SEMESTER LEARNING PLAN

COMBINATORIAL THEORY
(COMPULSORY COURSE)

DEPARTMENT OF MATHEMATICS AND DATA SCIENCE
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS ANDALAS
2024

SEMESTER STUDY PLAN (SSP)
MASTER OF MATHEMATICS PROGRAM
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS ANDALAS

RENCANA PEMBELAJARAN SEMESTER

Course Name	Code	Course URL *i-Learn*	Credits	Semester	Date
Combinatorial Theory	MAT82151	https://sci.ilearn.unand.ac.id	3	2	April 7th, 2024

Person in Charge	Create by	Head of Research Group	Head of Master Program
	Dr. Lyra Yulianti	Prof. Dr. Syafrizal Sy	Prof. Dr. Ferra Yanuar

Intended Learning Outcomes (ILO) and Course Learning Outcomes (CLO)	Intended Learning Outcomes	
	ILO-3	Comprehensive mastery of one several theories for development in the fields of analysis, algebra, applied mathematics, statistics, and combinatorial mathematics: a) An ability to identify theories used in related mathematical problems. b) An ability to apply theories for advancement in related fields (advanced theory). c) An ability to use advanced theory to solve related mathematical problems.
	ILO-4	Mastering scientific techniques and developing them in solving research problems through multidisciplinary or interdisciplinary approaches: a) An ability to apply mathematical techniques in research problem-solving. b) An ability to analyze research problems. c) An ability to formulate theorems/models and prove their validity. d) An ability to use various mathematical software to solve complex mathematical problems.
	ILO-5	An ability to work and conduct research in the field of mathematics and related fields of science by developing the latest issues independently or collaboratively and communicating them academically: a) Capable of formally and correctly proving mathematical statements.

		b) An ability to employ relevant techniques for conducting research. c) Capable of communicating research findings in an academic manner.
	Course Learning Outcomes	
	1. An ability to understand the concept of binomial and multinomial coefficients and their simple applications. (ILO-3, ILO-4, ILO-5). 2. An ability to understand and apply the pigeonhole principle, inclusion-exclusion principle, generating function and counting theory. (ILO-3, ILO-4, ILO-5). 3. An ability to understand about graph theory, distance in graphs, trees, and connectivity in graphs. (ILO-3, ILO-4, ILO-5). 4. An ability to understand the concept of vertex and edge colorings in graph, matching, Ramsey theory and some Ramsey numbers. (ILO-3, ILO-4, ILO-5).	
Brief Description	This course discusses several concepts in graph theory and combinatorics, i.e connectivity, panarity, some Ramsey numbers, binomial and multinomial theorems, pigeonhole and inclusion-exclusion principles, generating function, and counting theory. Concerning the targets above, this course is given with an emphasis on providing students with a relatively large amount of time to solve problems ranging from simple to quite complex ones. The learning method in this course is face-to-face (a combination of Teacher-Centered Learning and Student-Centered Learning)	
Course Materials	1. Some Concept in Combinatorics 2. Binomial and Multinomial Coefficients 3. Pigeonhole Principle, Inclusion-Exclusion Principle 4. Generating Function and Counting Theory 5. Some Concept in Graph Theory, Trees, Trail, Circuits, Path, and Cycles 6. Planarity, Coloring and Matching 7. Ramsey Theory, Classical Ramsey Theory 8. Graph Ramsey Number and Size Ramsey Number.	
References	**Main:**	
	1. J.M. Harris, J.L. Hirst, M.J. Mossinghoff, *Combinatorics and Graph Theory*, 2nd edition, 2008, Springer	
	Additional	

	1. R. Diestel, 2017, *Graph Theory*, 5th edition, Springer	
Learning Media	**Software:**	**Hardware:**
	• LMS Unand (http://fmipa.ilearn.unand.ac.id/) • Zoom meeting • Whatsapp	• Komputer/Laptop • Smartphone
Team Teaching	Dr. Lyra Yulianti, Dr. Des Welyyanti	
Required courses	-	
Academic Norms	https://akademik.unand.ac.id/images/2022-03-30%20Peraturan%20Rektor%20Nomor%207%20Tahun%202022%20Penyelenggaraan%20Pendidikan-khusus%20Bab%20II.pdf	

Weekly Plan Study

Week (1)	Course Outcomes (2)	Indicator (3)	Assessment (4)	Activities/Forms of Learning [Estimated time]					Subject (10)	Weight (11)
				Synchronous*		Asynchronous**		Media (9)		
				Face-to-face Offline (5)	Face-to-face Online (6)	Individual (7)	Collaboration (8)			
1/1	An ability to understand Assessment Rules, RPS, Syllabus, and College Contract. **CLO-1** An ability to understand the concept of binomial and multinomial coefficients and their simple applications. (ILO-3, ILO-4, ILO-5).	Discipline in carrying out college contracts. Accuracy in explaining and understanding related material.	Activeness in lectures	Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes]		● Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Assessment Rules, RPS, Syllabus, and College Contract. Some problems in combinatorics	
2/2	**CLO-1** An ability to understand the concept of binomial and multinomial coefficients and	Accuracy in explaining and understanding related material.	Activeness in lectures	Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes]		● Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom	Binomial coefficient and its applications	

	their simple applications. (ILO-3, ILO-4, ILO-5).							meeting, WA group, learning video)		
3/3	**CLO-1** An ability to understand the concept of binomial and multinomial coefficients and their simple applications. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures	Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes]		●Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand)(Specific condition: Zoom meeting, WA group, learning video)	Multinomial coefficient and its applications	
4/4	**CLO-2** An ability to understand and apply the pigeonhole principle, inclusion-exclusion principle, generating function and counting theory. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures	Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes]		●Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Pigeonhole Principle, Inclusion-exclusion Principle, and their applications	
5/5	**CLO-2** An ability to understand and apply the pigeonhole	Accuracy in explaining and understanding related material.	Activeness in lectures	Teaching and discussion: ● explanation of learning		●Students read and study learning materials		● PPT ● I learn (LMS Unand) (Specific	Recurrence relation and generating function	

