Module Description/Course Syllabi

Study Programme: Master of Mathematics
Faculty of Mathematics and Natural Sciences
Universitas Andalas

1. *Course number and name*

MAT82252 Topics in Combinatorics 1

2. *Credits and contact hours/Number of ECTS credits allocated*

3 SKS / 4.52 ECTS

3. *Instructors and course coordinator*

1. Dr. Lyra Yulianti, 2) Dr. Des Welyyanti

4. *Text book, title, author, and year*

1. R. Diestel, *Graph Theory*, Graduate Text in Mathematics, 4th electronic edition, 2010, Springer

5. *Recommended reading and other learning resources/tools*

Recent papers in Schur and Rado numbers, nowhere zero flows, and Ramsey theory

6. *Specific course information*

A. Brief description of the content of the course (catalogue description)

This course discusses about Schur number, Rado number, nowhere zero flows, and Ramsey theory, including Size Ramsey numbers and Ramsey minimal graphs.

B. Prerequisites or co-requisites

MAT82151 Combinatorial Theory

C. Indicate whether a required or elective course in the program
Elective
D. Level of course unit (according to EQF: first cycle Bachelor, second cycle Master)
Second Cycle Master
E. Year of study when the course unit is delivered (if applicable)
2nd Year
F. Semester when the course unit is delivered
Even Semester
G. Mode of delivery (face-to-face, distance learning)
Face to face

7. *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) Able to identify theories used in related mathematical problems. b) Able to apply theories for advancement in related fields (advanced theory). c) Able 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) Able to apply mathematical techniques in research problem-solving. b) Able to analyze research problems. c) Able to formulate theorems/models and prove their validity. d) Able to use various mathematical software to solve complex mathematical problems.

ILO-5
Able 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) Able to employ relevant techniques for conducting research.
c) Capable of communicating research findings in an academic manner.

ILO-6

a) Able to independently expand and deepen learning based on acquired knowledge.
b) Able to expand and deepen interdisciplinary competencies based on acquired knowledge.
c) Able to understand and apply the latest developments in mathematical theory.

8. *Course Learning Outcomes*

Understanding and mastering the material about Schur numbers and Rado numbers.

Understanding and mastering the material about *nowhere zero flows*.

Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs

9. *Brief list of topics to be covered*

1. Review some concepts in number theory and coloring in graphs
2. Definition of Schur number and some examples
3. Definition of Rado number and some examples
4. Nowhere zero flows
5. Size Ramsey number for some simple graphs
6. Ramsey minimal graphs for some simple graphs

10. Learning and teaching methods

Project-Based Learning, Student Centre Learning

11. Language of instruction

Bahasa

12. Assessment methods and criteria
Summative Assessment: 1. Mid-term exam: 30% 2. Final exam: 30% 3. Quiz: 20% 4. Task: 20%

SEMESTER STUDY PLAN
TOPICS IN COMBINATORICS 2
(ELECTIVE COURSE)

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

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

Course Name	Course Code	URL *I-Learn*	Credits	Semester	Compilation Date
TOPICS IN COMBINATORICS 1	MAT82252	https://sci.ilearn.unand.ac.id/	3	2	12 May 2024

Person In Charge	Study Plan Creator	Head of Research Group	Head of Study Program
	Dr. Lyra Yulianti, Dr. Des Welyyanti	Prof. Syafrizal Sy	Prof. Dr. Ferra Yanuar

Intended Learning Outcomes (ILO) and Performance Indicator (PI)	**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) Able to identify theories used in related mathematical problems. b) Able to apply theories for advancement in related fields (advanced theory). c) Able 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) Able to apply mathematical techniques in research problem-solving. b) Able to analyze research problems. c) Able to formulate theorems/models and prove their validity. d) Able to use various mathematical software to solve complex mathematical problems.
	ILO-5	Able 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) Able to employ relevant techniques for conducting research. c) Capable of communicating research findings in an academic manner.
	ILO-6	a) Able to independently expand and deepen learning based on acquired knowledge. b) Able to expand and deepen interdisciplinary competencies based on acquired knowledge. c) Able to understand and apply the latest developments in mathematical theory.
	Course Learning Outcomes	

