Kingdom of Saudi Arabia
Ministry of Education
King Khalid University

DEPARTMENT OF MATHEMATICS HANDBOOK

COLLEGE OF SCIENCE

Prepared By
Dr. Mohammad Mazyad Hazzazi

Contents

CONTACT

Department Head: Dr. Metib Alghamdi

Phone: +966–17–241–7734

Fax: +966–17–241–8202

Email: malgamdy@kku.edu.sa

Mailing Address:

Mathematics Department,
Faculty of Science,
King Khalid University,
 P.O. Box: 9004, Abha 61413,
Kingdom of Saudi Arabia

Female Section: Dr. Aisha Alderremy

 Phone: +966–17–241–2814

 Email: aaldramy@kku.edu.sa

For more information, you can visit the department's website through the online portal of the university at the link:

https://science.kku.edu.sa/en/content/1594

Brief Overview of the Department

Overview

The Department of Mathematics was initially established within the departments of the College of Education, which was established in 1396 AH within the branch of King Saud University in Abha, and the situation continued until the Royal directives were issued to establish King Khalid University, which restructured the faculties and departments, headed by the Department of Mathematics. The department includes a group of professors who represent different scientific schools, who are responsible for teaching advanced courses in the basic and advanced elements of mathematics. The number of its students in the current academic year is 280 students

Vision - Mission - Objectives

❖ Vision:

The Department of mathematics at the University of King Khalid aspires to regional excellence in education, research and qualitative fruitful and positive interaction with the local society.

❖ Mission:

Proffer distinguished educational programs to graduate individuals, who are able to think critically about complex issues, analyze and adapt to new situations, solve problems of various kinds, communicate their thinking effectively and serve the community.

❖ Objectives:

➢ Proffer distinguished educational programs.
➢ Graduate individuals, who are able to think critically about complex issues, analyze and adapt to new situations, solve problems of various kinds, communicate their thinking effectively and serve the community.
➢ Overcome the shortfall in the other institutions of higher education and government institutions that need professionals with advanced degrees.
➢ Attract outstanding teaching and research staff.
➢ Create a work environment where team spirit and professional ethics of Islam prevail.
➢ Promote research and scientific collaborations.
➢ Strengthening links with modern technology programs.
➢ Serve the regional community.

Career Options after Graduation

The department graduate can work in the following fields:

- ❖ The pre-university education sector
- ❖ Career paths in research centers and public and private institutions that requires skills in mathematics such as Ministry of Finance, Saudi Arabian Monetary Agency, General Organization for Social Insurance, General Authority for Statistics, Public Pension Agency, Banks, Insurance Companies and others.
- ❖ Distinguished students are appointed as teaching assistants in order to study abroad to complete their higher studies, then they are appointed within the teaching bodies of Saudi universities.

Department Administration

S	Name	Ext. Office	Office	Role	Email
1	Dr. Metib Said Alghamdi	7734	C/2/30	Head of Department	malgamdy@kku.edu.sa
2	Dr. Khaled Abdullah Alhazmy	8621	C/2/12	Department Council	khazmy@kku.edu.sa
3	Dr. Aisha Abdullah Aldramy	2814	K/2/15	Department Coordinator (Female)	aaldramy@kku.edu.sa

Program Coordination Unit:

S	Name	Office Ext.	Office	Coordinator	Email
1	Dr. Mohammed Kbiri Alaoui	8215	C/2/37	MSc. Program	mka_la@yahoo.fr
2	Dr. Khalid Ouarghi	8620	C/2/35	BSc. Program (Male)	kouarghi@kku.edu.sa
3	Dr. Aisha Abdullah Aldramy	2814	K/2/15	BSc. Program (Female)	aaldramy@kku.edu.sa

Academic Advising Unit (Male):

S	Name	Office Ext.	Office	Email
1	Dr. Tamer Nabil Abdelsadek Mohamed	8018	C/2/31	tnmohammed@kku.edu.sa
2	Dr. Abdou Yassen A. Alzubaidi	8652	C/2/34	abdoya@kku.edu.sa
3	Dr. Maher Said Mejai	9408	C/2/27	mmejai@kku.edu.sa
4	Dr. Mohamed Wahideddin Altanji	7246	C/2/37	maltenji@kku.edu.sa
5	Dr. Kamel Tetraoui	7289	C/2/59	titraoui@yahoo.fr
6	Dr. Fuad Ali Ahmed Almahdi	7577	C/2/12	faahmad@kku.edu.sa

Academic Advising Unit (Female):

S	Name	Office Ext.	Office	Email
1	Dr. Manal Mohamed Alqarni	2666	K/2/12	malqrni@kku.edu.sa
2	Nujud Fayez Alshehri	2768	K/2/27	nfaiez@kku.edu.sa
3	Nada Fayez Alshehri	2768	K/2/27	nfalshehri@kku.edu.sa
4	Wafa Misfir AlAhmari	2798	K/2/17	walahmry@kku.edu.sa

Mathematics Department Faculty Members:

S	Name	Office Ext.	Office	Nationality	Rank	Specialization	Email
1	Prof. Ahmed Bachir Bachir	8224	C/2/63	Algerian	Professor	Functional Analysis	abishir@kku.edu.sa
2	Prof. Laksaci Ali	9512	C/2/63	Algerian	Professor	Probability Theory	alikla@kku.edu.sa
3	Prof. Muhammad Yousaf Malik	8648	C/2/26	Pakistani	Professor	Applied Mathematics	drmymalik@qau.edu.pk
4	Dr. Abdulaziz Saad Deajim	7776	C/2/33	Saudi	Associate Professor	Number Theory	deajim@gmail.com
5	Dr. Awad Hussin Al-Mohy	8105	C/2/12	Saudi	Associate Professor	Functional Analysis	aalmohy@hotmail.com
6	Dr. Ali Hussain A Alkhaldi		C/2/26	Saudi	Associate Professor	Non-Euclidean Geometry	ahalkhaldi@kku.edu.sa
7	Dr. Ibrahim Almanjahi	7734	C/2/12	Saudi	Associate Professor	Applied Statistics	imalmanjahi@kku.edu.sa
8	Dr. Ali Saeed Al Talhan	8022	C/2/12	Saudi	Associate Professor	Differential Equations	algahtani@kku.edu.sa
9	Dr. Metib Said Alghamdi	9323	C/2/12	Saudi	Associate Professor	Applied Mathematics	malgamdy@kku.edu.sa
10	Dr. Mohammed Fathy M. Elettreby	7317	C/2/27	Egyptian	Associate Professor	Applied Mathematics	mohfathy@mans.edu.eg
11	Dr. Muhammad Aslam	7266	C/2/12	Pakistani	Associate Professor	Algebra	muamin@kku.edu.sa
12	Dr. Mohamed Abdelaziz A. Abouelela	8228	C/2/31	Egyptian	Associate Professor	Fluid Mechanics	m_abdelaziz999@yahoo.com
13	Dr. Messaoud Saadi Kooli	8226	C/2/59	Algerian	Associate Professor	Applied Mathematics	kollimes@yahoo.fr
14	Dr. Ahmed Hcine Soulayman	8222	C/2/36	Egyptian	Associate Professor	Functional Analysis	ahsolimanm@gmail.com
15	Dr. Mohammed Kbiri Alaoui	8215	C/2/37	Moroccan	Associate Professor	Nonlinear Analysis	mka_la@yahoo.fr
16	Dr. Tamer Nabil Abdelsadek Mohamed	8018	C/2/31	Egyptian	Associate Professor	Numerical	tnmohammed@kku.edu.sa
17	Dr. Zouaoui Chikr Elmezouar	9487	C/2/63	Algerian	Associate Professor	Statistics and Probabilities	zchikrelmezouar@kku.edu.sa
18	Dr. Khaled Abdullah Alhazmy	8621	C/2/12	Saudi	Assistant Professor	Commutative Algebra	khazmy@kku.edu.sa
19	Dr. Marei S. Alqarni	8252	C/2/12	Saudi	Assistant Professor	Applied Mathematics	msalqarni@kku.edu.sa
20	Dr. Yahya Ahmed Almalki	8701	C/2/12	Saudi	Assistant Professor	Complex Analysis	yalmalki@kku.edu.sa
21	Dr. Abdou Yassen A. Alzubaidi	8652	C/2/34	Saudi	Assistant Professor	Differential Equations	abdoya@kku.edu.sa
22	Dr. Mohammad Mazyad M. Hazzazi	7248	C/2/34	Saudi	Assistant Professor	Applied Algebra	mmhazzazi@kku.edu.sa
23	Dr. Mohammed Zaidi A. Alqarni		C/2/34	Saudi	Assistant Professor	Numerical Analysis	mzalzarni@kku.edu.sa
24	Dr. Anouar Ben Abdelawhab Houmia	9409	C/2/35	Tunisian	Assistant Professor	Nonlinear Analysis	asalehh@kku.edu.sa
25	Dr. Maher Said Mejai	9408	C/2/27	French	Assistant Professor	functional analysis	mmejai@kku.edu.sa
26	Dr. Khalid Ouarghi	8620	C/2/35	Moroccan	Assistant Professor	Commutative Algebra	kouarghi@kku.edu.sa
27	Dr. Mohamed Wahideddin Altanji	7246	C/2/37	Syrian	Assistant Professor	Functional Analysis	maltenji@kku.edu.sa
28	Dr. Kamel Tetraoui	7289	C/2/59	French	Assistant Professor	Functional Analysis	titraoui@yahoo.fr

S	Name	Office Ext.	Office	Nationality	Rank	Specialization	Email
29	Dr. Younes Chahlaoui	8106	C/2/26	Moroccan	Assistant Professor	Scientific Computing and Numerical Simulation	ychahlaoui@kku.edu.sa
30	Dr. Fuad Ali Ahmed Almahdi	7577	C/2/12	Yamani	Assistant Professor	Abstract Algebra	faahmad@kku.edu.sa
31	Dr. Mohamed Bouye Moulaye Ahmed	7233	C/2/74	Mauritanian	Assistant Professor	Linear Algebra	mbmahmad@kku.edu.sa
32	Dr. Khursheed Jamal Ansari	8235	C/2/58	Indian	Assistant Professor	Differential Equations	kansari@kku.edu.sa
33	Dr. Bouleryah Mohamed Leminr	8234	C/2/74	Mauritanian	Assistant Professor	Differential Geometry	elhadhramii@yahoo.com
34	Dr. Lahsen Aharouch	8214	C/2/58	Moroccan	Assistant Professor	Applied Mathematics	alahsan@kku.edu.sa
35	Dr. Salman Saleem	8574	C/2/36	Pakistani	Assistant Professor	Fluid Dynamics	saakhtar@kku.edu.sa
36	Dr. Akram Ali	8637	C/2/40	Indian	Assistant Professor	Differential Geometry	akali@kku.edu.sa
37	Dr. Sajjad Shaukat Jamal	8635	C/2/40	Pakistani	Assistant Professor	Cryptography	shussain@kku.edu.sa
38	Dr. Taseer Muhammad Javied Asgher		C/2/12	Pakistani	Assistant Professor	Fluid Dynamics	tasgher@kku.edu.sa
39	Dr. Abd-Allah Ahmed Hyder	8620	C/2/35	Egyptian	Assistant Professor	Functional Analysis	abahahmed@kku.edu.sa
40	Dr. Ahmed Mohamed Zanaty	8613	C/2/12	Egyptian	Assistant Professor	Functional Analysis	ahmoahmed@kku.edu.sa
41	Dr. Mohammed Zakarya Nasr Ibrahim		C/2/40	Egyptian	Assistant Professor	Functional Analysis	mzibrahim@kku.edu.sa
42	Prof. Hamza Mohammed Shaggara		C/2/27	Tunisian	Professor	Mathematical Analysis	hshaggara@kku.edu.sa
43	Dr. Zehba A. Raizah	2833	K/2/2	Saudi	Associate Professor	Applied Mathematics	zaalrazh@kku.edu.sa
44	Dr. Sameh Elsayed Ahmed	2783	Network	Egyptian	Associate Professor	Applied Mathematics	sehassan@kku.edu.sa
45	Dr. Zoulikha Zaid	2798	K/2/17	Algerian	Associate Professor	Statistics and Probabilities	zqayd@kku.edu.sa
46	Dr. Abdelraheem Mahmoud Aly	2783	Network	Egyptian	Associate Professor	Applied Mathematics	abadallah@kku.edu.sa
47	Dr. Muajebh M. S. Hedan	2833	K/2/2	Saudi	Assistant Professor	Complex Analysis	mhedan@kku.edu.sa
48	Dr. Turkish Ali Alahmari	2757	K/2/5	Saudi	Assistant Professor	Numerical Analysis	talahmry@kku.edu.sa
49	Dr. Fawzia Ali Abdullah Algheris	2757	K/2/5	Saudi	Assistant Professor	Statistics	falgoras@kku.edu.sa
50	Dr. Asmaa Abdel Moneim Hassan Alfurt	2768	K/2/27	Egyptian	Assistant Professor	Applied Mathematics	aahaasn@kku.edu.sa
51	Dr. Aisha Abdullah Aldramy	2814	K/2/15	Saudi	Assistant Professor	Numerical Analysis	aaldramy@kku.edu.sa
52	Dr. Mohra Abdullah Zayed	2752	K/2/4	Saudi	Assistant Professor	Pure Mathematics	Mzayed@kku.edu.sa
53	Dr. Yasser Ahmed Sadek Elmasry	2786	Network	Egyptian	Assistant Professor	Operations Research	sadek@kku.edu.sa
54	Dr. Aeshah Abdullah S. AL Raeah	2767	K/2/12	Saudi	Assistant Professor	Applied Mathematics	aalraezh@kku.edu.sa
55	Dr. Manal Mohamed Alqarni	2666	K/2/12	Saudi	Assistant Professor	Numerical Analysis	malqrni@kku.edu.sa
56	Dr. Mona Hosny Abd ElKhaleeq	2768	K/2/27	Egyptian	Assistant Professor	Topology	maly@kku.edu.sa
57	Dr. Mohamed Abdalla Mahmoud	2789	Network	Egyptian	Assistant Professor	Complex Analysis	moabdalla@kku.edu.sa

Lecturers of the Department of Mathematics:

S	Name	Office Ext.	Office	Nationality	Rank	Specialization	Email
1	Mohammed Mahdi Alwadiy	8216	C/2/34	Saudi	Lecturer	Mathematics	mmalwadiy@kku.edu.sa
2	Saleh Saeed Ali Aseeri		Network	Saudi	Teaching Assistance	Numerical Analysis	saseeri@kku.edu.sa
3	Nujud Fayez Alshehri	2768	K/2/27	Saudi	Lecturer	Differential Equations	nfaiez@kku.edu.sa
4	Nada Fayez Alshehri	2768	K/2/27	Saudi	Lecturer	Differential Equations	nfalshehri@kku.edu.sa
5	Eman Shaya Alzedani	2752	K/2/4	Saudi	Lecturer	Functional Analysis	eshaya@kku.edu.sa
6	Wafa Misfir AlAhmari	2798	K/2/17	Saudi	Lecturer	Statistics and Probabilities	walahmry@kku.edu.sa

Data of the Scholarship Students:

S	Name	Nationality	Rank	Specialization	Email
1	Abdel Salam Shaflout	Saudi	Lecturer	Mathematics	shaflout2011@hotmail.com
2	Abdulaziz Muhammad M. Al-qahtani	Saudi	Teaching Assistance	Numerical Analysis	A.M.H2022@hotmail.com
3	Muhammad Barakat M. Al-Ammari	Saudi	Teaching Assistance	Statistics and Probabilities	malamari@kku.edu.sa
4	Ali Yahya Asiri Akour	Saudi	Teaching Assistance	Algebra	ali-hummdi@hotmail.com
5	Abdullah Mohammed A. Almughrad	Saudi	Teaching Assistance	Statistics and Probabilities	ealmaghrud@kku.edu.sa
6	Nisreen Abed Rabb Alrasol	Saudi	Lecturer	Mathematics	
7	Iman Ali Qassem Alfifi	Saudi	Teaching Assistance	Mathematics	Memo-222@windowsLive.com
8	Bushra Abdul Latif Alqahtani	Saudi	Teaching Assistance	Mathematics	Bamer@kku.edu.sa
9	Maram Salem Salman Alshahrani	Saudi	Teaching Assistance	Mathematics	mssalman@kku.edu.sa
10	Hajda shaalan fayez alharthi	Saudi	Teaching Assistance	Mathematics	hshfayez@kku.edu.sa
11	Hanan Ahmed M. Albarqi	Saudi	Lecturer	Differential Geometry	halbargi@kku.edu.sa
12	Nawal Hilal Hilal Alharbi	Saudi	Lecturer	Numerical Analysis	Nhalharbi@kku.edu.sa
13	Manal Jaber Abdullah Al-asmari	Saudi	Teaching Assistance	Mathematics	malaswari@kku.edu.sa
14	Nadia Zafer Abdullah Al-shehri	Saudi	Lecturer	Functional Analysis	nadia@kku.edu.sa
15	Fatima Saeed Alasmari	Saudi	Lecturer	Differential Equations	fsabood@kku.edu.sa

System of study in the College of Sciences

❖ **Academic system:**

The Deanship of Admission and Registration is considered the first line of support for university students. The deanship provides academic support for students from admission and up to graduation. One of the deanship's important roles is to keep students up to data with the regulations of study and examinations. Hence, the deanship has unified its efforts to provide many students' services that are based on high standards and precision. Therefore, it is pleased to present to you the following guides to know what is related to the university's rules and regulations that are related to the academic situation of each student.

