

# Study Plan Manual

Master of Science in Mathematics Department of Mathematics and Statistics College of Science King Faisal University



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Useful Links

## <u>Curriculum</u>

#### **Study Plan Structure**

The master program in Mathematics mainly consists of two tracks namely course track and thesis track. To obtain the degree of M. Sc in Mathematics, a candidate must successfully complete 42 units (24 credit hours in compulsory courses, 16 credit hours in electives courses, 2 credit hours for article and essay course) in Course Track and 32 units (24 credit hours in compulsory courses and 8 credit hours for thesis course) in Thesis Track. Complete detail's structure for both tracks is presented in below tables. Each courses are linked with a short description.

Program Structure		No. of Courses	Credit Hours	Percentage
Course	Required	8	24	57.14%
Course	Elective	4	16	38.1%
<b>Graduation Project</b> (if any)		1	2	4.76%
Thesis (if any)		0	0	0
Field Experience(if any)		0	0	0
Others ()		0	0	0
Total		13	42	100%

#### 1. Study Plan Structure Courses Path

#### 2. Study Plan Structure Courses with Thesis Path

Program Structure		No. of Courses	Credit Hours	Percentage
Course	Required	8	24	75%
Course	Elective	0	0	0
Graduation Project (if any)		0	0	0
Thesis (if any)		Thesis	8	25%
Field Experience(if any)		0	0	0
<b>Others</b> ()		0	0	0
Total		8+Thesis	32	100%

#### Program Courses

This section enlisted all courses in the program as its appearance. To have a clear view, the course is listed in tabular form according to Courses Path and Thesis path. It is to be noted here that both paths are further classified as Pure and Applied sections.

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Credit Hours
	08171641	Real Analysis I	Required		3
Level 1	08171631	Abstract Algebra I	Required		3
	Total				6
Level 2	08171642	Real Analysis II	Required	08171641	3
	08171601	Numerical Analysis I	Required		3
	Total	a shall a			6
Level 3	08171643	Complex Analysis I	Required		3
	08171632	Abstract Algebra II	Required	08171631	3
	Total				6
Level 4	08171 <mark>644</mark>	Complex Analysis II	Required	0817 <mark>1643</mark>	3
	08171660	Topology	Required		3
	Total				6
Level 5		Elective Course 1	Elective		4
		Elective Course 2	Elective		4
	Total				8
		Elective Course 3	1		4
Level 6		Elective Course 4	Elective		4
	08171600	Essay and Article			2
	Total				10
	Grand Total				42

Courses Path (Pure Mathematics)

Level	Course Code	Course Title	Required or Elective	Pre- Requisite Courses	Credit Hours
	08171641	Real Analysis I	Required		3
Level 1	08171631	Abstract Algebra I	Required		3
	Total				6
Loval 2	08171601	Numerical Analysis I	Required		3
Level 2	08171604	Ordinary Differential Equations I	Required		3
	Total				6
1	08171643	Complex Analysis I	Required		3
Level 3	08171606	Partial Differential Equations	Required		3
	Total				6
	08171608	Mathematical Methods	Required		3
Level 4	08171602	Numerical Analysis II		08171601	3
	Total				6
Laural E		Elective Course 1	Elective		4
Level 5		Elective Course 2	Elective		4
	Total				8
		Elective Course 3			4
Loval 6		Elective Course 4	Elective		4
Level 0	08171600	Essay and Article		ł	2
	Total				10
	Grand Total				42

#### Courses Path (Applied Mathematics)

#### Thesis Path (Pure Mathematics)

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Credit Hours
	08 <mark>171</mark> 641	Real Analysis I	Required		3
Level 1	0817 <mark>163</mark> 1	Abstract Algebra I	Required		3
	Total	10	5	S. 1	6
Level 2	08171642	Real Analysis II	Required	<mark>081</mark> 71641	3
	08171601	Numerical Analysis I	Required		3
	Total				6
Level 3	08171643	Complex Analysis I	Required		3
	08171632	Abstract Algebra II	Required	08171631	3
	Total				6
	08171644	Complex Analysis II	Required	08171643	3
Level 4	08171660	Topology	Required		3
	Total				6
Level 5,6,7,8	08171700	Thesis	Required		8
	Total				8
	Grand Total				32

Level	Course Code	Course Title	Required or Elective	Pre-Requisite Courses	Credit Hours
	08171641	Real Analysis I	Required		3
Level 1	08171631	Abstract Algebra I	Required		3
	Total				6
	08171601	Numerical Analysis I	Required		3
Level 2	08171604	Ordinary Differential Equations I	Required		3
	Total				6
	08171643	Complex Analysis I	Required		3
Level 3	08171606	Partial Differential Equations	Required		3
	Total				6
Level 1	08171608	Mathematical Methods	Required		3
Level 4	08171602	Numerical Analysis II	Required	08171601	3
	Total	- LL-AL			6
Level	08171700	Thesis	Required		8
5,6,7,8	Total			1	8
	Grand				32
	Total				

