المملكة العربية السعودية
وزارة التعليم
جامعة أم القري

جامعة أم القري
الكلية الجامعية بالقنفذة
قسم الرياضيات

الخطة الدراسية

الكلية الجامعية بالقنفذة   القسم: الرياضيات

التخصص: 2904 الرياضيات   التوصية: 39   ساعات الخطة الدراسية:137   فصل البدء: الاول 1439-1440

المستوى الاول

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر للمتطلب
28041101-4	تفاضل وتكامل		
28141401-4	اللغة الانجليزية (1)		
2807101-2	الثقافة الاسلامية (1)		
2801101-2	القران الكريم (1)		
28151101-4	الكيمياء العامة (1)		

المستوى الثاني

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28131101-4	الفيزياء العامة		
2802501-2	اللغة العربية		
28141402-4	اللغة الانجليزية (2)	28141401-4	اللغة الانجليزية (1)
2807102-2	السيرة النبوية		
28161101-4	الاحياء العامة		

المستوى الثالث

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28042501-4	تفاضل وتكامل (2)	28041101-4	تفاضل وتكامل
28042401-4	المجموعات والبنى الجبرية		
2807201-2	الثقافة الاسلامية (2)	2807101-2	الثقافة الاسلامية (1)
28042301-3	مبادئ الاحصاء والاحتمالات	28041101-4	تفاضل وتكامل
28042402-4	الجبر الخطي (1)		

المستوى الرابع

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28042502-4	المعادلات التفاضلية العادية	28042501-4	تفاضل وتكامل (2)
28042101-3	المدخل الى التحليل الحقيقي	28042501-4	تفاضل وتكامل (2)
2801201-2	القران الكريم (2)	2801101-2	القران الكريم (1)
28042503-4	تفاضل وتكامل عديد المتغيرات	28042501-4	تفاضل وتكامل (2)
28044201-3	البرمجة الخطية	28042402-4	الجبر الخطي (1)

المستوى الخامس

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28043102-3	التحليل الحقيقي (1)	28042101-3	المدخل الى التحليل الحقيقي
28043403-3	نظرية الزمر	28042401-4	المجموعات والبنى الجبرية
2807301-2	الثقافة الاسلامية (3)	2807201-2	الثقافة الاسلامية (2)
28043302-3	نظرية الاحتمالات	28042301-3	مبادئ الاحصاء والاحتمالات
28043701-4	ميكانيكا التلاحم	28042502-4	المعادلات التفاضلية العادية
2801301-2	القران الكريم (3)	2801201-2	القران الكريم (2)

المستوى السادس

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28043702-3	التحليل العددي	28042502-4	المعادلات التفاضلية العادية
28043103-3	التحليل الحقيقي (2)	28043102-3	التحليل الحقيقي (1)
28043405-3	الرياضيات المتقطعة	28042402-4	الجبر الخطي (1)
		288043403-3	نظرية الزمر
28043404-3	الجبر الخطي (2)	28042402-4	الجبر الخطي (1)
2807401-2	الثقافة الاسلامية (4)	2807301-2	الثقافة الاسلامية (3)
28043504-4	المعادلات التفاضلية الجزئية	28042502-4	المعادلات التفاضلية العادية
		28042503-4	تفاضل وتكامل عديد المتغيرات

المستوى السابع

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28044303-3	الاحصاء الرياضي	28043302-3	نظرية الاحتمالات
2801401-2	القران الكريم (4)	2801301-2	القران الكريم (3)
28042601-3	الهندسة التفاضلية	28042401-4	المجموعات والبنى الجبرية
28044602-3	التوبولوجي العام	28043102-3	التحليل الحقيقي (1)
28044703-4	ميكانيكا الموائع	28043701-4	ميكانيكا التلاحم
2804406-3	نظرية الاعداد	28042401-4	المجموعات والبنى الجبرية

المستوى الثامن

رقم المقرر	اسم المقرر	المتطلب	اسم المقرر المتطلب
28044105-3	القياس والتكامل	28043103-3	التحليل الحقيقي (2)
28044901-2	مشروع بحثي		
28044304-3	الرياضيات المالية	28044303-3	الاحصاء الرياضي
28044202-3	حزم البرمجيات الرياضية	28043702-3	التحليل العددي
		28044303-3	الاحصاء الرياضي
28044104-4	التحليل المركب	28043102-3	التحليل الحقيقي (1)
28044407-3	نظرية الحلقات والحقول	28043403-3	نظرية الزمر

First Level

Course title and code: **Calculus(I)** (**28041101-4**)	
Pre-requisites for this course (if any) None	

Objectives

- use the concepts of introductory calculus
-have concise and authoritative definitions of mathematical terms
-solve linear equations and inequalities
-solve quadratic equations and inequalities
-evaluate the limit of functions.
-find derivatives of functions using theorems and rules.
-extend the concept of limits to infinity.
-differentiate implicit and explicit functions.
-study a function: where it goes, how it evolves, studying its monotonicity and critical points, concavity and inflexion points

List of Topics	Weeks	Contact Hours
Real numbers, Exponents and Radicals, Polynomials: Basic Operations and Factoring . Solving Equations, Rational Expressions: Basic Operations, Inequalities, Absolute Values.	3	12
Definition of Functions (Domain and Range), Graphs of Functions, Operations on Functions, Trigonometric Functions and Identities	2	8
Introduction to Limits, Theorems on limits, Limit from Right and from Left, Definition of Continuity	2	8
Definition of Derivative (Using Limits), Rules and Theorems for Finding Derivatives, Derivative of Trigonometric Functions, Chain Rule, Higher Order Derivatives, Implicit Differentiation	3	12
Maxima and Minimum, Monotonicity, Local Maxima and Minimam, Concavity, Sketching the Graphs	2	8
Integration of Functions, Definite Integrals	2	8

Third Level

Course title and code: **Calculus (II)** **(28042501-4**)
Pre-requisites for this course (if any) Calculus**(I)**

Objectives:

By the end of the course the students will learn the following main concepts:

-Some properties and Aids in evaluating definite integrals and applications of the integrals..