	1	Understanding and mastering the material about Schur numbers and Rado numbers.
	2	Understanding and mastering the material about *nowhere zero flows*.
	3	Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs
Brief Description	This course discusses about Schur number, Rado number, nowhere zero flows, and Ramsey theory, including Size Ramsey numbers and Ramsey minimal graphs.	
Course Materials	1. Review some concepts in number theory and coloring in graphs 2. Definition of Schur number and some examples 3. Definition of Rado number and some examples 4. Nowhere zero flows 5. Size Ramsey number for some simple graphs 6. Ramsey minimal graphs for some simple graphs	
References	**Main:** 1. R. Diestel, *Graph Theory*, Graduate Text in Mathematics, 4th electronic edition, 2010, Springer **Additional:** Recent papers in Schur and Rado numbers, nowhere zero flows, and Ramsey theory	
Learning Media	**Software:** • LMS Unand (http://fmipa.ilearn.unand.ac.id/) • Zoom meeting • Whatsapp	**Hardware:** • Computer/Laptop • Smartphone
Team Teaching	1. Dr. Lyra Yulianti 2. Dr. Des Welyyanti	
Assessment	Homework, Quiz, Mid-Term exam, Final exam	
Required courses	Combinatorial Theory	

Weekly Study Plan

Week / Meet (1)	Course Outcomes (2)	Indicator (3)	Assessment (4)	Activities/Forms of Learning [Time estimated]			Subject, references (10)	Weight (11)
				Synchronus*	Asynchronus**	Media (9)		

				Face to face Offline (5)	**Face to face Online (6)**	**Individual (7)**	**Collaboration (8)**			
1/1	CLO-1 Understanding and mastering the material about Schur numbers and Rado numbers	• Discipline in carrying out course contracts • Accurate understanding of related material	Activeness in lectures	Teaching and discussion: - Introduction to SSP - material explanation - task explanation - discussion and question-and-answer lecture material - brief explanation of the final project [1 x 3 x 50 minute]		Students read and study the learning materials individually [1 x 3 x 50 minute]	Students discuss in groups about lecture material [1 x 2 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video	○ Introduction to SSP, material explanation, task explanation, discussion, and question-and-answer lecture material ○ Definition of Diophantine linear and non-linear equations ○ Definition of k-coloring, monochromatic solution	
2/2	CLO-1 Understanding and mastering the material about Schur numbers and Rado numbers	Accurate understanding of related material	Activeness in lectures	Teaching and discussion: - material explanation [1 x 2 x 50 minute]		Students read and study the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video	○ Definition of Schur k-color number and some previous results	
3/3	CLO-1 Understanding and mastering the material about Schur numbers and Rado numbers	Accurate understanding of related material	Activeness in lectures	Teaching and discussion: material explanation [1 x 2 x 50 minute]		Students read and study the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video	○ Definition of Generalized Schur k-color number and some previous results ○ Definition of Rado number and some previous results	
4/4	CLO-1 Understanding and mastering the material about Schur numbers and Rado numbers	Accurate understanding of related material	Activeness in lectures	Teaching and discussion: material explanation [1 x 2 x 50 minute]		Students read and study the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting,	Rado 2-color number and some simple equations	

