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University of Kerala

Discipline	Mathematics				
Course Code	UK3DSCMAT203				
Course Title	Numerical Analysis				
Type of Course	DSC				
Semester	III				
Academic Level	200-299				
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 3. Solution of system of equations				
Course Summary	This course enable the students to gain a thorough understanding of various numerical methods used for solving mathematical problems				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Solution of Algebraic and Transcendental equations**	**9**
	1	Introduction, Bisection Method, Method of false position. Chapter 2: Section 2.1 to 2.3 of Text[1]	
	2	Iteration Method (excluding acceleration of convergence: Aitken's Δ^2 -process), Newton-Raphson method (excluding generalized Newton's method) . Chapter 2: section 2.4 to 2.5 of Text[1]	
II		**Interpolation**	**10**
	3	Finite differences. Chapter 3: Section 3.3 excluding 3.3.4	
	4	Newton's formulae for interpolation, Central difference interpolation formulae, Chapter 3: Section 3.6, 3.7 of Text[1]	
III		**Numerical Differentiation**	**8**
	5	Numerical differentiation. Chapter 6: Section 6.2 (excluding 6.2.1 and 6.2.2) of Text[1]	

Module	Unit	Contents	Hrs
	6	Maximum and Minimum values of a tabulated function. Chapter 6: Section 6.3 of Text[1]	
IV	**Numerical Integration and Solution of Ordinary Differential equations**		**9**
	7	Numerical integration Chapter 6: Section 6.4.1 to 6.4.4 of Text[1]	
	8	Solution by Taylor's series Chapter 8: Section 8.2 of Text[1]	
	9	Picard's method of Successive Approximations. Chapter 8: Section 8.3 of Text[1]	
V	**Suggestions for the teacher designed module**		**9**
	10	Ramanujan's method, Secant method, Muller's method. Chapter 2: Section 2.6 to 2.8 of Text[1]	
	11	Divided differences and their properties. Chapter 3: Section 3.10 of Text[1]	
	12	Euler's method Chapter 8: Section 8.4 of Text[1]	
	13	Runge- Kutta Methods.Chapter 8: Section 8.5 of Text[1]	

Practical sessions and examinations – 30 hours

All the topics mentioned above should be used for practical sessions using SageMath software. 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
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

A record should be maintained with atleast 7 problems from the main topics/teacher designed topics. 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.

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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, J. Douglas Faires,*Numerical Analysis* , Ninth Edition, Cengage Learning, 2011.
3. Timo Heister, Leo G. Rebholz, Fei Xue, *Numerical Analysis An Introduction* , De Gruyter, 2019.
4. Timothy Sauer, *Numerical Analysis*, Third Edition, Perason Education, 2018.

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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

- 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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