University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT108				
Course Title	Differential Calculus				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3	-	2	5
Pre-requisites	Functions				
Course Summary	Brief review of calculus, Polynomial and elementary transcendental functions and their applications, derivatives, extremum problems, curve-sketching, approximations, Use of symbolic manipulation and graphics software in calculus.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Introduction to derivatives**	**9**
	1	The derivative of a function, Algebra of derivatives – derivatrives of sum, product, quotient, Sections 2.2, 2.3, 2.4 of Text[1] (Proofs of theorems excluded)	
II		**Chain rule**	**9**
	2	The chain rule. Implicit differentiation. Sections 2.6, 2.7 of Text[1]	
III		**Special derivatives**	**9**
	3	Derivatives of logarithmic, exponential and inverse functions, L'Hopital rule. Sections 6.1, 6.2, 6.3, 6.5 of Text[1] (Integrals involving logarithmic, exponenial and inverse functions are excluded)	

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Module	Unit	Contents	Hrs
IV		**Analysis of functions using derivatives**	**9**
	4	Increasing, decreasing and concavity, extremum problems, absolute maxima and minima, Sections 3.1, 3.2, 3.4 of Text[1]	
V		**Topics suggested for the teacher designed module**	**9**
	5	Families of functions, inverse functions, Exponential and logarithmic functions, related rates and local linear approximation, graphing polynomials, Rolle's theorem, Mean-value theorem	

Note : In all these topics above, proofs of theorems are to be excluded.

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Demonstrate the basic arithmetic operations (`+`, `-`, `*`, `^`, `/`)

2. Demonstrate how to use the standard trigonometric, log, exponential functions, and how to evaluate them at given real numbers

3. Define polynomials of various order, evaluate them

4. Define functions, and evaluate two-sided limits

5. Define functions, and evaluate one-sided limits

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

7. Define functions, find their derivatives of different orders

8. Solving polynomial equations and equations involving standard functions

9. Sketching graphs of curves using plot with various styling options (thickness, line style, color etc)

10. Finding maxima, minima using first and second derivative tests.

11. Finding points of inflection and sketching them

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, 2012.

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

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.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)	Assignment (As)
CO 1	Understand the basic concept of functions, limit, continuity and derivatives	PSO1,2, PO1	U	F,C	L,T	
CO 2	Analyse the properties of functions using derivatives	PSO2, PO3, 4	An	F	L,T	
CO 3	Apply deferentiation techniques to solve various problems	PSO1,3, PO2, 3	U,An	C	L,T	

(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	2	1					3							
CO2		2							1	3				
CO3	2		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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