#### Thesis Path (Applied Mathematics)

Table1: Elective	: courses	
Course Code	Course Title	Credit Hours
08171611	Calculus of Variations	4
08171612	Ordinary Differential Equations II	4
08171613	Theory of Partial Differential Equations I	4
08171614	Theory of Partial Differential Equations II	4
08171615	Boundary Value Problems	4
08171616	Approximation Theory	4
08171617	Numerical Methods of Ordinary Differential Equations	4
08171618	Numerical Methods of Partial Differential Equations	4
08171621	Mathematical Logics I	4
08171622	Mathematical Logics II	4
08171623	<u>Set Theory</u>	4
08171624	Model Theory	4
08171625	Proof Theory	4
08171626	Theory of computation	4
08171633	Commutative Algebra	4
08171634	Arithmetic Algebra	4
08171635	Rings and Modules	4
08171636	Fields and Galois theory	4
08171637	Groups Theory	4
08171645	Introduction to Harmonic Analysis	4
08171646	Functional Analysis I	4
08171647	Functional Analysis II	4
08171648	Theory of Operators	4
08171649	Banach Algebra	4
08171651	Numerical Methods of Linear Algebra	4

08171653	Special Functions in Applied Mathematics	4
08171654	Integration Transforms and Operation Methods	4
08171655	Applied Functional Analysis I	4
08171656	Applied Functional Analysis II	4
08171657	Theory of Distributions	4
08171661	Algebraic Topology I	4
08171662	Algebraic Topology II	4
08171671	Differential Geometry I	4
08171672	Differential Geometry II	4
08171673	Algebraic Geometry	4

Table 2 – Special Topics in Mathematics						
Course number	Course title	Lecture	tutorial	Lab	Prerequisites	
08171695	Special Topics in Mathematics	4	11 - 1			

#### Thesis and Its Requirements

**1. Registration of the thesis:** (Requirements/conditions and procedures for registration of the thesis as well as controls, responsibilities and procedures of scientific guidance)

- 1- The admission requirements are established in accordance with the criteria set by the college council, the Unified Regulations for Postgraduate Studies in the Kingdom of Saudi Arabian, and the admission requirements of King Faisal University.
- 2 To be eligible for admission, the applicant must successfully pass twelve credit hours of required courses (4 courses) with a GPA with a minimum average 3.75 out of 5.

**2. Scientific Supervision:** (The regulations of the selection of the scientific supervisor and his/her responsibilities, as well as the procedures/ mechanisms of the scientific supervision and follow-up)

- The department assigns supervisors for the thesis.
- The student should prepare a thesis under supervision. This work requires the following main steps:
  - ✓ Choose the subject of the project.
  - ✓ Prepare a literature survey about the (project) topic.
  - ✓ Recognize the importance of library and internet in expansion of our knowledge.
  - ✓ Develop a research plan.
  - ✓ Investigate the area of interest.
  - ✓ Apply appropriate software and web resources.
  - ✓ Write up the thesis and defend it.

**3.Thesis Defense/Examination:**(The regulations for selection of the defense/examination committee and the requirements to proceed for thesis defense, the procedures for defense and approval of the thesis, and criteria for evaluation of the thesis)

The thesis should be characterized by originality and reviewed by internal and external reviewers.

## Course short description

### Required Courses:

Course Name	Real Analys	is 1					
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
	Math0817	1641	1st	3	None		
Course Track	Universit	y Requirement 🗌 (	College Requireme	nt 🛛 Specialized	Core Electives		
Course Descr This course dea Arzela theorem	<b>Course Description:</b> This course deals with the measure theory in the Lebesgue sense ,Convergence theorems, Lebesgue spaces, Ascoli- Arzela theorem,. and Linear operators.						
Course Object This course pro	tives: vides a clear ur	derstanding of the ma	in concepts related to	o the Lebesgue mea	sure theory and operators.		
<ol> <li>State t such a and lin</li> <li>Exami</li> <li>Apply</li> <li>Disting</li> <li>Apply</li> <li>Apply</li> <li>Presen</li> </ol>	<ol> <li>Courses Learning Outcomes:         <ol> <li>State the basic definitions, concepts and some fundamental results in measure theory and real analysis such as measurability, integrability, absolutely continuous functions, function of bounded variation and linear operators.</li> <li>Examine the measurability and integrability of function</li> <li>Apply convergence theorems and Ascoli Ascoli-Arzela theorem</li> <li>Distinguish the L<sup>p</sup> -spaces and its properties.</li> <li>Apply the closed graph and open mapping theorems, the uniform boundedness principle</li> <li>Analyze the hypotheses of a given problem and apply the suitable results encounter it through a homework</li> <li>Presentation a project on a subject related to the contents of the course.</li> </ol> </li> </ol>						
Assessment Policy	Assig <mark>nme</mark> Quizzes, Presentat Project/ F	nts, ions Report	20%	Lab	NA		
	Midterm	30%	Final 50%	Others	NA		
Textbook	<ul> <li>H. L. Royden. Real Analysis. Macmillan publishing company ,New-York1968 (Text book).</li> <li>D.L.Cohn. Measure Theory. Birkhauser, Berlin.Basel.Stuttgart.1980.</li> </ul>						
References	<ul> <li>P. R. Halmos. Measure Theory. D. Van Nostrand Co.Inc.Princeton.N.J.1950.</li> <li>W. Rudin . Real and Complex Analysis. McGraw-Hill.1979.</li> <li>R.L. Weeden and A. Zygmond .Measure and Integrals: An Introduction to Real Analysis. Marcel Dekker.Inc.1977</li> </ul>						
Electronic Materials	http://www	http://www.math.math.com/					
Other Learning Materials							