S	Electronic Guides	
	Guide Name	**Links**
1	Electronic Services Directory	https://dar.kku.edu.sa/sites/dar.kku.edu.sa/files/دليل الاستخدام-طلاب.pdf
2	Student Guide	https://dar.kku.edu.sa/sites/dar.kku.edu.sa/files/1_29%281% 29%281% 1دليل الطالب نسخه جديدة.pdf
3	Student's rights and duties guides	https://www.kku.edu.sa/sites/default/files/general_files/pdf/Administration/guide.pdf
4	College Directory	https://registration.kku.edu.sa/kku/ui/guest/major_plans/index/facultiesMajorsIndex.faces
5	Regulations of Study and Examinations	http://dar.kku.edu.sa/sites/dar.kku.edu.sa/files/general_files/files/laeha.pdf
6	Ethical framework	https://www.kku.edu.sa/portfolio/5264
7	Frequently Asked Questions	https://faq.kku.edu.sa

Programs Offered by the Department

An information- and technology-based society like the Kingdom requires individuals, who can think critically about complex issues, analyze, and adapt to new situations, solve problems of various kinds, and communicate their thinking effectively. The study of mathematics equips students with knowledge, skills, and habits of mind that are essential for successful and rewarding participation in such a society. To learn mathematics in a way that serves them well throughout their lives, students need classroom experiences that help them to develop mathematical understanding; learn important facts, skills, and procedures; develop the ability of mathematical logical thinking; and acquire a positive attitude towards mathematics. Therefore, the department currently offers two programs in mathematics, a bachelor's program and a master's program.

Bachelor of Science in Mathematics:

❖ BSc in Mathematics Program Mission:

Graduating well-qualified individuals, who use mathematical critical thinking to face complex issues, analyze, and adapt to new situations, solve problems of various kinds, and communicate their thinking effectively to serve society.

❖ BSc in Mathematics Program Goals:

➢ Qualifying graduates specialized in Mathematics.
➢ Preparing graduates to endeavor in teaching for public education.
➢ Developing logical thinking and IT skills in Mathematics.
➢ Embracing distinguished local candidates for academic rehabilitation to postulate for MSc and after for PhD.

❖ BSc in Mathematics Program learning Outcomes:

➢ Memorize related mathematical definitions, hypothesis, and theorems.
➢ State different methods of mathematical proofs.
➢ Write mathematical procedure to solve some mathematical problems.
➢ Recognize some applications of mathematics and statistics.
➢ Use definitions and theorems to solve problems.
➢ Justify logically and mathematically the solving steps.
➢ Link different knowledge and skills in the program.
➢ Formulate mathematical models for some practical issues.
➢ Use some mathematical and statistical software in solving problems.
➢ Enhance the ability to self-learning and eLearning and acquire effective communication skills.
➢ Work effectively, both independently and as a part of group.
➢ Adhere to Islamic values and excellence in professional practices.
➢ Able to articulate awareness of and demonstrate personal characteristics that positively impact the learning process.
➢ Take full responsibility for initiating, identifying, amending, and achieving aims.

❖ BSc in Mathematics Program Admission Requirements:

➢ Obtaining a high school diploma or its equivalent in the past five years.
➢ Entry of the necessary tests for the major.

The GPA is calculated as follows:

30% of the high school cumulative average
+ 30% of the General Aptitude Test score
+40% of the Academic Achievement Test score.

➢ Obtaining the national identity.
➢ No previous admission to King Khalid University.
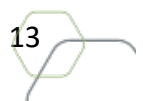
❖ BSc in Mathematics Program Study Plan:

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 1			
Mandatory			
011ENG-6	Intensive English Program 1		6
101BIOL-4	General Biology		4
101MATH-3	Calculus - 1		3
111ICI-2	The Entrance to the Islamic Culture		2
Total credit hours			**15**

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 2			
Mandatory			
101CMS-3	Computer Science		3
101PHYS-4	Introduction to Physics		4
101CHEM-4	General Chemistry - 1		4
110NGL-3	Scientific English for Science Students	011ENG-6	3
112ICI-2	Islamic Culture - 2		2
201ARAB-2	Arabic Language Skills		2
Total credit hours			**18**

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 3			
Mandatory			
102CMS-2	Computation Skills 2	101CMS-3	2
113ICI-2	Islamic Culture - 3		2
202MATH-3	Calculus 2	101MATH-3	3
202ARAB-2	Arabic Editing		2
211STAT-3	Principles of Statistics & Probability		3
232MATH-3	Foundations of Mathematics	101MATH-3	3
Total credit hours			**15**

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 4			
Mandatory			
114ICI-2	Islamic Culture 4		2
203MATH-3	Calculus 3	202MATH-3	3
212STAT-3	Mathematical Statistics	211STAT-3	3
242MATH-3	Linear Algebra 1	232MATH-3	3
251MATH-2	Programming for Mathematics	101CMS-3 102CMS-3	2
263MATH-3	Introduction to Differential Equations	202MATH-3	3
Total credit hours			**16**

Level 5			
Mandatory			
304MATH-3	Vector Analysis	203MATH-3	3
322MATH-3	Real Analysis 1	203MATH-3	3
343MATH-3	Linear Algebra 2	242MATH-3	3
344MATH-3	Number Theory	232MATH-3 242MATH-3	3
361MATH-3	Applied Mathematics	202MATH-3	3
Total credit hours			**15**

Level 6			
Mandatory			
313STAT-3	Probability Theory 1	211STAT-3 203MATH-3	3
323MATH-3	Real Analysis 2	322MATH-3	3
345MATH-3	Group Theory	232MATH-3 344MATH-3	3
352MATH-3	Numerical Analysis	242MATH-3 263MATH-3	3
363MATH-3	Mathematical Methods	263MATH-3 343MATH-3	3
Total credit hours			**15**

Level 7			
Mandatory			
423MATH-3	Functions of Complex Variables	203MATH-3 322MATH-3	3
445MATH-3	Rings and Fields	345MATH-3	3
464MATH-3	Theory of Differential Equations	263MATH-3 343MATH-3	3
481MATH-3	Introduction to Topology	322MATH-3	3
490MATH-2	Special Topics	322MATH-3 313STAT-3	2
491MATH-3	Research Project	322MATH-3 345MATH-3 363MATH-3	3
Total credit hours			**17**

Level 8			
Mandatory			
414STAT-3	Probabilities Theory 2	323MATH-3 313STAT-3	3
424MATH-3	Analysis in Several Variables	323MATH-3	3
432MATH-3	Introduction to Graphs Theory & Combinatorics	344MATH-3	3
453MATH-3	Mathematical Programming	203MATH-3	3
472MATH-3	Differential Geometry	203MATH-3 263MATH-3	3
Total credit hours			**15**

Total Credit Hours for Completing the Program: (126**)**

❖ BSc in Mathematics Courses:

Course Name: Calculus I
Course Code: 101MATH-3
Level: 1

Credit hours: 3
Prerequisite: None

Course Overview:

A course presents the fundamental concepts of the basics of calculus.

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the basic concepts of limits, continuity, and differentiability.
➢ Find and interpret the derivative of functions.
➢ Understand the geometric concepts of continuity and differentiability.
➢ Study some applications of differentiation.

Course Contents:

Real numbers, inequalities, absolute values, sets, coordinate system, lines and circles, functions and relations, limits and continuity, the derivative and its rules, implicit differentiation, tangent and perpendicular lines, angle between two curves, mean value and its applications.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ W. Swokowski, Calculus , PWS Publishing Company, Boston, 1994.
➢ H. Anton, " Calculus with Analytic Geometry ".
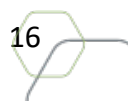
Course Name: Principles of Statistics and Probabilities

Course Code: 211STAT-3   **Credit hours:** 3

Level: 3   **Prerequisite:** None

Course Overview:

A course presents the Principles of Statistics and Probability, their methods, and applications

Course Objectives:

By the end of the course, the student must be able to:

- ➢ Outline the process of collecting data and characterization.
- ➢ Recognize the concepts of Central Tendency and Measure of Dispersion.
- ➢ Define different types of correlations and regression linear model.
- ➢ Outline The probability distribution of a given statistic based on a random sample.

Course Contents:

Data presentation, measure of Central tendency, measures of dispersion, correlation coefficient and regression lines. Principles of probability theory. Estimation and tests of hypothesis.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- ➢ R. Sholden, A first Course in Probability.
- ➢ N. Gilbert, Statistics".

Course Name: Calculus II

Course Code: 202MATH-3

Level: 3

Credit hours: 3

Prerequisite: 101MATH-3

Course Overview:

A course presents the fundamental concepts of the basics of integration.

Course Objectives:

By the end of the course, the student must be able to:

- ➤ Understand differences between integration methods.
- ➤ State and recognize properties of elementary functions.
- ➤ Write integrals as the opposite process of differentiation.
- ➤ Outline the applications of integration.

Course Contents:

Definition of the definite integral using Riemann sums. Properties of the definite integral. Mean value theorem in integration. The fundamental theorem of differentiation and integration. The primary function and the indefinite integral. Integration by substitution. The logarithmic and exponential functions. The hyperbolic and inverse hyperbolic functions. Methods of integration by parts. Trigonometric substitutions, completing the square method, integration of rational functions. Numerical integration: The trapezoidal rule. L'Hospita1 rule. Improper integrals. Areas, Volumes and surface areas of solids of revolutions. Arc length. Polar coordinates. Curves in polar coordinates. Areas in polar coordinates.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- ➤ W. Swokowski, Calculus, PWS Publishing Company, Boston, 1994.
- ➤ H. Anton, Calculus with Analytic Geometry.
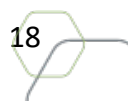
Course Name: Foundation of Mathematics

Course Code: 232MATH-3   **Credit hours:** 3

Level: 3   **Prerequisite:** 101MATH-3

Course Overview:

A course presents the mathematical logic and proofs.

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the role and importance of proofs in mathematics, as well the concept of the importance of assumptions in the proof.
➢ Know the concepts and methods of mathematical logic, set theory, relation calculus, and concepts concerning functions which are included in the fundamentals of various disciplines of mathematics.
➢ Understand the issues associated with different types of infinity and orders in sets.

Course Contents:

Review in set theory, sets and operations, propositions. Methods of proofs (direct proof, contradiction proof, contrapositive, proof by induction). Relations, binary relations, equivalence relation, classes of equivalence and their properties. Partition of sets and its relationship with equivalence relation. The set of integers mod n. Type of applications, composition of applications. Fundamental theorems of applications. Permutations.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ E. S. Epp, Discrete Mathematics with applications,
➢ K.H. Rosen, Discrete Mathematics and its Applications, McGraw- Hill, 4th Edition, 1999.

Course Name: Calculus III

Course Code: 203MATH-3 **Credit hours:** 3

Level: 4 **Prerequisite:** 202MATH-3

Course Overview:

A course presents the fundamental concepts of the multivariable calculus.

Course Objectives:

By the end of the course, the student must be able to:

- ➢ Understand the difference between sequences and series of numbers.
- ➢ State the convergence of sequences and the convergence of series.
- ➢ Understand the difference between all the tests of convergence for series.
- ➢ Outline the functions of several variables and their properties.
- ➢ Understand the extrema of several variables and the saddle points

Course Contents:

Sequences and series. Numerical sequences and their limits. Numerical series, convergence tests. Power series and representation of functions. Taylor's and Mac Laurin series. The binomial theorem with arbitrary exponent. Analysis in several variables, Functions of two and three variables, limits and continuity, partial derivatives. The chain rule. Maxima and minima of two variables, Lagrange multipliers. Double integrals and applications. Double integrals in polar coordinates. Triple integrals and their applications. Triple integrals in cylindrical and spherical coordinates.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- ➢ W. Swokowski, Calculus", PWS Publishing Company, Boston, 1994.
- ➢ H. Anton, Calculus with Analytic Geometry
- ➢ W. Ferrar, A Text-book of Convergence", Oxford University Press, 7th edition, Oxford, 1969.

Course Name: Linear Algebra I

Course Code: 242MATH-3

Level: 1

Credit hours: 3

Prerequisite: 232MATH-3

Course Overview:

A course presents the fundamental concepts of matrices and use it to solve linear homogeneous and nonhomogeneous system of equations.

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the operations of matrices and their properties.
➢ Know the operations on rows of matrices and their applications.
➢ Describe the determinant of a matrix and calculate it.
➢ Memorize how to solve homogeneous and nonhomogeneous systems of equations.

Course Contents:

Algebraic operations on matrices, some type of matrices, elementary transformations on matrices and their applications. Reductions rows of matrices and their applications. Determinant and manual calculations, algebraic properties of determinant, method of computing inverse of matrix, Homogeneous linear systems and nonhomogeneous and manual resolution.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ B. Kolman, Introductory to Linear Algebra.
➢ L. Johnson, Introduction to Linear Algebra.

Course Name: Programming for Mathematics

Course Code: 251MATH-3   **Credit hours:** 2

Level: 4   **Prerequisite:** 101CMS-3
                                                              102CMS-3

Course Overview:

A course presents studying programming with MATLAB for mathematics.

Course Objectives:

By the end of the course, the student must be able to:

> ➤ Describe MATLAB environment.
> ➤ Classify operations on matrices and vectors.
> ➤ Describe methods for solving math problems on MATLAB.
> ➤ Outline the error associated with the algorithms.

Course Contents:

Introduction to Algorithm, MATLAB and problem-solving, Array and matrix operations, M-Files, Functions and Script files, Programming with MATLAB, Plotting and model building Mathematical Applications, Linear algebraic equations, Probability, Statistics, Interpolation, Numerical Calculus, Differential equations
.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	First practical exam	Second practical exam	Final exam	Total
Grade percentage	10%	10%	15%	15%	50%	100%

Teaching Method/s: Lectures and Practical sessions.

Required Textbooks:

> ➤ A. Gilat, MATLAB An Introduction with Applications, 3rd Ed., JOHN WILEY & SONS (2008).
> ➤ S. Attaway, MATLAB A Practical Introduction to Programming and Problem Solving, 2nd Ed., Butterworth-Heinemann, Elsevier (2012).
> ➤ D. McMahon, MATLAB Demystified, McGraw-Hill Companies (2007).

