SEMESTER STUDY PLAN INTRODUCTION TO FRACTIONAL CALCULUS AND APPLICATIONS (ELECTIVE COURSES) Case-Based Method



DEPARTMENT OF MATHEMATICS AND DATA SCIENCE FACULTY OF MATHEMATICS AND NATURAL SCIENCES UNIVERSITAS ANDALAS

2024



SEMESTER STUDY PLAN (SSP) BACHELOR PROGRAM OF MATHEMATICS FACULTY OF MATHEMATICS AND NATURAL SCIENCES UNIVERSITAS ANDALAS

Course Name			Course Code	URL I-	URL I-Learn		Semester	Compilation Date	
Introduction to Fraction Applicat	onal Calculu ions	is and	MAT62223	https://sci.ilearn.unand.ac.id		3	6	February 12, 2024	
Person in Charge			Study Plan Creator Head of			ad of Research Group Head of the study p			
			Efenc	li, M.Si	Dr. Har	ipamyu	Dr. N	overina Alfiany	
Intended Learning	Intended	Learning Outcomes							
Outcomes (ILO) and Performance Indicators (PI)	ILO-4	An abil mather PI-1: A sin PI-2: A m PI-3: A co	ity to use conce natical problem n ability to choo nple mathemati n ability to illus athematical con n ability to solv ncepts and tech	pt and fundamer s ose appropriate b ical problems strate simple mat cepts and technic e simple mathem niques	ntal technique pasic mathema hematical prol ques natical problen	of mathemati tical concepts olems based c ns using appr	cs in solvin and techni on appropri opriate bas	g simple ques in solving ate basic ic mathematical	
	ILO-5	An abil methoc PI- PI-	lity to formally a ls that have bee 1: An ability to 2 : An ability to	and correctly pro n studied. identify the form use facts and apj	ves a simple n al structures a ply methods ir	nathematical s nd analogy fo n proving sim	statements orms in mat ple mathen	using facts and hematics natical statements	

	PI-3: An ability to present simple mathematical statements proof rigorously (sequentially and
	consistently)
	PI-4: An ability to conclude or interpret the results of the proving simple mathematical statement
ILO-6	Have an ability data literacy and technology and can apply them in solving simple mathematical
	problems or other relevant fields
	PI-1: An ability to identify the right data and technology to solve simple mathematical problems or other fields
	PI-2: An ability to use data and technology and apply them to solve simple mathematical statements or other areas
	PI-3: An ability to process data using available technology in simple mathematical problems or other fields
	PI-4: An ability to conclude and interpret data processing results for simple mathematical
	problems or other fields
	PI-5: An ability to design an algorithm to solve simple mathematical problems or other fields
ILO-7	An ability to communicate effectively especially in the area of mathematics in with diverse
	communities
	PI-1 An ability to convey ideas or study results orally, especially in the field of mathematics
	PI-2: An ability to present ideas or study results in writing, especially in the field of
	mathematics
6 -	PI-5: An ability to respond to reedback given
Course Le	earning Outcomes
1	Students are able to understand the main idea of fractional calculus.
2	Students are able to calculate and analyze fractional integrals.
3	Students are able to calculate and analyze fractional derivatives
4	Students are able to calculate and analyze fractional differential equations.
5	Students are able to apply fractional calculus.