Course Name	Abstract Al	gebra 1								
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)					
	Math0817	1631	1st	3	None					
Course Track	Universit	y Requirement 🗌	College Requireme	nt 🛛 Specialized	Core Electives					
Course Descr This course pro action, Sylow's rings of polynor	<b>Course Description:</b> This course provides the basic knowledge of groups, group homomorphism, finitely generated abelian groups, group action, Sylow's theorems, normal series and solvable groups. Rings, ideals, ring homomorphism, rings of quotients, rings of polynomials, Principal ideal domains.									
<b>Course Objectives.</b> The aim of this course is to give a clear understanding of the main results about groups, finite abelian groups, the applications of Sylow's theorems and rings.										
<ol> <li>State t</li> <li>Apply</li> <li>Recog</li> <li>State t</li> <li>State t</li> <li>Analy and rin</li> <li>Form e</li> <li>Form e</li> <li>Compa</li> <li>Recogn</li> <li>Calculation</li> <li>Examining</li> </ol>	<ol> <li>State the basic definitions, concepts and some fundamental results in group theory.</li> <li>Apply the orbit equation and Sylow's Theorems in some problems.</li> <li>Recognize simple groups of given order</li> <li>State the basic definitions, concepts and some fundamental results in ring theory.</li> <li>Analyze the hypotheses of a given problem and apply the suitable results and the properties of rings and ring isomorphism to encounter it.</li> <li>Form examples of groups.</li> <li>Compare group structures.</li> <li>Recognize simple groups and finite abelian groups.</li> <li>Calculate the invariant factors and elementary divisors of a finite abelian group.</li> </ol>									
Assessment Policy	As <mark>signme</mark> Quizzes, Presentat Project/ I	nts, ions Report	20%	Lab	NA					
	Midterm	30%	Final 50%	Others	NA					
Textbook	• I. N.	Herstein, Topics	in Algebra; John V	Wiley and sons, I	New York, 1977.					
References	<ul> <li>D. Saracino, Abstract Algebra: A first course, Waveland Press, 2008.</li> <li>P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul, Basic Abstract Algebra, Cambridge University Press, 1994.</li> <li>Jonathan. D. H. Smith, Introduction to Abstract Algebra, CRC Press, Taylor and Francis Group, 2008.</li> </ul>									
Electronic Materials										
Other Learning Materials										

Course Name	Real Analys	is 2							
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)				
	Math0817	1642	2nd	3	08171641				
Course Track	Universit	y Requirement 🗌 (	College Requiremen	nt 🛛 Specialized	Core Electives				
Course Description: Abstract measure space, measurable function, Borel functions, The integral of a real function with respect to a measure and the convergence theorems, Signed measure and Radon Nikodym 's theorem, Outer measure, Jordan decomposition . Lebesauge stieltijes integral, Product measure, Tonnili and Fubbini theorems, Linear functional, Borel measure and the conjugate of the space of real continuous functions. The Daniel integral Course Objectives.									
At the end of the integrable funct	he course, stud ions. Moreover	lents are expected to Understanding how v	have a clear underst ve can generate a mea	anding the properti asure and product m	ies of measure spaces and neasures.				
<ol> <li>State t</li> <li>Apply</li> <li>Examin</li> <li>Disting</li> <li>Apply</li> <li>Conduct</li> <li>To record</li> <li>Analyz</li> <li>Act in</li> </ol> Assessment	urses Learning Outcomes:         1. State the basic definitions, concepts, and some fundamental results on measure theory         2. Apply the theoretical methods to create a measure         3. Examine the measurability and integrability of function with respect to any measure.         4. Distinguish the signed measure and its properties.         5. Apply Jordan decomposition.         6. Conduct a measure from an outer measure         7. To recognize the product measure and apply Tonelli and Fubini theorems         8. Analyze the hypotheses of a given problem and apply the suitable results encounter it         9. Act in a group to solve diverse problem related to the contents of the course.         Assignments,         Quizzes,       20%         Lab       NA								
	Project/ I Midterm	Report 30%	Final 50%	Others	NA				
Textbook	<ul><li>H. L. I</li><li>D.L.C.</li></ul>	Royden. Real Analysis ohn. Measure Theory.	. Macmillan publishi Birkhauser, Berlin.B	ng company ,New- asel.Stuttgart.1980.	York1968 (Text book).				
References	<ul> <li>P. R. Halmos. Measure Theory. D. Van Nostrand Co.Inc.Princeton.N.J.1950.</li> <li>W. Rudin . Real and Complex Analysis. McGraw-Hill.1979.</li> <li>R.L. Weeden and A. Zygmond .Measure and Integrals: An Introduction to Real Analysis. Marcel Dekker.Inc.1977</li> </ul>								
Electronic Materials	http://www	http://www.math.math.com/							
Other Learning Materials									

