University of Kerala

Discipline	Mathematics				
Course Code	UK2DSCMAT104				
Course Title	Integral Calculus and Ordinary Differential Equations				
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 2. Differentiation				
Course Summary	This course enable the students to find the integrals and to solve certain differential equations				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Definite Integral**	**9**
	1	Integration by Substitution, The Definite Integral *(Chapter 4: Sections 4.3, 4.5 of Text [1])*	
	2	Evaluating Definite Integrals by Substitution *(Chapter 4: Sections 4.9 of Text [1])*	
II		**Evaluation of Integrals**	**9**
	3	Integration by Parts *(Chapter 7: Section 7.2 of Text [1])*	
	4	Integrating Trigonometric Functions *(Chapter 7: Section 7.3 of Text [1])*	
III		**Differential Equations**	**9**
	5	Solution curves without a solution (not meant for examination purpose), Separable Equations *(Chapter 2: Sections 2.1, 2.2 of Text [2])*	
	6	Linear Equations, Exact Equations *(Chapter 2: Section 2.3, 2.4 of Text [2])*	

Module	Unit	Contents	Hrs
	7	Solutions by Substitutions, A Numerical Method *(Chapter 2: Section 2.5, 2.6 of Text [2])*	
IV	**Higher Order Differential Equations**		**9**
	8	Initial-Value and Boundary-Value Problems, Homogeneous Equations, Nonhomogeneous Equations, *(Chapter 3: Sections 3.1 of Text [2])*	
	9	Homogeneous Linear Equations with Constant Coefficients *(Chapter 3: Section 3.3 of Text 2)*	
V	**Suggestions for teacher designed module**		**9**
	For internal assessment examinations only.		
	10	Average Value of a Function and its Applications Trigonometric Substitutions Linear Models, Nonlinear Models Reduction of Order Cauchy–Euler Equations	
	These topics can be found on Chapter 4: Section 4.8, Chapter 7 Section 7.4 of Text [1] and Chapter 2: Section 2.7, 2.8, Chapter 3: Section 3.6 of Text [2]		

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. Using `integrate` command to compute indefinite and definite integrals
   Ref : Section 3.3.4 of P2

5. Finding average value of a function over an interval, sketch it to demonstrate its relation with the MVT
   Ref : Section 6.2 of P4

6. `diff` command to find derivatives of standard functions, polynomials
   Ref: Section 3.1 of P4

7. Solving differential equations (de) using `desolve`
   Ref : P11

8. Solving linear ODE of first order
   Ref : Section 1.4 of P10, Section 10.1 of P2

9. Solving separable ODE of first order
   Ref : Section 1.4 of P10, Section 10.1 of P2

10. ODE Initial value problems
    Ref : Section 1.2 of P10

11. Solving Higher order constant coefficient linear homogeneous ODEs
    Ref : Section 1.3 of P10

12. Numerical solutions to ODE
    Ref : Section 1.6 of P10

Problems for the practical examination

1. Computing indefinite and definite integrals of standard functions (trigonometric, log, e, polynomials)

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

3. Defining and solving polynomial equations, evaluating them

4. Finding avarage value of function using integration

5. Solving differential equations

6. Solving linear ODE of first order

7. Solving separable ODE of first order

8. ODE Initial value problems

9. Solving Higher order constant coefficient linear homogeneous ODEs

10. Numerical solutions to ODE

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

2. Dennis G. Zill, *Advanced Engineering Mathematics* 6th Edition, Jones & Bartlett Learning, 2016.

References

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley Publishers, 10th Edition, 2018.

2. Joel Hass, Maurice D. Weir, *Thomas' Calculus Early Transcendentals*, 12th Edition, Addison-Weseley Publishing Company, 2004.

3. Peter V. O. Neil, *Advanced Engineering Mathematics*, Thompson Publications, 2007.

4. G. F. Simmons, *Differential Equations with Applications and Historical Notes*, Tata McGraw- Hill, 2003.

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

6. 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 variableshttps://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 – Parametric plots https://doc.sagemath.org/html/en/reference/plot3d/sage/plot/plot3d/parametric_plot3d.html#sage.plot.plot3d.parametric_plot3d.parametric_plot3d

P6. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P7. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P8. SageMath documentation – 3D Graphics https://doc.sagemath.org/html/en/reference/plot3d/index.html

P9. Ajit Kumar, One Variable Calculus with SageMath https://ajitmathsoft.wordpress.com/wp-content/uploads/2019/07/cal_onevar_sage.pdf

P10. David Joyner, Marshall Hampton, *Introductory Differential Equations using Sage* http://www.sandal.tw/upload/Introduction%20to%20Differential%20Equations%20Using%20Sage%20[David%20Joyner,%20Marshall%20Hampton.pdf

P11. Sagemath documentation – Sage Quickstart for Differential Equations https://doc.sagemath.org/html/en/prep/Quickstarts/Differential-Equations.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	Understand the concept of integration	PSO 1	U	F, C	L	
CO 2	Describe the integration of a function and learn its physical interpretation through various examples.	PSO 2, 4	Ap, An	P	L	
CO 3	Demonstrate a thorough understanding of basic concepts in ordinary differential equations and initial value problems.	PSO 1	U	F, C	L	
CO 4	Able to solve various types of first-order, second order ordinary differential equations, including separable equations, linear equations and equations with constant coefficients	PSO 2, 5	Ap	P	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	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	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	✓	✓		✓