	6	6 Students are able to communicate the results of their thoughts and work both orally and in writing.								
Brief description	This course integrals an discussed is Integrals Differential the opportu abilities in o are given g	This course discusses Fractional Calculus . The lecture begins with definitions and theorems related to integrals and fractional derivatives developed by mathematicians Riemann and Liouville. The material discussed is History of Fractional Calculus, Definition of Fractional Calculus, Riemman Liovile Fractional Integrals. After the mid-semester evaluation, Riemman Liovile Fractional Derivatives and Fractional Differential Equations were introduced. Towards the end of the semester evaluation , participants will have the opportunity to study various applications of Fractional Calculus. To complement students' skills and abilities in communicating mathematically and using Maple software, towards the end of the semester they are given group collaboration assignments related to topics in Fractional Calculus								
Course Materials	 Introduct Riemann Riemann Fractiona Applicat 	 Introduction Riemann-Liovile Fractional Integrals Riemann-Liovile Fractional Derivatives Fractional Differential Equations Application 								
References	Main : 1. A.M Supporters 1. J.M. Kent	 Main : A.M. Mathai, HJ Haubold; An Introduction to the Fractional Calculus, John Wiley & Sons, Inc., 2017. Supporters : J.M. Kimeu; Fractional Calculus: Definitions and Applications, Master Thesis, 2009. Western Kentucky University 								
Instructional Media	Softwares:	oftwares: Hardwares :								
	• LMS Un (<u>http://</u>	 LMS Unand (<u>http://fmipa.ilearn.unand.ac.id/</u>) Computer/Laptop Smartphones 								

	Zoom meetings
	• WhatsApp
Team Teaching	1. Efendi, M.Sc
Required courses	Calculus 1
Academic Norms	https://akademik.unand.ac.id/images/2022-03- 30%20Peraturan%20Rektor%20Nomor%207%20Tahun%202022%20Penyelenggaraan%20Pendidikan- khusus%20Bab%20II.pdf

I. Weekly Lecture Plan

					Activit	ies/Forms of Le Time estimated	arning 1]			
Week/	Course	Indicators	Assessment	Synchron	ous *	Asynchi	ronous **			
Meet (1)	Outcomes (2)	(3)	(4)	Face to face Offline (5)	Face to face Online (6)	Individual (7)	Collaborative (8)	Media (9)	Subject, references (10)	Weight (11)
1/1	• CPMK 1 Students are able to understand the main ideas of Fractional Calculus. (CP-2: PI-1, PI-2, PI-3))	 Discipline in carrying out college contracts Accurate understanding of related material 	MIDTERM EXAM (2%)	 SL Introduction to RPS Studying : concept explanation, discussion and question and answer course material [1 x 2x 50] minutes 		• A.M Students look for references according to the RPS and study lecture material: Analytical geometry of planes and space [2 x 2 x 120 minutes]		LMS (ilearn UNAND)	 Introduction to College (Assessment Rules, RPS, Syllabus, Tuition Contract) A Glimpse into Fractional Calculus [1] 	3%

2/2	• CPMK 1 Students are able to understand the main ideas of Fractional Calculus. (CP- 2: PI-1, PI-2, PI-3))	• Accurate understanding of related material	MIDTERM EXAM (2%)	 SL Studying : concept explanation discussion and question and answer course material x 2 x 50 minutes 	• A.M Students look for references and study material equations of circles and ellipses [2 x 2 x 120 minutes]	LMS (ilearn UNAND)	Introduction to Fractional Calculus [1]	3%
3/3	• CPMK 1 Students are able to understand the main ideas of Fractional Calculus. (CP- 2: PI-1, PI-2, PI-3))	• Accurate understanding of related material	MIDTERM EXAM (3%)	 SL Studying : concept explanation discussion and question and answer course material [1 x 2 x 50 minutes] 	• A.M Students look for references and study material using TDK II and the substitution method to calculate	LMS (ilearn UNAND)	Introduction to Fractional Calculus [1]	3%

					definite integrals [2 x 2 x 120 minutes]			
4/4	• CPMK 2 Students are able to calculate and analyze isometry. CP- 2: PI-1, PI-2, PI-3))	• Accurate understanding of related material	MIDTERM EXAM (3%)	 SL Studying : concept explanation discussion and question and answer course material x 2 x 50 minutes] 	• A.M Students look for references and study material on parametric equations and curvature of curves [2 x 2 x 120 minutes]	LMS (ilearn UNAND)	Riemann-Liovile Fractional Integrals [1]	3%
5/5	• CPMK 2 Students are able to calculate and analyze CP-2 fractional integra: PI-1, PI-2, PI-3))	• Accurate understanding of related material	MIDTERM EXAM (3%)	 SL Studying : concept explanation discussion and question and answer course material x 2 x 50 minutes 	• A.M Students look for references and study material rotation [2 x 2 x 120 minutes]	LMS (ilearn UNAND)	Riemann-Liovile Fractional Integrals	3%