Course Name	Abstract	Algebra 2							
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)				
Information	Math0 817	1632	3rd	3	08171631				
Course Track	Unive	rsity Requirement [	College Require	ment 🛛 Specializ	zed Core Electives				
Course Descript To have knowledg domains, primary is extensions, algebra the primitive eleme Galois Theory and Course Objective The aim of this cou- such as Noetherian primitive rings, alg group. Courses Learnin 1. State the 2. Describe 3. Classify f 4. Construct 5. Apply the	<ul> <li>To have knowledge in commutative rings with chain conditions such as Noetherian, Artinian rings, principal ideals domains, primary ideals and primary decomposition, simple and primitive rings, field extensions, degree, simple extensions, algebraic, transcendental and finite extensions, splitting fields, normal extensions and separable extensions, the primitive element theorem, Galois group of a field extension and of a polynomial, the Fundamental Theorem of Galois Theory and its Applications, solvability by radicals, insolvability of the quintic</li> <li>Course Objectives.</li> <li>The aim of this course is to give a clear understanding of the main results about Commutative rings with chain conditions such as Noetherian, Artinian rings, Principal ideals domains. Primary ideals and Primary decomposition. Simple and primitive rings, algebraic extensions Splitting fields of polynomials, Normal and separable extensions, and the Galois group.</li> <li>Courses Learning Outcomes: <ol> <li>State the basic definitions, concepts and some fundamental results in ring theory and field theory.</li> <li>Describe some classes of commutative rings with chain conditions.</li> <li>Classify finite field extensions and determine the degree of an extension and the minimal polynomial.</li> <li>Construct Splitting fields of polynomials over a field.</li> <li>Apply the Primitive element theorem and the fundamental theorem of Galois Theory.</li> </ol> </li> </ul>								
Assessment Policy	A <mark>ssi</mark> gnme Quizzes, Presentat Project/ H	nts, ions Report	20%	Lab	NA				
	Midterm	30%	Final 50%	Others	NA				
Textbook	• Steve Sprin	n Rom <mark>an, Field</mark> T ger, 1995.	heory, Second Ed	i <mark>tion</mark> , Graduate T	Texts in Mathematics,				
References	<ul> <li>Iain T. Adamson, Introduction to field theory, Second edition, Cambridge University Press, 1982.</li> <li>M. M. Postnikov, Foundations of Galois Theory, Dover Publication, INC, Mineola, New York, 2004.</li> <li>Morandi, Patrick, Field and Galois Theory, Graduate texts in Mathematics, Springer, 1996.</li> <li>Stewart, Galois Theory – (Chapman and Hall 2003); Library reference 512.4 STE.</li> </ul>								
Electronic Materials	512.								
Other Learning Materials									

Course Name	Complex	Analysis 1								
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)					
Information	Math0 817	1643	3rd	3	None					
Course Track	Unive	rsity Requirement	t 🗌 College Require	ement 🛛 Specializ	zed Core Electives					
Course Descript To grasp the basic representation of a zeros of Analytic f Rouche's theorem.	<b>Course Description:</b> To grasp the basic knowledge of complex numbers and functions, analytic and harmonic functions, power series representation of analytic and meromorphic functions, Cauchy's theorem, applications of Cauchy's Integral Formula, zeros of Analytic function, Maximum Modulus Principal, conformal maps, Residue Calculus and its applications, Rouche's theorem.									
At the end of the	Course Objectives. At the end of the course, students are expected to have a clear understanding of analytic and meromorphic functions,									
Courses Learni	ng Outcon		alculus							
<ol> <li>State the</li> <li>Describe</li> <li>Test the</li> <li>Evaluate</li> <li>Construct</li> <li>Test the a</li> <li>Act in a g</li> </ol>	a basic definitions, concepts, and some fundamental results. be the geometric and algebraic representations of complex objects. c analyticity and harmonicity of functions te complex and improper integrals with a variety of methods. act a solution of a given problem using appropriate mathematical argument. analyticity and harmonicity of functions. group to solve diverse problem related to Complex analysis Assignments, Quizzes,									
Policy	Presentat Project/ H	ions Report								
	Midterm	30%	Final 50%	Others	NA					
Textbook	<tbook <tr="">       • J. B. Conway. Functions of One Complex Variable. Springer. 2002.</tbook>									
References	• Serge Lang, Complex Analysis, 4th edition, Springer Science., 2003.									
Electronic Materials										
Other Learning Materials										

Course Name	Topology								
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)				
mormation	Math0817	1660	4th	3					
Course Track	Universit Electives	ty Requirement 🗌 (	College Requiremen	t 🛛 Specialized	Core				
Course Descripti Topological space Convergence of se normal spaces. Co connectedness, pa Baire theorem	on: es. Continuous equences nets ountability pro th wise conne	s functions, open and and filters. The sepa operties. Compactnes octedness, continua.	d closed mappings. l aration axioms, regu ss and local compac Metrizable spaces.	Product and quotic larity and comple tness. Connectedn Complete metric s	ent spaces. te regularity, less, local spaces and the				
<b>Course Objective</b> To know the basic c	<b>Course Objectives.</b> To know the basic concepts of ordinary differential equation and to study the stability of linear and quasi-linear equations.								
<ol> <li>To recogn compactne</li> <li>To examin</li> <li>To recogni</li> <li>To recogni</li> <li>To recogni</li> <li>To examin</li> <li>to use the l</li> <li>Act in a gr</li> </ol>	To recognize and state some of the basic definitions of concepts concerning topological spaces such as compactness, connectedness, completeness and Countability properties To examine the Convergence of sequences, nets and filters To recognize the product and quotient spaces To recognize compact space, local compactness, metrizable spaces and Complete metric spaces To examine Connectedness, local connectedness, pathwise connectedness to use the Baire theorem Act in a group to solve diverse problem related to Topology								
Policy	Project/ H Midterm	Report 30%	Final 50%	Others	NA				
Textbook	Textbook     J. L. Kelley: "General Topology"       • Stephen Willard: "General Topology"								
References	John G. Hocking and Gail S. Young:"Topology"								
Electronic Materials									
Other Learning Materials									