Course Name: Introduction to Ordinary Differential Equations

Course Code: 263MATH-3   **Credit hours:** 3

Level: 4   **Prerequisite:** 202MATH-3

Course Overview:

A course presents different types of ordinary differential equations and the different methods of solutions.

Course Objectives:

By the end of the course, the student must be able to:

➤ Define differential equations.
➤ Recall the definition of order and degree of differential equations.
➤ List different methods to solve ordinary differential equations.
➤ Write a solution to an ordinary differential equation.

Course Contents:

Elimination of constants. Ordinary differential equations of first order (separation of variables, homogeneous equations, exact equations, linear equations, integrating factor, Bemoulli and Ricatti equations, equations with linear coefficients). Differential equations of second order (linear dependence and independence of functions, the Wronskian, equation of higher order with constant coefficients, nonhomogeneous equations, reduction of order. The method of differential equations. The variation of parameters. Application of differential equations. Solution by power series (near ordinary and singular points). Application to electric circuits and networks.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➤ D.G Rainville and P.E. Bediest, Elementary Differential Equations, McMillan, New York, 1995.
➤ D.G. Zill, A first Course in Differential Equations, PSW, Kent Pub. Comp., 1993.

Course Name: Mathematical Statistics

Course Code: 212STAT-3   **Credit hours:** 3

Level: 4   **Prerequisite:** 211STAT-3

Course Overview:

A course presents the methods of the statistical inference.

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the difference between the parameters and the estimates.
➢ State the test of hypothesis (one sample and two samples).
➢ Define ANOVA (one way and two-way classification) and some continuous distributions in addition to the sufficient statistics.
➢ Outline The probability distribution of a given statistic based on a random sample.

Course Contents:

Estimation. Tests of hypothesis, linear normal models, regression models. Least square method. Analysis of variance, parametric methods, coefficient statistics. Statistical inference. Multiple normal distributions.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ R. Hogg and A. Craig, Introduction to Mathematical Statistics, McMillan
➢ J. A. Rice, Mathematical Statistics and Data Analysis, Wadsworth.
➢ E.L. Lehman, Testing Statistical Hypothesis, Wiley and Sons.

Course Name: Vector Calculus

Course Code: 304MATH-3   **Credit hours:** 3

    Level: 5   **Prerequisite:** 203MATH-3

Course Overview:

A course presents the methods of vector analysis and their applications.

Course Objectives:

By the end of the course, the student must be able to:

 ➢ Define equations of lines and planes in three dimensions and describe surfaces of revolution and their equations in cylindrical and spherical coordinates.
 ➢ Define vector-valued functions (Domains-continuity-Differentiability-Integrals).
 ➢ Recognize vector fields and vector calculus, and define Gradient, Divergence and Curl, as well as conservative fields.
 ➢ Define equations of tangent planes and normal lines to surfaces, directional derivatives.
 ➢ Recognize line integrals and surface integrals and state the famous theorems of Green-Gauss-Stokes.

Course Contents:

Vectors in two dimensional spaces and three-dimensional spaces, scalar and vector products. Equation of straight line and equation of plane in three-dimensional space. Figures and volume of revolution in cylindrical and spherical coordinates. Vector functions in real variables. Curves in plane and space. Curvature, rate of change in the direction of the tangent and normal. Vector differentiation, gradient of a function. Applications to the equation of the normal to any surface and tangent plan to any surface at a point on it. Vector fields, divergence and curl of vector. Integration on a curve or surface. Green's theory Gauss's divergence theory. Stocks' theory.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

 ➢ W. Swokowski, Calculus", PWS Publishing Company, Boston, 1994.
 ➢ B. Spain, Elementary Vector Analysis.
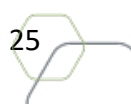
Course Name: Real Analysis I

Course Code: 322MATH-3   **Credit hours:** 3

Level: 5   **Prerequisite:** 203MATH-3

Course Overview:

The course is intended as rigorous proof of the Fundamental Theorems of Calculus.

Course Objectives:

By the end of the course, the student must be able to:

➢ List of axioms of real numbers and their properties. Outline the completeness property.

➢ Define sequences and their limits. List limit theorems. Define monotone sequences. State the Cauchy criterion. Outline the Bolzano-Weierstrass theorem. Define subsequences, open and closed sets.

➢ Recall the limits of functions. List limit theorems. Describe the Limit concept. Define monotone functions. Describe continuous functions, and continuous functions on intervals.

➢ Outline the concept of derivative and list its properties. State the Mean-Value Theorem, and L'Hospital's Rule.

Course Contents:

Fundamental properties of the real numbers. Completeness axiom, Mountable sets, sequences and convergence, monotone sequences, Bolzano-Weirstrass theorem. Cauchy test. Topological properties of real numbers. Limits of functions, continuous functions, compact sets and continuity. Heine-Borel's theorem. The derivative and its rules. L'Hospital theorem. Taylor's theorem.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ K.A. Ross, Elementary Analysis: Theory of Calculus, Springer Verlag 1980.

➢ W. Rudin, Principles of Mathematical Analysis, McGraw Hill 1976.

➢ T.E. Marsden, Elementary Classical Analysis, Freeman and Company 1974.

Course Name: linear Algebra II

Course Code: 343MATH-3   **Credit hours:** 3

Level: 5   **Prerequisite:** 242MATH-3

Course Overview:

A course presents the concepts of vector spaces and their basis, the linear transformations, and their properties.

Course Objectives:

By the end of the course, the student must be able to:

➢ Describe the concept of vector space and sub-vector space.
➢ State different methods to find basis of vector spaces.
➢ Define the linear transformation, find the range and null space
➢ Outline inner product and reduction of matrices.

Course Contents:

Linear spaces, linear dependence and linear independence, finite dimensional linear spaces, bases, subspaces, inner product spaces, linear transformations, eigenvectors and eigenvalues of matrices and of linear transformations.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ B. Kolman, Introductory to Linear Algebra.
➢ L. Johnson, Introduction to Linear Algebra.

Course Name: Number Theory

Course Code: 344MATH-3   **Credit hours:** 3

Level: 5   **Prerequisite:** 232MATH-3
242MATH-3

Course Overview:

A course presents the fundamental concepts of the set of integers and related Theorems

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the Divisibility, primality, and factorization,
➢ Recognize the GCD, LCM and linear Diophantine equations,
➢ Define the congruences, system of linear congruences and multiplicative functions.
➢ State the binary and decimal representations.

Course Contents:

Natural and Integers numbers, divisibility, prime numbers. Fundamental theorem of arithmetic, greatest common divisor and least common multiple. Euclidean algorithm with mod n. The Chinese reminder theorem, the order of an integer with mod n, Euler's function, Fermat's little theorem, Euler's theorem, primitive roots, Legendre's symbol, the law of quadratic reciprocity, multiplicative functions, Wilson's theorem, linear Diophantine equations, some of numerical functions. Pythagorean triples, some of Fermat's situations.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ K.H. Rosen, Elementary Number Theory and its Applications, 4th Edition, Addison-Wesley, 2000.
➢ D.M. Burton, Elementary Number Theory, 4th Edition McGraw Hill, 1997.
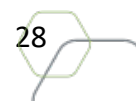
Course Name: Applied Mathematics

Course Code: 361MATH-3

Credit hours: 3

Level: 5

Prerequisite: 202MATH-3

Course Overview:

A course presents state three different mechanics: Newtonian, Lagrangian, and Hamiltonian mechanics, and present solution methods for some physical phenomena.

Course Objectives:

By the end of the course, the student must be able to:

- Describe the basic concepts of Newton mechanics.
- Memorize the concepts of the generalized coordinates and generalized forces.
- List the basic equations of Lagrange mechanics.
- Outline the main concepts of Rigid body motion.

Course Contents:

Velocity and acceleration in different coordinates systems. Motion with variable mass. Motion of satellite relative to the earth. Motion in a plane (orbital motion). Motion of a particle in the three dimensions with applications. Moments of inertia for a rigid body. Angular velocity. Angular momentum. General motion of a rigid body. Euler's equations. Introduction to the calculus of variations. Analytical mechanics, Lagrange equations. Hamilton's principle.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- F. Chorlton. Text book of Dynamic, John Wiley and Sons, 1983.
- G. Fowles, Analytical Mechanics Sounders College Publishing, 1986.
- D. Kleppner and R. Kolenkow, An introduction to Mechanics, McGraw- Hill, 1973.
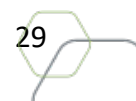
Course Name: Real Analysis II

Course Code: 323MATH-3   **Credit hours:** 3

Level: 6   **Prerequisite:** 322MATH-3

Course Overview:

A course presents the fundamental concepts of Lebesgue's theory of integration.

Course Objectives:

By the end of the course, the student must be able to:

➢ State the pointwise and uniform convergence of a sequence of functions.
➢ State the pointwise and uniform convergence of a series of functions.
➢ Describe the notion of algebra and sigma algebra.
➢ Define Lebesgue measure and Lebesgue outer measure.
➢ Recognize a Lebesgue integrable function.
➢ Outline the different theorems of convergence

Course Contents:

Riemann integral, Darboux theorem and the fundamental theorem of integration. Uniform convergence of sequences and series of functions. Power series. Lebesgue measure, Borel algebra, properties of the Lebesgue measure, measurable sets. Lebesgue integral, measurable functions. Lebesgue's dominated convergence, monotone convergence. Relationship of Riemann and Lebesgue integrals.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ H.L. Royden, Real Analysis, McMillan, 1988.
➢ G. De Barra, Measure Theory and Integration, Ellis Howwood, 1981.
➢ B. Craven, Lebesgue Measure and Integration, Pitman, Boston, 1982.

Course Name: Group Theory

Course Code: 345MATH-3

Level: 6

Credit hours: 3

Prerequisite: 232MATH-3
344MATH-3

Course Overview:

A course presents the fundamental concepts of Group Theory.

Course Objectives:

By the end of the course, the student must be able to:

➢ Outline the basic concept of this course.
➢ State and prove the fundamental theorems and properties of the algebraic constructions of this course.
➢ Recognize the main differences between the basic notions of this course
➢ Memorize examples and counterexamples for the basic notions and applications of the main theorems of this course.

Course Contents:

Binary operations, definition of a group, elementary group properties, commutative groups, cyclic groups, group of permutations. Direct product of groups, subgroups and fundamental theorem. Order of an element, Lagrange's theorem, infinite groups, normal subgroups and quotient groups. Homomorphism of groups. Kernel of a homomorphism. Fundamental theorems of group homomorphism. Cayley Theorem.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ I.N. Herestein, Abstract Algebra.
➢ J.R. Dublin, Modern Algebra.

Course Name: Numerical Analysis I

Course Code: 352MATH-3

Level: 6

Credit hours: 3

Prerequisite: 242MATH-3
263MATH-3

Course Overview:

A course presents fundamental direct and iterative methods to solve mathematical problems that are difficult to solve analytically and analyze the approximation error.

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the difference between direct and iterative methods.
➢ State numerical methods.
➢ Define the approximation error.
➢ Outline direct and iterative methods.

Course Contents:

Approximate methods to solve equations in one variable. Polynomial interpolation and spline functions, approximation of functions. Numerical integration. Numerical solution of initial value problem associated with differential equations. Numerical methods for solving linear and nonlinear systems of algebraic equations.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ K.E. Atkinson, "An Introduction to Numerical Analysis" John Wiley & Sons Inc., 1978.
➢ R.L. Burden & J.D. Faires, "Numerical Analysis", 6th edition brooks, Cole Publishing Comp., 1996.
➢ S.D Conte & Carl De Boor, "Elementary Numerical Analysis (An algorithmic Approach", McGraw-Hill Book Co., New York, 1965, 1972.

Course Name: Mathematical Methods
Course Code: 363MATH-3   **Credit hours:** 3
                   Level: 6   **Prerequisite:** 263MATH-3
                                                            343MATH-3

Course Overview:

A course presents the theory and application of mathematical methods to solutions of problems that arise in science and engineering.

Course Objectives:

By the end of the course, the student must be able to:

➢ Recognize the inner product space of functions in L2
➢ Outline properties of the eigenvalue problem for a self-adjoint operator in L2
➢ Define the Sturm-Liouville problem.
➢ Describe orthogonal polynomials and its properties
➢ State Fourier series and Fourier transform

Course Contents:

Inner product spaces, sets of orthogonal functions, orthogonal polynomials, generator functions. Sturm-Liouville Problems. Fourier series. Special functions: gamma function, beta function, Bessel function, Legendre polynomial. Laplace transformations. Applications of generalized functions and Dirac function.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ R.C. Buck, Advance Calculus", McGraw Hill, 1978.
➢ R. Courant and D. Hilbert, Methods of Mathematical Physics, Interscience, 1955.

Course Name: Probability Theory I

Course Code: 313STAT-3   **Credit hours:** 3

Level: 6   **Prerequisite:** 211STAT-3
                                                      203MATH-3

Course Overview:

A course presents probability models for both discrete and continuous random variables and the basic principle of counting to determine the probability of events..

Course Objectives:

By the end of the course, the student must be able to:

- List the probability axioms and basic principles of combinatorial analysis
- Recognize fundamental theorems in the calculus of probability such as Multiplicative Theorem, Bayes' theorem, and Total Probability Theorem
- Understand the difference between discrete random variable and continuous random variables
- Understand and describe sample spaces events for random experiments

Course Contents:

Probability and its axioms. Random variables. Mathematical expectation of Random variables, moments, moment generating functions. Discrete probability distributions. Continuous probability distributions. Limits and inequalities of probability, Reliability theory. Queuing systems.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- 1.W. feller, An introduction to Probability theory and its Applications, vol 1, J. Wiley and Sons.
- S. Ross, A First Course in Probabilit, McMillan.
- R. Hogg and A. Craig, Introduction to Mathematical Statistics, McMillan.

Course Name: Functions of Complex Variables

Course Code: 423MATH-3   **Credit hours:** 3

Level: 7   **Prerequisite:** 203MATH-3
322MATH-3

Course Overview:

A course presents the fundamental ideas of the functions of complex variables

Course Objectives:

By the end of the course, the student must be able to:

- ➢ Recall operations on the complex numbers
- ➢ State Cauchy-Riemann theorem and harmonic conjugate.
- ➢ Define zero and poles.
- ➢ Outline the residue method.

Course Contents:

Complex Numbers: algebraic properties, polar form, exponents and radicals, De Moivre's theorem. Complex variable functions: Limits and continuity. Analytic functions. Cauchy-Riemann equations. Harmonic functions, exponential and logarithmic functions. Trigonometric and Hyperbolic functions. Complex integration, line integral. Cauchy-Goarsat lemma, Cauchy integral formula. Maximum modulus principle. Series representation of analytic functions. Taylor series, Laurent series, singular points. Essential singular points. Residue theorem and its applications.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- ➢ E.B. Saff and A.D. Snider, Fundamentals of Complex Variables for Maths. Sciences and Engineering Prentice and Hall, Englewood Cliffs, New Jersey, 1976.
- ➢ R.V. Churchill and J.W. Brown, Complex Variables and Applications, McGraw-Hill, Company, New York, 1990.
- ➢ L.V. Ahlfors, Complex Analysis, McGraw-Hill, Company, New York, 1979.

Course Name: Rings and Fields
Course Code: 445MATH-3   **Credit hours:** 3
     Level: 7   **Prerequisite:** 345MATH-3

Course Overview:

A course presents the fundamental concepts of rings and fields.

Course Objectives:

By the end of the course, the student must be able to:

➢ Define many examples of certain types of Rings, fields, subrings, and ideals.
➢ Study the characteristic of rings, zero divisors and
➢ integral domains and some elementary properties of rings and ideals.
➢ Learn the concept of rings homomorphism and its kernel and image, and quotient rings.
➢ Ability to study the abstract concept in polynomial rings and fields extensions.

