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*, 10th 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 variables `https://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`