Course Name								
Course Maine	Complex Ar	alysis 2		-				
Course Information	Course Code	Course	No.	Credit Hour	Prerequisite(s)			
	Math0817	1644	1	4	th	3	0817-1643	
Course Track	University Electives	y Requirem	ent 🗌	College R	equiremen	t 🛛 Specialized	Core	
Course Descripti	on:							
To grasp the basic subharmonic func	c knowledge o tions, Dirichle	f The Riem t problem a	ann ma Ind Shot	pping theo tcky's and	rem, infin Picard's th	ite product, Harm oerems.	nonic functions,	
Course Objective	25.				_			
At the end of the c advanced complex a	ourse, students analysis.	are exp <mark>ectec</mark>	d to dem	ionstrate the	eoretical kr	nowledge and to h	nave practical skills in	
<ol> <li>Courses Learnin</li> <li>State the line</li> <li>Apply the ising the second sec</li></ol>	g Outcomes: basic definition method of infini- armonicity and applications of a solution of a g	as and funda te products a subharmonic relevant resu iven problen area problen	amental and the V tity of fur alts such n using a	l results rel Weierstrass nctions. as: theoren appropriate	ated to the factorizations of Mittage mathematic	e main concepts o on. g-Leffler, Shotcky, cal argument.	of complex analysis	
Assessment Policy	Assignmer Quizzes, Presentati Project/R	nts, ons eport		20%	( analysis	Lab	NA	
	Midterm	+11	30%	Final	50%	Others	NA	
Textbook	<ul> <li>John B. Conway: "Functions of One Complex Variable" first volume</li> <li>Lars V. Ahlfors:" Complex Analysis</li> </ul>							
References	<ul> <li>E. Hille: "Analytic Function Theory"(2 vols)</li> <li>C. Caratheodory: "Theory of a Function of a Complex Variable" (2vols)</li> </ul>							
Electronic Materials			_					

Other Learning Materials

Course Name	Numerica	l Analysis	51							
Course	Course Code	Cour	se No.	Course	e Level	Credit Hour	Prerequisite(s)			
Information	Math08 17	16	501	2r	d	3	None			
Course Track	Univers	sity Requi	rement	College I	Requireme	nt 🛛 Special	ized Core 🗌 Electives			
Course Description	Course Description:									
This deals with basi to approximate prol interpolation, nume	This deals with basic understanding of numerical methods and skills to implement algorithms to approximate problems of root-finding of nonlinear equations, approximation of functions, interpolation, numerical differentiation and numerical integration.									
Course Objectives This course aims to numerical methods interpolation, nume	<b>Course Objectives.</b> This course aims to give a clear understanding of the main concepts related to error analysis, numerical methods for root-finding of nonlinear equations, approximation of functions, interpolation, numerical differentiation and numerical integration									
<b>Courses Learning</b>	Outcomes:		-							
<ol> <li>State the basic of</li> <li>Calculate numeri</li> <li>Write polynomia</li> <li>Estimate approxi</li> <li>Calculate approx</li> <li>Use a numerical</li> <li>Implement nume</li> </ol>	the basic definitions, concepts, and some fundamental results in numerical analysis ate numerical solutions of nonlinear equations with appropriate numerical methods polynomial interpolation for functions ate approximations of derivatives and integrals of functions with numerical algorithms and methods. ate approximations for functions and data with several numerical methods numerical method in physical applications									
Assessment Policy	Assignme Quizzes, Presentat Project/ I	ents, ions Report	5	20%	1	Lab	NA			
	Midterm	100	30%	Final	50%	Others	NA			
Textbook	-Kendall.I -Burden R	E.At <mark>kinso</mark> I.L., Faire	<mark>n,An Intro</mark> s J.D. Nur	duction to nerical ana	Numerica Ilysis (9ed	l Analysis " J , Brooks Cole	ohn Wiley(1989) e, 2010)			
References	-P.Henric -A Raloste	i,"Elemen on, "A Fii	ts of Num st Course	erical Ana in Numeri	lysis" .Joh cal Analys	n Wiley&Sor sis". Mc Grow	ns Inc (1966). 7-Hill Book			
	http://ocw	.mit.edu/o	courses/ma	athematics	/18-330-in	troduction-to	-numerical-analysis-			
Electronic Materials	spring-2004/ <u>http://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/</u>									
Other Learning Materials	MATLAE	8 Software	2							