- Transcendental functions and its differentiation.

- Inverse of a functions and its differentiation.

- Techniques of integration.

-Indeterminate forms and improper integrals

List of Topics	Weeks	Contact Hours
The first fundamental theorem of calculus, the second theorem of calculus, the mean value theorem for integrals and the use of symmetry, the area of a plane region, volume of solids, length of a plane curve.	3	12
The natural logarithm function, inverse functions and their derivatives, the natural exponential function and logarithm functions, The inverse trigonometric functions and their derivatives, the hyperbolic functions and their inverses.	5	20
Basic integration rules, integration by part, some trigonometric integrals, rationalizing substitution, integration of rational functions using partial fractions.	4	16
Indeterminate forms of type 0/0, other indeterminate forms, improper integrals: infinite limits of integration, improper integral: infinite integral.	3	12

Course title and code: **Sets and Algebraic Structures** **28042401-4**
Pre-requisites for this course (if any) **None**

Objectives

The main purposes of this course are learning basic facts of sets theory, mathematical logics binary operations, elementary algebraic structures such as groups, rings and fields. Namely the topics are:

1-Sets, Operations on Sets, Cartesian product of sets

2-Mathematical Logic and Methods of Proof, integers, primes and division algorithm.

3-Relations and Mappings, Binary Operations and closure, commutative

and associative properties, identity and inverse elements 4-

Introduction of groups: examples

5-Cyclic Groups, permutations and the symmetric groups: examples 6-

Rings: Definition and examples

7-Fields: Definition and examples

List of Topics	Weeks	Contact Hours
Sets, Operations on Sets, Cartesian product of sets	1-2	8
Mathematical Logic and Methods of Proof, integers, primes and division algorithm.	3-4	8
Relations and Mappings, Binary Operations and closure, commutative and associative properties, identity and inverse elements	5-7	12
Introduction of groups: examples	8-9	8
Cyclic Groups, permutations and the symmetric groups: examples	10-11	8
Rings: Definition and examples	12-13	8
Fields: Definition and examples	14-15	8

Course title and code: **Introduction to Statistics and Probability (28042301-3)**
Pre-requisites for this course (if any) Calculus**(I)**

Objectives

Acquiring the basic knowledge and concepts of describing data statistically and elementary theory of probability

List of Topics	Weeks	Contact Hours
Definition and general view of statistics	1	3
Organization and presentation of statistical data	1	3
Measures of central tendency (Mean, Median, Mode) of the simple data and the frequency distribution	2	6
Measures of dispersion (The Range – The Variance and the standard deviation - Coefficient of variation) of the simple data and the frequency distribution	2	6
Correlation measures	1	3
Simple Linear regression	1	3
Sample space and Events Counting Techniques (Fundamental basics, Addition Rule – Multi-plication Rule-Permutation and Combinations)	2	6
Definition of the probability and its applications	1	3
Conditional probability- Independence of events and Bayes theorem and its applications	1	3

Course title and code: **Linear Algebra (1) (28042402-4)**
Pre-requisites for this course (if any) None

Objectives

The main purposes of this course are:

1-Linear equations in linear algebra: systems of linear equations, consistent and inconsistent systems of linear equations, examples

2-Elementary row operations, row reduction and echelon forms: examples

3-Matrix Algebra: Matrix operations, Properties of matrix multiplication,

the inverse of a matrix (invertible matrix theorem), elementary matrices, column space and null space of a matrix: examples

4-Determinants: Recursive definition of a determent, properties of determinants. Applications: Cramer's rule and volume.

5-Vector spaces: Definition, examples, substructures, and linear transformations of vector spaces examples

6-Linearly independence and basis of a vector space: examples

7-Eigen values and Eigenvectors of matrices, Orthogonality and least Squares.

List of Topics	Weeks	Contact Hours
Linear equations in linear algebra: systems of linear equations, consistent and inconsistent systems of linear equations, examples	1-2	8
Elementary row operations, row reduction and echelon forms: examples	3-4	8
Matrix Algebra: Matrix operations, Properties of matrix multiplication, the inverse of a matrix (invertible matrix theorem), elementary matrices, column space and null space of a matrix: examples	5-7	12
Determinants: Recursive definition of a determent, properties of determinants. Applications: Cramer's rule and volume.	8-9	8
Vector spaces: Definition, examples, substructures, and linear transformations of vector spaces examples	10-11	8
Linearly independence and basis of a vector space: examples	12-13	8
Eigen values and Eigenvectors of matrices , Orthogonality and least Squares	14-15	8

Fourth Level

Course title and code: **Introduction to Real Analysis** (**28042101-3)**
Pre-requisites for this course (if any) Calculus **(2)**

Objectives

This course is intended to familiarize the students with the basic concepts, principles and methods of real analysis and its applications. It will cover algebraic and order properties of the real numbers, the least upper bound axiom, Archimedean property and its applications. Sequences and series of numbers will then be discussed, and theorems presented to analyze their convergence properties.

-Derive and apply the basic properties of real numbers.

-Understand and prove the density theorem and the Archimedean property.

-Understand the properties of sequences and the fundamental theorems.

-Be familiar with of serial numbers and apply the tests of convergence to determine whether a sequence or series converges or diverges.