				Tutorials [1 x 2 x 50 minutes]				
6/6	• CPMK 2 Students are able to calculate and analyze CP-2 fractional integra: PI-1, PI-2, PI-3))	• Accurate understanding of related material	MIDTERM EXAM (4%)	 SL Studying : concept explanation discussion and question and answer course material x 2 x 50 minutes 	• A.M Students look for references and study polar coordinates material [2 x 2 x 120] minutes	LMS (ilearn UNAND)	Riemann-Liovile Fractional Integrals	3%
7/7	• CPMK 6 Students are able to communicate the results of their thoughts and work both orally and in	 Accurate understanding of related material Accuracy in carrying out tasks 	presentation	 SL Studying : concept explanation discussion and question and answer course material 	• A.M Students look for references and study material on the length of curves and tangent lines	LMS (ilearn UNAND)	Presentation	8%

	writing. (CP- 7: PI-1, PI-2, PI-3)			[1 x 2 x 50 minutes]		in polar coordinates [2 x 2 x 120] minutes				
	ļ		1	Mid	-Term Exam	(30%)	1	ł		
8/8	• CPMK 3 Students are able to calculate and analyze fractional derivatives (CP 4: PI-1, PI-2, PI-3)	• Accuracy in explaining and understanding related material	FINAL EXAM (3%) Quiz (5%)	Studying : - concept explanation - discussion and question and answer course material [1 x 2 x 50] minutes		Students look for references and study material on Cartesian coordinates in dimensional space three [2 x 2 x 120 minutes]		LMS (ilearn UNAND)	Riemann-Liovile Fractional Derivatives	8%
9/9	• CPMK 3 Students are able to calculate and analyze fractional derivatives (CP 4: PI-1, PI-2, PI-3	• Accuracy in explaining and understanding related material	FINAL EXAM (3%)	Studying : - concept explanation - discussion and question and answer course material [1 x 2 x 50] minutes		Students look for references and study material on vector-valued functions [2 x 2 x 120 minutes]		LMS (ilearn UNAND)	Riemann-Liovile Fractional Derivatives [1]	3%

10/10	• CPMK 4 Students are able to calculate and analyze fractional differential equations (CP 4: PI-1, PI-2, PI-3)	 Accuracy in explaining and understanding related material Accuracy in answering quiz questions 	FINAL EXAM (3%) Quiz (5%)	Studying : - concept explanation - discussion and question and answer course material [1 x 2 x 50] minutes	Students look for references and study curvilinear motion [2 x 2 x 120 minutes]	LMS (ilearn UNAND)	Fractional Differential Equations [1]	3%
11/11	• CPMK 4 Students are able to calculate and analyze fractional differential equations (CP 4: PI-1, PI-2, PI-3)	• Accuracy in explaining and understanding related material	FINAL EXAM (3%)	Studying : - concept explanation - discussion and question and answer course material [1 x 2 x 50] minutes	Students look for references and study the equations of tangent lines in three- dimensional space [2 x 2 x 120 minutes]	LMS (ilearn UNAND)	Fractional Differential Equations [1]	3%
12/12	• CPMK 5 Students are able to apply fractional Calculus (C-6: PI-1- PI-4)	• Accuracy in explaining and understanding related material	FINAL EXAM (4%)	Studying : - concept explanation - discussion and question and answer course material [1 x 2 x 50] minutes	Students look for references and study tube coordinates [2 x 2 x 120 minutes]	LMS (ilearn UNAND)	Application [1]	4 %