Course Name	Numerica	l Analysis	2						
Course	Course Code	Cours	e No.	Cours	se Level	Credit Hour	Prerequisite(s)		
Information	Math08 17	160	)2	4	th	3	08171601		
Course Track	Univers	University Requirement College Requirement Specialized Core Elec							
<b>Course Description:</b> This course deals with numerical methods for solving initial value problems and boundary value problems for ordinary differential equations, direct methods for solving linear systems, iterative methods for solving linear systems and numerical methods for approximating eigen values.									
At the end of the co and boundary value algebra.	urse, studen e problems	ts are expe for or <mark>di</mark> nar	ct <mark>ed to un</mark> ry differen	derstand ntial equa	the main co tions and t	ncepts of solving i he main concepts	nitial value problems for numerical linear		
<ol> <li>State the baand Bounda</li> <li>Apply a nut</li> <li>Calculate aappropriate</li> <li>Solve lineaa</li> <li>Estimate ap</li> <li>Implement nut</li> </ol>	ate the basic concepts of numerical linear algebra and numerical methods for Initial Value problems ad Boundary value problems. pply a numerical method in other fields. alculate approximations solutions of Initial Value Problems and Boundary Value Problems using opropriate numerical method. olve linear systems with direct methods and iterative methods. stimate approximate eigenvalues and eigenvectors for appropriate methods.								
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nts, ions Report		20%		Lab	NA		
	Midterm		30%	Final	50%	Others	NA		
Textbook	-Kendall.H -Burden R	E.Atkinson L., Faires	,An Intro J.D. Nun	duction to	Numerical alysis (9ed.,	Analysis " John , Brooks Cole, 201	Wiley(1989) 0)		
References	-P.Henrici -A Ralosto	,"Elements on, "A Firs	s of Nume st Course i	erical Ana in Numer	llysis" .Johr ical Analysi	n Wiley&Sons Inc is". Mc Grow-Hill	(1966). Book		
Electronic Materials	http://ocw spring-200 http://ocw analysis-fo	http://ocw.mit.edu/courses/mathematics/18-330-introduction-to-numerical-analysis- spring-2004/ http://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical- analysis-for-engineering-13-002j-spring-2005/							
Other Learning Materials	MATLAB	Software							

Course Name	Ordinary D	Ordinary Differential Equations I							
Course Information	Course CodeCourse No.Course LevelCredit HourPrerequise								
	Math0817	1604	2nd	3					
Course Track	Universit	University Requirement College Requirement Specialized Core Electives							

#### **Course Description:**

The course covers core topics for ordinary differential equations such that the existence and the unicity of solutions, properties of linear systems of differential equations with constants and periodic coefficients, and the Lyapunov stability direct method.

**Course Objectives.** To know the basic concepts of ordinary differential equation and to study the stability of linear and quasi-linear equations.

#### **Courses Learning Outcomes:**

7. State and recognize the main theorems related to theory of differential equations.

- 8. Examine the existence and uniqueness of solutions to some ODE
- 9. Study the properties of solutions of some linear systems of differential equations.
- 10. Classify the singularities of a linear systems with variable coefficients to apply the Frobenius method.
- **11.** Apply the Poincare-Bendixson theory
- 12. Investigate the stability of solutions by the Lyapunov direct method.

Assessment Policy	Assignments, Quizzes, Presentations Project/ Report	6	20%	2	Lab	NA	
	Midterm	30%	Final	50%	Others	NA	
Textbook References	<ul> <li>E. A. Coddington Pub Co 1984.</li> <li>K. Yosida: "Lect</li> <li>Guckenheimer a Bifurcations of V</li> <li>P. Hartman: "Ore mathematics 200</li> </ul>	ngton and N. Levinson:" Theory of Ordinary Differential Equations" Krieger 4. "Lectures on Differential and Integral Equations", Interscience publisher 1991. ner and P. Holmes:" Nonlinear Oscillations, Dynamical Systems, and of Vector Fields" Springer 2002. "Ordinary Differential Equations" Society for industrial and applied s 2002					
Kererences							
Electronic Materials							
Other Learning Materials							

Course Name	Partial Diffe	rential e	quations						
Course Information	Course Code	Cour	se No.	Course Level	Cred Hou	it r	Prerequisite(s)		
mormation	Math0817	16	506	3rd	3				
Course Track	Universit	y Require	ement 🗌	College Re	quirement	Specialize	d Core 🗌 Electives		
Course Description:									
This course covers core for partial differential equations such as calculate the integral curves and surfaces of a vector field, solve quasi-linear and linear equations of the first order using suitable different method and apply to the Equations of Mathematical physics.									
Course Objective	s.								
This course provides a clear understanding of the main concepts related to partial differential equations and to solve certain equations of mathematical physics									
<ol> <li>State and recognize the main theorems related partial differential equation</li> <li>Apply to the Equations of Mathematical physics.</li> <li>Calculate the integral curves and surfaces of a vector field.</li> </ol>									
<ul><li>5. Apply to th</li><li>6. Solve given</li></ul>	e Equations of a problems thro	Mathema ugh a hon	tical physic nework	s.	ng suitable (		u.		
Assessment Policy	Assignmer Quizzes, Presentati Project/ R	nts, ions leport		20%		Lab	NA		
	Midterm	+12	30%	Final	50%	Others	NA		
Textbook	<b>Textbook</b> 1. I. G. Petrovsky. Lectures on Partial Differential Equations, Dover Publications, 1992.         2. E. Zauderer. Partial Differential Equations of Applied Mathematics, Wiley-Interscience; 3rd 2006.         3. R. Courant, D. Hilbert. Methods of Mathematical Physics, vol. 2, Wiley-VCH, 1989.         4. Lawrence C. Evans. Partial Differential Equations, American Mathematical Society; 2nd edition, 2010.								
References	ences								
Electronic Materials									
Other Learning Materials									

Course Name	Mathematical Methods							
Course Information	Course Code	Course Code Course No.		Credit Hour	Prerequisite(s)			
	Math0817	1608	4th	3	None			
Course Track	University Requirement College Requirement Specialized Core							

#### **Course Description:**

This course deals with Laplace and Fourier transformations and its applications. Integral operators and Fredholm alternative, Green's functions. Sturm- Liouville expansion, Bessel and Legendre functions. Special Functions of Applied Mathematics.

