.

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, 2004.

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. Ajit Kumar, One Variable Calculus with SageMath https://ajitmathsoft.wordpress.com/wp-content/uploads/2019/07/cal_onevar_sage.pdf

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	Evaluation of integrals of functions and learn its physical interpretation through various examples	PSO 2, 4	Ap, An	P	L	
CO 3	Define maxima, minima, critical points and points of inflection	PSO 1	U	F, C	L	
CO 4	Apply the concept of differentiation in real life situation	PSO 3, 4	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	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	3	-	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	✓	✓		✓