Course Contents:

Definition of ring. Elementary facts about rings, zero divisors in ring, an integral domain. Fields, theorems in finite ring, subring, direct sum of rings, ideals, prime ideals, maximal ideals, quotient rings, homomorphism of rings, isomorphism theorem, characteristic of ring, Euclidian ring, ring of polynomials, root of polynomial. Extension fields. Algebraically closed field.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ I.N. Herestein, Abstract Algebra.
➢ J.R. Dublin, Modem Algebra.

Course Name: Theory of Differential Equations

Course Code: 464MATH-3   **Credit hours:** 3

Level: 7   **Prerequisite:** 263MATH-3

343MATH-3

Course Overview:

A course presents different classes of Differential Equations, and different techniques to solve them.

Course Objectives:

By the end of the course, the student must be able to:

➢ Recognize the difference between ODE's, PDE's and boundary values problems.
➢ State the methods for solving the linear system of DE's.
➢ Define the Lipschitz condition and non-homogeneous boundary conditions.
➢ Outline the transform methods.

Course Contents:

The existence and Uniqueness of solutions for differentials equations. Nonlinear differentials equations. Partial differential equations. Transform methods. Boundary value problems. Systems of linear equations.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ F.U. Myint, Ordinary Differential Equations, North Holland, 1978.
➢ D. Greenspan, Introduction to Partial Differential Equations, McGraw-Hill, 1988.
➢ F. John, Partial Differential Equations, Springer Verlag, 1978.

Course Name: Introduction to Topology

Course Code: 481MATH-3   **Credit hours:** 3

Level: 7   **Prerequisite:** 322MATH-3

Course Overview:

A course presents the essentials of point set topology which is the mathematical study of shapes, or topological spaces..

Course Objectives:

By the end of the course, the student must be able to:

➢ Write the definition of topology, define open, closed, closure, limit point, interior, exterior, and boundary of a set, and describe the relations between these sets.
➢ Define basis for a topology, list conditions under which one can generate a topology from a certain collection of subsets, and describe how to generate a topology from any collection of subsets without any condition.
➢ State the definition of continuity of a function between topological spaces, and list the equivalence definitions of continuous functions.
➢ Recall the definition of homeomorphic spaces, and describe the homeomorphism

Course Contents:

Topological spaces, bases, topological subspaces, continuity, homeomorphism, quotient spaces, finite product of topological spaces. First and second axiom of countability, separation axioms, compactness, connectedness. Metric topologies.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ R.A Canover, A First Course in Topology, The Williams & Willines Company, 1968.
➢ R. Engelking, Outline of General Topology, North Holland, Amsterdam, 1968.
➢ I.Kelley, General Topology, Van Nostrand, Princeton, N.Y. 1955.
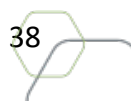
Course Name: Special Subjects

Course Code: 490MATH-2   **Credit hours:** 2

Level: 7   **Prerequisite:** 322MATH-3

313STAT-3

Course Overview:

A special course to study a selected advanced topic (or more than one topic) in Mathematics.

Course Objectives:

By the end of the course, the student must be able to:

➢ Define notions relevant to the chosen topic.
➢ List properties of the notions relevant to the chosen topic.
➢ Recall the facts and results relevant to the chosen topic.
➢ Outline relevant methods.

Course Contents:

In this course, students will be introduced to selected topics in mathematics that have not have not been taught in other mathematic courses. These topics will be carefully selected each semester subject to council approval and must be of special importance to a wide spectrum of mathematical subjects.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ Relevant textbook(s) will be selected by the assigned teacher and requires the approval of the Educational Affairs Committee at the Department.

Course Name: Research Project

Course Code: 491MATH-3

Level: 7

Credit hours: 3

Prerequisite: 322MATH-3
345MATH-3
365MATH-3

Course Overview:

A course Encourage students to extend their knowledge in a special topic (or more than one topic) in Mathematics using tools and methods of scientific research.

Course Objectives:

By the end of the course, the student must be able to:

➢ Define notions relevant to the chosen topic.
➢ List properties of the notions relevant to the chosen topic.
➢ Recall the facts and results relevant to the chosen topic.
➢ Outline relevant methods.

Course Contents:

The department shall give the student an abridged idea about the following:

➢ Fundamentals of the scientific method in research (Definition of research, types of research, the scientific method, the method of choosing the research problem).
➢ The library and research (The library system and look finding references, collecting research sources).
➢ Methodology of scientific research (Classification of research methods, authenticated research, surveying of methods, case study, research in mathematics and physics)
➢ Preparation of research plan (The essential elements, importance of study, plan of progress in research).
➢ Report writing (Report contents and steps of writing, general principles in report writing).
➢ Then comes the application stage which is a research project in mathematical sciences which applies the methods and concepts which the student has learnt before. The project must be real and of appropriate length which must be under the supervision of a staff member. The research projects are determined by the department and approved by the department board.

Assessments:

The grade percentage is divided as follows:

Assessment type	First committee member	Second committee member	Advisor	Total
Grade percentage	20%	20%	60%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ Relevant textbook(s) will be selected by the assigned teacher and requires the approval of the Educational Affairs Committee at the Department.

Course Name: Analysis in Several Variables

Course Code: 424MATH-3   **Credit hours:** 3

Level: 8   **Prerequisite:** 323MATH-3

Course Overview:

A course presents the fundamental concepts of algebraic and geometric structure of the complex number system.

Course Objectives:

By the end of the course, the student must be able to:

- Demonstrate an understanding of the proofs of some fundamental theorems already introduced in Calculus 3.
- Determine the basic topological properties of the Euclidean space.
- Determine the limits, continuity, and differentiability of functions in several variables.
- Distinguish between differentiability and partial differentiability and understand the relationship between them.
- Find the critical points of a real function in several variables and classify them.

Course Contents:

The Euclidean Space the topology of the space (open sets, closed sets, limit points, interior points, sequences, series), compactness and connectedness (Heine-Borel and Bolzano Weirstrass, connectedness by arcs). Continuous functions and the uniform. Differentiable functions, rules of differentiation, inverse functions theorem. Implicit functions. Integral in several variables.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- J.E. Marsden, Elementary Classical Analysis, W.H. Freeman and Company, 1973.
- W. Rudin, Principles of mathematical Analysis, 2'^{d} edition, New York.

Course Name: Introduction to Graphs and Combinatorics

Course Code: 432MATH-3   **Credit hours:** 3

Level: 8   **Prerequisite:** 344MATH-3

Course Overview:

A course presents the fundamental concepts of graph theory and combinatorics to mathematics students and show some real-world applications.

Course Objectives:

By the end of the course, the student must be able to:

- ➢ Understand the difference between direct and iterative methods.
- ➢ Understand basic notions in graph and combinatory theory
- ➢ Write the procedure for solving recurrences relations
- ➢ Recognize many techniques namely coloring, how transform a graph into another similar for tracing it in the plan, chromatic numbers.

Course Contents:

Basic definitions, paths, cycles and trees, Euler graphs, Hamilton cycles, planar graphs. Colouring. Direct graphs. Dilworth theorem. Permutations and Combinations, inclusion and exclusion principle. Recurrence relations, generated functions. Analysis of Algorithms. Algorithms in graphs and direct graphs.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- ➢ Bela Bollobas, Graduate Texts in mathematics 184. Springer- Verlag, N.Y. 1998.
- ➢ M. Townsend, Discrete Mathematics: Applied Combinatorics and Graph Theory, Cummings Publishing Company, Inc.
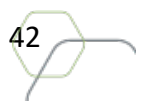
Course Name: Mathematical Programming

Course Code: 453MATH-3   **Credit hours:** 3

         Level: 8   **Prerequisite:** 203MATH-3

Course Overview:

A course presents the mathematically formulate some real-life problems to linear programming (LP) problems and solve these using LP methods..

Course Objectives:

By the end of the course, the student must be able to:

- Memorize a profound knowledge of the concepts related to the theory of linear programming.
- Outline the difference between different linear programming methods.
- Recognize the steps to follows of each method of linear programming
- Recognizing the process of mathematical formulation of LP problems.

Course Contents:

The Geometric method to solve a linear program. Simplex method. Two steps method. Instability. The modified simplex method. Problems in binary optimization and computerability analysis. Applications in transport problems.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- M.S.Bazaraa & J.J.Jarvis, Linear Programming and Network Flows, John Wiley and sons.

Course Name: Differential Geometry

Course Code: 472MATH-3

Level: 8

Credit hours: 3

Prerequisite: 203MATH-3
263MATH-3

Course Overview:

A course presents the elementary and geometric introduction to differential Geometry

Course Objectives:

By the end of the course, the student must be able to:

➢ Define parameterization of curves and arc length parameterization
➢ Describe the curvature and torsion of curves
➢ List the Frenet -Serre apparatus and osculating planes
➢ Define the parametrization of surfaces, fundamental forms, principal curvatures
➢ State the Gaussian curvature, mean curvature, and geodesics of a surface

Course Contents:

Curves in Euclidean spaces. Existence and uniqueness theorems. Parametric representation. Regular curve. Representation of curves by arc length. Tangent, local canonical form and osculants. Frenet formulas. Winding number and rotation index. Envelopes of curves. Surfaces, Parameterization. Functions and fundamental forms, principle curvatures. Asymptotic curves and conjugate. Geodesics.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ Chuan-Chih Hsiung, A first Course in Differential Geometry, A Wiley-lnterscience publication, 1988.
➢ J. A.Thorpe, Elementary Topics in Differential Geometry, Springer-Verlag, 1979.
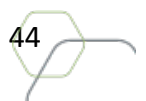
Course Name: Probability Theory II

Course Code: 414STAT-3   **Credit hours:** 3

Level: 8   **Prerequisite:** 323MATH-3

313STAT-3

Course Overview:

A course deepens and expands the basic knowledge in probability theory.

Course Objectives:

By the end of the course, the student must be able to:

➢ Memorize the difference between different convergence modes
➢ State the Markov property and memorize different definitions of the martingale process
➢ Recognize the different   versions of central limit theorems
➢ Outline the general properties of the catachrestic function

Course Contents:

Borel theory of natural number, probability measures, countable probabilities, law of large numbers. Distribution functions, Random variables and distributions. Expect values, summation of independent Random variables. Convergence, weak convergence. Characteristic functions. Central limit theorem. Conditional probability, conditional expectation. Martingale theorem.

Assessments:

The grade percentage is divided as follows:

Assessment type	First Midterm	Second Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	20%	20%	10%	50%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ P. Billingsley, Probability and Measure, john Wiley, 1986.
➢ A.L. Breiman, Probability, Addison Wesely , 1986.
➢ K.L. Chung, A Course in Probability, Academic Press, 1974.

Master of Science in Mathematics:

❖ MSc in Mathematics Program Mission:

Graduating students possessing thorough understanding of mathematical concepts, theories, research, and recent developments of mathematics by providing an integrated academic environment and research addressing the needs of community and bolstering economy of knowledge.

❖ MSc in Mathematics Program Goals:

The Program aims mainly at having students with the following traits:

➢ Possession of a profound background in the foundations of graduate-level mathematical analysis, abstract algebra, statistics, and applied mathematics**.**
➢ Development of critical thinking and ability to synthesize different mathematical concepts to obtain definite conclusions for mathematical problems.
➢ Obtainment of solid theoretical and practical knowledge in a particular field of study.
➢ Ability to conduct a research project and effectively communicate its findings to the research community.
➢ Practice of essential academic attributes, such as: self-learning, independence, responsibility, professional ethics, intuition, and pro-activity.

❖ MSc in Mathematics Program learning Outcomes:

➢ State fundamentals of mathematics.
➢ Write well-defined features of some branches of mathematics.
➢ Recognize features of some applications of mathematics in other disciplines.
➢ Memorize mathematics and mathematical methods to some applications.
➢ Use definitions and theorems to solve problems.
➢ Justify logically and mathematically the solution steps.
➢ Link different knowledge and skills in the program.
➢ Formulate mathematical models for some practical issues.
➢ Communicate effectively. An ability to communicate concepts and methods of applied mathematics, and their relation to problems in different disciplines.
➢ Work effectively, both independently and as part of an interdisciplinary group.
➢ Identify, select, plan for (including resource planning), use and evaluate IT applications and strategies to enhance the achievement of aims and desired outcomes.
➢ Take full responsibility for initiating, identifying, amending, and achieving aims and desired outcomes, using new skills/ techniques as required.
➢ Able to articulate awareness of and demonstrate personal characteristics that positively impact the workplace.
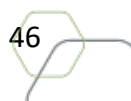
❖ The degree awarded by the program:

Master of Science in Mathematics.

❖ MSc in Mathematics Program Admission Requirements:

The department of Mathematics is committed to the **Unified Regulations of Postgraduate Studies at Saudi Universities** and its **Executive Regulations at King Khalid University**. And especially, **Article 15 for the entrance exam**, and **Article 18 for the complementary courses.**

Particularly, the department requires:

> ➢ A bachelor's degree in mathematics.
> ➢ Proficiency in English verified through one of the following:

Test	Required level
TOEFL-IBT	45
STEP	67
IELTS	4

> ➢ Passing tests and personal interview conducted by the department.

If needed, all complementary courses that will be proposed must be passed with a grade of C or higher.

❖ MSc in Mathematics Program Study Plan:

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 1			
Mandatory			
522MATH-3	Measure Theory		3
543MATH-3	Linear Algebra		3
562MATH-3	Partial Differential Equations		3
Total credit hours			**9**

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 2			
Mandatory			
511STAT-3	Probability Theory	522MATH-3	3
524MATH-3	Functional Analysis	543MATH-3	3
541MATH-3	Abstract Algebra		3
Total credit hours			**9**

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 3			
Mandatory			
690MATH-2	Special Course	Department Approval	2
Elective- (two courses are chosen according to the specialty track after department's council approval)			
513STAT-3	Advanced Mathematical Statistics		3
542MATH-3	Rings and Fields	541MATH-3	3
551MATH-3	Numerical Analysis	562MATH-3	3
581MATH-3	Topology		3
618STAT-3	Special Topics in Statistics and Probability	511STAT-3	3
628MATH-3	Special Topics in Analysis	524MATH-3	3
648MATH-3	Special Topics in Algebra	541MATH-3	3
668MATH-3	Special Topics in Applied Mathematics	562MATH-3	3
Total credit hours			**8**

Course Code	Course Title	Pre-Requisite Courses	Credit Hours
Level 4			
Mandatory			
691MATH-6	Thesis	Department Approval	6
Total credit hours			**6**

Total Credit Hours for Completing the Program: (32)

❖ MSc in Mathematics Courses:

Course Name: Probability theory

Course Code: 511STAT-3

Credit hours: 3

Level: 2

Prerequisite: 522MATH-3

Course Overview:

A core course consists of some basic concepts in the theory of probability and measure and their relationship.

Course Objectives:

By the end of the course, the student must be able to:

➢ Use probabilistic reasoning and the foundations of probability theory to model and analyze the stochastic phenomena.
➢ Generate data from various distributions.
➢ Evaluate the probability of real events by using the theory of probability.
➢ Write a logical proof of a statement in probability theory.
➢ Develop decision-making tools based on data exploration through probability modeling.

Course Contents:

General probability spaces; random variables as measurable functions; some usual distributions; types of convergence; characteristic functions; central limit theorems; the weak and strong laws of large numbers.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ R. Durrett, *Probability: Theory and Examples*, Duxbury Press, 1996.
➢ Billingsley, *Probability and Measure*, Wiley, 1995.
➢ R. Dudley, *Real Analysis and Probability*, Chapman and Hall, 1994.
➢ Breiman, *Probability Theory*, Addison Wesely, 1968.
➢ K. Chang, *A Course in Probability Theory*, Academic Press, 1974.

Course Name: Advanced Mathematical Statistics

Course Code: 513STAT-3

Level: 3

Credit hours: 3

Prerequisite: None

Course Overview:

An elective course consists of some advanced concepts in the mathematical statistics. Precisely, it concentrates on basic properties for some classical methods in the theory of estimation, hypothesis tests, decision making, and Bayesian.