#### **Course Objectives.**

This course provides a clear understanding of the main concepts related to the common mathematical methods such as: Laplace and Fourier transformations, Integral operators and Fredholm alternative...etc and their applications.

#### **Courses Learning Outcomes:**

- 1. To realize some concepts in mathematical methods such as Laplace and Fourier transformations. Green's functions, integral operators
- 2. To derive Sturm- Liouville expansion
- 3. To write research or a report about the relation between concepts of the course.
- 4. To apply some special Functions
- 5. To solve problems related to the concepts of the course
- 6. Presentation a project on a subject related to the contents of the course.

Assessment Policy	Assignments, Quizzes, Presentations Project/ Report		20%		Lab	NA
	Midterm	30%	Final	50%	Others	NA
Textbook	-R. Courant and D. H	ilbert: "Me	thods of Ma	athematical P	'hysics''	
References	<ol> <li>G. Arfken: "Mathe</li> <li>J. Mathews and R.</li> </ol>	matical Ma L. Walker:	athods for P	hysicists" tical Methods	s of Physics"	
Electronic Materials						
Other Learning Materials						

#### **Elective Courses**

Course Name	The Calculu	us of Variation			
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)
Information	Math0817	1611	5th/6th	4	None
Course Track	Universit	ty Requirement 🗌 (	College Requ	uirement 🗌 S	Specialized Core 🛛 Electives
Course Descripti Gateaux and Fre conditions for ext Erdmann-Weierstr application to mer methods. Variation Course Objective The aim in this cour will make them lea Pontryagin maximu specific special case these well selected a	on: echet differe: remals. Jacol cass condition chanics and t nal methods f es. se is to provide rn how to der m principle an es. Our plan is the cademic problem	ntials. Classical ca bi and Legendre co a. Multiple integral p heory of small osci or eigenvalue probl students with a good ive from first princip d the Hamilton-Jacob o incorporate a compu	lculus of v nditions. Na problems. C llations. Dire ems. background i les many imp i –Bellman ec ter program, s	ariations. Net tural boundary onstrained ext ect method, in n the calculus o portant results s juation to cite a such as Matlab/	cessary conditions. Sufficient y conditions. Broken extrema, trema. Hamilton principle with icluding the Galerkin and Ritz f variations and optimal control. It such as Euler-Lagrange equation, if few, and solve such problems in Python/Julia in order to go beyond
<ul> <li>Courses Learning</li> <li>Show a good un</li> <li>Model variation</li> <li>Derive the main</li> <li>Solve analytica</li> <li>Work profession</li> <li>Communicate r</li> <li>Use mathematic variational and</li> <li>Show good known</li> </ul>	g Outcomes: nderstanding or nal and optimal n results in the lly and/or num- nally and ethic nathematics or cal reasoning a optimal contro wledge of soft	n how to formulate a v control problems calculus of variations erically variational and ally individually and i ally and in written for nd proof techniques t l problems and comm ware tools available to	and optimal pro and optimal c d optimal con n a team m. o formulate, a unicate the res o solve real lif	blem and an op ontrol. trol problems unalyze and solv sults orally and e variational and	timal control problem. ve analytically and/or numerically in written form professionally d optimal control problems
Assessment Policy	Assignme Quizzes, Presentat Project/ F	ents, ions Report	20%	NUL	ab NA
	Midterm	30%	Final	50% C	Others NA
Textbook	I. M. Gelfa Publication	nd and S. V. Fomin, C is, Inc., 2000.	Calculus of Va	riationsPrentice	e-Hall, Inc., 1963; Dover
References	<ul> <li>J. L. T</li> <li>Weins Publica</li> <li>George NY, 19</li> <li>Daniel Introdu</li> </ul>	routman, Variational ( tock, Calculus of Vari ations, Inc., 1974 3) e M. Ewing.Calculus of 985 4) Liberzon,Calculus of action, Princeton, 2012	Calculus and Cations: With A of Variations Variations ar 2	Optimal Control Applications to 1 with Application d Optimal Cont	l, (2nd edition), , Springer 1996 2) Physics and Engineering. Dover ns. Dover Publications,New York, trol Theory: AConcise
Electronic Materials					
Other Learning Materials					

Course Name	Ordinary Di	ifferential Equatior	ns II		
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)
Information	Math0817	1612	5th/6th	4	None
Course Track	Universit	y Requirement 🗌 C	College Requ	iirement 🗌 S	pecialized Core 🛛 Electives
Course Descripti This course deal solution and relate	on: s with the Se ed theorems li	lf-adjoint and non a ke as Sturm-Liouvill	Self-adjoint le theory. Os	boundary-valucillation and	e problems, behavior of the comparison theorems
Course Objective	es.				
This course provider value problems	s a clear unders	tandin <mark>g o</mark> f the main co	ncepts related	to the Self-adjoi	int and non Self-adjoint boundary-
<ol> <li>State the basic</li> <li>Apply Sturn eigenfunction</li> <li>Use Sturm-L</li> <li>Apply Oscill</li> <li>Make a present</li> </ol>	g Outcomes: definitions and n-Liouville theo iouville theo ation and con- entation on a	fundamental results re heory in studying ry in studying the mparison theorems topic in Mathemat	elated to the be the asym hypergeom in finding ics.	oundary value p ptomatic pro etric and simi number of ei	roblems perties of eigenvalues and ilar special functions genvalues
Assessment Policy	A <mark>ssig</mark> nme Quizzes, Presentat Project/ F	nts, ions Report	20%	L	ab NA
	Midterm	30%	Final	50% O	others NA
Textbook	• E. A. C	Coddington and N. Lev	vinson: "Theo	ry of Ordinary I	Differential Equations
References	<ul> <li>K. Yo Public</li> <li>Gucke Bifurc</li> </ul>	osida: "Lectures on ations (April 1, 199 enheimer and P. Hole ations of Vector Fie	Differentia 1) mes:"Nonlin lds Springer	Il and Integra ear Oscilation -Verlag New Y	l Equations" Dover , Dynamical Systems, and York"
Electronic					
Other Learning Materials					