								WA group, learning video)		
5/5	CLO-2 Understanding and mastering the material about *nowhere zero flows*	Accurate understanding of related material	Activeness in lectures	Teaching and discussion: material explanation [1 x 2 x 50 minute]		Students read and study the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	○ Definition of nowhere zero k-flows, k-face colorable, and k-edge colorable ○ Definition of proper coloring	
6/6	CLO-2 Understanding and mastering the material about *nowhere zero flows*	Accurate understanding of related material	Task 1	Teaching and discussion: material explanation [1 x 2 x 50 minute]		• Students read and study learning materials • Students do assignments independently	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	Some results related to nowhere zero k-flows for some values of k: 3-NZF, 4-NZF, 5-NZF, and 6-NZF graphs	10%
7/7	CLO-2 Understanding and mastering the material about *nowhere zero flows*	• Accurate understanding of related material • Accuracy in answering assignment questions • Neatness of task execution • Originality of task	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		• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	Deetermination of graphs with properties of nowhere zero k-flows for some k	10 %
8 and 9	**MID-TERM EXAM**									
10/10	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	Accurate understanding of 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 %	Students read and study the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) • Specific condition: Zoom meeting, WA group, learning video)	• Definition of Classical Ramsey numbers and Graph Ramsey numbers • Definition of Size Ramsey numbers and some previous results on Size and Graph Ramsey numbers	

					of the total number of meetings)					
11/11	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	Accurate understanding of 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 the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) • Specific condition: Zoom meeting, WA group, learning video)	• Size Ramsey numbers for some pair of graphs G and H • The upper and lower bounds of size Ramsey number of a pair of graphs G and H	
12/12	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	Accurate understanding of 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 the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	• The relation between size Ramsey number and Ramsey minimal graphs • Definition of Ramsey (G,H)-minimal graphs for anrbitrary graphs G and H	
13/13	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	Accurate understanding of 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	Students read and study the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	The finite and infinite class of Ramsey (G,H)-minimal graphs	

					meetings)					
14/14	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	Accurate understanding of related material	Activeness in lectures	Teaching and discussion: material explanation [1 x 2 x 50 minute]	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 the learning materials individually [1 x 1 x 50 minute]	Students discuss in groups about lecture material [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) pecific condition: Zoom meeting, WA group, learning video)	Finite class of Ramsey (G,H)-minimal for matching and some simple graph H	
15/15	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	Accurate understanding of related material	Task 2	Teaching and discussion: material explanation [1 x 2 x 50 minute]	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 the learning materials individually • Students do assignments independently [1 x 1 x 50 minute]	Students discuss in groups about lecture material and assignment [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	Some results on Infinite class of Ramsey (G,H)-minimal graphs	
16/16	**CLO-3** Understanding and mastering the material about size Ramsey number and Ramsey minimal graphs	• Accurate understanding of related material • Accuracy in answering assignment questions • Neatness of task execution • Originality of task	Quiz 2	Teaching and discussion: • explanation of learning material • explanation of the task • explanation of the assessment [1 x 2 x 50 minutes]	Teaching and discussion: • explanation of learning material • explanation of the task • explanation o the assessment [1 x 3 x 50 minutes] Specific conditions: The total number of	• Students read and study learning materials • Students do assignments independently	Students discuss in groups about lecture material and assignment [1 x 1 x 50 minutes]	• PPT • i-learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	Infinite class of Ramsey (G,H)-minimal graphs for stars and some simple graph H	10 %

					blended learning meetings is 50 % of the total number of meetings)					
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 2 credits = 2×50 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	Homework	20
4	Quiz	20
TOTAL		**100**

2. Assessment weight for Intended Learning Outcome
   a) CLO-1: 25 %
   b) CLO-2. 25 %
   c) CLO-3: 50 %

Assessment Plan Table:

ASSESSMENT	Task		Quiz		Mid-term Exam	Final Exam	TOTAL
CLO	1	2	1	2			
CLO-1 Have the understanding about the metric dimension of a graph and determine the metric dimension of a given graph.	5%		5%		15%		25%

CLO-2 Have the understanding about the partition dimension of a graph and determine the partition dimension of a given graph	5%		5%		15%		25%
CLO-3 Have the understanding about the locating chromatic number of a graph and determine the locating chromatic number of a given graph		10%		10%		30%	50%
TOTAL BOBOT	**20%**		**20%**		**30%**	**30%**	**100%**

Matrix of CLO and ILO

CLO	ILO																															
	1			2			3			4			5				6					7			8				9			
	PI			PI			PI			PI			PI				PI					PI			PI				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				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											