13/13	• CPMK 5	• Accuracy in	FINAL	Studying :	Students look		LMS	Application	9 %
	Students are able to apply fractional Calculus (C-6: PI-1- PI-4)	explaining and understanding related materialAccuracy in answering quiz questions	EXAM (4%) Quiz (5%)	 concept explanation discussion and question and answer course material [1 x 2 x 50] minutes 	for references and study spherical coordinates [2 x 2 x 120 minutes]		(ilearn UNAND)	[1]	
14/14	• CPMK 6 Students are able to communicate the results of their thoughts and work both orally and in writing. (CP- 7: PI-1, PI-2, PI-3)	 Skills in explaining in the form of presentations Accuracy of answers in discussions Skills in using mathematical software Accuracy in answering assignment questions Neatness in completing tasks Originality of task results 	Task (5 %) Presentation (5 %)	Discussion/Pr esentation: - concept explanation - discussion and question and answer course material [1 x 2 x 50 minutes]	• A.M Students look for references independent ly regarding analytical geometry topics and use mathematica l software to solve them [1 x 2 x 60 minutes]	• AK Students discuss in groups and make presentations in class [1 x 2 x 60 minutes]	LMS (ilearn UNAND)	presentation [1]	10 %

Final Exam (30%)

Indicators, Criteria and Assessment Weights

1. Assessment Weight for Each Form of Assessment

NO	Form of Assessment	WEIGHT (%)
1	Mid-Term Exam	30 %
2	Final Exam	30%
3	Quizzes	15 %
4	Presentation	10 %
5	Tasks (Presentations, reports)	15 %
	TOTAL	100 %

2. Assessment weight for each course learning achievement

- CLO-1: 15 %
- CLO 2: 25%
- CLO 3: 20 %
- CLO 4: 20 %
- CLO 5: 10 %
- CLO 6: 10 %

II. Assessment Plan Table

	Form of assessment										
CLO	Mid-Term	Final	Quizzes	Presentation	Homework						
CLOS	Exam (%)	Exam	(%)		/Reports						
		(%)			(%)						
1. Students are able to understand the main idea of fractional	15%				15%						
calculus.											
2. Students are able to calculate and analyze fractional	15%			10%	25%						
integrals.											
3. Students are able to calculate and analyze fractional		15 %		5%	20%						
derivatives											
4. Students are able to calculate and analyze fractional		15%		5%	20%						
differential equations.											
5. Students are able to apply fractional calculus.			10%		10%						
6. Students are able to communicate the results of their				10%	10%						
thoughts and work both orally and in writing.											
Total Weight	30%	30%	10%	30%	100%						

Matrix of CLOs and ILOs

					II	.0			
CLOs	1	2	3	4	5	6	7	8	9
	PI								

	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	1	2	3	4	5	1	2	3	1	2	3	4	1	2	3	4
1														✓	✓	~	✓	✓				~	✓	✓								
2														✓	~	~	✓	✓				~	✓	✓								
3														✓	~	~	✓	✓				~	✓	✓								
4																			✓													
5													✓	✓	~							~	✓									
6										✓	\checkmark			✓	✓	~						~	✓	✓								
7													\checkmark	\checkmark	\checkmark	✓						~	\checkmark	\checkmark								

Task	Task Type	Recommended Questions (reference [1])
1	Student's task on basic understanding of fractional calculus	Problem set 1.1, Problem set 1.2, No 3-5 for each problem
2	Student's task on basic understanding of Riemann Lioville Integral	Problem set 2.2, Problem set 2.3 No 3-5 for each problem
3	Student's task on basic understanding of Riemann Lioville Derivative	Problem set 3.1, No 3-5 for each problem
4	Student's task on basic understanding of application of fractional calculus	Problem set 4.1, Problem set 4.2, No 3-5 for each problem