List of Topics	Weeks	Contact Hours
Real numbers: 1. The Algebraic properties of R. 2. Applications. 3. The Order properties of R. 4. The absolute Value 5. Proof by Induction.	3	9
1. The completeness property of R. 2. The Archimedean principle in R	2	6
Real Sequences: 1. Limit of a sequence. 2. Applications. 3. Convergent sequence.	2	6
1. Monotone and Bounded sequences. 2. Applications. 3. Subsequences and Cauchy Sequences. 4. Bolzano-Weierstrass Theorem	3	9
Numerical Series: 1. Definition, convergent numerical series. 2. Prove Cauchy’s convergence criteria. 3. Determine nature of convergence of numerical series using the comparison test, integral test, ratio test and Raabe’s test…	3	9

Course title and code: **Multivariable Calculus**	
Pre-requisites for this course (if any) **Calculus (2)**	

Course title and code: Multivariable Calculus (**28042101-3)**
Pre-requisites for this course (if any) Calculus **(2)**

Objectives

The role of the course is to introduce concepts and quantitative techniques for differentiation and integration of functions of several variables**.**

28042503-4

List of Topics	Weeks	Contact Hours
The Derivative in n-space - Functions of several variables- Partial Derivatives- Limits and continuity - Differentiability- Directional Derivatives- The Chain rule- Tangent planes. - Approximations- Maxima and minima- Lagrange's method	6	24
The integral in n-space - Double integrals over rectangles - Double integrals over nonrectangular regions - Double integrals in polar coordinates - Applications - Surface area - Triple integrals in Cartesian, cylindrical and spherical coordinates	5	20
Vector calculus - Vector fields - Line integrals - Independence of path - Green's theorem - Surface integrals - Gauss's divergence theorem - Stokes's theorem	4	16

Course title and code: **Ordinary Differential Equations**
Pre-requisites for this course (if any) **Calculus (2)**

Course title and code: Ordinary Differential Equations (**28042502-4)**
Pre-requisites for this course (if any) Calculus **(2)**

Objectives

The main purpose of the course is to introduce quantitative and qualitative techniques for the study of Ordinary Differential Equations (ODEs) interspersed with applications of ODEs drawn from various areas of Applied Mathematics.

List of Topics	Weeks	Contact Hours
First order differential equations Techniques: Separable equations. **-** Homogeneous equations. **-** Linear equations. **-**Bernoulli and Ricatti equations. **Applications:** Radioactive decay of a single species. Notion of half-life. - Beer's Law for the absorption of light/energy. - Newton's Law of Cooling. - Conduction of heat in planar, cylindrical and spherical geometries. - Notion of concentration. Mathematics of continuous mixing and dilution. - Atmospheric models for a compressible fluid in a gravitational field. - Notion of escape velocity. - Mathusian and Logistic models of single species population growth. - Harvesting models **-** the notion of bifurcation. **Qualitative Methods:** Notion of Phase Space in one dimension. - Notion of orbit in one dimension. - Notion of equilibrium point or fixed point. - Notion of Phase Portrait and its application to the behaviour of simple autonomous ODEs, *e.g.* models of populations. - Notion of stability and asymptotic stability of simple autonomous ODEs. - Linearisation about fixed points	6	24
Second order linear differential equations Techniques: Linear independence and the Wronskian. - Homogeneous equations with constant coefficients. - Inhomogeneous with constant coefficients and the particular integral. - Reduction of order. - Removal of the first derivative. - Variation of parameters. **Applications: -** Kinematics - velocity, acceleration in one dimension. - Newton's Laws - motion in one dimension with constant acceleration. - Resisted motion - concept of terminal velocity. - Simple Harmonic Motion. **-** Under-damped, critically damped and over-damped systems. Notion of resonance. - Voltage, current and charge. Definition of capacitance, inductance and resistance. Differential equations describing simple electrical circuits.	6	24
Systems of differential equations Techniques: - Reduction to a system of linear equations. - Solution of higher order equations with constant coefficients. **Applications:** Projectile motion under a constant gravitational field.	3	12

Course title and code: **Introduction to Differential Geometry**
Pre-requisites for this course (if any) **Set and Algebraic Structure**

Objectives

Summary of the main learning outcomes for students enrolled in the course.

The student has the knowledge of

1. Theory of curves in R3-Regular curves
2. arc length and reparametrization –Natural parametrization
3. Serret-Frenet apparatus
4. Existence and uniqueness theorem for space curves
5. Local theory of surfaces-Simple surfaces
6. First and second fundamental forms

List of Topics	Weeks	Contact hours
Skew and plane curves- arc length – tangent Osculating plane- normal plane	2	6
- curvature - Principal normal – circle of curvature- binormal- torsion- rectifying plane	3	9
Serret Frenet formulas - cylindrical helix – involutes and evolutes – Pertrand curves	2	6
Parametric equations of a surface- tangent plane to a surface- linear element of a surface	3	9
First and second fundamental quadratic forms of a surface	2	6
Normal curvature of a surface- lines of curvature of a surface- geodesics	2	6

Fifth Level

Course title and code: **The theory of probability** **28042301-3**
Pre-requisites for this course (if any) Introduction **to Statistics and Probability**

Objectives

Acquiring the basic knowledge and concepts of theory of probability concerning random variables, its characteristics and different types of its probability distributions.

List of Topics	Weeks	Contact Hours
The Random Variable	2	6
Probability distribution of random variable	2	6
Cumulative distribution function	2	6
Mathematical expectation	2	6
Moments	2	6
Moments generating	2	6
Feature of probability distribution	2	6
Some popular probability distribution	3	9
Popular continuous probability distribution	3	9

Course title and code: **Real Analysis 1** **28043102-3**	
Pre-requisites for this course (if any) Introduction **to Real Analysis**	

Objectives

- Be able to deal with different metric spaces and with some types of points such as interior, isolated, boundary and accumulation points.
- Be Familiar with the concepts of open and closed sets.
- Understand the concepts of connectedness and compactness.
- Deal with bounded sets and bounded functions.
- Study the continuity of some functions.
- Be familiar with the Baire category theorem and its applications.

List of Topics	Weeks	Contact Hours
Mathematical logic and set theory. Real analysis of the real line	3	9
Definition of metric spaces, basic properties and examples	4	12
Topology of a metric space and related notions	4	12
Complete metric spaces and Baire category theorem	3	9

Course title and code: **Introduction to Group Theory** **28043403-3**
Pre-requisites for this course (if any) **Set and Algebraic structures.**

Objectives

The main purpose of this course are learning basic facts of group theory, permutation groups, alternating groups, groups of symmetries, homomorphisms between groups, substructure of group theory, group action on sets, orbits, stabilizers, conjugacy classes, class equations, isomorphism theorems, Sylow theorems of finite groups. Namely the topics are:

1-Definition of a group, subgroups, Cyclic groups, generating sets and Caley Diagrams 2-

Permutations, groups of symmetries (triangle, rectangle, square),

3-Co-sets, and Direct Products of groups.