Course Objectives:

By the end of the course, the student must be able to:

➢ Gain familiarity with various discrete and continuous probability distributions and their usefulness in modeling statistical processes.
➢ Plan the appropriate strategies for a statistical analysis.
➢ Estimate the population parameters using the statistical techniques.
➢ Evaluate the statistical procedures in terms of efficiency, robustness, and accuracy.
➢ Extract the pertinent information in the data.

Course Contents:

Statistical models; sufficiently and completeness; best estimator; methods of estimation; confidence intervals; hypotheses tests; Bayesian method.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ T. Ferguson, *Mathematical Statistics: A decision theoretic Approach*, Academic Press, 1969.
➢ E. Lehmman, *Theory of Point Estimation*, Springer, 1995.
➢ E. Lehmman, *Testing Statistical Hypothesis*, Springer, 1997.
➢ D. C. Montgomery & G. C. Runger, *Applied Statistics and Probability for Engineers*, 3rd ed., John Wiley & Sons, 2002.

Course Name: Measure Theory

Course Code: 522MATH-3

Credit hours: 3

Level: 1

Prerequisite: None

Course Overview:

A core course presents basic tools and concepts in the advanced real Analysis and measure theory.

Course Objectives:

By the end of the course, the student must be able to:

- Define a measure and an outer measure.
- Determine if a function is integrable with respect to a specific measure or not.
- Use the different theorems of convergence: monotone convergence, Fatou and dominated convergence theorem.
- Understand the different type of convergence: almost everywhere convergence, convergence in measure and strong convergence.
- Understand and apply the Radon Nikodym theorem, and Riesz representation theorem.
- Understand and apply Fubini's theorem.

Course Contents:

Definitions and examples of measures; outer measures; Lebesgue-Stieltjes; measures, Caratheodory extension theorem; measurable functions; Lebesgue integral; monotone convergence theorem; Fatou's lemma; dominated convergence theorem; comparison ; type of convergence (almost everywhere convergence, measure convergence, and strong convergence); definition and properties of Lp spaces; Radon Nikodym theorem, Riesz representation theorem; decomposition of measures; product measures; Fubini's theorem.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- R. Bartle, *The Elements of Integration and Lebesgue Measure*, Wiley, 1995.
- G. Folland, *Real Analysis: Modern Techniques and Their Applications, 2nd Ed.*, Wiley, 1999.
- H. Royden, *Real Analysis, 3rd Ed.*, Prentice Hall, 1988.

Course Name: Functional Analysis

Course Code: 524MATH-3   **Credit hours:** 3

Level: 2   **Prerequisite:** 543MATH-3

Course Overview:

A core course that provides the student with the basic concepts in functional analysis and some of their applications.

Course Objectives:

By the end of the course, the student must be able to:

➢ Distinguish between metric space, normed, Banach and Hilbert spaces.
➢ Demonstrate deep understanding of the basic concepts of Linear and bounded operators.
➢ Apply the fundamental theorems of functional analysis.
➢ Demonstrate deep understanding of the basic concepts of spectral theory of Linear operators.

Course Contents:

Metric spaces; normed spaces; Banach spaces; Hilbert spaces; linear operators; Hahn-Banach theorem; Banach-Steinhous theorem; open mappings; closed graph theorem; compact operators; self-adjoint operators; introduction to spectral theory.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ E. Kreyszig, *Introductory Functional Analysis with Applications*, 1st Ed., Wiley ,1989.

➢ W. Rudin, *Functional Analysis, 2nd Ed.*, McGraw Hill, 1991.

➢ J. Conway, *A Course in Functional Analysis*, 2nd Ed., Springer.

Course Name: Abstract Algebra

Course Code: 541MATH-3   **Credit hours:** 3

Level: 2   **Prerequisite:** None

Course Overview:

A core course in algebra contains some basic concepts in the theory of groups and principles in the theory of rings.

Course Objectives:

By the end of the course, the student must be able to:

➢ Introduce students to some basic concepts in advanced algebra.
➢ Prepare student for advanced topics in algebra and its applications.
➢ Support the student's logical mathematical thinking and develop his or her research abilities in the fields of algebra and its applications.

Course Contents:

Symmetric and dihedral groups; Centralizer, normaliszer and stabilizer; Quotient groups; Homomorphisms; Group action; The Sylow theorems; Product of groups; Generators and relations; Free groups; The fundamental theorem of finitely generated abelian groups; Rings of Matrices and Rings of Polynomials.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ D. Dummit and R. Foote, *Abstract Algebra, 3rd Edition*, Prentice Hall
➢ T. Hungerford, *Algebra, 1st Ed.*, Springer, 2003.
➢ J. Rotman, *Advanced Modern Algebra*, 2nd, AMS, 2010.

Course Name: Rings and Fields

Course Code: 542MATH-3

Level: 3

Credit hours: 3

Prerequisite: 541MATH-3

Course Overview:

An elective course in advanced algebra contains some basic concepts in the theory of rings and fields.

Course Objectives:

By the end of the course, the student must be able to:

➢ Giving the student part of the necessary background in modern algebra.
➢ Introduce student to the concept of rings, fields, and their properties.
➢ Familiarize student with mathematical proofs and logical maturity.
➢ Prepare student for advanced work and research in the relevant areas.

Course Contents:

Ideals over commutative rings; Euclidean domain; principal ideal domain; unique factorization domain; fractional field; polynomial rings; algebraic field extension; splitting field; algebraic closure; separable/inseparable extension; simple extension; the Fundamental Theorem of Galois Theory; finite fields; composite extension; cyclotomic extension; abelian extension; Galois group and computations; solvable extension; radical extension; transcendental extension.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ D. Dummit and R. Foote, *Abstract Algebra, 3rd Edition*, Prentice Hall.
➢ T. Hungerford, *Algebra, 1st Ed.*, Springer, 2003.

Course Name: Linear Algebra

Course Code: 543MATH-3

Level: 1

Credit hours: 3

Prerequisite: None

Course Overview:

A core course presents the fundamental concepts in advanced linear algebra.

Course Objectives:

By the end of the course, the student must be able to:

- ➢ Show that a set is a vector space ore subspace.
- ➢ Prove that a map is a linear transformation.
- ➢ Calculate the characteristic polynomial, eigenvalues, and eigenvectors of a linear transformation.
- ➢ Identify the dual space, the inner product of spaces, orthonormality and orthogonality and use Gram- Schmidt theorem.
- ➢ Show that a matrix is Unitary, Hermitian, and normal.

Course Contents:

Minimum and characteristic polynomials; canonical forms; matrix decompositions; orthogonal, unitary, symmetric, Hermitian, and normal matrices; vector spaces; linear transformations; eigenvalues and eigenvectors; dual space; inner product spaces; bilinear forms; tensors.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

- ➢ S. Friedberg, A. Insel, L. Spence, *Linear Algebra, 4th Ed.*, Pearson, 2002.
- ➢ K. Hoffman, R. Kunze, *Linear Algebra, 2nd Ed*, Prentec3-Hall, Inc., Englewood cliffs, New Jersey, 1973.

Course Name: Numerical Analysis
Course Code: 551MATH-3   **Credit hours:** 3
                Level: 3   **Prerequisite:** 562MATH-3

Course Overview:

An elective course presents to student some basic concepts and tools in numerical analysis.

Course Objectives:

By the end of the course, the student must be able to:

➢ Use numerical methods to solve problems that are difficult to solve analytically.
➢ Use MATLAB for the numerical algorithms.
➢ Use the acquired knowledge for research in numerical analysis or applied mathematics.

Course Contents:

Linear and nonlinear systems; iterative methods; interpolation; approximation of solutions; error estimate; data fitting; numerical differentiation and integration; numerical solution of differential equations; boundary value problems; stability and convergence of solutions; finite difference method; finite element method.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ J. Epperson, *An Introduction to Numerical Methods and Analysis, Revised Ed.*, Wiley.

➢ K. Atkinson, *An Introduction to Numerical Analysis, 2nd Ed.*, Wiley.

➢ R. L. Burden, J. D. Faires & A. M. Burden, *Numerical Analysis, 10th Ed.*, Cengage Learning, 2015.

➢ A. Quarteroni, R. Sacco & F. Saleri, *Numerical Mathematics, 2nd Ed.*, Springer, 2007.

Course Name: Partial Differential Equations

Course Code: 562MATH-3   **Credit hours:** 3

Level: 1   **Prerequisite:** None

Course Overview:

A core course devoted to the basic concepts and methods of solving Partial Differential Equations and their applications.

Course Objectives:

By the end of the course, the student must be able to:

➢ Provide the student with some basic concepts and important methods for solving partial differential equations.
➢ View the latest developments and trends of modern applied research in this branch of mathematical science.

Course Contents:

Sobolev spaces and their properties; initial and boundary conditions; Dirichlet, Neumann, and Robin conditions; existence, uniqueness, stability, and regularity of solutions; inverse problems; systems of first and second order PDEs; hyperbolic, parabolic, and elliptic equations; solutions via Fourier series and Laplace transform.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ E. Zachmanoglou and D. Thoe, *Introduction to Partial Differential Equations with Applications*, Dover, 1986.
➢ L.Evans, *Partial Differential Equations*, AMS, 1998.
➢ H. Brezis*, Functional Analysis, Sobolev spaces and Partial Differential Equations*, Springer, 2011.

Course Name: Topology

Course Code: 581MATH-3 **Credit hours:** 3

Level: 3 **Prerequisite:** None

Course Overview:

An elective course provides the essential of point set topology treated in a profound fashion.

Course Objectives:

By the end of the course, the student must be able to:

➢ Understand the notions of general topology and some example of topologies.
➢ Use continuous functions and homeomorphisms to understand structure of topological spaces.
➢ Be able to compare the relative strengths of definitions, including separation axioms and countability axioms, using standard examples and theorems.
➢ Recognize compactness and connectedness in topological spaces and metric spaces.
➢ Explain the relation between different types of compactness in general topological spaces and in metric spaces.
➢ Understand the compactification, metrizability, fundamental group.
➢ Know the major theorems, their proofs, and examples that demonstrate sharpness.

Course Contents:

Basic concepts of point-set topology; examples of important topologies (e.g. product topology, metric topology, quotient topology, etc.); connectedness; compactness; countability; separation axioms; Tychonoff theorem; compactification; metrization; fundamental group.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ J. Munkres, *Topology, 2nd Ed.*, Prentice Hall, 2000.

Course Name: Special Topics in Statistics and Probability

Course Code: 618STAT-3   **Credit hours:** 3

Level: 3   **Prerequisite:** 511STAT-3

Course Overview:

An elective course covering selected advanced topics in statistics and probability.

Course Objectives:

By the end of the course, the student must be able to:

➢ Direct the student to important topics in statistics and probabilities.
➢ Provide the student with the opportunity to choose between the theoretical and the applied research side in this branch of mathematics.
➢ Prepare the student scientifically to research in the field of statistics and probabilities.

Course Contents:

Selected advanced topics in Probability and/or Statistics. The topics are to be determined by the department's Probability and Statistics committee. The approval of the department's council is also required.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ To be determined according to the selected topics and after approval of the Postgraduate Studies Committee at the department.

Course Name: Special Topics in Analysis

Course Code: 628MATH-3   **Credit hours:** 3

Level: 3   **Prerequisite:** 524MATH-3

Course Overview:

An elective course covering selected advanced topics in Analysis and its applications.

Course Objectives:

By the end of the course, the student must be able to:

➢ Direct the student to advanced topics in the field of analysis.
➢ Provide an opportunity for the student to choose between different disciplines in the analysis.

Course Contents:

Selected advanced topics in analysis and its applications. The topics are to be determined by the department's analysis committee. The approval of the department's council is also required.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ To be determined according to the selected topics and after approval of the Postgraduate Studies Committee at the department.

Course Name: Special Topics in Algebra

Course Code: 648MATH-3   **Credit hours:** 3

Level: 3   **Prerequisite:** 541MATH-3

Course Overview:

An elective course covering selected advanced topics in modern algebra.

Course Objectives:

By the end of the course, the student must be able to:

➢ Direct the student to advanced topics in advanced algebra or number theory.
➢ Give opportunity to the student to choose between different disciplines in algebra or number theory and their applications.

Course Contents:

Selected advanced topics in algebra and/or number theory and their applications. The topics are to be determined by the department's Algebra and Number Theory committee. The approval of the department's council is also required.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ To be determined according to the selected topics and after approval of the Postgraduate Studies Committee at the department.

Course Name: Special Topics in Applied Mathematics

Course Code: 668MATH-3   **Credit hours:** 3

Level: 3   **Prerequisite:** 562MATH-3

Course Overview:

An elective course covering selected advanced topics in Applied Mathematics.

Course Objectives:

By the end of the course, the student must be able to:

➢ Guide the student to advanced subjects in one or more areas of Applied Mathematics.
➢ Give opportunity to the student to choose between different disciplines in the branches of Applied Mathematics.

Course Contents:

Selected advanced subjects in one or more areas of Applied Mathematics. The subjects are selected by the Applied Mathematics Committee and must be approved by the department's council.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ To be determined according to the selected topics and after approval of the Postgraduate Studies Committee at the department.

Course Name: Special Course

Course Code: 690MATH-2

Level: 3

Credit hours: 2

Prerequisite: Department's Approval

Course Overview:

A special core course to be taught individually the student's supervisor of the scientific thesis in a precise field that serves the subject of the thesis.

Course Objectives:

By the end of the course, the student must be able to:

➢ Prepare and defend a research proposal.
➢ Collect research material and data.
➢ Demonstrate deep understanding of the material relevant to the selected mathematical topic.
➢ Give and comprehend examples and counterexamples for concepts relevant to the topic.
➢ Justify correctly and intelligibly (both orally and in written form) all relevant facts and results.

Course Contents:

Selected advanced subjects in one or more areas that serves the research topic. The subjects are selected by the student's advisor and must be approved by the Postgraduate Studies Committee at the department.

Assessments:

The grade percentage is divided as follows:

Assessment type	Midterm	Homework, quizzes and/or oral exams	Final exam	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

➢ To be determined by the student's advisor according to the selected research topic and after approval of the Postgraduate Studies Committee at the department.

Course Name: Thesis

Course Code: 691MATH-6

Level: 4

Credit hours: 6

Prerequisite: Department's Approval

Course Overview:

A mandatory requirement for obtaining a Master of Science degree in Mathematics. Student submits for passing a specialized scientific thesis that is original and innovative in one of the research topics previously approved by Postgraduate Studies Committees determined by the relevant regulations.

The department appoints an advisor for the student's thesis, so that during the thesis preparation period, the professor will carefully supervise the thesis. Student ends up successfully passing a scientific discussion of the thesis by a specialized committee approved by Postgraduate Studies Committees determined by the relevant regulations.

Course Objectives:

This course aims to further develop the approved proposal at the end of the Special Course, based on the feedback provided by the committee and the continuing guidance of the assigned advisor. The student will refine a research question/hypothesis or design methods based on identified challenges or opportunities in Mathematics to write up publications.

Course Contents:

The topic is to be chosen by the student and his/her thesis advisor. The approval of the department's council is required.

Assessments:

Discussion of the thesis by a specialized committee in accordance with the criteria specified in the relevant regulations. The grade percentage is divided as follows:

Assessment type	First committee member	Second committee member	Advisor	Total
Grade percentage	30%	30%	40%	100%

Teaching Method/s: Lectures.

Required Textbooks:

Determined by agreement between the student and his/her supervising professor of the thesis according to the need and relationship to the research topic.

MSc in Mathematics Program Guide

College of Science
Department of Mathematics
1442

Table of Contents

1   Head of the Department's Message

Dr. Metib Alghamdi

Dear faculty and students,

I welcome you to the Department of mathematics, College of Science at King Khalid University and wish you the very best for all the new academic ventures here. We believe that each of you contributes directly to the Department's growth and success, and we hope you will take pride in being part of our department.

The handbook was developed to describe some of the expectation of our members and to outline the policies and MSc in Mathematics in the department. You may wish to familiarize yourselves with the content of the handbook as it will answer many questions about department, college, academic and administrative regulations.

We hope that your experience here will be challenging, enjoyable, and rewarding. Again,

welcome!

Head of the Department

Phone: +966–17–241–7734
Fax: +966–17–241–8202
Email: malgamdy@kku.edu.sa

Mailing Address:
Mathematics Department,
Faculty of Science,
King Khalid University,
P.O. Box: 9004, Abha 61413,
Kingdom of Saudi Arabia
Female Section: Dr. Aisha Alderremy
Phone: +966–17–241–2814
Email: aaldramy@kku.edu.sa

For more information, you can visit the department's website through the online portal of the university at the link:
https://science.kku.edu.sa/en/content/1594

2 About Abha

Abha is the capital of Aseer Province and has the 6th largest population in the Kingdom of Saudi Arabia. It is famous for being the highest large city of Saudi Arabia at over 2200 meters, some parts of the city being even around 2400 meters. With such an altitude it is not surprising that Abha benefits from milder climatic conditions that most the rest of the country with day temperatures ranging from 15°C to 35°C. What is more unexpected is that while the rest of the country has one rainy season in March and May, Aseer Province enjoys a second one in July and August thanks to the Indian monsoon that reaches the southwest of Saudi Arabia.

3 King Khalid University

3.1 About the University

On Tuesday 09/01/1419 AH (06/05/1998) HRH Crown Prince ordered the merger of Imam Mohammad Ibn Saud Islamic University and King Saud University in the Southern Region into one entity under the new identity of 'King Khalid University'. Later, on 11/3/1419 AH (6/7/1998 AD), a Royal Decree, Decree 7/78/M was issued to complete all regular procedures necessary to effect the merger. The University's first budget was issued on 14/09/1419 AH (02/01/1999 AD) within the general state budget.

The University is in the Aseer region in the southwestern part of Saudi Arabia. The area of Aseer region is about 80.000 square kilometers occupied with more than 1.600.000 people distributed in seventy- eight governorate and centers.

3.2 Vision

King Khalid University in the top 200 universities worldwide by 2030.

3.3 Mission

To provide an academic environment conducive to teaching, learning, scientific research and social contribution through optimal utilization of our resources.

3.4 Objectives

- To enhance teaching and learning quality.
- To provide a facilitative academic environment.
- To promote effective partnership with the community.
- To support and promote scientific research.
- To improve graduate studies.
- To develop institutional performance.
- To increase financial resources.

4 College of Science

4.1 About the College

The College of Science at King Khalid University was established in 17–01–1976 as a branch of the College of Education at King Saud University in Abha. The establishment was based on the recommendation of the Supreme Committee for Education Policy in the Kingdom of Saudi Arabia under the chairmanship of the Royal Highness Prince Sultan bin Abdul Aziz (may Allah have mercy on him). At that time, College of Education was established with two departments, namely, Scientific Studies and Humanity Studies. The Department of Scientific Studies, the core of the current College of Science, offered two programs, namely, Bachelor of Education in Biology and Bachelor of Education in Physics. The first graduation batch of these two programs was in 1980. In 1977, two more programs were offered by the College of Education, namely, Bachelor of Education in Chemistry and Bachelor of Education in Mathematics. The first graduation batch of Chemistry and Mathematics programs was in 1981. Thereafter, these four academic programs had been managed by four departments under the College of Education.

In 06–05–1998, the Custodian of the Two Holy Mosques, King Abdullah bin Abdul Aziz (may Allah have mercy on him), announced the establishment of King Khalid University in Abha by merging the branches in the southern region, namely, the Imam Muhammad bin Saud Islamic University branch and King Saud University branch. In 28–06–1999, the Royal approval was issued for the academic structure of the University (colleges, institutes, and supporting deanships). The College of Science, as part of the new academic structure, includes four departments, namely, Biology, Chemistry, Mathematics, and Physics. In addition, the College of Science contains several research and educational centers and units

4.2 Vision

To attain local and regional leadership in distinguished graduates, high quality scientific research, and effective contribution in community development.

4.3 Mission

To provide distinct academic programs and perform scientific research at international standards to develop the local and regional communities.

4.4 Objectives

- To qualify competitive graduates in knowledge and professional skills.
- To provide competitive academic programs.
- To provide an attractive and motivative academic environment.
- To perform scientific research with international standards.
- To attract highly qualified faculty and researchers.
- To perform administrative processes with high quality.

4.5 Major Values

Honesty, commitment, respect, excellence, innovation, and transparency.

5 Department of Mathematics

5.1 About the Department

The Mathematics Department was initially established as one of the departments of the College of education in 1396 as of King Saud University in Abha. It continued like this until the high recommendations for the establishment of King Khalid University were issued. The recommendations included the restructuring of the colleges and departments including the mathematics department. The department combines a select group of professors from various scientific backgrounds who are keen on teaching advanced curricula in basic and advanced mathematics.

5.2 Vision

The Department of mathematics at the University of King Khalid aspires to regional excellence in education, research, and qualitative fruitful and positive interaction with the local society.

5.3 Mission

Proffer distinguished educational programs to graduate individuals, who can think critically about complex issues, analyze, and adapt to new situations, solve problems of various kinds, communicate their thinking effectively and serve the community.
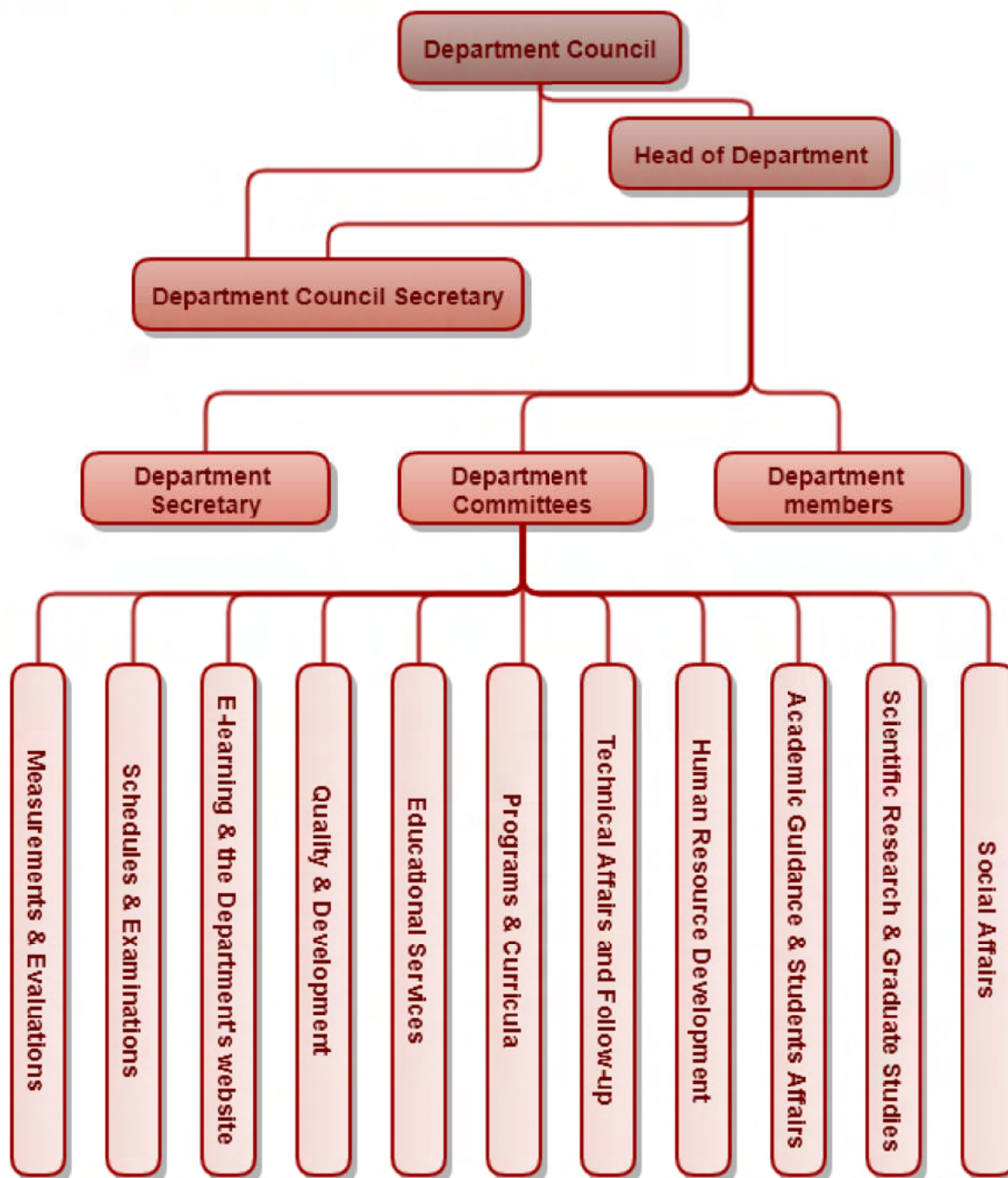
5.4 Objectives

- Proffer distinguished educational programs.
- Graduate individuals, who are able to think critically about complex issues, analyze and adapt to new situations, solve problems of various kinds, communicate their thinking effectively and serve the community.
- Overcome the shortfall in the other institutions of higher education and government institutions that need professionals with advanced degrees.
- Attract outstanding teaching and research staff.
- Create a work environment where team spirit and professional ethics of Islam prevail.
- Promote research and scientific collaborations.
- Strengthening links with modern technology programs.
- Serve the regional community.

5.5 Major Values

Honesty, commitment, respect, excellence, innovation, and transparency.

5.6 Organization Chart

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                        Department Council
                                │
                        Head of Department
                                │
            Department Council Secretary
                                │
        ┌───────────────────────┼───────────────────────┐
  Department              Department              Department
  Secretary              Committees                members
                                │
  ┌──────┬──────┬──────┬──────┬──────┬──────┬──────┬──────┬──────┬──────┐
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- Measurements & Evaluations
- Schedules & Examinations
- E-learning & the Department's website
- Quality & Development
- Educational Services
- Programs & Curricula
- Technical Affairs and Follow-up
- Human Resource Development
- Academic Guidance & Students Affairs
- Scientific Research & Graduate Studies
- Social Affairs

6 Department's Research groups

6.1 Analysis, Geometry and Their Applications

The research fields are:

- **Geometry and Applications:**
  - Interrelation of geometry and analysis of physical systems
  - Differential and algebraic geometry
  - Equivariant Characteristics Classes in the Cartan Model
  - Spectrum and the Fixed-Point Sets of Isometries III
  - Quaternionic Geometry and Complex Methods
  - Spectral Asymptotic for Quasi-Elliptic Partial Differential Equations
  - Intrinsic and Extrinsic Characterizations of Contact Metric Manifolds
- **Analysis and Applications:**
  - On the Convolution Structure of Hermite Transforms
  - The Hilbert Transform of Periodic Functions and Distributions
  - Nonstandard Theories of Generalized Functions
  - Wavelets in a Weighted Sobolev Space
  - Classical and modern analysis including the theory of distributions (linear and nonlinear)
  - Partial differential equations and wavelets
  - Lie Algebraic Approach to Special Functions.

6.2 Algebra, Number Theory and Their Applications

The research fields are:
- Classical algebra and number theory problems
- Modules and ideals
- Rings with polynomial identity
- Representation theory of rings and algebras
- Klosterman sums and its various properties
- Exponential sums and its power mean
- Upper bound estimations and applications of character sums
- Primes and related problems
- Primitive roots and k^{th} residues
- Riemann, Hurwitz and Lerch zeta functions
- Other Dirichlet series and zeta functions

6.3 Applied Mathematics

The research fields are:
- Physical Applied Mathematics
- Mathematical Medicine and Biology
- Computational Science & Numerical Analysis
- Theoretical Computer Science
- Theoretical and Mathematical Physics

- Control and Dynamical Systems (including differential equations)
- Fluid Mechanics
- Mathematics of Data Science and Machine Learning
- Scientific Computing

6.4 Statistics and Probability

The research fields are:
- Probability and stochastic processes
- Asymptotic distributions
- Distribution's theory
- Symmetry in probability distributions
- Statistical inference
- Statistical modeling
- Statistics in Biological and Medical Sciences
- Advances in statistical methods and applications
- Applied Statistics
- Probability theory

6.5 Research Activities in the Department

The activities of the research groups include:
- Weekly seminars for each research group
- Department's day each semester.
- An international conference
- Series of lectures by international distinguished mathematicians
- Summer school, workshops, and symposia.

7 The Advisory Committees

7.1 Goals of the Advisory Committee

- Studying the consistency of the program mission and goals with the needs of the education sector and the private sector in Saudi Arabia
- Studying how the department programs suit the requirements and needs of the job market.
- Evaluating the knowledge and skills the department aims to provide to its current and prospective students.
- Establishing collaboration and communication channels between the department and the society
- Helping the department in determining its priorities regarding programs and operational plans
- Reflecting the needs of the labor market for the purpose of developing current programs and establishing new programs
- Presenting suggestions to help the department council in making plans and decisions.

7.2 Advisory Committee

Composition of the Advisory Committee:

The head of the department of Mathematics, based on the requirements of interest and organization of the department, decided on 7/03/2021 to form the Advisory Committee for Bachelor of Mathematics as follows:

	Name	Current Job	Committee Assignment
1	Dr. Metib Alghamdi	Head of the Department	Chairman
2	Dr. Yahya Almalki	Head of the Math MSc Accreditation Team-KKU	Vice Chairman/Secretary
3	Dr. Mohammad Alshamrani	Former President of Northern Border University	Committee Member
4	Dr. Sultan Almorqi	Director of Defense Electronics at the Saudi Military Industries (SAMI)	Committee Member
5	Dr. Sultan Alshamari	Economic consultant at the Saudi Central Bank (SAMA)	Committee Member
6	Dr. Zahba Alraizah	Vice Dean of Scientific Research- KKU	Committee Member
7	Dr. Hamad Alsiari	Chief Technician at Aramco	Committee Member
8	Eng. Raed Alghamdi	Executive at Metro Jeddah Co.	Committee Member
9	Ms. Aisha Abdullah	Lecturer at Jazan University	Committee Member

8 The Department Committees and Units

8.1 Social Affairs

This committee encourages community services for the staff and students. The committee organizes the social activities of the department's employees. The committee provides an annual report of the held events and benefactors.

8.2 Scientific Research & Graduate Studies

This committee coordinates the postgraduate study programs and the postgraduate courses during the semester with the scientific college dean. The committee organizes the seminars and follows up the research processes in different research areas. This committee facilitates the procedures of organizing the reviewers committee for master and doctoral degrees.

8.3 Academic Guidance & Students Affairs

This committee provides academic support with continuous follow-up to the students. This committee has the responsibility of deciding the academic guides and performing orientation for the new students. The committee is assisting the economical and psychological cases by contacting the Registration Deanship. Further, this committee provides academic services for all students at all levels from enrolment until graduation.

8.4 Human Resource Development

This committee studies the department's needs of human resources and prepares a job description for all the functions of the department. The committee follows up on the department's needs of contractors and recommends appointments. This committee examines the applicants' CVs and confirms that the application processes are clear and followed according to the KKU recruitment policies and procedures.

8.5 Technical Affairs and Follow up

The aim of this committee is evaluating the requirements and demands of the department's laboratories, halls, and offices. This committee has responsibility in preparing the annual lists of purchasing for the educational and research purposes. The Committee guarantees the safety and risk management policies and procedures in the department's laboratories.

8.6 Programs & Curricula

This committee organizes the work in the program learning and curricula. The committee is evaluating the achievement of quality in education activities and finding ways of improvement. The committee has responsibility in achieving the fulfilment of the Program Learning Outcomes (PLOs) with the vision and mission of the college and the University and with the NCAAA requirements.

8.7 Educational Services

This committee is evaluating the technical specifications of educational equipment and supplies. The committee evaluates the provided services in the educational and research laboratories and measures their suitability to the requirements of study plans. This committee ensures the safety and risk management policies and procedures in the department's laboratories.

8.8 Quality & Development

This committee is responsible for improving the culture of quality in the department. The committee is supervising the department's strategic plan for COP and following up on its implementation. This committee serves in preparation of the Self-Study Report (SSR) as an accreditation requirement. The committee suggests educational goals and outcomes for the department's various programs (bachelor's - master's).

8.9 E-learning & the Department's website

This committee provides guidance and expertise necessary to develop a rich and rigorous eLearning ecosystem that produces a consistent, cohesive, quality learning experience for students; examine innovative eLearning models and initiatives, based on the most current national and local eLearning trends; and ensure the eLearning direction is directly linked to the Vision, Core Values, Mission, and Core Themes of the department.

8.10 Schedules & Examinations

This committee coordinates the students' schedules and matches that with students' distribution and faculties loads. The committee prepares a list of students assigned to each academic advisor. This committee ensures the appropriateness of the final examination schedule and prepares the final examination environments.

8.11 Measurements & Evaluations

This committee prepares the examination management manual, all the rules, regulations, and general rules of the evaluation. The committee has responsibility in follow-up examination results and ensures their agreement and the average curve of examination results.

9 MSc in Mathematics Program

9.1 Mission

Graduating students possessing thorough understanding of mathematical concepts, theories, research, and recent developments of mathematics by providing an integrated academic environment and research addressing the needs of community and bolstering economy of knowledge.

9.2 Goals

- Possession of a profound background in the foundations of graduate-level mathematical analysis, abstract algebra, statistics, and applied mathematics.
- Development of critical thinking and ability to synthesize different mathematical concepts to obtain definite conclusions for mathematical problems.
- Obtainment of solid theoretical and practical knowledge in a particular field of study.
- Ability to conduct a research project and effectively communicate its findings to the research community.
- Practice of essential academic attributes, such as: self-learning, independence, responsibility, professional ethics, intuition, and pro-activity.

9.3 Graduate Attributes

Graduate attributes for which MSc in Mathematics students are prepared are as follow:
- Profound background in postgraduate level mathematics.
- Use appropriate knowledge and skills to identify, formulate, analyze, and solve complex scientific problems.
- Work effectively either independently or as a member of a team.
- Communicate complex mathematical concepts within the community and with society at large.
- Apply professional ethics, accountability, and equity.
- Able to identify and address his own educational needs to maintain competence for adapting to new needs and environment.

9.4 Student Admission

The department of Mathematics is committed to the Unified Regulations of Postgraduate Studies at Saudi Universities and its Executive Regulations at King Khalid University.
And especially, Article 15 for the entrance exam, and Article 18 for the complementary courses.
Particularly, the department requires:
- A bachelor's degree in mathematics.
- Proficiency in English verified through one of the following:

Test	TOEFL-IBT	STEP	IELTS
Required level	45	67	4

- Passing tests and personal interview conducted by the department.

If needed, all complementary courses that will be proposed must be passed with a grade of C or higher.

9.5 Program Learning Outcomes

Knowledge and understanding	
K1	Advanced knowledge and understanding that covers theories, principles, and concepts in mathematics.
K2	Critical awareness of techniques, practices, conventions and/or terminology relevant to mathematics.
K3	Advanced knowledge and understanding of recent development in mathematics.
K4	Advanced knowledge and understanding of a range of established and specialized techniques of research and/or inquiry in mathematics.
Skills	
S1	Apply specialized theories, principles, and concepts to solve problems in complex and advanced contexts, in mathematics.
S2	Assess, objectively analyze, and focus on the key ideas, values, and theories; and offer innovative solutions to current issues and problems in diverse and advanced contexts in mathematics.
S3	Carry out advanced research using specialized techniques of research and enquiry in mathematics.
S4	Use quantitative and/or qualitative methods to process data and information in complex and advanced contexts, related to mathematics.
S5	Communicate in various forms to disseminate knowledge, skills, research results related to mathematics.
S6	Identify, select, plan for (including resource planning), use and evaluate ICT applications and strategies to enhance the achievement of aims and desired outcomes.
Values	
V1	Work effectively, both independently and as part of an interdisciplinary group.
V2	Take full responsibility for initiating, identifying, amending, and achieving aims and desired outcomes, using new skills/ techniques as required.
V3	Able to articulate awareness of and demonstrate personal characteristics that positively impact the workplace and reflect integrity and professional and academic values when dealing with various issues.

9.6 Teaching and Learning Strategies to Achieve Program Learning Outcomes

Lectures, up-to-date textbooks, hand-outs, skills in using library and other learning resources, working groups, presentations, feedback, assignments, structured experiences in groups.

9.7 Thesis and Its Requirements

9.7.1 Registration of the thesis:

The subject and content of the research thesis depend on many factors such as the student's interests, abilities, skills, and courses the student successfully passed. The student writes a master's thesis in a specific subject in mathematics under the direct supervision of a department faculty member after the approval by the Department's Postgraduate Studies Committee.

The process starts at level 3 with the special course 690MATH-2. The student and his advisor choose a topic and propose a research plan to a committee of two experts from the departments, after approval from the Department's Postgraduate Studies Committee. The student elaborates his research thesis during the 4th level (can be extended upon approval of the Department's Postgraduate Studies Committee).

9.7.2 Scientific Supervision:
- Weekly regular meeting between the student and his/her supervisor.
- The supervisor advises the student periodically via blackboard and other technological means to:
  - Prepare and apply a research project according to scientific principles and research practices.
  - Learning mechanisms of scientific methods in data collection.
  - Learning scientific methods in data analysis and writing results.
  - Use of computers, internet, and ability to choose the best.
  - Ability to write a research strategy plan.
  - Self-learning and individual work.
  - Communication and interaction with others.
  - Ability to write research papers and reports.
  - Presenting results in writing and orally.

9.7.3 Thesis Defense/Examination:

As approved by the Department's Postgraduate Studies Committee:
- Student writes the research thesis and provides the thesis defense committee with copies.
- The student gives a seminar, and the thesis can be evaluated by the supervisor and two examiners.

9.8 Study Plan

Course Code	Course Title	Prerequisite Courses	Credit Hours
	Level 1		
	Mandatory		
522MATH-3	Measure Theory		3
543MATH-3	Linear Algebra		3
562MATH-3	Partial Differential Equations		3
		Total credit hours	**9**
	Level 2		
	Mandatory		
511STAT-3	Probability Theory	522MATH-3	3
524MATH-3	Functional Analysis	543MATH-3	3
541MATH-3	Abstract Algebra		3
		Total credit hours	**9**
	Level 3		
	Mandatory		
690MATH-2	Special Course	Department Approval	2
	Elective (two courses are chosen according to the specialty track after department's council approval)		
513STAT-3	Mathematical Statistics		3
618STAT-3	Special Topics in Statistics and Probability	511STAT-3	3
628MATH-3	Special Topics in Analysis	524MATH-3	3
542MATH-3	Rings and Fields	541MATH-3	3
648MATH-3	Special Topics in Algebra	541MATH-3	3
551MATH-3	Numerical Analysis	562MATH-3	3
668MATH-3	Special Topics in Applied Mathematics	562MATH-3	3
581MATH-3	Topology		3
		Total credit hours	**8**
	Level 4		
	Mandatory		
691MATH-6	Scientific Thesis		6
		Total credit hours	**6**

Total Credit hours for completing the program (32).

9.9 Program Regulations

The department of Mathematics is committed to the **Unified Regulations of Postgraduate Studies at Saudi Universities** and its **Executive Regulations at King Khalid University**.
https://dps.kku.edu.sa/ar/content/261
and to the **Code of Students Rights and Duties** adopted by the University
http://bit.do/eQJt3
and to the **Code of Rights and Duties for Graduate Students** adopted by the University
http://bit.do/eQJtA

9.10 Evaluation of Program Quality Matrix

Evaluation Areas/Aspects	Evaluation Sources/References	Evaluation Methods	Evaluation Time
effectiveness of teaching & assessment	Students and Faculty	Surveys & Interviews	At the end of each semester.
Learning outcomes			
Learning resources			
Objectives of the operational plan			At the end of each year

10 Members of the Teaching Staff

10.1 Definition

Members of the teaching staff are the lecturers, assistant professors, associate professors, and professors participating in the academic, research and community service activities within the university.

10.2 Tasks of the Teaching Staff Members

- Achieving the higher aims and policies in the university.
- Carrying out the decisions of the department council, the faculty, or the university as for his responsibilities.
- Participating in preparing the strategic plan of the department.
- Attending and participating actively in the sessions of the department council.
- Sharing in developing the department in the administrative, academic and research aspects.
- Teaching the educational units within the academic allocation.
- Teaching the non-educational or excess units of the allocation if necessary, according to the organizing rules.
- Supervising the research of the higher studies students according to the organizing rules.
- Instruction for the higher studies students.
- Sharing in making the department committees and its activities and activating them.
- Attending the seminars and the conferences related to his specialization according to the organizing rules.
- Submitting the difficulties which might hinder the performance of the educational, research duties or social care to the department head.
- Sharing in social care programs executed by the department or the faculty.
- Preparing the suitable evaluation tools for measuring the acquisition/abilities of the students and extracting the results and benefiting from them in developing the teaching/training process.
- Committing to the continuous professional development and developing the abilities and the teaching and research information.
- Monitoring all new things in the field of specialization and sharing in its development through scientific activities.
- Transferring to the students the most modern things in science in the field making them love science and knowledge and the proper scientific thinking.
- Working a full-time job in the university, while permission to work outside the university is by prior approval according to the systems and rules.

10.3 **Teaching Load**

Each faculty member is expected to prepare, teach, and participate in exam preparation for certain courses. According to the Ministry of Education (Higher Education), the faculty member teaching load is based on his academic rank as:

Academic ranking	Teaching load (Credit hours)
Teaching Assistant/Lecturer	16
Assistant Professor	14
Associate Professor	12
Professor	10

11 Student Assessment Methods Policies and Regulations

11.1   Assessment Methods

The performance of the students is evaluated based on their performance on tests, quizzes, lab and programming assignments, and written assignments such as essays and research articles. Every single course does not necessarily use all these assessment items; this is done with respect to the nature of the courses. The college has well-defined mechanism for the progression as follows:

- Every academic year has two semesters and an optional summer semester. Two midterms during the semester and a final examination are scheduled at the end of every semester.
- If a student fails in a particular course, he must re-register himself next semester. In some cases, re-exam is organized on special approval.
- If a student fails to attain the required level in an exam, he will be graded as failed.
- During the semester the students are assessed in all parameters through different assessment methods as follows:
  - ➢ Quizzes
  - ➢ Midterm Exams
  - ➢ Final Exam
  - ➢ Written Assignments
  - ➢ Practical Midterm (for courses with practical components).

11.2 Summative Assessments

It is a way to measure a student's achievements at the end of an instructional unit. It consists of midterm and final examinations for both theory and practical sessions. The questions will be assessed before conducting the exam based on the different learning domains.

Type of Examination	Timing of Examination	Percentage of Total Grades
Courses		
Midterm	Week 8	30
Final	Week 16	40
Course 690 Math		
Midterm	Week 10	20 20 for each member of the discussion committee.
Final	Week 16	
Course 691 Math		
Final	Week 16	30 for each member of the discussion committee

Interim Testing:

It is a way to assess students' performance throughout the academic semester. It consists of assignments and quizzes. Assignments are given via Blackboard and students are encouraged to access online resources to answer the assignment tasks.

The assignment could involve critical thinking questions, exercises, or a group activity. Quizzes can be paper-based or online-based.

The questions will be assessed before conducting the exam based on the different learning domains.

Other Assessment Methods:

An oral presentation is given as a form of assessment in some of the courses, depending on the level of the students. Students are asked to present on topics individually or as a group. Presentations are intended to assess the communication skills of students.

Presentations are assessed using a rubric and comprise 5-10 marks of the total course grade.

11.3 Assessment Instructions

Examination Policies

- All course coordinators and students must adhere to the approved examination schedule.
- The department board determines the duration of the exam based on the recommendation of the relevant committees.
- The following assessment methods to be conducted for each course with practical components, one quiz, two assignments, one theory midterm exam, one practical midterm exam, final practical and final theory. For courses without practical components, the above-mentioned assessments except the practical exams.
- TWO Midterm theory examinations for 20--30 Marks.
- Midterm theory exam includes topics that have been taught in 5 weeks only of the study period regardless of the exam date.
- All grades should be announced in the BB for any exams within one week of exam date.
- The head of the department may view exam questions before exam date to ensure their suitability with the content covered in the exam.

11.4 Examination and Grading System

- At the university level there is a well-defined grading system inline to the guidelines of Ministry of Education for the measurements of varying levels of achievement of the students.
- There is a mechanism on the accumulated Grade Point Average (GPA) by the students. If a student score less than 3.5 cumulative GPA, he will get warning on

respective semesters or over the period of study and if the student fails to improve the percentage, the admission to the program would be cancelled.

● The examination process is controlled and monitored in hierarchy by the department and college exam committees exclusively in accordance with the defined policies.

● The teacher(s), coordinator, and knowledge area heads of the course are responsible for smooth handling of the course, to conduct and evaluate the exam and to publish the result. This must be according to the set guidelines by following the quality standards.

● The evaluation of student performance on each course is measured and graded on the following scale.

Table: Grading System for the Program

Percentage	Grade	Grade Description	Grade Points (Out of 5.00)
95--100	A+	Exceptional	5
90--less than 95	A	Excellent	4.75
85--less than 90	B+	Superior	4.5
80--less than 85	B	Very Good	4
75--less than 80	C+	Above Average	3.5
70--less than 75	C	Good	3
65--less than 70	D+	High Pass	2.5
60--less than 65	D	Pass	2
less than 60	F	Fail	1

● An exclusive guidelines and policy mechanisms is available in hard copy as well as online.

● A pursuing student must complete all credit hours in the curriculum with a minimum of 60% scored in every single course on the program.

● The graduating students must complete the defined duration of the program in levels or semesters subsequently in two years 2.

● Finally, the students will be awarded with the master's degree.

● The student will be dismissed from the University in either of the following situations

● The student receives a maximum of three consecutive academic probations for having a cumulative GPA lower than 3.5 out of 5.0 based on the recommendations of the department and college councils. The University Council may grant a fourth chance to a student who can improve his cumulative GPA by studying the available courses.

● If a student fails to complete the graduation requirements within maximum additional periods, equal to one-half of the period determined for his graduation in the original program period, the University Council may make an exception and award the student an opportunity to complete the graduation requirements within an additional period of a maximum duration equal to that specified for the degree.

- The University Council may make an exception and give students falling under (a) or (b), an opportunity to complete their studies within an additional period of two semesters.

11.5 Assignment Policies and Regulations

The assignment must be aligned with the Course Learning Outcomes (CLOs) and within the topics covered in the course

- Assignment must not exceed two per semester
- Assignment scheduling should be agreed by the course instructor and students early in the semester
- Assignment must be announced on the Blackboard ahead of time
- The assignment must be submitted by the deadline on the Blackboard
- ANY Copying from others (STUDENTS) is strictly prohibited. Zero mark will be awarded for students who submit plagiarized work
- Any similarity with internet resources must not exceed 25%
- Assignment can be given in different forms/modalities such as written assay, open-ended questions, equations, case-based scenario…etc.
- Assignments must be provided with the model answer after the deadline ON THE BLACKBOARD.
- Students have the right to revise and receive feedback for their works from the course instructor.

11.6 Assignment Formatting

The assignment must be submitted in a PDF or Word document (as an attachment) headed with the student's full name and university ID.

11.7 Assignments Grading

- Assignment can be graded out of 5 (2 ASSIGNMENTS) or out of 10 (1 ASSIGNMENT), as an example, depends on the nature of the course.
- Following the formatting appropriately worth 5-10% of the total grade depends on the nature of the course.
- Marks should be fairly distributed on the total number of questions.
- Each question must have specified marks and to be clearly stated for students

- Any late submission will be considered LATE, and students will be given ZERO mark.

12 Rules and Responsibilities for Exams

Assessment, conducting and grading (theory, practical, quizzes, assignments, etc.) go through specific procedures to safeguard the quality of the examination procedures.

Certain regulations have been provided for the invigilators as well as the course coordinators to follow before, during, and after examinations. All invigilators should be aware of his/her tasks in case of any misconduct, fraud, or cheating by any student.

The development and quality committee will receive a copy of all exam's activities.

In case of an issue regarding grades (inflation or deflation), several processes are undertaken to ensure that exam(s) indeed reflect the students' knowledge and abilities. The process starts with a request from the head of the department to the course coordinator to provide justification. Head of the department might discuss this issue with the department board to decide to solve this issue.

12.1 Before the exam

- All invigilators must arrive at the examination room at least 20 minutes before the examination to make a random redistribute of some seats and distribute the examination materials.
- A maximum separation between seats must be achieved depending on the space availability.
- Invigilators must place different exam modules on seats next to each other (in all four directions).
- Students should not be allowed to enter the examination room more than 10 minutes before the scheduled time for the examination.
- One of the invigilators must stand just outside the examination room to check the student identities (one student at a time – no rush, please take your time) to confirm the student's name, picture, university number, student academic status "prohibition".
- The invigilator should record the student's presence on the official class list.
- Students who are prohibited for a course are not permitted to enter the examination for that course.
- The acceptable identification documents are university id or academia "online". (The Saudi national id or passport are not acceptable).
- No need for a student signature when entering the exam room, but it is required later during the examination.
- Personal property such as coats, backpacks, notes, texts must be left outside the examination room.
- Cell phones, Bluetooth headsets, smartwatches and other electronic devices must be turned off, put inside a plastic bag, and left underneath the student seat.
- Students are allowed to enter the exam room with pens, pencils and, when permitted, calculators.
- The other invigilator(s) must be inside the examination room to distribute the students.

- Examination committee will display the seat plan at the entrance to the examination room (colleges of science).
- Invigilators are responsible for ensuring students are seated in the designated desks according to the seat plan. However, since seat plans will not be provided for central auditoriums, invigilators inside the auditoriums must make a random distribution for every student when he/she is entering the auditorium.
- Invigilator(s) should ask the students to write their names and student numbers on the examination booklets and answer sheets. However, students are not allowed to open the examination booklet and start the exam (this act is considered cheating).
- Students should not be permitted to enter the examination room after the first 30 minutes of the examination period.

12.2   During the Exam

- Invigilators must announce the start of the examination at the official start time. Invigilators should never allow students to start the examination before the official start time.
- All exams are closed book and closed notes.
- Student desks must be clear of all materials except pencils, pens and, when permitted, calculators.
- Calculators should not be shared, and cell phones are not allowed to be used as calculators.

- The invigilators must confirm student name and id number in the examination booklet and answer sheet with the student's id.
- Students who arrive late (within the first 30 minutes) will not be allowed extra time at the end of the examination to account for their late arrival.
- Students should not leave the examination room until the first 30 minutes of the examination period have passed.
- Invigilators should ask students to be quite when they leave the examination room and never stay and chat with each other at the examination room entrance.
- Invigilators must not allow students for toilet breaks or leave the examination room until he finishes his/her examination and submitted the examination materials. However, in an emergency in which a student suffers from a medical condition that necessitates going to toilets, invigilators should call the vice dean for academic affairs who will send somebody to accompany the student.
- Students should be awarded the time limit on the exam.
- Please, call the vice dean for academic affairs in the event of noise just outside the examination room or if there are any other factors that disturb the examination.
- Invigilators should announce the time to students at 30, 15 and 5 minutes before the end of the examination period.

- Invigilators must not disrupt the examination process including, but not limited to the following actions: unnecessary talking with other invigilators, answering cell phone calls, and playing videos or music tracks.
- Invigilator must report to the vice dean for academic affairs as soon as possible if he/she find inacceptable act by another invigilator. Failing to report that is a violation.
- During cheating incidents and other violations, actions should be conducted as quietly and discreetly as possible.
- Invigilators must remain in the examination room during the entire duration of the examination. In emergency situations in which it is necessary for an invigilator to leave the examination hall, he/she must call another faculty member to invigilate instead of him/her and notify the vice dean for academic affairs.
- Course coordinators must stop by the examination halls occasionally to clarify questions.
- Department head should come to the examination room and check the preparation process in the courses that are taught by the same department. In addition, they are encouraged to make a random visit to the examination room during the examination.
- Course coordinators are responsible to submit a full and accurate examination report (form is attached) on each course documenting invigilators names, students' attendance, incidents, and violations.
- Invigilators are responsible to report incidents and violations, including cheating, immediately to the vice dean for academic affairs.
- Cheating reports must be submitted by the invigilators directly to the vice dean for academic affairs.

12.3 After the Exam

- Time allotted for the exam must be enforced.
- Students who have completed the examination prior to the expiration of the allotted time must hand their examination materials to an invigilator before leaving the room.
- Invigilators are responsible to make sure that no student leaves the exam room with examination booklet and/or answer sheet.
- At the end of the examination, invigilators must ask remaining students to stop writing and stay seated until the examination materials of all students are collected by the invigilators.

12.4 Cheating Incidents and Misconduct

- Cheating involves actual, intended, or attempted deception and/or dishonest action in relation to any academic work of the university.
- Cheating includes, but is not limited to the following:

Cheating incident	The appropriate action
• Students talk to each other when entering the room and before the examination starts. • Reading the examination paper before official examination time has started	1. Invigilators should notify the students verbally one time. 2. At least two invigilators should be aware of the incident. 3. When it happens a second time, invigilators should prevent students from attending the exam and write a cheating report.
• Communicating with each other during examination (e.g., talking, hand signals, sharing stationery/equipment). • Looking at another student's paper during an examination or allowing a student to look at one's paper	1. Invigilator should notify his/her colleague without being noticed by the students involved in the cheating. 2. Then, at least two invigilators should witness the cheating incident, and then write the cheating report.
• A person attending the examination instead of the officially enrolled student.	1. One invigilator is enough. 2. Invigilator should ask the person for his/her ID's, and immediately call the vice dean.
• Possessing cellphone, Bluetooth headsets or smartwatches outside the plastic bag.	1. At least two invigilators should be aware of the incident. 2. Invigilators should terminate the examination of the student. 3. Then, write a cheating report.
• Using or displaying notes "cheat sheets".	1. One invigilator is enough. 2. Wait until the student brings the note outside his/her pocket. 3. Then, the invigilator should ask the student to give him/her the cheat sheet.
• Continuing to write when told to stop at the end of the examination	1. Invigilators should notify the students verbally one time. 2. At least two invigilators should be aware of the incident. 3. When it happens a second time, invigilators should withdraw and sign on the student's examination material. 4. Then, write a cheating report.
• Student refuse to obey the rules and/or disturb the examination procedure.	1. At least two invigilators should be aware of the incident. 2. Invigilators should terminate the examination of the student. 3. Then, call the vice dean.

13 Course Syllabus

Based on the academic year, at the beginning of each semester, each course coordinator uploads the course description/syllabi onto the KKU e-learning platform called Blackboard. This description includes a short course description, course learning outcomes (CLOs), teaching strategies, assessment methods, resources, list of topics (theory and practical), time for each section, campus location where the course is taught, proposed exam time, instructions, required reference books, instructor's office hours, contact information and course policies.

14 Course Report

At the end of each term, the course coordinator is required to deliver the course report forms using National Center for Academic Accreditation and Evaluation (NCAAA) formats along with SPSS grade analysis, the used assessment methods blueprint and assessment methods mapping CLOs to PLOs forms to the head of department. Any issues or variations in the student performance in a particular course are discussed in the department board and recommendations are taken place and action plans for improvement are being effective in the next term. All documents regarding the course outcomes are discussed with the quality assurance committee and delivered to the college board for any further action. After implementation of the action plans, the department must follow up on the implemented actions and provide the feedback to the department and college boards.

15 Research

The Department of Mathematics has established a comprehensive research plan including strategies for faculty to increase their research and publication outputs. The University aims to advance knowledge through creative research and scholarships across a wide range of academic disciplines and to nurture a high-quality graduate research environment. The Deanship of Scientific Research is one of King Khalid University's service providers engaged in promoting innovation, creativity and excellence for faculty, researchers. The Deanship of Scientific Research offers funding for research to promote successful work through two types of grants which are the General Research Project and the Research Groups (s.kku.edu.sa/8X). The grant fund is intended for both the Saudi and the Non-Saudi faculty members. Joint research projects among different departments are considered important and are strongly funded by the University. The focus of faculty research is mostly on Applied Mathematics, Algebra, Analysis, and Probability and Statistics.

15.1 Research Requirements

The Department has established relationships with different international universities and institutes, as per the Deanship of Scientific Research Policies and Regulations. Every year, all faculty members must be actively involved in some sort of research, and they are expected to publish at least two scientific papers in peer reviewed journals. All the staff are encouraged to take part in professional and academic development programs to improve their skills and be updated with the latest developments in their fields of specialization.

15.2 Excellence Awards

The Department of Mathematics is committed to maintaining the highest standards in the conduct of research. To be competent and follow organizational policies that regulate research operations, is the responsibility of all members involved in supervising, overseeing, performing, or supporting research activities. The research students present their work at the end of each semester in the form of podium presentations and reports. Faculty members are encouraged to participate in quality research activities. Non-funded research scientific papers which are published in ISI journals receive annual awards.

16 Community Services

The Department of Mathematics provide community access to cultural activities, to establish services for the benefit of the community. The department aims at promoting community-oriented research to establish services for the benefit of the community, to develop research or consultancy programs focusing on requirements of local communities.

Department emphasizes meeting the needs and serving the community through recruitment of qualified and experienced faculty, graduating qualified mathematicians as attached in the program Mission and Vision Statement and Strategic plan. These services are provided on different levels at the department through the Development and Quality committee, Academic Affairs and Educational Experiential committee, Scientific Research Committee.

   KKU exhibits high levels of interaction with its community, manifested by different facilities and units that are involved in different community service activities. It has achieved important successes in establishing and being the patron of different community support units.

17 Department Development and Promotion

17.1 Workshops and Training

All department members and employees are provided with fair and appropriate opportunities for personal and career development. The professional development courses held by the University for faculty members and carried out by the Faculty Development Unit at the Deanship of Development and Quality, are announced as well as the courses to be implemented by the Deanships of Libraries and E-Learning. This reflects the availability of equal opportunities for everyone. In addition, faculties are encouraged to participate in seminars, workshops, and scientific conferences nationally and internationally. Vice Deanship for Development and Quality is responsible for arranging the workshops, seminars and webinars for the updating and betterment of the department members within the College of Science, under the guidance of the college leadership.

The academic process, whether it is theoretical or applied, develops constantly. Development is an on-going phenomenon and is not limited to a specific faculty.

The University is highly committed to improve the teaching and learning process by sending its Saudi teaching assistants to the best universities worldwide to pursue the higher educational degrees, taking into consideration the values and principles, which the male and female scholarship graduates should abide by. The training includes a package of courses for department members in the fields of quality education, teaching methods, modern methods of evaluation and a package of courses for employees and administrative leaderships at the University. Such training courses and workshops are implemented for faculty members and employees based on the study of training needs. The University also encourages department members and employees to register in these courses and give certificates to attendees.

17.2 Promotion

The promotions by law and its equivalence include criteria that ensure the achievement of the University mission, the quality of education and its improvement, the community service, in addition to the contribution to scientific research.

A policy and procedure for department and teaching staff promotion has been developed and implemented recently by the University of King Khalid. It stipulates a detailed procedure for evaluation of faculty's request for promotion. Lecturers who have Ph.D. or equivalent are also eligible to apply for promotion fulfilling other criteria as well. This policy applies to all teaching staff irrespective of their nationality (s.kku.edu.sa/8Z). All department's staff are offered opportunities for personal and career development through a set of criteria and guidelines stipulated in the policy and procedure for faculty promotion that includes promotion policies, policies for attending conferences and staff scientific leave policy.

17.3 Conferences

Faculties, and then all departments, are encouraged to participate in seminars, workshops, and scientific conferences nationally and internationally. A policy and procedure for faculty

attending conferences has been developed and implemented recently by the University of King Khalid (s.kku.edu.sa/8Y).

17.4 Department Awards

The high performing faculty will be appropriately recognized for outstanding achievements and encouraged. The College of Science has a practice of recognizing the best faculties in academic performance, research activities and community service. The best faculties are awarded annually in a ceremony with high attendance by administrative staff, faculty and supporting staff. Members of senior management from the University are invited to attend this ceremony and present the awards.

17.5 Department Evaluation

To assess the performance of faculty and teaching staff a policy and procedure is established. Criteria for performance evaluation are clearly specified and made known to teaching staff. The criteria include quality of academic performance, research activities, personality and communication, and participation in college, university, and community services.

The evaluation is carried out confidentially, and the results are recorded in a way that enables the college to give equal opportunity to the department members to develop professionally through training sessions, seminars, and workshops.

18 Electronic Services

Service	Description	Link
Contact guide	Search by name, college, or department	s.kku.edu.sa/cz
Self Service	It provides information about paychecks, benefits, and other professional and personal matters.	s.kku.edu.sa/cy
KKU New Services	Description of different electronical services	s.kku.edu.sa/cj
Student's Guides	Guide to Registration	s.kku.edu.sa/ck
Acceptance Guide	Acceptance Guide	s.kku.edu.sa/cl
Registration Deanship	Registration's services	s.kku.edu.sa/co
Exam Rules	Executive rules for Exams	s.kku.edu.sa/cp
Academic Calendar	Academic Calendar	s.kku.edu.sa/cq
Graduate Studies Deanship		dps.kku.edu.sa
Academia	Academic services like the academic record, schedule handling, inserting the final grades, lecture absence etc...	s.kku.edu.sa/cx
E-mail	A University e-mail account is established for every new full-time department member.	email.kku.edu.sa
Blackboard	Blackboard is a user-friendly suite of computer programs that assist department members in distributing course syllabus, administering online tests and exams, keeping a grade book, setting up discussion boards, and various other tasks.	lms.kku.edu.sa
Saudi Digital Library	The Saudi Digital Library can search a wide range of computerized bibliographic databases.	sdl.edu.sa
Maintenance Ticketing System	The Technology help desk provides faculties and staffs for technology related products and services supported by Information Technology.	itcsvc.kku.edu.sa
Enjaz	It is a system for correspondence mailing, tracking and archiving transactions.	enjaz.kku.edu.sa

Research	A web page where you can access the research services, research centers, and scientific journals.	**s.kku.edu.sa/cw**
Research Excellence	The service allows the member of the department to apply for numerous awards such as research awards, patent awards, and prizes for scientific publications.	**s.kku.edu.sa/cv**
Conference Attending	This service allows the department members to apply for attending a conference electronically and the application is carried out within specific work procedures until the request is approved or rejected electronically.	**s.kku.edu.sa/cu**
My Meeting	This program helps to manage the university meetings such as sending invites, conducting online meetings, closing, archiving, and tasking meetings and reviewing them.	**s.kku.edu.sa/ct**
Services of Educational Affairs	A set of services provided to department members by the University's vice presidency of education, including renewal of services – reducing short holidays – allocating excess hours to officials – allocating excess hours to contractors – managing academic human resources.	**s.kku.edu.sa/cr**
Permission System	The program helps university staff to seek permission to leave work during working hours and to receive online approval or refusal	**s.kku.edu.sa/cs**
Forms	Forms needed by department members can be found in this webpage.	**In Arabic** **s.kku.edu.sa/cm** **In English** **s.kku.edu.sa/cn**