University of Kerala

Discipline	Mathematics				
Course Code	UK4SECMAT201				
Course Title	Numerical Methods				
Type of Course	SEC				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	3	2	-	2	4
Pre-requisites	1. Differentiation 2. Integration				
Course Summary	This course enable the students to gain a thourough understanding of various numerical methods used for solving mathematical problems				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Solution of Algebraic and Transcendental equations**	**6**
	1	Introduction, Bisection Method, Method of false position. Chapter 2: Section 2.1 to 2.3 of Text	
	2	Iteration Method, Newton-Raphson method. Chapter 2: section 2.4 to 2.5 of Text	
II		**Interpolation**	**6**
	3	Finite differences. Chapter 3: Section 3.3 (excluding 3.3.4)	
	4	Newton's formulae for interpolation. Chapter 3: Section 3.6 of Text	
III		**Numerical Differentiation**	**6**
	5	Numerical differentiation. Chapter 6: Section 6.2 (excluding 6.2.1 and 6.2.2) of Text	
	6	Maximum and Minimum values of a tabulated function. Chapter 6: Section 6.3 of Text[1]	

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Module	Unit	Contents	Hrs
IV		**Numerical Integration**	**6**
	7	Numerical integration Chapter 6: Section 6.4.1 to 6.4.3 of Text	
V		**Teacher Designed**	**6**
	8	Ramanujan's method, Secant method. Chapter 2: Section 2.6 to 2.8 of Text	
	9	Interpolation with unevenly spaced points. Chapter 3: Section 3.9	

Topics and problems for Practical sessions and practical examinations using SageMath software – 30 hours

Note : All these problems are to be done either using a for/while loop or use atleast 5 individual iterations.

1. Bisection method

2. Method of false position

3. Iteration method

4. Newton-Raphson method

5. Finite differences

6. Newton's formulae for interpolation

7. Numerical differentiation

8. Trapezoidal rule for integration

9. Simpson's 1/3 rule

10. Simpson's 3/8 rule

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, the student should be able to answer two problems selected by the examiner from the 7 available in the record . Some useful resources for solving these problems using the SageMath software are given below.

1. SageMath – documentation
   https://doc.sagemath.org/html/en/tutorial/introduction.html

2. Online SageMath server https://sagecell.sagemath.org/

3. Solving equations using SageMath https://doc.sagemath.org/html/en/tutorial/tour_algebra.html

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4. Bisection method https://wiki.sagemath.org/interact/calculus#Root_Finding_Using_Bisection

5. Newton-Raphson method https://www.sfu.ca/~jtmulhol/calculus-applets/html/sagemath-cell-newtonsmethod.html

6. Interpolation problems https://www.youtube.com/watch?v=2lPNfYNSoJA

7. Numerical methods https://www.cfm.brown.edu/people/dobrush/am33/sage/ch3/part3.html

Textbook

1. S.S. Sastry, *Introductory Methods of Numerical Analysis* , Fifth edition, PHI Learning Pvt. Ltd, 2012

References

1. A. C. Faul, *A Concise Introduction to Numerical Analysis*, CRC Press, 2016.

2. Richard L. Burden and J. Douglas Faires, *Numerical Analysis*, Ninth Edition, Cengage Learning, 2011.

3. Timo Heister, Leo G. Rebholz, and Fei Xue, *Numerical Analysis — An Introduction*, De Gruyter, 2019.

4. Timothy Sauer, *Numerical Analysis*, Third Edition, Pearson Education, 2018.

5. Razvan A. Mezei, *An Introduction to Sage Programming with Applications to SAGE Interacts for Numerical Methods*, Wiley, 2016.

6. Solving Equations using SageMath. https://doc.sagemath.org/html/en/tutorial/tour_algebra.html

7. Gregory V. Bard, *Sage for Undergraduates* (online version). https://www.faculty.luther.edu/~bernatzr/Courses/M351/sage_for_ug_color.pdf

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

9. Robert A. Beezer, *A First Course in Linear Algebra*. http://linear.ups.edu/html/sage.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	Find 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	PO2, PSO1, 2,3	U, Ap	F,C	L	
CO 4	Apply numerical techniques for integration	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

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- 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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