4-Homomorphisms between groups, normal subgroups and factor groups, automorphisms of groups

5-Group Action on a set (Orbit Stabilizer Theorem), fixed points, p-groups, examples

6-conjugacy classes, class equations 7-

Sylow theorems of finite groups

List of Topics	Weeks	Contact Hours
Introduction and examples: Definition of a group, subgroups, examples	1-2	6
Cyclic groups, generating sets and Caley Diagrams	3-4	6
Permutations, groups of symmetries (triangle, rectangle, square), Co-sets, and Direct Products of groups.	5-6	6
Homomorphisms between groups normal subgroups and factor groups, automorphisms of groups	7-8	6
Group Action on a set (Orbit Stabilizer Theorem), fixed points, p-groups, examples	9-11	9
conjugacy classes, class equations	12-13	6
Sylow theorems of finite groups	14-15	6

Course title and code: **Continuum Mechanics** **28043701-4**	
Pre-requisites for this course (if any) **Ord. Differential Equations**	

Objectives

Introduce concepts and quantitative techniques for the study of Continuum Mechanics.

List of Topics	Weeks	Contact Hours
Introduction to Cartesian Tensors: Introduction to summation convention. Definitions of scalar product, cross product and matrix product in terms of the summation convention. - Definition of the Kronecker delta and the alternating tensor. Specialist properties of the alternating tensor in three dimensions. - Definition of a determinant and definition of the cofactors of a square matrix. Establish connection between a matrix and its adjugate matrix. - Define vector operations of gradient, divergence and curl using summation convention. - Use of the summation convention to establish a selection of vector identities and identities from vector Calculus. - Introduce symmetric tensors, skew-symmetric tensors, isotropic tensors of orders 2, 3 and 4. Eigenvalues and eigenvectors of rank 2 tensors.	3	12
Kinematics and deformation: - Introduce the concept of a body, reference coordinates (Lagrangian coordinates) and material coordinated (Eulerian coordinates). Define what is meant by a deformation. - Define a rigid body motion and demonstrate why it is a rigid body motion. - Introduce the notion of a material or convected derivative. Define material velocity and material acceleration. - Define the deformation gradient tensor. Define the velocity gradient tensor and deduce the deformation rules for elemental areas and volumes. - Establish the Transport Theorem. - Establish rules for the material differentiation of line and surface integrals. - Derive representation theorems for positive definite tensors. Introduce the polar decomposition theorem. - Describe common deformations such as simple elongation, pure dilatation, pure shear,simple shear.	2.5	10
Conservation laws: - Derive the Law of Conservation of Mass. - Derive the Law of Conservation of Linear and Angular Momentum. - Use the tetrahedron argument to deduce the connection between the stress vector and the stress tensor. - Derive the Law of Conservation of Energy- Introduce the Clausius Duhen Entropy Inequality and the Helmhottz Free Energy function. Deduce expressions for pressure, the stress tensor and specific entropy in terms of the Helmholtz Free Energy.	2.5	10
Constitutive laws: - Introduce the concept of a constitutive or phenomenological equation. - Introduce the constitutive function for a classical Thermo-Elastic Material. Introduce the concept of Superimposed Rigid Body Motions and the concept of Objectivity. Apply this idea to refine the constitutive form of the equations of Thermo-Elasticity. - Introduce the constitutive function for a classical fluid and in this case refine the constitutive form of the equations for a fluid. - Introduce the concept of an isotropic solid and an isotropic fluid. - Introduce the principle stretches - 1, - 2 and - 3. Express the stress tensor in terms of the principle stretches. - Introduce the Perfect Fluid and investigate its thermodynamic properties, for example, specific heats at constant volume and constant pressure, adiabatic expansions etc. - Discuss the generic form for the linear stress tensor for a viscous fluid. Introduce the Riener-Rivlin fluid.	2.5	10

Exact solutions in Nonlinear Elasticity: - Exact solution of the pure shear of a cube in nonlinear Elasticity. Particularisation to an incompressible elastic solid. - Exact solution of the pure inflation of a tube in nonlinear Elasticity. Particularisation to an incompressible elastic solid.	1.5	6
Linear elasticity: - Develop the general equations for the infinitesimal deformations from the reference configuration. - Particularise the problem to an isotropic elastic solid. - Use the entropy inequality to deduce constraints of the material properties of the linearized isotropic stress tensor. Introduce Poisson's ratio. - Investigate various classes of pure homogeneous deformation for the linear theory of elasticity, for example, normal stress, uniaxial tension, pure shear etc.. - Discuss wave propagation in a linearly elastic half space. Discuss S-waves and P-waves.	3	12

Sixth Level

Course title and code: **Partial Differential Equations** **28043504-4**	
Pre-requisites for this course (if any) **Ord. Differential Equations and Multi-Variable Calculus**	

Objectives

This course aims to provide an introduction to the theory and applications of partial differential equations. It trains students to develop a systematic approach of solving elementary partial differential equations.

