Course Specification
— (Postgraduate Programs)

Course Title:	**Combinatorics**
Course Code:	**MAT 7251**
Program:	**Doctor of Philosophy in Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**None**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:
4 (4 Lectures, 0 Lab, 0 Tutorial)

2. Course type				
A.	☐ University	☐ College	☒ Program	☐ Track	☐ Others
B.	☐ Required		☒ Elective		

3. Level/Year at which this course is offered: Level 3 / Year 2

4. Course general Description:
Topics in combinatorics will be covered. They include Techniques in counting, Inclusion-exclusion principle, Stirling Numbers, Group Class Equation and Cycle Index Theorem, Burnside's Lemma, Identities and Expansions, General and Multivariate Generating Functions, Recurrence Relations, Partitions of Integers, Ramsey's Theorem with Applications.

5. Pre-requirements for this course (if any)**:**
None.

6. Co-requisites for this course (if any)**:**
None.

7. Course Main Objective(s):
Combinatorics has many applications in sciences, e.g., in Computer Sciences, Probability and Operation Research. The objective of this course is to give a detailed knowledge within counting techniques, Striling numbers, Burnside's Lemma and some other interesting topics in combinatorics.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	60
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)**	0

Total	60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Describe problems in mathematics and natural sciences using combinatorics	**K1, K2**	4 lecture hours\week	**Direct: Regular Exams**
1.2	Reproduce recurrence relations and generating functions.	**K1, K2**	• 4 lecture hours\week • Self-study	**Direct: Short Quizzes**
2.0	**Skills**			
2.1	Develop techniques of proof in counting and permutation methods..	**S1, S2**	Self-study	**Direct:** • **Participations** • **Short Quizzes**
2.2	Improve oral communication and technical writing skills through multivariate functions and recurrence relations.	**S3**	Real-life problems	**Direct: Homework and Mini projects**
2.3	Use Internet in searching for some related identities.	**S4**	Real-life problems	**Direct: Short Quizzes**
2.4	Demonstrate deep proofs of main theorems.	**S1, S2**	Self-study	**Direct: Participations**
3.0	**Values, autonomy, and responsibility**			
3.1	Work with independence and responsibility.	**V1, V2**	Personal questions	**Direct: Participation**
3.2	Lead team works.	**V1, V3**	Teamwork and class discussions.	**Direct: Homework and Mini projects**

C. Course Content

No	List of Topics	Contact Hours
1.	**Counting and Inclusion Exclusion Principles.** **Real Factorials and Stirling's Formula, Stirling Numbers of First and Second Kinds.**	**18**

4

2.	**Group Class Equation and Cycle Index Theorem, Counting by Permutation Methods.** **Burnside's Lemma, Identities and Expansions.** **General and Multivariate Generating Functions.**	**22**
3.	**Recurrence Relations.** **Partitions of Integers, Ramsey's Theorem with Applications.**	**20**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**HomeWorks, Quizzes, Mini projects**	**During the semester**	**30%**
2.	**Midterm**	**Week 9-10**	**30%**
3.	**Final Exam**	**Week 15-16**	**40%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• **C. Charalambides, Enumerative Combinatorics, Chapman and Hall/CRC, 2002.**
Supportive References	1. **M. Aigner, A Course in Enumeration, Springer, 2007.** 2. **J. Van, R. Wilson, A Course in Combinatorics, Cambridge University Press, 2001.** 3. **R. Brualdi, Introductory Combinatorics, 5th Ed., Prentice-Hall, 2009.**
Electronic Materials	**None**
Other Learning Materials	**None**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ **Each class room should be equipped with a whiteboard and a projector.** ▪ **Laboratories should be equipped with computers and an internet connection.**

Items	Resources
Technology equipment (projector, smart board, software)	**The rooms should be equipped with data show and Smart Board.**
Other equipment (depending on the nature of the specialty)	**None**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**During the semester and at the end of the course each student will complete two evaluation forms.**
Effectiveness of Students assessment	**Instructor**	**At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.**
Quality of learning resources	**Students**	**During the semester and at the end of the course each student will complete two evaluation forms.**
The extent to which CLOs have been achieved	**Instructor**	**At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.**
Other	**None**	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**