	principle, inclusion-exclusion principle, generating function and counting theory. (ILO-3, ILO-4, ILO-5).			material [1 x 3 x 50 minutes]		[1 x 3 x 120 minutes]		condition: Zoom meeting, WA group, learning video)		
6/6	**CLO-2** An ability to understand and apply the pigeonhole principle, inclusion-exclusion principle, generating function and counting theory. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material, accuracy in answering task questions, neatness in task work, and originality of task results.	Task 1	Teaching and discussion: ● explanation of learning material ● explanation of the task ● explanation of the assessment [1 x 3 x 50 minutes]		●Students read and study learning materials ●Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Fibonacci and Catalan Numbers, related to generating function and recurrence relation	
7/7	**CLO-2** An ability to understand and apply the pigeonhole principle, inclusion-exclusion principle, generating function and	Accuracy in explaining and understanding related material, accuracy in answering task questions, neatness in task work, and originality of task results.	Quiz 1	Teaching and discussion: ● explanation of learning material ● explanation of the task ● explanation of the assessment [1 x 3 x 50 minutes]		●Students read and study learning materials ●Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Partition, Stirling Cycle dan Stirling Set Numbers	

	counting theory. (ILO-3, ILO-4, ILO-5).									
8 s/d 9	**MID-TERM EXAMINATION**									**30 %**
10/8	**CLO-3** An ability to understand about graph theory, distance in graphs, trees, and connectivity in graphs. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures		Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Distance in graphs, walk, trail, path, connected graph, disconnected graph Graph and Matrices	
11/9	**CLO-3** An ability to understand about graph theory, distance in graphs, trees, and connectivity in graphs. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures		Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is	●Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Tress and their characterizations, spanning tress and the number of trees in graph	

					50% of the total number of meetings)					
12/10	**CLO-3** An ability to understand about graph theory, distance in graphs, trees, and connectivity in graphs. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures		Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	●Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Eulerian Graf, Eulerian Trail and Circuit, Hamiltonian Paths dan Cycles	
13/11	**CLO-4** An ability to understand the concept of vertex and edge colorings in graph, matching, Ramsey theory and some Ramsey numbers. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures		Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning	●Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Coloring in graph, chromatic number, Four Color Theorem and chromatic polynomial	

					meetings is 50% of the total number of meetings)					
14/12	**CLO-4** An ability to understand the concept of vertex and edge colorings in graph, matching, Ramsey theory and some Ramsey numbers. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material.	Activeness in lectures	Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes]	Teaching and discussion: ● explanation of learning material [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	●Students read and study learning materials [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Matching in graph, Ramsey theory	
15/13	**CLO-4** An ability to understand the concept of vertex and edge colorings in graph, matching, Ramsey theory and some Ramsey	Accuracy in explaining and understanding related material, accuracy in answering task questions, neatness in task work, and originality of task results.	Task 2		Teaching and discussion: ● explanation of learning material ● explanation of the task ● explanation of the assessment	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Classical Ramsey number, Graph Ramsey number	

	numbers. (ILO-3, ILO-4, ILO-5).				[1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)					
16/14	**CLO-4** An ability to understand the concept of vertex and edge colorings in graph, matching, Ramsey theory and some Ramsey numbers. (ILO-3, ILO-4, ILO-5).	Accuracy in explaining and understanding related material, accuracy in answering task questions, neatness in task work, and originality of task results.	Quiz 2		Teaching and discussion: ● explanation of learning material ● explanation of the task ● explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Size Ramsey number and Ramsey minimal graphs	

17 s/d 18	**FINAL EXAMINATION**									**30 %**

1 credit = *50* minutes face-to-face meeting, *60* minutes structured study, *60* minutes independent study
Each meeting duration is 3 credits = *3* × *50* minutes

Indicators, Criteria, and Assessment Weights

1. Assessment weight for each Assessment

NO	Assessment	Weight (%)
1	Mid-Term Exam	30
2	Final Exam	30
3	Quiz	20
4	Task (Homework)	20
TOTAL		**100**

2. Assessment weight for Intended Learning Outcome
   a) CLO-1: 25 %
   b) CLO-2: 25 %
   c) CLO-3: 25 %
   d) CLO-4: 25 %

Table Assessment Plan:

No.	Course Learning Outcomes	Weight (%)						
		Mid-term Exam (%)	Final Exam (%)	Quiz (%)		Task (%)		Total
				1	2	1	2	
1	An ability to understand the concept of binomial and multinomial coefficients and their simple applications. (ILO-3, ILO-4, ILO-5).	15		5		5		5
2	An ability to understand and apply the pigeonhole principle, inclusion-exclusion principle, generating function and counting theory. (ILO-3, ILO-4, ILO-5).	15		5		5		10
3	An ability to understand about graph theory, distance in graphs, trees, and connectivity in graphs. (ILO-3, ILO-4, ILO-5).		15		5		5	
4	An ability to understand the concept of vertex and edge colorings in graph, matching, Ramsey theory and some Ramsey numbers. (ILO-3, ILO-4, ILO-5).		15		5		5	
Total		**30 %**	**30 %**	**20 %**		**20 %**		**100**

Matrix of CLO and ILO

CLO	ILO

	1	**2**	**3**	**4**
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✓
4	✓	✓	✓	✓