List of Topics	Weeks	Contact Hours
Introduction: Definition of a partial differential equation (PDE). Definition of properties such as 'order' and 'linear/nonlinear'. Descriptions of how partial differential equations arise in the context of applications. Specifically, how conservation laws lead to the derivations of Laplace's equation (elliptic), diffusion equation (parabolic) and the Wave Equation (hyperbolic).	1	4
First order equations: - Define the general form of a first order partial differential equation. Find s o l u t i o n of first order linear equations of the generic type. Construct particular solution from given data. - The use of characteristic methods to solve nonlinear first order PDEs	5	20
Classification of second order linear equation: Classification by reduction to canonical form. Use of change of variable to find the general solution of second order linear partial differential equation in 2 variables. Determination of particular solutions from given information.	2.5	10
Fourier Series and applications: - Description of Fourier series, and its particularizations to half-range sine and cosine series. The Dirichlet conditions for the existence of a Fourier series. Proof of Dirichlet's Theorem for the sum to infinity of a one-dimensional Fourier Series. Selected examples of the construction of Fourier series. - Solution of linear partial differential equations by the method of separation of variables. Examples of the application of the method to the solution of boundary value problems for Laplace's equation in two dimensions and initial boundary value problems for the diffusion equation in one-dimension.	3.5	14
Introduction to Special Functions: The derivation of Bessel's equation and Legendre's equation from Laplace's equation when expressed in Cylindrical Polar coordinates and in Spherical Polar coordinates respectively. - Use of Leibnitz rule to construct series expansions for Jn(x) and Pn(x). The concept of a Generating Function and the use of generating functions to establish algebraic and analytical properties of these functions with particular reference to the development of orthogonality conditions and their use in the construction of Fourier-Bessel and Fourier-Legendre series. Properties of the companion solutions Yn(x) and Qn(x) which may be constructed from Jn(x) and Pn(x) respectively.	3	12

Course title and code: **Real Analysis (2) 28043103-3**	
Pre-requisites for this course (if any): **Introduction to Real Analysis**	

Objectives

1. The primary purpose of the course is to introduce the student to the concepts and ideas of Real functions, Limits, Continuity, Differentiability.
2. Also, we introduce the concept of Riemann integration and its basic properties and some applications.
3. To familiarize the students with the basic knowledge of Analysis needed for higher level courses.
4. To develop the students' awareness to the relevance of Mathematics for other areas of sciences**.**

List of Topics	Weeks	Contact Hours
Real numbers: ✓ Limits, continuity, Uniform continuity. ✓ Differentiability and Examples. ✓ Rules of Differentiability and Problems.	5	15
✓ Riemann Integration and Examples. ✓ Fundamental theorem of Calculus	5	15
Real Sequences: ✓ Sequences and Series of functions. ✓ Power Series.	3	9

Course title and code: **Linear Algebra (2)** **28043404-3**
Pre-requisites for this course (if any): **Linear Algebra (1)**

Objectives

The main purpose of this course are:

1- Some revisions of vector space, bases, dimension and linearly independence. 2-

Ring of linear transformations of a vector space, invariant subspaces.

3-Linear functional and duals and double duals. 4-

Elementary canonical forms

5-Rational canonical forms, Jordan canonical forms and Inner product spaces

6-Operators on inner product spaces

7-Bilinear forms

List of Topics	Weeks	Contact Hours
Some revisions of vector space, bases, dimension and linearly independence. Ring of linear transformations of a vector space, invariant subspaces. Linear functional and duals and double duals.	1-2	6
Elementary canonical forms	3-4	6
Rational canonical forms	5-7	9
Jordan canonical forms	8-9	6
Inner product spaces	10-11	6
Operators on inner product spaces	12-13	6
Bilinear forms	14-15	6

Course title and code: **Numerical Analysis** **28043702-3**	
Pre-requisites for this course (if any): **Ord. Differential Equation**	

Objectives

The role of the course is to introduce concepts and quantitative techniques for solving numerical problems.

List of Topics	Weeks	Contact Hours
Introduction: - Numbers representation on a computing machine with particularization to single precision, double precision, quadruple precision and the Intel 86 family of processors. - Definitions of numerical rounding error and chopping error. - Discussion of major sources of error in numerical analysis.	1	3
Solution of algebraic equations: - Description of: Bijection algorithm and its coding; Method of False Position and its coding; The Secant algorithm and its coding; The Newton-Raphson algorithm and its coding. Brief discussion of the robustness and relative performance of these algorithm. - Properties of the fixed-point algorithm $x_{n+1} = g(x_n)$ given x_0. - Definition of the Lipshitz condition and the notion of a contraction algorithm. - Conditions for convergence of $x_{n+1} = g(x_n)$ - Error estimation for algorithm $x_{n+1} = g(x_n)$ - General notion of the order of an iterative algorithm. - Aitken acceleration and Steffensen's algorithm. - Solution of systems of algebraic equations.	4	12
Numerical Interpolation: Polynomial interpolation. - Definition of the Lagrange interpolating polynomial. - Interpolation based on the Lagrange interpolating polynomial. - Newton interpolation using divided differences. - Error analysis underlying polynomial interpolation based on Rolle's theorem. - The Chebyshev Economization and its optimality. Spline interpolation - Piecewise linear spline. - Subbotin quadratic spline. - Construction of the cubic spline. Least-squares data fitting; its use and implementation.	4	12
Solution of linear equations: Direct methods - Concept of Gaussian elimination, the concept of pivoting and a simple illustration of why pivoting is needed. - LU factorisation of matrices with and without partial/full pivoting. - The Choleski factorisation. - Matrix inversion. Iterative methods - The concept of a matrix norm with simple examples, e.g. the Frobenius norm. - The Jacobi iteration algorithm. - The Gauss-Seidel algorithm. - The Gauss-Seidel algorithm with over-relaxation.	3	9
Numerical calculation of matrix eigenvalues: - Gershgorin's theorem with an example - The Power algorithm. - The Inverse Power algorithm. - The Jacobi transformation. - The Householder transformation. - Construction of the Upper Hessenberg matrix. - The QR algorithm.	3	9

Course title and code: **Discrete Mathematics 28043405-3**
Pre-requisites for this course (if any): **Group Theory and Linear Algebra (1)**

Objectives

1-**Some revision**: Algorithems, integers, relations, matrices, induction and recursion.

2-**Counting methods**: the basic of counting, pigeonhole principle, permutation and combinations,

binomial coefficients. Some generalizations. Application: P´olya-Burnside counting arguments.

3-**Graph theory:** Definition of graphs, examples and graph models, path and cycles, types of graphs,

representation of a graph, graph isomorphism, connectivity. Euler and Hamilton path, Planer graphs, Graph coloring.

4-**Trees:** Introduction to trees, examples, tree traversal, example, Spanning and minimum spanning trees.

5-**Booloean Algebra**: Boolean functions and representing Boolean functions.

List of Topics	Weeks	Contact Hours
Some revisions: Algorithems, integers, relations, matrices, induction and recursion.	1-2	6
Counting methods: the basic of counting, pigeonhole principle, permutation and combinations, binomial coefficients. Some generalizations. Application: P´olya-Burnside counting arguments.	3-4	6
Graph theory: Definition of graphs, examples and graph models, path and cycles, types of graphs, representation of a graph, graph isomorphism, connectivity.	5-7	9
Graph theory: Euler and Hamilton path, Planer graphs, Graph coloring	8-9	6
Trees: Introduction to trees, examples, tree traversal, example	10-11	6
Trees: Spanning and minimum spanning trees	12-13	6
Booloean Algebra: Boolean functions and representing Boolean functions.	14-15	6

Seventh Level

Course title and code: **Linear Programming** **28044201-3**	
Pre-requisites for this course (if any) **Linear algebra (1)**	

Objectives

Gain experience in modeling, solving and analyzing problems using linear programming.

Recognize different methods for solving linear programming problems (LPP).

Reveal the fundamental concepts and theories related to linear programming problems.

List of Topics	Weeks	Contact Hours
Introduction to operations research and linear programming problem (LPP)	1	3
Convex sets, Convex function, vertex points, and optimization theory	1	3
Graphical method for solving LPP	1	1
Simplex methods,	2	6
Special cases of simplex method Duality Problem, sensitivity analysis	2	6
Special cases of simplex method Two Phase Method	2	6
applications of the linear programming problem (Transportation problems, Game Theory, Network)	3	9
Use software application to solve LPP	3	9

Course title and code: **Mathematical Statistics 28044303-3**	
Pre-requisites for this course (if any) : **Probability Theory**	

Objectives

At the completion of this course, Student are expected to know how to use mathematical models in estimating and testing statistical hypothesis concerning population parameters from sample statistics.

List of Topics	Weeks	Contact Hours
Sampling distribution – Sampling distribution of the mean	1	3
Sampling distribution of the proportions and of the variance	1	3
Sampling distribution of the difference between the means of two independent samples – Important distributions of small samples with applications (the chi-square – T Distribution – F Distribution	1	3
Estimation of the population parameters- Point estimate – properties of point estimate - Mean squared error - properties of best estimate (Unbiasedenss – Consistency – Sufficiency - Efficiency)	3	9
Method of estimation (Method of moments –Maximum likelihood method- Lest square method – Bayesian estimators). Interval estimate (mean- probation – variance).	3	9
Confidence intervals and hypothesis testing The property of un-biasedness Interpret a confidence interval and confidence level.	2	6
The P-value of a test statistic - One—way analysis of variance (ANOVA).	2	6

Course title and code: **General Topology** **28044602-3**	
Pre-requisites for this course (if any) : **Real analysis (1)**	

Objectives

Definition of topological spaces and examples.
Distinguish between open and closed sets.
Knowledge of topological equivalence consept and topological property.
Identify the continuous functions and the ability of classifying them over the topological and metric spaces.
Knowledge of compactness by a point, sequences and metric spaces.

List of Topics	Weeks	Contact Hours
Topological Spaces: Definitions and examples.	2	6
Sets closure – Sets of partial spaces	2	6
Rules – the limited topological product – partial rules	2	6
The metric spaces: examples - the metric problem	3	9
Continuos Functions: Examples - Classification of continuos functions over the topological and metric spaces - topological Equivalance, Examples, Topological property.	3	9
Compact spaces: Examples, Compactness in R^n, Compactness by the endpoint, Compactness by sequences.	3	9

Course title and code: **Fluid Mechanics**	
Pre-requisites for this course (if any): **Continuum Mechanics**	

Objectives

The role of the course is to introduce concepts and quantitative techniques for the study of Fluid Mechanics and to introduce different types of flow.

List of Topics	Weeks	Contact Hours
Introduction and Kinematics: - What is a fluid and what distinguishes it from a solid? - What do we mean by density and viscosity? - Define fluid velocity and introduce the concepts of streamlines, streak lines and path lines and give some simple examples.	1	4
Conservation laws: - The material derivative and the law of conservation of mass. - Establish the transport theorem. - Discuss the notion of an incompressible fluid. - Introduce notions of force and the stress tensor. - Derive the equation for the balance of linear momentum. - Derive the equation for the balance of angular momentum and deduce that the stress tensor is symmetric.	2.5	10
Ideal Fluid: - Define what is meant by an ideal fluid. - Show that kinetic energy is conserved for ideal fluids in motions with in a fixed volume if the body force is conservative. - Derive Bernoulli's Theorem for conservative body force. - Define vorticity and derive the vorticity equation for an ideal fluid. - Consider the special case of 2D flow for which vorticity is characterized by a scalar function. Give examples. - Define irrotational flow and particularize Bernoulli's theorem to irrotational flow. - Define circulation and establish its properties, for example, conditions under which the circulation is zero.	2.5	10
Introduction to viscous flow: - Introduce the Newtonian Fluid and its stress tensor. - Derive the Navier-Stokes equation assuming incompressibility. - Verity that the presence of viscosity causes dissipation by considering the evolution of total kinetic energy in the motion of a viscous fluid. - Construct exact solutions for Poiseuille and Couette flow. Calculate shearing forces of boundaries. - Non-dimensionalise the Navier-Stokes equations with respect to characteristic lengths and velocities to obtain the Reynolds number. - Discuss the case Re >> 1 - low viscosity, flow is approximately that of an ideal fluid away from boundaries. Discuss also the case Re <<1 - low dominated by viscosity and inertia terms now ignorable. - Explain the reasoning driving the non-dimensionalisation procedure. Check that Reynolds number is indeed a non-dimensional number.	2.5	10
Vorticity and Boundary layers: - Derive the vorticity equation for a viscous fluid and particularize to 2D flow. - Solve problem for an impulsively moved plane boundary for viscous fluid in a half-space. Observe the importance of the similarity variable - Use the exact solution to elucidate the idea of a boundary layer in the respect to that of inviscid solution. - Reconsider the Navier-Stokes equation and argue with general thickness of a boundary layer.	2.5	10

Potential flow: - Consider only 2D incompressible inviscid flow and introduce the concept of the velocity potential and stream function. - Introduce the complex velocity potential via the CR equations. Illustrate complex VPs for some simple 2D flows, e.g. source, sink, line vortex, streaming ow at speed U etc. - Establish the expression for the force on an obstacle in a 2D ow of an inviscid fluid, that is, the integral expression for $F_x - iF_y$ (Blausius's Theorem). - Establish the Milne-Thomson circle theorem for 2D flow around a circular cylinder. - Do some examples calculating forces for simple flows. - Analyze the general Joukowski airfoil in which z = 0 is interior to the airfoil so that the VP has a Laurent expansion about z = 0. - Introduce the Method of Images regions for semi-infinite.	2	8
Surface and Interfacial waves: - Introduce the concepts of amplitude, frequency (Hz and angular), wavelength and phase velocity. - Introduce the concept of dispersive waves leading to the notion of group velocity. Provide some examples of dispersion and calculation their group velocities. - Introduce the concept of surface tension and its mathematics formulation. - Establish expressions for the speed of surface waves on an incompressible inviscid fluid of depth h, ignoring surface tension and in the presence of surface tension. - Extend analysis to interfacial waves and do a few examples.	2	8

Course title and code: **Numbers Theory**	
Pre-requisites for this course (if any): **Sets and Algebraic Structures**	

Objectives

The main purposes of this course are:

1-Primes, Divisibility and the Fundamental Theorem of Arithmetic

2- Greatest Common Divisor (GCD), Euclidean Algorithm

3- Congruences, Chinese Remainder Theorem, Hensel's Lemma, Primitive Roots

4- Quadratic Residues and Reciprocity

5- Arithmetic Functions, Diophantine Equations.

6- Continued Fractions.

7- introduction of cryptography as an application.

List of Topics	Weeks	Contact Hours
Primes, Divisibility and the Fundamental Theorem of Arithmetic	1-2	6
Greatest Common Divisor (GCD), Euclidean Algorithm	3-4	6
Congruences, Chinese Remainder Theorem, Hensel's Lemma, Primitive Roots	5-7	9
Quadratic Residues and Reciprocity	8-9	6
Arithmetic Functions, Diophantine Equations.	10-11	6
Continued Fractions	12-13	6
Introduction of cryptography:	14-15	6

Eighth Level

Course title and code: **Research Project** **28044901-2**	
Pre-requisites for this course (if any): **Department Approval Pass the sixth Level**	

Objectives

Introduce students to emerge mathematical subjects and to improve their knowledge background and skills in this area.

Introduce the students to research atmosphere.

Help students to make a fruitful discussion in a mathematical question or problem.

Gaining knowledge about the resources for obtaining the information which will help in outgoing research.

Using library, computers and internet for obtaining the required information for handling excellent research.

Getting knowledge about how to write scientific reports.

Implement a small research project.

Make a presentation using up to date presentation packages.

Choosing the appropriate mathematical topic and the corresponding references.

List of Topics	Weeks	Contact Hours
Introduce a subject selected by the lecturer.	1	2
Ways and means of collecting information through the library and online scientific recourses.	1	2
Lear about journals, workshops, seminars, talks, conference, dissertation, report, books, research papers, scientific communications, patent publications , posters , scientific article, impact factor, etc.	1	2
How to find and read appropriate references and software.	1	2
How to introduce and solve the problem theoretically and practically.	1	2
Learn about writing results before submitting them.	1	2
Choose a subject and few elementary references.	1	2
Develop some of the results therein.	3	6
Preparation of a first version of the report.	2	4
Discussion of the report an making corrections.	1	2
Prepare a presentation and give a plenary talk (department seminar)	1	2

Course title and code: **Financial Mathematics 28044304-3**
Pre-requisites for this course (if any): **Mathematical Statistics**

Objectives

Provide the students with knowledge of a range of mathematical and computational techniques that are required for a wide range of quantitative positions in the financial sector and to develop student appreciation of the major issues involved in rigorous advances in the area of financial mathematics.

List of Topics	Weeks	Contact Hours
Review of Probability Theory and Random Variable	1	3
Interest: Simple and compound interest. Effective and nominal interest rates. Force of interest. Interest paid monthly.	1	3
Options and option pricing	2	6
The Arbitrage Theorem, Pricing Contracts via Arbitrage	2	6
Deferred and varying annuities, annuities payable continuously.	2	6
Loans, loan structure and equal payments. Discounted cash flow: Generalised cash flow model.	2	6
The Black–Scholes Formula	2	6
Measurement of investment performance.	2	6

Course title and code: **Mathematical Software-Packages 28044202-3**	
Pre-requisites for this course (if any) : **Mathematical Statistics and Numerical Analysis**	

Objectives

This course provides an introduction of several Mathematical software packages which are useful for mathematical science students. Among the packages are Matlab® numerical computation, Mathematica® for symbolic computation and SPSS® for statistical analysis.

1. Training the students on variant software's to solve real problems related to mathematical and statistical science.
2. Improving the programming skills of the students to handle mathematical and statistical science problems.
3. Modeling the mathematical and statistical science problems and build algorithms to solve it by the level language.

List of Topics	Weeks	Contact Hours
Introduction to Matlab	1	3
Programming in Matlab	2	6
Solving Mathematical problems using Matlab	2	6
Introduction to Mathematica	1	3
Solving Mathematical problems using Mathematica	2	6
Entering data to SPSS	1	3
Analyzing data using SPSS	2	6
Visulazing data using SPSS	2	6

Course title and code: **Complex Analysis** **28044104-4**	
Pre-requisites for this course (if any): **Real Analysis (1)**	

Objectives

By the end of the course the students will learn **the following main concepts:**

a) Analytic functions.
b) Elementary functions.
c) Definite integral of functions w(t) and contour integrals.
d) Convergence of complex sequence and series.

List of Topics	Weeks	Contact Hours
Chapter 1: Analytic Functions 1.1 Functions of a Complex Variable 1.2 Mappings 1.3 Mappings by the Exponential Function 1.4 Limits 1.5 Theorems on Limits 1.6 Limits Involving the Point at Infinity 1.7 Continuity 1.8 Derivatives 1.9 Differentiation Formulas 1.10 Cauchy–Riemann Equations 1.11 Sufficient Conditions for Differentiability 1.12 Polar Coordinates 1.13 Analytic Functions 1.14 Examples 1.15 Harmonic Functions 1.16 Uniquely Determined Analytic Functions 1.17 Reflection Principle	4	16
Chapter2: Elementary Functions 2.1 The Exponential Function 2.2 The Logarithmic Function 2.3 Branches and Derivatives of Logarithms 2.4 Some Identities Involving Logarithms 2.5 Complex Exponents 2.6 Trigonometric Functions 2.7 Hyperbolic Functions 2.8 Inverse Trigonometric and Hyperbolic Functions	2	8

	Chapter 3: Integrals 3.1 Derivatives of Functions w(t) 3.2 Definite Integrals of Functions w(t) 3.3 Contours 3.4 Contour Integrals 3.5 Some Examples 3.6 Examples with Branch Cuts 3.7 Upper Bounds for Moduli of Contour Integrals 3.8 Antiderivatives 3.9 Proof of the Theorem 3.10 Cauchy–Goursat Theorem 3.11 Proof of the Theorem 3.12 Simply Connected Domains 3.13 Multiply Connected Domains 3.14 Cauchy Integral Formula 3.15 An Extension of the Cauchy Integral Formula 3.16 Some Consequences of the Extension 3.17 Liouville's Theorem and the Fundamental Theorem of Algebra 3.18 Maximum Modulus Principle	5	20
	Chapter 4: Series 4.1 Convergence of Sequences 4.2 Convergence of Series 4.3 Taylor Series 4.4 Proof of Taylor's Theorem 4.5 Examples 4.6 Laurent Series 4.7 Proof of Laurent's Theorem 4.8 Examples 4.9 Absolute and Uniform Convergence of Power Series 4.10 Continuity of Sums of Power Series 4.11 Integration and Differentiation of Power Series 4.12 Uniqueness of Series Representations 4.13 Multiplication and Division of Power Series	4	16

Course title and code: **Introduction of Rings theory** **28044407-3**
Pre-requisites for this course (if any): **Introduction to Group Theory**

Objectives

The main purpose of this course are learning basic facts of rings and fields theory, integral domains, the field of quotients of an integral domain, rings of polynomials over a field and their factorizations, the evaluation homeomorphisms for field theory, homeomorphisms and factor rings, Prime and maximal ideals, introduction to extension fields. Namely the topics are:

1-Rings and fields: Definitions and basic examples substructures of rings, ideals 2-

Integral domain, the field of fractions of an integral domain.

3-Rings of polynomials and factorization of polynomials over a field 4-

Isomorphism theorems of rings

5-Prime and Maximal ideals

6-Introduction to extension fields and some examples of finite fields.

7-Principal ideal domain (PID), Unique factorization domain (UFD), Euclidean domain (ED)

List of Topics	Weeks	Contact Hours
Rings and fields: Definitions and basic examples substructures of rings, ideals	1-2	6
Integral domain, the field of fractions of an integral domian	3-4	6
Rings of polynomials and factorization of polynomials over a field	5-6	6
Isomorphism theorems of rings	7-8	6
Prime and Maximal ideals	9-10	6
Introduction to extension fields and some examples of finite fields.	11-12	6
Principal ideal domain (PID), Unique factorization domain (UFD), Euclidean domain (ED)	13-15	9

Course title and code: **Measure and Integration** **28044105-3**	
Pre-requisites for this course (if any): **Real Analysis (2)**	

Objectives

The course introduces the Lebesgue integral and develops the elements of measure theory. We give the notions of special set systems, rings and algebras of sets, generated set systems. Borel sets, additive and sigma-additive set functions, outer measure and measure, extension and completion of measure, construction of Lebesgue and Lebesgue-Stieltjes measure, measurable functions and their properties, simple functions, construction of Lebesgue integral and its properties, absolute convergence of integral, integrable functions, Lebesgue theorem on dominated convergence, Lebesgue-Stieltjes integral, Convergence theorems.

List of Topics	Weeks	Contact Hours
Preliminaries on Set Theory and Topology: Basic concepts from set theory and topology. Rings, sigma-rings, algebras and sigma-algebras of sets. Generated set systems, connection between some types of generated systems, examples of rings and sigma-rings over intervals. Concept of set function and some types of set functions. Properties of additive functions defined on rings of sets.	3	9
Measure: Non-negative sigma-additive functions and their properties, measure, connection of measure with non-negative additive functions, examples of measures over intervals. Outer measure, measurability in sense of Carathéodory. Extension and completion of measure, m*-measurability and completeness, system of m*-measurable sets with respect to induced measure. Existence and uniqueness of extension of a measure. Lebesgue measure.	4	12
Measurable functions: Measurable space, simple measurable functions, measurable functions and criteria of measurability of functions. Further properties of measurable functions, sequences of measurable functions, Borel and Lebesgue measurability.	3	9
Integral: Measure space, integral of simple functions. Integral of a non-negative measurable function, definition of integral of a measurable function and its properties. Integral and limit of a sequence of functions, integral as a set function, Lebesgue and Lebesgue-Stieltjes integral, convergence theorems.	3	9