University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT104				
Course Title	Differentiation and Theory of Numbers				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
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				
Course Summary	This course provides a brief idea about differentiation and theory of numbers.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Differentiation**		**9**
	1	Tangent lines and rate of change, The derivative function[Chapter 2 Sections 2.1, 2.2 of Text 1]	
	2	The Chain Rule, Implicit Differentiation [(Chapter 2 Sections 2.6, 2.7 of Text 1]	
II	**Differentiation of exponential and logarithmic functions**		**9**
	3	Exponential and logarithmic functions (review only) [Chapter 6 Section 6.1 of Text 1]	
	4	Derivatives involving Exponential and logarithmic functions [Chapter 6 Section 6.2 of Text 1]	
	5	L'Hospital's rule [Chapter 6 Section 6.5 of Text 1]	

Module	Unit	Contents	Hrs
III		**Divisibility**	**9**
	6	Mathematical induction : Well-ordering Principle, Weak version of induction, Principle of Mathematical induction [Chapter 1 Sections 1.3 of Text 2 (Exclude all from Example 1.12)]	
	7	Division Algorithm : Theorem 2.1, Example 2.1, Div and Mod operators, Theorem 2.2, Example 2.2, Theorem 2.3,Theorem 2.4. Exclude the subsections marked as *Optional* [Chapter 2 - Section 2.1 of Text 2]	
	8	Prime and Composite Numbers : Prime numbers, composite numbers, Lemma 2.1, Theorem 2.8, Theorem 2.9, Example 2.22. Exclude the subsections marked as *Optional*, The topics in this section is covered upto Example 2.22 [Chapter 2 - Section 2.5 of Text 2]	
IV		**The Euclidean Algorithm**	**9**
	9	Greatest Common Divisor : Definition of GCD, Relatively prime integers, Lemma 3.1, Theorem 3.2, Theorem 3.4. Exclude the subsections marked as *Optional* [Chapter 3 Section 3.1 of Text 2]	
	10	The Euclidean Algorithm : Theorem 3.11, Example 3.5, Example 3.6, The Euclidean algorithm, Example 3.7, Example 3.8. Exclude the subsections marked as *Optional* [Chapter 3 Section 3.2 of Text 2]	
	11	The Fundamental Theorem of Arithmetic : Lemma 3.3, Lemma 3.4, Corollary 3.9, Theorem 3.13(Without proof), Canonical decomposition, Example 3.9, Example 3.10. The topics in this section is covered upto Example 3.10. [Chapter 3 Sections 3.3 of Text 2]	
V		**Teacher designed module - suggested topics**	**9**
	12	Tangent lines and limits (review only), One sided limits (review only), Limits at infinity, Infinite limits, Continuity (up to continuity of composite functions)[Chapter 1 Sections 1.1, 1.3, 1.4 and 1.5 of Text 1]	
	13	Introduction to Techniques of Differentiation, The Product and Quotient Rules, Derivatives of Trigonometric Functions (review only) [Chapter 2: Sections 2.3, 2.4, 2.5 of Text 1]	
	14	Strong version of induction [Section 1.3 - Theorem 1.7 of Text 2]	
	15	Union, Intersection and Complement, The inclusion exclusion principle[Chapter 2 - Section 2.1 - Theorem 2.6 of Text 2]	
	16	Least Common Multiple : Definition of LCM, Important Observation, Example 3.14, Theorem 3.17, Example 3.15, Corollary 3.10. [Chapter 3 Sections 3.4 of Text 2]	

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. Demonstrating basic arithmetic operators `+, −, ⋆, ^,` , modulo operator`%`
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 one-sided limits
5. Define functions, and evaluate two-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. Finding remainder and quotient
9. Finding Gcd using Euclidean algorithm
10. Problems using inclusion-exclusion principle
11. Determining if a number is a prime, finding list of primes
12. Using Euler ϕ function
13. Canonical decomposition

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. Howard Anton, Irl Bivens, Stephens Davis, Calculus 10th Edition ,Wiley,2012.
2. Thomas Koshy, Elementary Number Theory with Applications, 2nd Edition, Academic Press, 2007.

References

1. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.

2. K. F. Riley, .M. P. Hobson, S. J. Bence, Mathematical Methods for Physics and Engineering, Third Edition, Cambridge University Press, 2006.

3. J Stewart, Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited, 2008.

4. Mary L Boas, Mathematical Methods in Physical Science, 3rd Edition, 2006.

5. David M. Burton, Elementary Number Theory, 7th Edition, McGraw Hill, 2011.

6. G A Jones, J M Jones, Elementary Number Theory, Springer, 1998.

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

P7. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

P8. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.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	Calculate the solution of algebraic and transcendental equation using numerical methods	PO 2, PSO1, 2,3	U, Ap	F,C	L	
CO 2	Apply numerical techniques to interpolate data points effectively	PO1, PSO1, 2,3	U, Ap	F,C	L	
CO 3	Apply numerical techniques for differentiation and integration	PO2, PSO1, 2,3	U, Ap	F,C	L	
CO 4	Calculate the solution of ordinary differential equations using numerical methods	PO2, PSO1, 2,3	U, Ap	F,C	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	2	-	-	-	-	3	-	-	-	-	-	-
CO2	3	3	2	-	-	-	3	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	3	-	-	-	-	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam