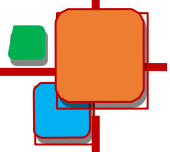
المملكة العربية السعودية
وزارة التعليم
جامعة جازان
كلية العلوم

Curriculum Overview and Study Plan
For M.Sc. Mathematics Program

قسم الرياضيات

Department of Mathematics

College of Science,
Jazan University, Jazan, KSA



1. Table of Contents

1. About the Program

The Mathematics Program was established to prepare specialized qualified mathematicians in order to contribute and achieve the progress of the society of the Kingdom of Saudi Arabia in so numerous fields as general and higher education, health, agriculture and society employment.

The department of mathematics offers its students a distinct learning experience through coherent programs and benchmarked degrees. The self-study recommends investigating ways to support learning on mathematical skills of students. More effort is being exerted on attracting research funds for students to promote their knowledge and skills in research. Furthermore, the Department offers training services to students for the qualifying national exams through Calculus Cafe and Mathematics Clubs, also provide text training program for students

In addition, the Department takes the responsibility of mathematics courses required by other programs of the College of Science such as, Chemistry, Physics, and Biology. The department also teaches mathematics and statistics courses at the Computer Science, Engineering, Pharmacy and Business Administration Colleges.

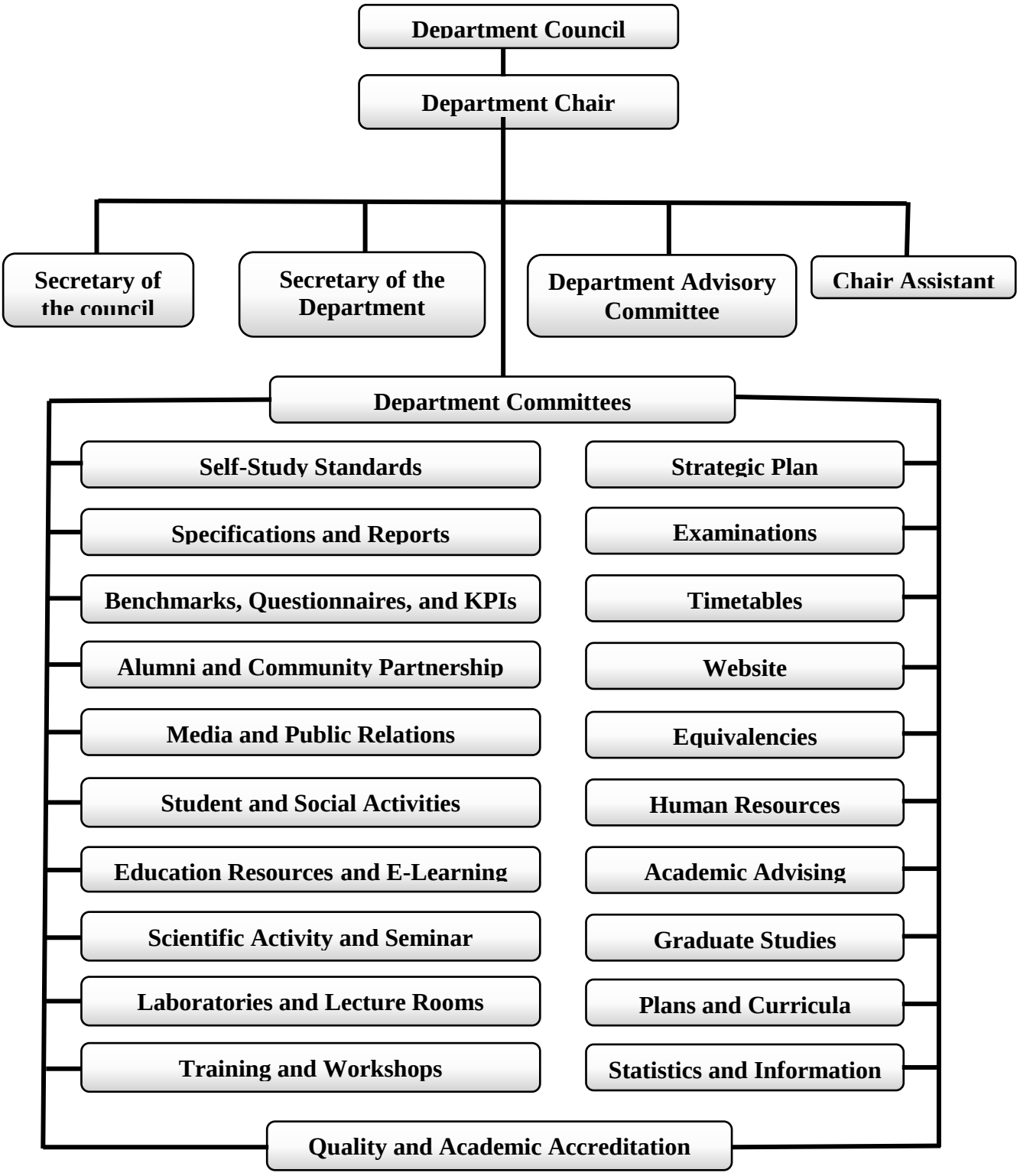
The educational objectives of the degree program in Mathematics reflect the mission, vision and values of Jazan University also consistent with the College of Science.

The system of Higher Education Saudi requires at least **36** credit hours for Master's degree (equivalent to **68.92** ECTS credit points). Jazan University regulates the education to enable the student to complete his/her Master degree in Mathematics in two years of full-time study.

1.1 Establishment

The Mathematics Degree program at the College of Science, Jazan University was established in 2006 after the approval letter from the Ministry of Higher Education on 08-08-1426H. It is continuously developing and improving in teaching and research. The Master of Science program was started on 19/6/1439 H (7/3/2018 AD) in the Department of Mathematics. Thus, the Department of Mathematics awards, B. Sc. and M. Sc. degrees in Mathematics.

The Mathematics Program Management System and Regulations Includes boards, councils, units, committees, etc. are shown in the following diagram.



1.2 Vision Statement

Mathematics Program Vision
Excellence in different fields of mathematics science to achieve competitiveness at the level of the Kingdom and the region through its research, teaching and community service

1.3 Mission Statement

Mathematics Program Mission
Produce scientific research cadre to enrich advanced mathematical sciences and allied applications to serve the vibrant society in view of KSA vision-2030.

1.4 Goals and Objectives.

No.	Mathematics Program Goals
1	Graduating distinguished and highly qualified mathematicians.
2	To teach math proficiency to the students and work on their creativity and capacity for lifelong learning
3	Use critical thinking and problem solving skills to analyze and assess the validity of mathematical information.
4	Supporting scientific research in the field of mathematics and other supporting disciplines.
5	To promote and keep up with the most recent scientific developments and methods in the area of mathematics, according to societal needs.

The main objectives of the program to fulfill the department six goals are as follows;

No.	Mathematics Program Objectives
1	Understand mathematical concepts and definitions, and to extend and generalize them to new situations
2	Good understanding of a few major realms of pure and applied mathematics. Gain admittance to a graduate program in mathematics
3	To enrich the scientific research in specialty areas, that has positive impact on updating student knowledge
4	To read and explain mathematics journal articles orally or in writing
5	To encourage research programs and participation in specialized scientific conferences using appropriate presentation tools to support the communication of mathematical documents
6	Be able to teach mathematics in primary or secondary schools; obtain employment in math-related fields
7	Develop skills to oral presentations to mathematics peers and professors

1.5 Values.

Jazan University Values	
Citizenship	Cherishing national identity and sensing social responsibility
Affiliation	A sense of commitment and initiative towards the goals and objectives of the university
Responsibility	Adherence to ethical standards and business values
Excellence	Application of standard practices and provision of quality services
Building competences	Investing in Human Capital
Teamwork	Devoting the principle of cooperation and work in the spirit of one team

Mathematics Program Values	
Mathematical Attitude	Cultivate a fine mathematical taste
Affiliation	Assess the impact of Mathematics in sustainable development of society
Teamwork & Responsibility	Sense of self-awareness, teamwork, emotional intelligence, social and ethical responsibilities in practicing Mathematics and its applications
Excellence	Skills in managing knowledge and ability to solve variety of problems in sciences and technical specialty courses
Building competences	Relevant academic and scientific competencies

1.6 Degree Offered.

The Department of Mathematics awards, Bachelor of Science (B. Sc.) and Master of Science (M. Sc.) degrees in Mathematics/ College of Science / Jazan University

No.	Mathematics Degree Programs
1	Bachelor of Science (B. Sc.) in Mathematics
2	Master of Science (M. Sc.) in Mathematics

1.7 Teaching Language

The mode of instructions in Mathematics Department is throughout in English Language.

Mathematics Degree Programs	
Teaching Language	English

2. Program General Information

2.1 Branches and Locations.

The Department of Mathematics, College of Science is located in the main campus of Jazan University on the heart of the Red sea whereas the other branches of Mathematics Departments are in Al-Darb and Al-Dayer as shown in the Table.

Program Mathematics		
	Main Campuses	**Locations**
1	Male Campus in Jazan	College of Science, Jazan University, New Campus, Jazan
2	Female Campus in Jazan	College of Science, Mahaliya, Jazan
	Branches	**Locations**
1	University College in Al-Darb	College of Science and Arts, Al-Darb
2	University College in Al-Dayer	College of Science and Arts, Al-Dayer

2.2 Resources & Teaching Facilities (Classes, Laboratories, Library)

2.2.1 Classes

A full-time study is conducted over five days/week (Sunday-Thursday). Courses conduct for two or three semesters per year, including the summer semester. The summer courses are offered only for special cases. The mandatory attendance for students is 75% at least, for each course in the program. Variable teaching methodologies are applicable as using traditional classes, smart classes as well as e-learning which help in self-study and also distance education.

The duration of each lecture is 50 minutes and scheduled two to three lectures per week. An instructor is responsible to conduct the classes and all teaching activities in a group of 4-10 postgraduate students. All the outlines and details belong to the courses in programs are displayed in Section-6: Study plan and Course Description

2.2.2 Laboratories

The department has well equipped laboratories to meet the academic and research requirements of students and teachers. It has four computer labs equipped with modern computers and required software that are important in teaching many of the subjects. The laboratories are allocated according to specialization pure mathematics, applied mathematics.

2.2.3 Library

The Library facilities provided by the **Deanship of Library affairs** at Jazan University can be seen in three different parts. First is the library facility available in the College of sciences, second is the main central library of the university and third is Saudi digital library. We will give small details for all of them.

The Library of College of science is inside the College of science building and therefore provides the easiest access for the teaching staff and students to the available books and related materials. There are two different College of Science libraries, one in male and the other in female campus. The library at College of science contains mostly targeted set of books which covers the list of recommended books offered in various discipline of sciences including Mathematics. Further details on the College of science library including timings and library rules are available in (**Appendix Math4.8)**. For the detailed list of available books in the College library to support Mathematics program can be seen in (**Appendix Math4.9)**.

The *Central Library* at Jazan University was established in year 2006 to support for science and culture, and to provide required academic services to the students and staffs of Jazan University. The new central library is located after moving to its new building on the north side of the university administration headquarters and it consists of three floors consisting of its estimated area about 1218 square meters, distributed over the sections of the library and the headquarters of the library affairs. The central library is divided in five different administrative sections. Namely, the department of Arabic books, the department of foreign books, the university theses department, the periodicals department and the manuscripts center.

The list of available books related to Mathematics in the central library is given in (**Appendix Math4.10)**. For further details related to Central library, one can see library handbook in (**Appendix Math4.11**).

The Saudi digital Library (SDL) is an integrated digital library source managed by the Ministry of Higher Education of Saudi Arabia. The SDL is the largest academic cluster of updated information sources in the Arab world, with more than (310,000) scientific sources that covers all academic areas or disciplines. The SDL has contracts with more than 300 best global publishers. The library won the award for the Arab Federation for Libraries and Information 'know' for outstanding projects in the Arab world in 2010. The library provides one set of information to all the universities and research organizations in the Kingdom of Saudi Arabia through digital environment to ensure standard facilities. Any further relevant detail can be found on SDL official website. In Jazan University, any staff member or student can access SDL by using their secure ID and password on the dedicated website link (https://sdl.jazanu.edu.sa).

2.3 Teaching Strategies

Mathematics program learning outcomes (PLOs) are designed according to the National Qualification Framework (NQF) provides three learning domains; Knowledge and Understanding, Skills and Values, autonomy, and responsibility (SAQF-2020).

Program Learning Outcomes (PLO) and Teaching Strategies			
Code	**Program Learning Outcomes**	**Teaching Strategies**	**Assessment Methods**
Knowledge and Understanding			
K1	Demonstrate in-depth knowledge of Mathematics, both in theories and applications.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
K2	Describe appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts as an application.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
K3	Integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
Skills			
S1	Discover and apply the most appropriate mathematical and/or statistical techniques.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
S2	Communicate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of Mathematical problems.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
S3	Analyze complex problems in Mathematics and propose solutions using research based knowledge.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
S4	Conduct scientific research on certain fields of Mathematics.	Lectures, Tutorials, Seminars, Direct Reading, Discussion	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
Values, autonomy, and responsibility			
V1	Demonstrate leadership qualities with sense of Commitment and accountability.	Dissertation and its oral defense, Activities, group works	Direct and indirect methods of assessment

Program Learning Outcomes (PLO) and Teaching Strategies			
Code	**Program Learning Outcomes**	**Teaching Strategies**	**Assessment Methods**
V2	Inculcate values and ethics in thoughts, expression and deeds.	Dissertation and its oral defense, Activities, group works	Direct and indirect methods of assessment
V3	Show responsibility for personal outputs, intellectual independence.	Dissertation and its oral defense, Activities, group works	Direct and indirect methods of assessment
V4	Promote Mathematics in scientific development as well as in the general education of the society.	Dissertation and its oral defense, Activities, group works	Direct and indirect methods of assessment

The program learning outcomes were established by a process that involved extension discussions with faculty members, students, Alumni and the quality assurance and accreditation committee. The program learning outcomes support program educational objectives.

The overall learning outcome is measured by the continual student's assessment, quizzes, tutorial participation, and presentations delivery, active participation during classes, small group discussions midterm exams and final exams. Although all courses have goals and objectives included in course descriptions, the achievement of these goals is assessed through a rigorous evaluation process. This evolution process is done through surveys and normally carried out at the end of each semester.

2.4 Other Facilities (IT, Students Campus Facilities, etc…).

2.4.1 Information Technology

The Deanship of e-learning and distance education in the Jazan University is responsible to provide integrated administrative and educational e-services for all stakeholders at the university. These customized services are provided for the teaching Staff, Students and employees of the university through the University website and mobile applications that can be accessed with a dedicated ID and password.

Following is a brief summary of some important e-services provided by Jazan University:

- E-learning: Each teaching staff and each student has access to the world-renowned distance learning management system “Blackboard Learn”, where teaching staff can manage complete online teaching process irrespective of on-campus or distance

learning courses. The learning management system is kept integrated and updated with respect to students, teachers, and courses in the respective program. It is worth mentioning that the pre-existence of this service was the reason for the smooth distance learning transition for all courses during the COVID-19 crises.

- Email: The Jazan University provides an email system for all stake-holders that is powered by Microsoft with the domain "username@jazanu.edu.sa".
- The Edugate Portal: A secured and advanced integrated online environment to manage attendance, marks, surveys, class and faculty schedules, and several other necessary services required for educational processes.
- EJUST: Employee Affairs services: These services provide detailed information of employee, his/ her job status, salaries, and other financial affairs. It is also a gateway to provide administrative letters and financial statements to all employees.

The other key services are free access to Microsoft office 365, Saudi digital library, all application forms, and a strong application management system.

2.4.2 Students Campus Facilities

The Department ensures all necessary and sufficient Equipment for all stakeholders in the department. In the male campus, each classroom at the Department is equipped with smart board, projector, including ordinary white board in case the smart board is malfunctions. All of the staff offices contain an office chair, two guest chairs, office table, computer table, a small coffee table, and a set of cabinet to ensure required comfort. There is a general cafeteria area for the faculty and students to spend some refreshing time with each other and discuss problems. Also, two designated praying areas are assigned for teachers and students. Each faculty member is provided with a personal laptop and/ or office desktops, a printing facility and a photocopy machine for academic purposes. The Department has also provided 4 computer labs facility for students and teachers; it contains all necessary software for scientific learning and research.

For the detailed list of available classrooms, labs and included facilities please see the updated list of available resources and report of Classroom and Lab committee of the department in (**Appendix Math4.7)**.

The Departments security is monitored through 24 hours on campus security guards and security cameras, provided by College of science. Adequate cleaning facilities are also available in the department to maintain high-quality hygiene standards.

Some general facilities are provided by the college of science such as cafeteria, Mosque, book store, library, gym and indoor games for exertion. The STC, VPN network and Wi-Fi internet is available free of costs for all employees and students in the College of science building. These facilities are comparable with other College program at any university inside the Kingdom.

2.5 Student Advising Policy

Academic advising & counseling service is an assistant educational system, where the faculty members introduce the students to the university and college systems and inform them by their roles, responsibilities and rights (**Appendix Math2.6**). Academic advising & counseling service provides guidance and support for students to overcome any academic problems or personal difficulties that may hamper student's academic progress, as well as develops the students' capacities and potentials, that enhances their academic performance. Academic advising and counseling services are basic steps that guarantee a collaborative relationship between faculty members and students. The intent of this collaboration is to facilitate learning by providing opportunities for students to achieve their goals and uphold the academic standards of the college. Each student at the Department of Mathematics is assigned a faculty advisor at the time of his initial enrolment. The faculty advisor is available to solve any problem that might arise during the student program. The University considers student advising by faculty as an important teaching-related activity. The faculty advisor is expected to advise students in planning their academic programs during early registration, and throughout their academic year. The faculty advisor has the following main roles: (**Appendix Math2.2**)

- Assign Teaching staff member as academic advisor to a group of students
- Announce reminder about the meeting between advisor and the student
- Monitor student attendance record.
- The academic advisor helps his students examine the course offerings in their major and understand their graduation requirements.
- The academic advisor helps the student explore the career fields within his/her major, and obtain related career information and survey job opportunities.
- The academic advisor serves as a link between the student and the administration by counseling the student on matters of failure, on the procedures for dropping and adding courses, course scheduling, and academic progress.
- The academic advisor must alarm students of the exclusion procedure well in advance and of any subsequent changes that might be enforced during the course of their studies.

In the department of Mathematics and the College of Science there are academic guidance units which aim to:

- Provide accurate and up-to-date information.
- Clarify the requirements, policies and procedures of the Programs being offered.
- Approve students' Programs of study and assist them in identifying appropriate resources.
- Facilitate relationships between the student and others within the University who may also be able to provide relevant assistance.

- Advise on and help in realizing educational and career options.
- Uphold the standards of the University.

The Deanship of Admission & Registration offers non-academic services which in turn make the learning and education processes more enjoyable. Some of these services are as follows: (**Appendix Math2.2 & JU2.3**)

- Issuing Student IDs
- Housing
- Students Fund
- Catering Service
- Scholarships

2.6 Attendance and Exam Policies

2.6.1 Attendance

Mathematics Study Program activities carried out with the number of students around 30-35 per class for Bachelor degree and 4-10 for Master Degree (regular classes), with the rule of student attendance of at least 75%. Response activities are carried out by the lecturer concerned or by the teaching assistant. The design of developing the academic climate is to include some of the above facilities as a structured meeting that must be conducted by students.

In addition, there is a planned work agenda for each study group or institution.

(a) The development of academic atmosphere in learning is carried out by providing facilities and infrastructure to support learning activities such as the use of multimedia projectors, provision of dictates, construction/ investment of laboratories, provision of scientific journals and provision of internet access. Then the application of active learning methods, prevention and application of disciplinary action sanctions, and transparency in the assessment system.

(b) The development of an academic atmosphere in research is carried out by conducting internal seminars, holding seminars/ public lectures by inviting researchers from domestic and abroad.

Development of an academic atmosphere in community service is done by involving students in community service activities. The development of scientific personality has been applied to students and lecturers since they first entered the Mathematics This scientific personality is also instilled in the learning methods used in each course, where a lecturer always uses the discussion method to develop scientific interactions between lecturers and students in the

classroom. Lecture activities and other campus activities that are conducive produce excellent students.

To sit in exam Jazan University requires 75% attendance of the total number of lectures, labs and tutorials. Students failing to meet this requirement in any of the courses are prohibited from attending the final examination of that course and earn a DN (Denied) grade in that course. A student who is absent in the final examination of a course(s) for a valid reason accepted by the department council and the Dean of the College is allowed to take the examination at a later date.

75% attendance is mandatory to appear in Exams. If any student fails to avail 75% attendance of the total lecture then he/she will not be allowed to sit in final exam and shall get DN grade that is denied entry in that respective course.

The Edugate Portal is a secured and advanced integrated online environment to manage attendance, marks, surveys, class and faculty schedules, and several other necessary services required for educational processes.

Mathematics Study Program activities carried out with the number of students around 30-35 per class for Bachelor degree and 4-10 for Master Degree (regular classes), with the rule of student attendance of at least 75%. Response activities are carried out by the lecturer concerned or by the teaching assistant. The design of developing the academic climate is to include some of the above facilities as a structured meeting that must be conducted by students.

2.6.2 Exam Policies

Student's achievements or success are based on many things in which exam are the key point with the learning outcomes of the course plan on the syllabus. The syllabus is actually a reflection of blueprint of the course, which determines the learning method and strategy to assist the students in achieving the best results to perceive their goals. The undergraduate program in the mathematics department of the College of Science, Jazan University, Jazan, has specific objectives aligned with the learning outcomes of the courses. The exams in the undergraduate and postgraduate program in the mathematics department are aimed based on learning outcomes planned on the syllabus of the course and is based on many other methods for example midterm exam-1, midterm exam-2, quizzes, home works, assignments, students presentations and their final exams at the end of the semester. These methods are utilized to ensure that the desired program outcomes are achieved. The grades are direct reflection of the course outcomes. Each course in the department of mathematics has a total of 100 points. Final Grade Breakdown of the course shown in the Table given below.

Final Grade Breakdown of the Course		
No	**Assessment task**	**Proportion of Total Assessment**

Final Grade Breakdown of the Course		
No	**Assessment task**	**Proportion of Total Assessment**
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%
	Total	**100%**

The exam as an assessment of learning outcomes is carried out in an aimed, unified, and ongoing method that can function as a competent evaluator to describe the development of student learning thoroughly and be able to motivate student learning better. In order to organize the academic activities of the undergraduate program, the college of science gives guidelines for each department. Before the new semester started, the mathematics department declares planning and schedule together with the syllabus comprising information about course learning objectives, prerequisites, description, content, assignments, textbook, readings, evaluation procedures, teaching methods, grading standard, office hours to the Faculty. When the semester ends, instructors should submit the grades and copies of their midterm exams-1, midterm exam 2, final exam, quizzes, assignments, home works and sample solutions copies of students with sample solution copies of each entity on a Google drive folder link provided by the quality unit in the department to all the faculty members to submit all e-files therein. All documents summited are essential for controlling the quality of the study program.

After completion of exam the instructor has to submit the result within 48 hours from the exam time on Edugate system https://edugate.jazanu.edu.sa/jazan/init. Before submitting the results the following documents stated in the following Table has to be submitted first to the departmental quality unit.

Final Grade Breakdown of the Course	
No	**Documents (Soft copies)**
1.	Instructor C.V. (if not provided before to the related course)
2.	Teaching plan of present Semester
3.	Quizzes & Homework's + 2 student answer samples
4.	1st Midterm exam sheet + model answer +3 students samples (High/ Average /Low)
5.	2nd Midterm exam sheet + model answer +3 students samples (High/ Average /Low)
6.	Practical Quiz+ Practical Quiz model answer
7.	Practical final exam+ instructor model answer + 3 students samples (High/ Average /Low)

Final Grade Breakdown of the Course	
No	**Documents (Soft copies)**
8.	Final exam sheet+ model answer + 3 students samples (High/ Average /Low)
9.	Print copy of CES Edugate + CES excel page
10.	LO assessment results-(excel and print all excel sheets)
11.	NCAAA course report based on final version 2024 (male, female, combined M & F)
12.	last absence record of students fom Edugate system
13.	Exam Cross Check Form of Examination Committee

The schedule of exam is as follows: Midterm Examination: Midterm-1 holds in week six/seven and Midterm-2 in week twelve/thirteen of the semester. Final Examination: week fifteen/sixteen of the semester. The University arranges examinations schedule for courses following the academic calendar. Examination dates and times for each department can be accessed in the College web site. Therefore, the exam schedule is always up-to-date. For both the midterm and final exams, the students who are unable to take these exams are required to apply for re-examination. About transparency after the assessment, students have the right to receive a duplicate of the paper assessed. After finishing Mid 1 and Mid 2 exams they can see their grades on university black board system https://lms.jazanu.edu.sa/webapps/login/?action=login. The students have right to obtain information about the application of examination criteria to their study attainments. They shall be allowed to see the assessed study attainment. At the beginning of the semester, students get all information related to the courses and evaluation from their academic advisor. Students also can get information from the College website. At the end of the semester, students can access their grades from the University Academic System (https://edugate.jazanu.edu.sa/jazan/init). It contains two papers for midterm and final examination the correlation between the exam and PLO can be explained as follow:

To sit in exam Jazan University requires 75% attendance of the total number of lectures, labs and tutorials. Students failing to meet this requirement in any of the courses are prohibited from attending the final examination of that course and earn a DN (Denied) grade in that course. A student who is absent in the final examination of a course(s) for a valid reason accepted by the department council and the Dean of the College is allowed to take the examination at a later date.

3. Employment Outlook

Student graduating from the mathematics program comply regulations education of the KSA Universities defined by the Ministry of Education. The content of the Master's Degree Program in Mathematics is determined on the basis of the general requirements concerning the teaching of Mathematics, and the needs and expectations of the Schools, Industries and Banking sectors.

The number of employees within the Mathematics field is likely to increase in the next decade. The proportion of University graduates will also increase, because of an increasing demand for Mathematics knowledge and skills in the industries within the application field. The most important fields our graduates can work as Teachers, Instructors Data analysts, Strategic planning, Administrations, Researchers, Data analysts, Lecturers, Tutors, Different Industries, Banking sectors, etc.

The KPIs showing in Table below is about the percentage of graduates from the program who within a year of graduation are employed during the first year of their graduation to the total number of graduates in the same year. It is clear that from the last year Alumni data around half of the graduates were employed in various sectors.

KPI: Graduates' Employability					
Actual Benchmark		**Target Benchmark**	**Internal Benchmark***	**External Benchmark****	**New Target Benchmark**
Overall	54.5%	50%	50%	50%	60%
Girls	55.5%				
Boys	50%				

3.1 Program Graduates Attributes.

The Mathematics Program was established to prepare specialized qualified mathematicians in order to contribute and achieve the progress of the society of the Kingdom of Saudi Arabia in so numerous fields as general and higher education, health, agriculture and society employment.

The department of mathematics offers its students a distinct learning experience through coherent programs and benchmarked degrees. The self-study recommends investigating ways to support learning on mathematical skills of students. More effort is being exerted on attracting research funds for students to promote their knowledge and skills in research.

No	Mathematics Program Graduates Attributes
1.	Deep discipline knowledge
2.	Critical thinking and problem solving
3.	Teamwork and communication skills
4.	Career and leadership readiness
5.	Self-awareness and emotional intelligence

3.2 Program Graduates and University Graduates Attributes.

JU has a clear academic structure to support the curriculum design, based on levels. The levels' structure also establishes the basis upon which each student's achievement can be measured and upon which progression through the program can be approved.

A postgraduate program comprises a minimum of four levels, and is delivered in a semester system. The exact number of levels for any program is specified in the study plans and program specifications. Two main semesters of 15 weeks and a summer semester or term of not more than eight weeks duration are the building blocks of the academic year, against which each college designs the study plan of every program offered. The periods of registration and final examination are not considered as a part of this period which defines a semester.

The credit hour formula is based on a numbering system in which a full-time student load is 9 to 12 credit hours in a semester and 36 credit hours in a two-year degree. The credit hour formula is used as a substitute for estimates of the amount of learning achieved. If a program has a high number of contact hours this formula can result in an unrealistically high number which does not accurately represent the amount of learning that can reasonably be expected.

Jazan University agreed to a number of revisions to its Graduate Attributes in 2021. These are incorporated into the list below.

No	Jazan University Graduates Attributes	
1.	Research and knowledge inquisitiveness and practical application of knowledge:	Graduates show a comprehensive and extensive knowledge of specialization and an understanding of the link of specialization with other areas through the practical application of knowledge and continuous self-learning
2.	The ability to solve problems and make decisions:	Identifying problems by critical analytical thinking and solutions using creative thinking, and is able to evaluate opinions and make informed decisions.
3.	Commitment to values, ethics and responsibility:	Committed to professional ethics, Islamic and community values, social responsibility through good citizenship and community service as well as responsibility, appreciation of cultural diversity and respect for other cultures

No	Jazan University Graduates Attributes	
4.	Effective communication:	Graduates can communicate effectively verbally and in writing.
5.	Digital communication	The graduate is able to access, evaluate and use information effectively and efficiently and creatively in sustainable learning, scientific research and effective communication
6.	Leadership and teamwork:	Graduates can lead teams and guide them towards achieving the desired goals, and work to develop entrepreneurial ideas and projects in self-determination and in cooperation with others.

4. Learning Outcomes.

4.1 Program Learning Outcomes (PLO's).

Mathematics program learning outcomes (PLOs) are designed according to the National Qualification Framework (NQF) provides three learning domains; Knowledge and Understanding, Skills and Values, autonomy, and responsibility (SAQF-2020).

Code	Program Learning Outcomes
Knowledge and Understanding	
K1	Demonstrate in-depth knowledge of Mathematics, both in theories and applications.
K2	Describe appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts as an application.
K3	Integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information.
Skills	
S1	Discover and apply the most appropriate mathematical and/or statistical techniques.
S2	Communicate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of Mathematical problems.
S3	Analyze complex problems in Mathematics and propose solutions using research based knowledge.
S4	Conduct scientific research on certain fields of Mathematics.
Values, autonomy, and responsibility	
V1	Demonstrate leadership qualities with sense of Commitment and accountability.
V2	Inculcate values and ethics in thoughts, expression and deeds.
V3	Show responsibility for personal outputs, intellectual independence.
V4	Promote Mathematics in scientific development as well as in the general education of the society.

4.2 Institute (JU) Learning Outcomes (JULO's).

The below mentioned eight learning outcomes represent the educational values of Jazan University, as a whole, that allow all students, regardless of their course of study, the opportunity to share in a collective academic culture and environment

Code	Institute (JU) Learning Outcomes (JULOs)
1.	Analyze and explain theories, concepts, principles, skills and practices in different disciplines. **(Knowledge and understanding)**
2.	Demonstrate leadership qualities and skills needed to communicate effectively with others orally and in writing in a sound language **(skills and values)**
3.	Commit to professional and ethical behaviors and show team spirit **(values)**
4.	Apply independent and critical thinking innovatively to solve complex problems **(skills).**
5.	Apply sustainable learning skills in all scientific and community aspects on environmental, economic and social issues **(values)**
6.	Promote the concept of community responsibility towards scientific and life issues. **(Values)**
7.	Apply the skills and ethics of scientific research, innovation and creativity efficiently. **(Skills)**
8.	Apply knowledge by accomplishing practical skills brilliantly (practical skills)

4.3 Consistency of PLO's with the Jazan University Learning Outcomes

Code	Program Learning Outcomes	Institute Learning Outcomes	Code
K1	Demonstrate in-depth knowledge of Mathematics, both in theories and applications.	Analyze and explain theories, concepts, principles, skills and practices in different disciplines. (Knowledge and understanding)	**1**
K2	Describe appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts as an application.		
K3	Integrate knowledge and handle		

Code	Program Learning Outcomes	Institute Learning Outcomes	Code
	complexity, and formulate judgments with incomplete or limited information.		
S1	Discover and apply the most appropriate mathematical and/or statistical techniques.	Apply knowledge by accomplishing practical skills brilliantly (practical skills)	**8**
S2	Communicate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of Mathematical problems.	Demonstrate leadership qualities and skills needed to communicate effectively with others orally and in writing in a sound language **(skills and values)**	**2**
S3	Analyze complex problems in Mathematics and propose solutions using research based knowledge.	Apply independent and critical thinking innovatively to solve complex problems (skills).	**4**
S4	Conduct scientific research on certain fields of Mathematics.		
V1	Demonstrate leadership qualities with sense of Commitment and accountability.	Demonstrate leadership qualities and skills needed to communicate effectively with others orally and in writing in a sound language (skills and values)	**2**
V2	Inculcate values and ethics in thoughts, expression and deeds.	Commit to professional and ethical behaviors and show team spirit (values)	**3**
V4	Promote Mathematics in scientific development as well as in the general education of the society.	Promote the concept of community responsibility towards scientific and life issues. (Values)	**6**
V3	Show responsibility for personal outputs, intellectual independence.	Commit to professional and ethical behaviors and show team spirit (values)	**3**
		Apply sustainable learning skills in all scientific and community aspects on environmental, economic and social issues (values)	**5**
		Promote the concept of community responsibility towards scientific and life issues. (Values)	**6**

4.4 Courses and Program Learning Outcomes Mapping.

Each course has a set of outcomes called Course Learning Outcomes (CLOs). The CLOs of a course describe the abilities to be attained at the end of the course. The CLOs for each course is specified so that they are non-overlapping and are as few as possible still covering the specified syllabus of the course. The curriculum committee is responsible for updating and revising the CLOs are based on the recommendations of the course coordinators. For each course, the CLOs are linked to the PLOs that are attained as a result of attaining the CLOs. JU uses credit hour

system. The program learning outcomes are classified into the three NQF learning domains. Each program learning outcome is verified by using appropriate assessment method, and supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. After the completion of the Bachelor's Degree Program in Mathematics, program learning outcomes require that our graduate will demonstrate the following outcomes:

The Mapping between Courses and the Program Learning Outcomes
(I = Introduced, P = Practiced, M = Mastered)

Course code & No.	Program Learning Outcomes											
	Knowledge and understanding				Skills				Values, Autonomy, and Responsibility			
	K1	K2	K3	---	S1	S2	S3	S4	V1	V2	V3	V4
601 Math	I	I	I		I		I	I	I	I	I	I
602 Math	I	I	I		I	I	I	I	I	I		I
603 Math	P	P	P		P	P	P	P			P	P
604 Math	P	P	P		P	P	P	P	P	P	P	
605 Math	I	P	M		I	P	P		I	P	M	M
606 Math	I	P	M		I	M		M	I	P	M	M
607 Math	M	M	M		M		M	M	M	M	M	M
620 Math	M	M	M		M	M			M	M	M	M
621 Math	M	M	M		M	M		M	M	M	M	M
622 Math	M		M		M	M		M	M	M		M
630 Math	M	M	M			M	M	M	M		M	
631 Math	M		M			M	M		M		M	
632 Math	M		M		M		M		M		M	M
633 Math		M	M		M		M		M	M		M
640 Math		M	M		M	M		M	M		M	M
641 Math	M	M	M			M		M			M	M

The Mapping between Courses and the Program Learning Outcomes
(I = Introduced, P = Practiced, M = Mastered)

Course code & No.	Program Learning Outcomes											
	Knowledge and understanding				Skills				Values, Autonomy, and Responsibility			
	K1	K2	K3	---	S1	S2	S3	S4	V1	V2	V3	V4
642 Math	M	M	M		M	M		M		M		M
643 Math	M	M			M	M	M	M	M			M
650 Math	M	M	M		M		M	M	M			M
651 Math	M	M	M			M		M	M	M		
660 Math	M	M	M		M			M	M			M
661 Math		M	M		M	M	M	M	M			M
662 Math	M	M			M			M	M	M	M	M
663 Math	M	M	M		M		M	M	M			
672 Math	M	M	M		M		M	M	M	M		
696 Math	M		M		M	M		M	M	M		
699 Math	M	M	M		M	M	M	M	M	M	M	M

4.5 Assessments Plan of LO's.

Each course has a series of findings called "Course Learning Outcomes" or CLOs, which are the base of all direct PLO evaluations. A course's CLOs identify the skills that are to be achieved at the completion of the course. The curriculum committee is responsible for updating and revising the CLOs based on the recommendations of the Course Coordinators. For Mathematics Program, the CLOs are part of the syllabus and are published for students in the student handbook. PLOs are linked to the CLOs of various courses through the CLO-PLO mapping, therefore, if the CLOs are attained to the required level of satisfaction, the relevant PLOs are assumed to be attained to the required level of satisfaction.

The process for preparing and approving assessment of course learning outcomes will involve the following steps:

1. A couple of weeks before the beginning of the semester the instructor of each course being informed by sending a reminder message about the need to carry out an assessment that semester. This message includes simple instructions for the assessment process (direct and indirect methods).

2. Each instructor carries out the assessment plan during the semester.

3. At the end of the semester, each instructor is sent a reminder message to prepare a course report. This message includes a template of course report.

4. Course report and results are archived electronically and/or in hardcopy and a copy is added to the course folder.

5. Course report should contain both direct assessment (using quizzes, exams, assignments, etc.) and indirect assessment (through surveys).

6. In addition to the raw assessment data, Course report includes analysis and interpretation of the results.

7. All Faculty members are required to maintain the record of the students' data (marks of the student in every assessment method, what percentage of outcome has every student achieved in that assessment method etc.) in the form of a matrix in the provided Excel sheet template.

8. Assessment is to be based mainly on the percentage of students achieving the satisfactory-exemplary levels for a specific program learning outcome instead of the average score of all students in a specific outcome.

The following is a brief description of the process used in assessing and evaluating Mathematics Program PLOs:

- Direct assessment

  Assessment Tools: The actual attainment levels of students in a course through exams, quizzes and assignments.

  Evaluation method:
  - Define Levels of attainment of PLOs for evaluating student's direct assessment results.
  - Tabulate and Display PLOs Achievement based on student's direct assessment results
  - Comment on PLOs assessment

- Indirect assessment

  Assessment Tools: Course Evaluation Survey

  Evaluation method:

- Define Levels of Attainment of PLOs for evaluating indirect assessment survey.
- Tabulate and Display PLOs Achievement based on Indirect Surveys
- Comment on PLOs assessment.

5 Program Structural

5.1 General outlines (total hours and list of requirements)

The Department of Mathematics runs undergraduate and postgraduate programs. The postgraduate students in the Department of Mathematics spend two years spread over four semesters and they earn a degree of Master of Science (M. Sc.) in Mathematics after completing 36 credit hours of studies (36×1.9144=**68.918** ECTS; "European Credit Transfer System). The study program begins with compulsory courses. The Mathematics Program is one of the most important programs in the College of science. It includes theoretical courses, exercise sessions and laboratory work. The study program includes the core courses (**Required & Elective**) and thesis work.

Total Hours and List of Requirements

Program Structure	Required/ Elective	No. of courses	Credit Hours	ECTS	Total Work load	Percentage
Course	Required	6	18	34.459	965	**50%**
	Elective	4	12	22.972	643	**33%**
Capstone Course/Project/ Thesis	Required	1	6	11.486	322	**17%**
Field Experience/ Internship (if any)	-	-	-	-	-	-
Others	-	-	-	-	-	-
Total		**11**	**36**	**68.918**	**1930**	**100.00%**

5.2 European Credit Transfer and Accumulation System (ECTS) Points

Students complete 68.92 ECTS points after completing the program

ECTS is a standard for comparing the study attainment and performance of students across the European Higher Education Area (EHEA) and making studies and courses more transparent. It helps students to move between countries and to have their academic qualifications and study periods abroad recognized.

ECTS credits express the accumulated load based on the defined learning outcomes and their associated workload. 60 ECTS credits are allocated to the learning outcomes

and associated workload of a full-time academic year or its equivalent, which normally comprises a number of educational components to which credits (on the basis of the learning outcomes and workload) are allocated. ECTS credits are generally expressed in whole numbers.

Workload is an estimation of the time the individual typically needs to complete all learning activities such as lectures, seminars, projects, practical work, work placements and individual study required to achieve the defined learning outcomes in formal learning environments. The correspondence of the full-time workload of an academic year to 60 credits is often formalized by national legal provisions. In most cases, workload ranges from 1,500 to 1,800 hours for an academic year, which means that one credit corresponds to 25 to 30 hours of work. It should be recognized that this represents the typical workload and that for individual students the actual time to achieve the learning outcomes will vary.

Awarding credits in ECTS is the act of formally granting students and other learners the credits that are assigned to the qualification and/or its components if they achieve the defined learning outcomes. National authorities should indicate which institutions have the right to award ECTS

Accumulation of credits in ECTS is the process of collecting credits awarded for achieving the learning outcomes of educational components in formal contexts and for other learning activities carried out in informal and non-formal contexts. A student2 can accumulate credits in order to:

- Obtain qualifications, as required by the degree-awarding institution;
- Document personal achievements for lifelong learning purposes.

Approach to allocating credit in Science Programs

1. Based on learning outcomes of each program component, teaching staff describes the learning activities, and estimates the workload typically needed for a student to complete these activities. Proposals are collected, analyzed, and synthesized and the estimated workload is expressed in credits.

2. Faculty may decide from the start to standardize the size of educational components, giving each one the same credit value.
3. Considering the average of each ECTS credit is equal to 28 learning hour.

Self-Learning Calculation

For University Requirements

ECTS for all university requirement courses were calculated **based on opinion of students through survey** and found to be in consistent with standard ECTS calculation equation as

No. of ECTS points = {credit unit *60 (ECTS for 2 Semesters) * 2 years}/ 36 (total credit of the program)

For Program Requirements

1. Each CH will be multiplied by 15 (official week number of a semester) to get the contact Hours
2. Every contact Hour is considered as 50 Min as per the University rule
3. For all program courses, it has been found **through surveying students' opinion** that each Contact Hours requires a minimum of **two** Learning Hours.
4. Add all together the contact hours with preparation times for exam, HWs, lab reporting and case studies, etc. to get the total Hours of Learning that the student spend for the course
5. Divide the learning hours by 28 to get the ECTS points:

Equivalent ECTS points=Total LH/28

5.3 Curriculum.

Curriculum Structure						
Program Structure	Required/ Elective	No. of courses	Credit Hours	ECTS	Total Workload	Percentage
Course	Required	6	18	34.459	965	50%
	Elective	4	12	22.972	643	33%
Graduation Project (if	-	-	-			-

any)						
Thesis (if any)	Required	**1**	**6**	11.486	322	**17%**
Field Experience(if any)	-	-	-			-
Others (.....)	-	-	-			-
Total		**11**	**36**	**68.918**	**1930**	**100%**

5.4 Program Requirements (Course list, Credit hours/week, and Actual hours/week).

The Section requirement is studied all compulsory courses by students during the years of study and involved 91credit hours to contribute and prepare student scientifically and academically.

The curriculum shown in Table below is reviewed periodically to fulfill the program goals and learning outcomes, and the educational, scientific, technical and professional development in the field of specialization. The objectives of degree programs and courses are defined as learning outcomes. The learning outcomes of courses are based on the mission of a given degree program.

Level	**Course Code**	**Course Title**	**Required or Elective**	**Pre-Requisite Courses**	**Credit Hours**			**workloads**	**ECTS Points**	**Type of requirements** (Institution, College or Department)
					Theory	**Practical**	**Total**			
Level-1	MATH 601	Abstract Algebra-1	R	MATH 323/ Equivalent	3	-	3	160	5.7	Department
	MATH 602	Real Analysis-1	R	MATH 315/ Equivalent	3	-	3	160	5.7	Department
	MATH 603	Complex Analysis	R	MATH 314/ Equivalent	3	-	3	160	5.7	Department
Level-2	MATH 604	Numerical Analysis	R	MATH 419/ Equivalent	3	-	3	160	5.7	Department
	MATH 605	Theory of Differential Equation	R	MATH 332/ Equivalent	3	-	3	160	5.7	Department
	MATH 606	Mathematical Statistics-1	R	MATH 453, MATH	3	-	3	160	5.7	Department

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Credit Hours			workloads	ECTS Points	Type of requirements (Institution, College or Department)
					Theory	Practical	Total			
				352/ Equivalent						
Level-3		Elective Course	E	---	3	-	3	160	5.7	Department
		Elective Course	E	---	3	-	3	160	5.7	Department
		Elective Course	E	---	3	-	3	160	5.7	Department
		Elective Course	E	---	3	-	3	160	5.7	Department
Level-4	MATH 699	Thesis	R	All above courses are required	6	-	6	322	11.5	Department

6. Program Study Plan

The Mathematics program has a demanding curriculum that students must cope with challenging workloads as part of their education. In Jazan University, the undergraduate Mathematics program has 130 credit hours and is designed to provide high quality Mathematics education to produce competent Mathematics graduates. It corresponds to the specific learning outcomes for Mathematics program outlined in the NCAAA Guidelines for Program Development and Review. The program also matches and in alignment with the vision and mission of the college of science and Jazan University.

6.1 Complete Study Plan (Courses List per Semester).

The Mathematics program has been prepared according to the institutional policies, standards and procedures. Subsequently, the program adapted these descriptions to the forms of NCAAA in which teaching and assessment strategies and methods are specified in detail. All courses have been specified in terms of ILOs, teaching and assessment methods using NCAAA forms and guidelines. Course-level ILOs have been mapped and linked to their respective programs. Curriculum committee evaluates new proposal for program establishment or modification based on selected criteria.

The study plan of Mathematics program ensures the balance between the general and specialty requirements, and between theoretical and applied aspects. The Q & AA committee reviews the study plan and course descriptions for every semester annually. The quality of the process is

evaluated by examining the curriculum and the degree program development. The quality indicators for the curriculum process are: continuous development and professional relevance of curricula and degree structures, true-to-life course descriptions that follow guidelines and the publication of the study guide on schedule.

The Vice Dean of academic affairs in the college of science facilitates the academic development of students. This is performed through various ways such as promoting the students and giving them opportunities for pursuing their interests and developing/refining their talents in the field of extracurricular activities. It provides facilities for games, sports and organizes competitions and tournaments in different types of indoor and outdoor sports and games. The Board provides coaching and training facilities to students in several types of sports and games.

First Level								
#	Course Code	Course Name	Number of hours of study		Credit Hours	Workloads	ECTS	Prerequisite
			Lectures	Sec./Lab				
1	MATH 601	Abstract Algebra-1	3	-	3	160	5.7	MATH 323/ Equivalent
2	MATH 602	Real Analysis-1	3	-	3	160	5.7	MATH 315/ Equivalent
3	MATH 603	Complex Analysis	3	-	3	160	5.7	MATH 314/ Equivalent
	Total		**9**	-	9	**480**	**17.1**	

Second Level								
#	Course Code	Course Name	Contact Hours		Credit Hours	Workloads	ECTS	Prerequisite
			Lectures	Sec./Lab				
1	MATH 604	Numerical Analysis	3	-	3	160	5.7	MATH 419/ Equivalent
2	MATH 605	Theory of Differential Equation	3	-	3	160	5.7	MATH 332/ Equivalent
3	MATH 606	Mathematical Statistics-1	3	-	3	160	5.7	MATH 453, MATH 352/ Equivalent
	Total		**9**	-	**9**	**480**	**17.1**	

Third Level							
#	Course Code	Course	Contact Hours	Credit			

		Name	Lectures	Sec./Lab	Hours			
1		Elective Course	3	-	3	160	5.7	-
2		Elective Course	3	-	3	160	5.7	-
3		Elective Course	3	-	3	160	5.7	-
4		Elective Course	3		3	160	5.7	-
	Total		**12**	**-**	**12**	**640**	**24.8**	

Fourth Level

#	Course Code	Course Name	Contact Hours		Credit Hours	Workloads	ECTS	Prerequisite
			Lectures	Sec./Lab				
1	MATH 699	Thesis	12	-	6	104	3.7	All above courses are required
	Total		**12**	**-**	**6**	**322**	**11.5**	

6.2 Courses Descriptions

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Abstract Algebra-1	MATH 601	3	-	3	1	1	MATH 323 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours = **160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course provides an introduction to abstract algebra, so it is designed to cover the basic concepts of the abstract algebra and entrench the algebraic ideas in the students mind, which lead to use mathematical logic concepts to prove basic theories, which easily lead to study deeply an advanced courses.

(2) Course Objectives

After completing this course, the student will be

1. Familiar with the basic concepts of abstract algebra, able to deal with abstract concepts as well as use mathematical logic to prove basic theories.
2. Familiar with the algebraic construction and its conditions.
3. Understand that the abstract algebra is the main theory of mathematics that study the important algebraic construction such as groups, rings, fields and other.

(3) Course Contents

Groups, subgroups, lattices of subgroups, cosets and normal subgroups, quotient group, homorphism, isomorphism and related theorems. Rings, subrings, ideals, ring homomorphism, quotient rings, polynomial rings and irreducibility criteria. Fields, field extensions, algebraic extensions, algebraic closure and fundamental theorem of algebra.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. I. N. Herstein, Topics in Algebra, John Wiley and Sons, 2006.
2. J.B. Farleigh, A first course in abstract algebra, Wesley Publishing Co. London, 7th edition, 2003.

(7) Reference Books

1. D. Dummit and R. Foote, Abstract Algebra, John Wiley & Sons, 3rd edition, 2004.
2. Thomas W. Hungerford, Algebra, Springer, 2003.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Real Analysis-1	MATH 602	3	-	3	1	1	MATH 315 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Real analysis is a branch of mathematics that deals with real numbers and the idea of sets, functions, and limits. Real analysis has become an important component in areas of natural science, social science, engineering, business and computer science. This course develops and examines the basic materials in real analysis in a systemic and rigorous manner in the context of real-valued functions of real variable. It covers the fundamentals of real analysis: the real number system, sequences, continuity, differentiation ,the Riemann-Stieltjes integral and sequence and series of functions .

(2) Course Objectives

After completion of this course; successful students are able to:

1. Describe the fundamental properties of the real numbers.
2. Demonstrate an understanding of limits and how they are used in sequences series and differentiation.
3. Apply the properties of sequences to solve related problems.
4. Analyze continuity of a function and distinguish between continuity and uniform continuity.
5. Construct rigorous mathematical proofs of basic results in real analysis.
6. Distinguish between point-wise convergence and uniform convergence.
7. Apply the properties of the Riemann-Stieltjes integral to identify integrable functions.

(3) Course Contents

Real number, Countable and uncountable sets, Sequences and Series, Limits and Continuity of real functions, Derivative of real functions, Riemann-Stieltjes integral, Functions of more than one variables

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
4.	Assignment-1 / Quiz-1/ Presentations-1	5%
5.	Midterm Exam-1	20%
6.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. Walter Rudin , Principle of Mathematical Analysis; Third Edition, McGraw –Hill. Inc. ISBN 1976

(7) Reference Books

1- R.G. Bartle and D.G. Sherbert,'' Introduction to Real Analysis'', , 3rd Edition JohnWiley and Sons, 2000
2- Richard R. Goldberg,''Methods of Real Analysis '',3rd Edition, John Wiley and Sons .Inc. 1976.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Complex Analysis	MATH 603	3	-	3	1	1	MATH 314 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Complex analysis is a branch of mathematical analysis that deals with functions of complex variables. It has a wide range of applications in various areas such as engineering, physics, differential equations and in number theory . The main focus of these course is on the study of analytic functions and their basic properties. Topics covered are: complex number system, limits, differentiation, analytic functions, Mobius transformations, complex line integral, Cauchy theorem, Cauchy integral formula and Taylor's theorem.

(2) Course Objectives

After completion of this course; successful students are able to:

1. Prove basic results relating to analytic functions.
2. Apply the Cauchy Integral formula to evaluate certain class of complex line integrals.
3. Express analytic functions in power series.
4. Find a harmonic conjugate of a given harmonic function in an appropriate domain.
5. Apply the Cauchy Riemann equations to problems related to differentiability of function of complex variable.
6. Apply the properties of Mobius transformation in mappings and related problems in analytic functions

(3) Course Contents

The complex number system, metric space and the topology of C, analytic function, power series, analytic function as mapping Mobius transformation, complex integration, power series representation of analytic function, zeros of an analytic function, Cauchy's theorem, integral formula, the homotopic version of Cauchy's theorem, simply connectivity, counting zeros, the open mapping theorem and Goursat's theorem..

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
7.	Assignment-1 / Quiz-1/ Presentations-1	5%
8.	Midterm Exam-1	20%
9.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. Jerrold E. Marsden and Michael J. Hoffman ,''Basic Complex Analysis'', third edition, W.H Freeman, New York, 1999.

(7) Reference Books

1- I, John B. Conway ,''Function of one Complex Variable'', Second edition, Springer, New York, 1978.

2- 1 Richard A. Silverman,''Introductory Complex Analysis'', ISBN, New York, Dover Publications, 1967.

3- B. Choudhary, Wiley Eastern ,''Elements of Complex Analysis'' Ltd., New Delhi, 1993.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Numerical Analysis	MATH 604	3	-	3	1	1	MATH 419 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Numerical analysis is the area of mathematics and computer science that creates, analyzes, and implements algorithms for solving numerically the problems of continuous mathematics. Which involves systems, approximation functions, solutions for ordinary and partial differential equations, Numerical differentiation and integration, methods to solve initial and boundary values problems, stability and convergence of the solutions that occur in different areas of sciences.

(2) Course Objectives

Students after studying the course are expected to:

1. Know linear and non-linear systems and different numerical methods.
2. Distinguish between different numerical methods.
3. Formulate appropriate method to approximate numerical solutions.
4. Apply the appropriate method to solve mathematical problems and prove the stability and convergence of these methods.
5. **Explore** some new numerical methods that have different areas of research

(3) Course Contents

Linear and nonlinear systems; Iterative methods ; Interpolation ; Approximation of solutions ; Error estimate ; Data fitting ; Numerical differentiation and integration ; Numerical solutions of boundary value problems ; Stability and convergence of solutions ; Finite difference method ; Finite element method.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
10.	Assignment-1 / Quiz-1/ Presentations-1	5%
11.	Midterm Exam-1	20%
12.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. Richard Burden and J.Dougias Faires,"Numerical Anlysis",Brooks/Cole, Cengage Learning, 2011

(7) Reference Books

1. Alfio Quarteroni ,Riccardo Sacco and Fausto Saleri, 'Numerical Mathematics ' Springer, 2007

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Theory of Differential Equations	MATH 605	3	-	3	1	1	MATH 352 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

The basic theory of differential equations as covered in all applied mathematics. Indeed, modern applied mathematics essentially began when Newton developed the calculus in order to solve the differential equations that followed from his laws of motion. However, this theory is not only of interest to the applied mathematician: indeed, it is an integral part of any rigorous mathematical training, and is developed here in a systematic way.

(2) Course Objectives

After completing this course, the student should be able to

1- Know the most technique of studying differential equations.
2- Solve various systems of differential equations.
3- Prove the existence and uniqueness of solutions.
4- Interpret the qualitative behavior of solutions for system of differential equations.

(3) Course Contents

Systems of differential equations, Existence and Uniqueness proofs, Singular points, Asymptotic behavior of solutions, Existence, Stability and Uniqueness for Initial-Value Problems, Sturm-Liouville Theory, Eigenvalues and Eigen functions, **Lyapunov's Second Method** , Rayleigh- Rietz methods, Perturbation theory.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
13.	Assignment-1 / Quiz-1/ Presentations-1	5%
14.	Midterm Exam-1	20%
15.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. R. Kent Nagle, E. B. Saff, A. D. Snider, Fundamentals of Differential Equations and Boundary Value Problems, Pearson Addison-Wesley 2008.

(7) Reference Books

1. Wolfgang Walter, Ordinary Differential Equations, (Translated by Russel Thompson), Springer 1998.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Mathematical Statistics-I	MATH 606	3	-	3	1	1	MATH 352 & MATH 453 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This is the first graduate course in mathematical statistics and it aims to use the probability techniques to build a statistical theory. It gives a rigorous mathematical foundation for Estimation theory and Testing hypothesis. It provides a firm basis for work on Statistical theory and its applications.

(2) Course Objectives

After completing this course, the student will be

1- Understand the language of probability theory to build Statistical Theory.
2- Know random variables and order variables and its distribution.
3- Learn concepts of Conditioning, Transforms and Convergence .
4- Learn Sampling and methods of Sampling .
5- Able to collect data and analyze problems in a critical manner and make a decision
6- Able to take advanced work on Statistical Theory and applications.

(3) Course Contents

a - Theoretical side

Axioms and foundations of probability. Conditional probability and Bayes' theorem. Independence. Random variables and distribution functions and moments. Characteristic functions, Laplace transforms and moment generating functions. Function of random variables. Random vectors and their distributions. Convergence of sequences of random variables. Laws of large numbers and the central limit theorem. Random samples, Sampling and sampling distributions, Sample moments and their distributions. Order statistics and their distributions.

b - The practical side (if applicable)

Using computer Statistical Software such as Minitab or any other computer tools.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
16.	Assignment-1 / Quiz-1/ Presentations-1	5%
17.	Midterm Exam-1	20%
18.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- R. V. Hogg and Allen T. Craig ,''Introduction to Mathematical Statistics'', Mcmillan, 1978, 1995

2- **R.V. Hogg, J. Mckean and A.T.Craig** ,''Introduction to Mathematical Statistics'',Prentice Hall, 2005

(7) Reference Books

1. D V.K. Rohatgi,''Introduction to Probability Theory and Mathematical Statistics'' **Wiley**, 1976

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Probability Theory-1	MATH 607	3	-	3	1	1	MATH 352 or Equivalent

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This is the first graduate course in probability theory and measure-theoretic probability. It provides a solid background and understanding of the basic results and methods in measure and probability theory before entering into a more advance measure-theoretic probability course. It develops the measure probability basis that is required in modern probability theories. The material in this course is fundamental not only in probabilistic analysis, but also in a various applied areas such as stochastic processes, queuing theory, mathematical finance and reliability.

(2) Course Objectives

After completing this course, the student will be

1- Learning the basic theorems in measure and probability Theory
2- Knowing mathematical transforms and operators in Probability Theory
3- Understanding the convergence theory and limits theory
4- Understanding the concept of conditional probability and martingale theory.
5- Developing theoretical problems-solving skills. Having probabilistic intuitions and insight in thinking about problems
6- Preparing and having a firm basis for advanced work on probability and measure.

(3) Course Contents

a - Theoretical side

Foundations of probability theory. Fundamentals of measure theory. Measure-theoretic approach to definitions of probability space, construction of probability spaces, measure constructions, random variables and distribution functions. Measurable functions and random variables. Independence. Tails events. Zero-one laws and Borel-Cantelli lemmas. Integration and Expectation. Modes of convergence and relations between the various modes. Laws of large numbers and sum of Independent variables. Convergence in distribution. Characteristic functions. The central limit theorem. Weak convergence of probability measures. Conditional expectations and martingales.

b - The practical side (if applicable)

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
19.	Assignment-1 / Quiz-1/ Presentations-1	5%
20.	Midterm Exam-1	20%
21.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- Patrick Billingsely .''Probability and Measure, , 2nd edition'', Wiley1986, 1995.

2- Richard Durrett ,''Probability: Theory and Example', Wadsworth and Brools/cole, ca, 1995

(7) Reference Books

1- Allan Gut ,''Probability: A graduate Course'', Springer, **2007**

2- Sidney Resnick ,''Probability Path'', Birkhauser, 1999.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Abstract Algebra-2	MATH 620	3	-	3	2	1	MATH 601

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course continues the study of algebra begun in the Abstract Algebra1. It places emphasis on the study of abelian groups (the classifications of finite abelian groups) as well as Direct products. Furthermore, we study the sylow theorems and its application and we also study the Jordan–Holder theorem and solvable groups. Moreover, we study the unique factorization in polynomial rings and we provide a brief summary of Galois theory.

(2) Course Objectives

After completing this course, the student will be

1- Understand that the abstract algebra is the main theory of mathematics that study the important algebraic construction such as groups, rings, fields and other.
2- Familiar with the algebraic construction and its conditions.
3- Able to develop the ability to think logically and positively, and the development of his skill in dealing with the abstract proofs.

(3) Course Contents

Number Theory, the study of the integer numbers is one of the oldest branches of mathematics and yet it continues to be a very active area of research today. Number Theory is rich with beautiful theorems and elegant patterns. It's unsolved problems have challenged the greatest mathematical minds and given rise to much of modern mathematics. So, this course is designed as an introduction to number theory, suited scientifically for students interested in developing their mathematical skills, and to enhance and reinforce the student's understanding of concepts through the theory of the integers from a list of axioms.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
22.	Assignment-1 / Quiz-1/ Presentations-1	5%
23.	Midterm Exam-1	20%
24.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. I. N. Herstein, Topics in Algebra, John Wiley and Sons, 2006.
2. J.B. Farleigh, A first course in abstract algebra, Wesley Publishing Co. London, 7th edition, 2003.

(7) Reference Books

1. D. Dummit and R. Foote, Abstract Algebra, John Wiley & Sons, 3rd edition, 2004.
2. Thomas W. Hungerford, Algebra, Springer, 2003.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Number Theory	MATH 621	3	-	3	1	1	MATH 601

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course provides an introduction to abstract algebra, so it is designed to cover the basic concepts of the abstract algebra and entrench the algebraic ideas in the students mind, which lead to use mathematical logic concepts to prove basic theories, which easily lead to study deeply an advanced courses.

(2) Course Objectives

After completing this course, the student will be able to

1- Analyze/interpret the algebraic structure of the integers from a list of axioms.
2- Write clear and precise mathematical proofs for the properties of integers.
3- Apply his theoretical knowledge in number theory to handle some problems in applied mathematics and computer security.
4- Explore some current research problems in number theory.

(3) Course Contents

Divisors, lest common multiples, linear Diophantine equations, primes numbers. Solutions of congruences, the Chinese remainder theorem, fundamental properties of congruences, residue system, reduced residue system and Euler's Φ, polynomial congruences, primitive roots, congruences of degree two, number theory from an algebraic viewpoint. The group of quadratic resides, the Legendre symbol, quadratic reciprocity, quadratic residues for prime power moduli. Arithmetic functions, definition of arithmetic functions and examples, multiplicative arithmetic functions, perfect numbers, the Möbius inversion formula with some application, properties of the Möbius function, the Dirichlet product. Diophantine equations, the use of congruences in solving Diophantine equations, Pythogo-rean triples, infinite descent method and Fermat's conjecture. Some applications to applied mathematics and computer security.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
25.	Assignment-1 / Quiz-1/ Presentations-1	5%
26.	Midterm Exam-1	20%
27.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- Ivan Niven, Herbert S. Zuckerman, and Hugh L. Montgomery. An Introduction to Theory of Numbers . John Wiley 1991

(7) Reference Books

1. Kenth Rosen. Elementary Number Theory and its Applications, Pearson, 2011

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Topics in Algebra	MATH 622	3	-	3	2	1	MATH 601

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours = **160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

The course discusses advanced topics in the field of Algebra. This course provides introduction to advance algebra, so it is designed to cover the advance concepts of algebra and entrench the algebraic ideas in the student mind, which lead to use mathematical logic and reasoning based ideas to prove theorems, which easily lead to know and develop ideas of other higher courses in algebra.
The topics in the course may vary from year to year

(2) Course Objectives

After finishing the course, the student is expected to be familiar with the following:

1. Know the basic and advance concepts of algebra.
2. Deal with abstract concepts as well as use mathematical logic to prove theorems and related results.
3. Understand the algebraic construction and its conditions.
4. Can carry out the research work on topics related to algebra.

(3) Course Contents
To be decided by the instructor as per research requirements

(4) Assessment Criteria		
No	**Assessment Activities**	**Percentage of Total Assessment Score**
1	Assignment-1 / Quiz-1/ Presentations-1	5%
2	Midterm Exam-1	20%
3	Assignment-2 / Quiz-2/ Presentations-2	5%
4	Midterm Exam-2	20%
5	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book
To be decided by the course instructor

(7) Reference Books
To be decided by the course instructor

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Real Analysis-2	MATH 630	3	-	3	1	1	MATH 602

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Measure theory is the study of measures. It generalizes the intuitive notions of length, area, and volume. The earliest and most important examples are Jordan measure and Lebesgue measure, but other examples are Borel measure, probability measure, complex measure, and Haar measure. Measure theory is applied in various disciples of mathematics in probability theory and Ergodic theory. This course focus on the construction of the Lebesgue measure on the real line and deals with measurable functions, integration with to respect to Lebesgue's measure, the monotone convergence theorem, Fatou's Lemma, dominated convergence theorem and differentiation and integration.

(2) Course Objectives

On completion of this course; successful students are able to:

1- Learn the basic theorems and supply their proofs correctly.
2- Understand the concept of measurable sets and measure and how they are used inintegration.
3- Construct rigorous mathematical proofs of basic results in measure theory .
5. Apply monotone convergence theorem in proofs and in evaluating integrals.
6. Calculate the Lebesgue integral of some functions.

(3) Course Contents

Lebesgue Measure: Outer measure, measurable sets, countable additively, continuity, non-measurable sets. Lebesgue Measurable functions: Definition and examples of measurable functions, sum, product and composition, sequential limits and approximations, Egoroff's theorem and Lusin's theorem. Lebesgues integration: The Lebesgue integral of a bounded measurable function, Lebesgue integral of a measurable nonnegative function, the monotone convergence theorem, the general Lebesgue integral, Lebesgue dominated convergence theorem. Differentiation and integration: Monotone functions, functions of bounded variation, absolutely continuous function, differentiating indefinite integrals.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
14.	Assignment-1 / Quiz-1/ Presentations-1	5%
15.	Midterm Exam-1	20%
16.	Assignment-2 / Quiz-2/ Presentations-2	5%
17.	Midterm Exam-2	20%
18.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- H.L.Royden and P.M.Fitzpatrick,'' Real Analysis'', Fourth Edition ; Prentice Hall,2010

(7) Reference Books

1- Gerald .B. Folland ,''Real Analysis –Modern techniques and their Applications'', Second Edition ,John Wiley & Sons, 2013.
2- Walter Rudin ,''Real and complex analysis'', Third Edition ,McGraw-Hill, 1987.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Topology	MATH 631	3	-	3	2	1	MATH 602

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Topology is an abstract study of mathematical concepts in some position ignoring the geometry of that position. Studying topology and the relations between the topological concepts increase the skills of the researcher and give him a deep and fair vision in most topics in pure mathematics

(2) Course Objectives

After completion of this course; successful students are able to:

1- Analyze topological concepts and its properties
2- Join between topological concepts and wave the value of that joint.
3- Understand the value of Topology in Pure Mathematics
4- Benefiting from Topology in some real life problems.
5- Knowing open problems and future researches

(3) Course Contents

Topological spaces, neighborhood structures, continuous functions and topological homeomorphism, higher separation axioms, some types of connectedness, some types of compactness, metric spaces, product topology, quotient topology.

(4) Assessment Criteria		
No	**Assessment Activities**	**Percentage of Total Assessment Score**
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- AkosCsazar,'' General Topology'' Adm. Hilger LTD, Bristol, 1978, 1978

(7) Reference Books

1- M. A. Armstrong, Basic Topology, Springer, 1983

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Functional Analysis	MATH 632	3	-	3	2	1	MATH 602

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Functional Analysis is an advance course of analysis in which theory and concepts from calculus and analysis generalized and study in more details.

(2) Course Objectives

After completing this course the student will be familiar with :

1- The metric space and convergence and divergence of sequences in the metric space.
2- The difference between complete and incomplete metric spaces; and between normed and metric space and Banach space.
3- The topology generated by the norm.
4- The inner product space and Hilbert space.
5- Some open problems.

(3) Course Contents

Metric Space: Metric Space, Continuous functions and Convergence in metric space, Complete Metric Space, Topology generated by Metric. Normed Space: Linear Space, Linear subspace, Normed Spaces, Relationship between Metric and Normed Spaces, Banach Space, Continuity and Convergence in Normed Spaces, Topology Generated by Norm. Inner Product Space: Inner product Space, Hilbert Spaces.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- E.Kreyzing ,''Introduction to Functional Analysis with Applications'', John Wiley and Sons, 1989.

(7) Reference Books

1- 1 E.Kreyzing,''A Course in Functional Analysis'', 2th ed ., Springer, Berlin,(1990).
2- C.Goffman and G.Pedrick ,''First Course in Functional Analysis'', Prentice-Hall, (1974)
3- E.B.V.Limaye ,''Functional Analysis'', 2th ed., New Age International, New Delhi, (1996).
4- A. Taylor and Delay,'' Introduction to Functional Analysis'', Wiley, New York, (1980).

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Topics in Analysis	MATH 633	3	-	3	2	1	MATH 602

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours = **160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course is designed to cover important and advanced topics Analysis that may be desired from time to time for specific students in the graduate program. It may also be used as a vehicle for development of new analysis courses for graduate program students.

(2) Course Objectives

After completing this course, the student will be

1. Know more advanced and further topics in Analysis.
2. Apply theories and methodologies to solve problems that arise in research.
3. Have a firm basis for advanced courses or research work.

(3) Course Contents

a- Theoretical side:

Variable contents can be changed from year to year

b- The practical side (if applicable):

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- To be decided by instructor as required

(7) Reference Books

1- To be decided by instructor as required

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Numerical Method for Ordinary Differential Equation (ODEs)	MATH 640	3	-	3	2	1	MATH 604

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Numerical methods for ordinary differential equations are methods used to find numerical approximations to the solutions of ordinary differential equations (ODEs). Many differential equations cannot be solved analytically, and a numeric approximation to the solution is often sufficient for some applications. The methods studied in this course can be used to compute explicitly approximation for the solution and provide an error analysis to test how far from the exact solution.

(2) Course Objectives

Students after studying the course are expected to:

1 Know the concept of numerical methods to solve ordinary differential equations.
2 Distinguish between the different types of numerical methods to solve ordinary differential equations.
3 Chose the appropriate method to solve ordinary differential equations.
4 Apply the appropriate methods to solve mathematical problems and prove the stability and convergence of the approximated solution.
5 Conclude the advantages of the methods used to solve ordinary differential equations in various fields.

(3) Course Contents

One step methods. Runge-Kutta methods. Multistep and predictor-corrector methods. Numerical analysis including stability. Convergence and error analysis. Boundary-value problems.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- Griffith and Higham,''Numerical Methods for Ordinary Differential Equations'', Springer, 2010.

(7) Reference Books

1- Richard Burden and J. Dougias Faires,"Numerical Analysis, Brooks/Cole Cengage Learning, 2011

2- Alfio Quarteroni ,Riccardo Sacco and Fausto Saleri, 'Numerical Mathematics ' Springer, 2007

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Numerical Method for partial differential equation (PDE)	MATH 641	3	-	3	2	1	MATH 604

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Numerical methods for partial differential equations are methods used to find numerical approximations to the solutions of (PDEs). Many partial differential equations cannot be solved analytically, and a numeric approximation to the solution is often sufficient for some applications. The methods studied in this course can be used to compute explicitly approximation for the solution and provide an error analysis to test how far from the exact solution.

(2) Course Objectives

Students after studying the course are expected to:

1. Know the concept of numerical methods to solve partial differential equations.
2. Distinguish between the different types of numerical methods to solve partial differential equations.
3. Chose the appropriate method to solve partial differential equations.
4. Apply the appropriate methods to solve mathematical problems and prove the stability and convergence of the approximated solution.
5. Conclude the advantages of the methods used to solve partial differential equations in various fields.

(3) Course Contents

Finite difference techniques for elliptic equations. Treatment of boundary conditions. Iterative methods. Successive ever relaxation method. Explicit and implicit method for parabolic equations. **Error analysis, stability analysis and convergence.** The method of characteristics for quasi-linear hyperbolic equations.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- K. W. Morton and D. F. Mayers,''Numerical Solution of Partial Differential Equations'',Cambridge University Press ,2005**.**

(7) Reference Books

1- David G. Luenberger, Yinyu Ye, ''Linear and Nonlinear Programming'', International Series in Operations Research & Management Science ,Springer 2013

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Approximation theory	MATH 642	3	-	3	2	1	MATH 604

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Approximation theory is concerned with how functions can best be approximated with simpler functions, and with quantitatively characterizing the introduced errors. The students, through this course will learn skills to prove convergence and existence for the solutions, and will be used to prove and conclude new results of mathematical theories.

(2) Course Objectives

Students after studying the course are expected to:

1. Know the concept of convergence.
2. Distinguish between theories of convergence.
3. Choose the appropriate mathematical approximation of the problem.
4. Apply appropriate theories to solve mathematical problems and prove the stability and convergence of the solutions.
5. Deduce some theories that can be applied in various numerical methods courses.

(3) Course Contents

Introduction, Chebyshev polynomials and series, Weierstrass Approximation Theorem, Convergence for differentiable functions, Convergence for analytic functions, Best approximation, Best and near-best, Linear approximations, Nonlinear approximations, Spectral methods rational best approximation, Rational interpolation and least-squares.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- Nick Trefethen ,'' Approximation theory and approximation practice'', Siam , 2013

(7) Reference Books

1- Elliott Ward Cheney, Jr,'' A course in approximation theory'',MMS Chelsea 2000
2- Michael J. D. Powell,''Approximation theory and methods''. Press of U. Cambridge, 1996

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Optimization	MATH 643	3	-	3	2	1	MATH 604

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Problems in optimization are the most common applications of mathematics. The main aim of this course is to present different methods of solving optimization problems in the area of nonlinear programming. In addition to theoretical treatments, there will be some introduction to numerical methods for optimization problems.

(2) Course Objectives

Students after studying the course are expected to:

1. Recognize and formulate optimization problems,
2. Choose appropriate solution technologies and strategies,
3. Interpret the solution of an optimization problem,
4. Analyze the effects of problem variation on the optimal solution.

(3) Course Contents

a - Theoretical side:

Unconstrained Optimization Optimality Conditions , Convex Unconstrained , Optimization Optimality Conditions, Newton's Method , Quadratic Forms ,Steepest Descent Method , Constrained Optimization Optimality Conditions , Projection Methods for Equality Constrained Problems , Projection , Methods/Penalty Methods , Barrier Methods, Conditional Gradient Method, Interior-Point Methods for Linear Optimization ,Analysis of Convex Sets and Convex functions, Duality Theory , Sub gradient Optimization ,Semi definite Optimization.

b - The practical side (if applicable)

Using Matlab, or Mathematica software or any other programming software.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. Weny u Sun, Ya-Xiang Yua,'' Optimization Theory and Methods: Nonlinear Programming'', Springer. (2010).

(7) Reference Books

1. David G. Luenberger, Yinyu Ye, ''Linear and Nonlinear Programming'', International Series in Operations Research & Management Science ,Springer 2013

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Integral Differential Equations	MATH 650	3	-	3	2	1	MATH 605

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course emphasizes concepts and techniques for solving integral equations from an applied mathematics perspective. Volterra and Fredholm theory, the Hilbert-Schmidt theorem; Wiener-Hopf Method; Wiener-Hopf Method; the Hilbert Problem and singular integral equations of Cauchy type. The models are taken from fluid and solid mechanics, acoustics, quantum mechanics, and other applications.

(2) Course Objectives

After finishing this course, the students will be able to:

1- Be familiar with integral equations.
2- Choose the appropriate method to use in studying integral equations.
3- Solve the problem involving integral equations.
4- Explore some integral equations that have different areas of research.

(3) Course Contents

Integral equations and Picard's method, Existence and Uniqueness, Homogeneous and non-Homogeneous linear equations, The Fredholm Alternative-Hilbert-Schmidt Theory, Transform methods, Green's Functions and Boundary-value Problems, Elements of Theory of Fredholm Integral Equations, Wiener-Hopf Integral Equations, Voltera Integral equations, Nonlinear Integral Equations.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- Michio Masujima, ''Applied Mathematical Methods in Theoretical Physics- Integral Equations and Calculus of Variations'', Wiley-Vch. Verlag GmbH & Co. KGaA, 2005.

(7) Reference Books

1- *Linear Integral Equations: Theory and Technique''*, Birkhauser , Boston, 1996
2- Stakgold, I.'' *Green's Functions and Boundary-value Problems''*. Wiley, NY, 1998

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Mathematical Modeling	MATH 651	3	-	3	2	1	MATH 605

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course covers many mathematical models one variable, multivariable and computational optimization. It includes application on dynamic system and study of probability models.

(2) Course Objectives

After successful completion of this course , the student will be able to;

1- Learn to formulate and analyze mathematical models.
2- Understand stochastic models.
3- Apply Monte Carlo simulation.
4- Solve optimization problems computationally.
5- To analyze dynamic models.
6- Simulate models using MATLAB or Maple.

(3) Course Contents

a - Theoretical side:

Optimization models (one variable and multivariable), discrete programming, discrete optimization. steady state analysis, dynamic system, discrete time systems, analysis of dynamic models, simulation of dynamic models. discrete and continuous probability models, stochastic models, Monte Carlo simulation, Markov property, particle tracking, fractional diffusion.

b - The practical side (if applicable): Simulation techniques using MATLAB or Maple software.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1. Mark M. Meerschaert,'' Mathematical Modeling'', 2nd edition, 2013. , Elsevier, 2013

(7) Reference Books

1- Frank R. Giordano, William P. Fox, Steven B,'' A First Course in Mathematical Modeling'', 5th Edition, Horton, 2014.
2- Amos Gilat,'' MATLAB: An Introduction with Applications'', 5th Ed., Wiley, 2014.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Differential Geometry	MATH 652	3	-	3	2	1	MATH 605

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

Differential geometry is the study of geometric properties of curves using differential and integral calculus and linear algebra. It has a wide applications in the field of sciences in particular in physics, architecture, engineering, econometrics. The course focuses on the basic theory of curves, surfaces and manifolds. The topic covered include: differential manifolds, tangent vectors, curvature, Riemannian manifolds, and sub-manifolds of Riemannian manifold.

(2) Course Objectives

After completing the course, successful student is able to:

1. State and prove the basic theory in differential geometry.
2. Calculate and interpret the curvature of a curve.
3. Apply the theory of differential geometry to solve some practical problems.

(3) Course Contents

Definition and examples of differentiable manifolds, tangent vectors, vector fields, differential forms and de Rham's theorem, tensors, the exterior derivatives, surfaces in R^3, Gaussian curvature, Affine connections, torsion tensor and curvature tensor of affine connection, Riemannian manifolds, Riemannian connections, Riemannian curvature tensor, sub-manifolds of a Riemannian manifold

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- N. J. Hicks ,''Notes on differential geometry'', Van Nostrand Reinhold Company, 2007

(7) Reference Books

1- U. C. De & A.A. Shaikh,'' Differential geometry of manifolds'', Ltd. Oxford, U.K., 2007.

2- Y. M. P. do Carmo ,''Differential geometry of curves and surfaces'', Prentice-Hall, Inc

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Mathematical Statistics-2	MATH 660	3	-	3	2	1	MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This is the second graduate course in mathematical statistics and it aims to build a more advanced statistical theories and techniques. It provides a firm basis for advanced work on Statistical theory and its applications

(2) Course Objectives

Students after studying the course are expected to:

1- Knowing more advanced concepts of probability theory to build Statistical Theory.
2- Learning tools and techniques in Sampling Theory and Statistical Inference
3- Applying methods of Statistical Inference
4- Knowing Linear Models and application in regression and analysis of variance.
5- Learning concepts of decision theory and Nonparametric theory
6- Providing a firm basis for advanced work on Statistical Theory and applications.

(3) Course Contents

a - Theoretical side:

Theory of point estimation, Properties of estimators, including unbiasedness, efficiency, consistency, sufficiency, minimum variance unbiased estimator, Rao-Blackwell theorem and Rao-Cramer inequality. Methods of moments and maximum likelihood. Bayes' and minimax estimation. Sufficient and Minimal sufficient statistics. Tests of hypothesis, Neymann-Pearson theory of testing of hypotheses. UMP tests, UMPU tests, likelihood Ration tests, Unbiased and invariant tests. Confidence estimation. Confidence intervals (shortest length, unbiased and Bayes'). The general linear hypothesis, regression and Analysis of variance. Decision theory. Nonparametric statistical inference.

b - The practical side (if applicable): Using Computer Package for simulation and modeling

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- John Freund ,''Mathematical Statistics'', Prentice Hall, 1992.
2- Casella and Berger ,''Statistical Inference'', Wadsworth and Brooks/Cole, Ca, 2001.

(7) Reference Books

1- Lehmann ,''Theory of Point Estimation'', Wiley. 1983
2- Lehmann.''Testing of Statistical Hypothesis'', Wiley 1986
3- Peter Bickel and Kjell Doksum ,''Mathematical Statistics'', Holden Day 1977
4- Ferguson ,''Mathematical Statistics'', Academic Press, 1986
5- Sahai and Ageel ,''ANOVA: Fixed, Random and Mixed Models'', Springer 2001

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Regression and Experimental Design	MATH 661	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

(1) Brief Course Description

This course is a global term that includes both the formal design of an experiment and the regression analysis by which the result of the experiment is analyzed. It provides the principles of experimental design and the techniques of analysis of variance in a manner that illustrates the aspects of statistical analysis. Also it covers important topic on screening design.

(2) Course Objectives

After successfully completion of this course, the student will be able to

1- Understanding Least Squares methods and its properties
2- Work on linear regression and testing of intercept and slope.
3- Estimate parameters through regression analysis.
4- Construct regression analysis table to describe relationship between variables.
5- Understand the concept of residual analysis and prediction.
6- Explain the assumptions necessary to perform ANOVA
7- Describe appropriate ways to transform data are not normally distributed
8- Understand the importance of statistical design of experiments and its benefits

(3) Course Contents

a - Theoretical side:

Least Square Methods and Properties, Simple linear regression. Testing of intercept and slope. Simple and Multiple linear regressions with matrix approach. Estimation of parameters and testing of regression coefficients. Prediction and correlation analysis. , Development of Linear models, Residual Analysis and Prediction, Polynomial Regression, Dummy Variable, Model Building and Variable Selection. Analysis of variance techniques, Concepts of Statistical Designs and Linear Model. Completely randomized and randomized block designs. Latin square designs models: Fixed, random and mixed models. Incomplete block design. Factorial design, 2k factorial design and blocking and confounding in 2k factorial design

b - The practical side (if applicable):

Using R programming software, Minitab or any other computer packages for implementation of the methods.

(4) Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

(5) Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

(6) Text Book

1- John O. Rawlings .''Applied Linear Regression: A Research Tool'', Wiley, 1988.
2- Montgomery D. C., John Wiley & Sons ,''Design and Analysis of Experiments'', New York, 2013.

(7) Reference Books

1- Oehlert. G. W ,''A First course in Design and Analysis of Experiments'', University of Minnesota, 2010
2- Cox, D. R. and Ried, N ,''The theory of the design of experiment'', CHAPMAN & HALL / CRC, 2000

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Time Series Analysis	MATH 662	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

2. Brief Course Description

The course is to present important concept of time series analysis such as stationary processes, autocorrelations, moving average, ARMA models, spectral analysis, etc. Also, it provides some detail of the theoretical foundations and practical applications of bivariate time series. This course is a mixture of theory and practical applications of time series methods.

3. Course Objectives

Students after studying the course are expected to:

1- Knowing concepts and theory of time series
2- Understand stationary time series models.
3- Learn Autoregressive and model averaging.
4- Work on fitting of ARMA and related models.
5- Estimate spectral analysis
6- Learning ARIMA models and its fitting
7- Analyze bivariate time series
8- Utilize R programming or Minitab for computation and Analysis

4. Course Contents

a - Theoretical side:

Trends, linear filters, smoothing. Stationary processes, autocorrelations, partial autocorrelations. Autoregressive, moving average, and ARMA process. Fitting of ARMA and related models. Forecasting. Seasonal time series. Spectral density of stationary processes. Period ogramsand estimation of spectral density. Bivariate time series, cross-correlations, cross-spectrum. Other topics as time permits. Extensive use of Computer Statistical Software

b - The practical side (if applicable):

Using R programming software or Minitab or any other Computer Software.

5. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

6. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

7. Text Book

1- Chatfield C, “The Analysis of times series”, 4th edition, Dover, 1993.
2- Jonathan D. Cryer “Time Series Analysis”, Duxbury , 1986, 2008
3- G.E.P, Jenkins, G.M, “Time Series Analysis, Forecasting and Control”, Box, Holden Day, 1976

8. Reference Books

1- Fuller W,’’ Introduction to Statistical Time series’’, Wiley 1990,
2- R. Shumway and D. Stoffer,’’Times series analysis and its applications with R Examples’’, 2006.
3- Kandal & Ord, J.K.’’Time Series’, Kandal & Ord, J.K., 3rd edition, Wiley , 1990.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Topics in Mathematical Statistics	MATH 663	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

This course is designed to cover important topics in Mathematical Statistics that may be desired from time to time for specific needs. It may also be used as a vehicle for development of new Mathematical Statistics course for graduate program students

2. Course Objectives

Students after studying the course are expected to:

1- Know more advanced and further topics in mathematical Statistics and Statistical Inference.
2- Apply theories and methodologies to solve problems that arise in other disciplines.
3- Have a firm basis for advanced courses or research work.

3. Course Contents

Theoretical side :
Variable contents and Topics change from year to year.

The practical side (if applicable)
Using computer Statistical Software and programming as possible.

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

6. Text Book

1. Instructor will decide at the time of course offer

2. Reference Books

1. Instructor will decide at the time of course offer

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Probability Theory-II	MATH 670	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

This is the basic graduate course in measure-theoretic probability theory. This course covers topics in measure-theoretic probability and modern stochastic calculus. The material in this course is fundamental not only in abstract probabilistic analysis, but also in various applied areas such as communication theory, queuing theory, mathematical finance and mathematical physics

2. Course Objectives

Students after studying the course are expected to:

1- Learning the language and core concepts of Measure and Probability.
2- Learning fundamental theorems of measure-theoretic Probability
3- Learning applications and methods of measure and probability
4- Giving students some probabilistic intuitions and insight in thinking about problems
5- Providing a firm basis for advanced work on measure –theoretic probability and Stochastic Calculus

3. Course Contents

Lp Convergence, Uniform integrability. Skorokhod representation theorem. Convergence of series. The Kolmogorov three series theorem. Strong law large number. Central limit theorems for independent and non-identically distributed random variables. Speed of convergence. Large deviations. Laws of the iterated logarithm. Stable and infinitely divisible distributions. Martingales and applications. Random walk, counting and Poisson Processes, Brownian motion.

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

6. Text Book

1- Patrick Billingsely,'' Probability and Measure'', 2nd edition, Wiley1986, 1995.
2- Richard Durrett,''Probability: Theory and Example'',
3- Sidney Resnick ,''Probability Path'', Birkhauser, 1999

7. Reference Books

1- Sheldon Ross Second Course in Probability Theory,
2- Allan Gut ,''A Graduate'' Course in Probability, Springer.
3- Kai, Lai, Chung ,''A course in Probability'', 2nd Edition, Academic Press.
4- Howard Tucker ,''A graduate course in Probability'', Academic Press.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Reliability Theory and Life Testing	MATH 671	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

This course focuses on the reliability systems and related distribution. It consists of failure rate functions and nonparametric classes, accelerated life testing, dependent failure analysis, statistical inference of reliability data.

2. Course Objectives

After successfully completion of this course, the student will be able to

1- Understand structural properties of Coherent systems
2- Apply the concepts of reliability of coherent systems\itmc reliability functions of systems.
3- Familiar with the probability distributions in system reliability theory.
4- Identify classes of life distributions based on notions of aging and bounds of reliability functions.
5- Analyze bivariate and multivariate life distributions.

3. Course Contents

a - Theoretical side:

Hazard Structural Properties of Coherent Systems - Structural functions, union/intersection and intersection/union methods, Reliability of Coherent Systems \itmc Reliability functions of systems with either independent or dependent components, Families of Probability Distributions in System Reliability Theory, Classes of Life Distributions Based on Notions of Aging - IFR, IFRA, DFR, and DFRA families of distributions, partial orderings of life distributions and probability inequalities, Multivariate Distributions for Systems with Dependent Components.

b - The practical side (if applicable):

Using R programming software or any statistical software.

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

6. Text Book

1- R. Barlow and F. Procshan Statistical Theory of Reliability and Life Testing.
2- Richard Barlow and F.Procshan ,''Mathematical Theory of Reliability'', Saim, 1996.

7. Reference Books

1- Mavin Rausand and Arnljot Hoyland ,''System Reliability Theory; Models, Statistical Methods and Applications''، 2nd Edition , John Wiley & Sons Inc Publications, 2004
2- Gnedenko, Igor Pavlov, Igor Ushakov ,''Statistical Reliability Engineering, John Wiley & Sons, Inc., New York, 1999
3- , Mohammad Modarres, Mark Kaminskiy and VasiliyKrivtsov ,''Reliability Engineering & Risk Analysis, A practical guide'', CRC Press, Taylor and Francis Group, 2009.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Stochastic Processes	MATH 672	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

This is the first graduate course in Stochastic Processes. It is a non-measure theoretic introduction to stochastic processes and as such assumes knowledge of calculus and probability. It gives the basic of stochastic processes to indicate its diverse range of applications and to give students some probabilistic intuitions and insight in thinking about problems. The materials of this course are also essential for other applied areas and various field. This course is also designed for those graduate students who are going to need to use stochastic processes in their research but do not have the measure-theoretic backgrounds.

2. Course Objectives

Students after studying the course are expected to:

1- Understanding the theory and basic concepts of Stochastic Processes
2- Leaning different forms of stochastic processes and its diverse range of applications.
3- Having some probabilistic intuitions and insight in thinking about problems.
4- Developing probabilistic problems-solving skills
5- Providing a firm basis for advanced work on stochastic processes

3. Course Contents

a - Theoretical side:

Simple random walk as approximation of Brownian motion. Discrete time Markov chains. Continuous time Markov chains; Poisson, compound Poisson, and birth-and-death chains; Kolmogorov's backward and forward equations; steady state. Diffusions as limits of birth-and-death processes. Examples drawn from diverse fields of application.

b - The practical side (if applicable):

Using computer Software and programming, as its possible.

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

6. Text Book

1- Sheldon Ross ,''Stochastic Processes'', Wiley, 1996

7. Reference Books

1- S. Karlin and H. Taylor ,''A First Course in Stochastic Procesees'', Academic Press, 1975
2- Sidney Resnick ,''Adventures of stochastic Process'', Birkhauser, 1992
3- Cinlar, E ,''Introduction to Stochastic Procesees'', , Prentice Hall, 1975

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Topics in Probability Theory	MATH 673	3	-	3	2	1	MATH 606 & MATH 607

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

This course is designed to cover important topics in Probability Theory that may be desired from time to time for specific students in the graduate program. It may also be used as a vehicle for development of new Probability course for graduate program students

2. Course Objectives

Students after studying the course are expected to:

1- Understanding the theory and basic concepts of probability theory
2- Leaning different forms of probability theory and its diverse range of applications.
3- Having some probabilistic intuitions and insight in thinking about problems.
4- Developing probabilistic problems-solving skills
5- Providing a firm basis for advanced work on probability theory

3. Course Contents

It will be added at the time of offer of this course.

a - Theoretical side

Variable contents and can be changed from year to year.

b - The practical side (if applicable):

Using computer Statistical Software and programming as possible.

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

6. Text Book

It will be added at the time of offer of this course.

7. Reference Books

It will be added at the time of offer of this course.

Course Name	Course Code	Contact Hours			Year	Level	Prerequisite
		Lectures	Sec/Lab	Credit Hours			
Selected Topics in Analysis	MATH 696	3	-	3	2	1	MATH 323

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

It will be added at the time of offer of this course.

2. Course Objectives

Students after studying the course are expected to:

1- Understanding the theory and basic concepts of advanced analysis
2- Leaning different forms of advanced analysis and its diverse range of applications.
3- Having some probabilistic intuitions and insight in thinking about problems.
4- Developing problems-solving skills
5- Providing a firm basis for advanced work on advanced analysis theory

3. Course Contents

It will be added at the time of offer of this course.

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Assignment-1 / Quiz-1/ Presentations-1	5%
2.	Midterm Exam-1	20%
3.	Assignment-2 / Quiz-2/ Presentations-2	5%
4.	Midterm Exam-2	20%
5.	Final Exam	50%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Home work
- Mini-model education
- Assignments to prepare scientific projects

6. Text Book

It will be added at the time of offer of this course.

7. Reference Books

It will be added at the time of offer of this course.

Course Name	Course Code	No of Study Hours			Year	Level	Prerequisite
		Theory	Lab/Tut	Credit Hours			
Thesis	MATH 699	3	6	6	2	2	90 Hours

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Orientation and discussion	30		Preparation for project work	40
Lab or theoretical work	30		Working on data and analysis or theoretical work	50
Presentation	15		Tasks accomplishments and report writing	40
Assignments	7		Preparation for presentation	20
Total	**82~69**		Total	**150**
Total Learning Hours **= 219**			Equivalent **ECTS points** = Total LH/28 = **8**	

Student's workload				
In-class activities	**Contact Hours**		**Self-learning/study**	**Hours**
Lectures	45		HW/Assignments	20
Laboratory			Study for exam	70
Exams and quizzes	5		Working for lab	
Presentation	4		Preparation for classes	24
Total	**54 ~46**		Total	**114**
Total Learning Hours **= 160**			Equivalent **ECTS points** = Total LH/28 = **5.7**	

1. Brief Course Description

The master program is designed to expand and consolidate existing mathematics knowledge and to develop skills in undertaking research projects in mathematics. The thesis is undertaken under the direction of a supervisor and will typically involve examining and writing in a specific area of mathematics with the requirement of obtaining original results.

2. Course Objectives

The thesis work gives students the opportunity to develop broader skills in the process of organizing, communicating and presenting their work and will prepare students well for further research.

3. Course Contents

1. Revision of coursework and develop computing skills (MATLAB) and Latex typing etc. to get ready for thesis work.
2. Explore existing literature to develop student's interest towards the research area in particular mathematical stream i.e. pure or applied or statistics.
3. Choose the area and topic for your thesis.
4. Perform literature survey to explore and get latest/advanced research in the specific chosen area.
5. Develop mathematical model or design experimental set up for your research problem practical/ lab work whichever applicable.
6. Thesis Preparation: The following items are to be included in the bound copy of a thesis/dissertation write-up in the exact order as given below:
   (a) Title Page
   (b) Approval Page
   (c) Dedication
   (d) Acknowledgement
   (e) Table of Contents
   (f) List of Tables
   (g) List of Figures
   (h) Abstract
   (i) Main Body
   (j) Appendix
   (k) Nomenclature
   (l) References

4. Assessment Criteria

No	Assessment Activities	Percentage of Total Assessment Score
1.	Obtain the required scientific material	5 %
2.	Result Analysis	5 %
3.	Respond to the guidance of supervisors	5 %
4.	Writing the thesis	5 %
5.	Candidate's commitment to attend and perform research	5%
6.	Presentation/Open Seminar/Viva Voce	10%
7.	Proposal for Defense	65%

5. Course Teaching Strategies

- Academic lectures
- Scientific discussions
- Presentations
- Home work
- Mini-model education
- Assignments to prepare scientific projects
- Assignments to prepare thesis

6. Text Book

It will be decided by concerned thesis supervisors

7. Reference Books

It will be decided by concerned thesis supervisors

Appendices

Appendix	
Math2.2	Mathematics Department Manual
Math2.6	Annual Program Report
Math4.7	Computer Lab and Classroom Committee Report, 2019-2020.
Math4.8	College of Science Library Rules.
Math4.9	List of Available Books on Mathematics, College of Science.
Math4.10	List of Available Books on Mathematics, Central Library.
Math4.11	Central Library Handbook.
JU2.3	The Student Guide