Course Name	Theory Of I	Partial Dif	ferential	Equations	I		
Course	Course Code	Cours	se No.	Course Level	Credit Hour	Prer	equisite(s)
Information	Math0817	161	13	5th/6th	4	None	
Course Track	Universit	y Require	ment 🗌 (	College Red	quirement	Specialized Co	ore 🛛 Electives
Course Description This course is m functions. Sobolev Operator theory, the Course Objective	on: ainly concer spaces, the spectral the s.	ned with Embedding eory of a co	the follow g theorem ompact op	wing topics , compactn perator, Stu	: Distribution ess properties rm-Liouville	ns, Fourier tran , the Trace theo boundary value	nsforms, Green's orem, duality. e problems
At the end of the c understand Greens f spaces to solve some	ourse, student unctions. More boundary val	s are expec eover, to use ue problem	ted to appl e the Embe s including	ly distribution adding and T Sturm-Liou	ons like Fourie race theorems a ville BVP.	r Transform to s as well as use pro	solve IVPs, and to operties of Sobolev
<ol> <li>Courses Learning</li> <li>To state the equations the</li> <li>To discuss Dis</li> <li>To discuss S properties.</li> <li>To use the Tr</li> <li>To adopt the</li> <li>To treat the S</li> <li>Analyze the I homework</li> </ol>	g Outcomes: basic defin ory related t stributions lik bobolev spa- cace theorem spectral theorem turm-Liouv hypotheses of	itions, co o initial a e Fourier t ces and t , and adm ory of a co ille bound of a given	ncepts and nd bound ransforms o apply nit duality ompact op lary value problem	nd some f lary value s, and to ac Embeddin y and opera perator e problems and apply	Fundamental problems lmit Green's g theorem, ator theory.	results in par functions. and understar results encour	rtial differential nd compactness nter it through a
Assessment Policy	Assignme Quizzes, Presentat Project/ I	ents, ions Report		20%	1	Lab	NA
	Midterm	14	30%	Final	50%	Others	NA
Textbook	<ul> <li>I. G. P</li> <li>E. Zau 3rd 20</li> <li>R. Cou Lawre editior</li> </ul>	etrovsky. L iderer. Parti 06. irant, D. Hil nce C. Evar i, 2010	ectures on ial Differer lbert. Meth ns. Partial I	Partial Diffe ntial Equatio ods of Math Differential I	rential Equations of Applied M managements of Applied M ematical Physic Equations, Ame	ns, Dover Public Iathematics, Wil cs, vol. 2, Wiley- rican Mathemati	ations, 1992. ley-Interscience; VCH, 1989. 4. cal Society; 2nd
References	<ul> <li>K. Ye Public</li> <li>Gucke Bifurc</li> </ul>	osida: "Le cations (Ap enheimer a cations of V	ectures on oril 1, 199 .nd P. Hol Vector Fie	n Different 1) mes:"Nonli elds Springe	ial and Integ near Oscilatio er-Verlag New	ral Equations" on, Dynamical S York"	' Dover Systems, and
Electronic Materials	http://www	.math.math	.com				
Other Learning Materials							

Course Name	Theory Of I	Partial Differe	ntial Eq	uations	I		
Course	Course Code	Course No	).	Course Level	Credit Hour	Prer	equisite(s)
Information	Math0817	1614	4	5th/6th	4	08171614	
Course Track	Universit	y Requirement		llege Req	uirement 🗌	Specialized Co	ore 🛛 Electives
<ul> <li>Course Description</li> <li>This course is ma</li> <li>Dirichlet problem</li> <li>Lax-Milgram theo</li> <li>Eigenfunction ex</li> <li>General Linear end</li> <li>Agmon's condition</li> <li>Interior and boundary regundations on clicition</li> <li>Course Objective</li> <li>At the end of the construction of the end of the construction of the end of the construction of the equations the equations the equations the equations of the end of the construction of the end of the en</li></ul>	on: inly concernent of linear ell rem, Garding pansions, Free lliptic problem and coercive dary regulari larity. assical Partia es. urse, students olve some bour what they hav he modern and g Outcomes: basic define ory related t e existence a ome fundam PDE. olm theory to he technique nterior and b hypotheses of	d with the follo iptic equations: 's Inequality an edholm theory. ns: Neuman pro- e problems. ties: Difference I differential equation are expected to I ndary problems r e learnt in Math6 I current direction itions, conception o boundary wand uniqueness ental theorem o determine E s to general lin boundary regulo of a given problems	wing to Existen d existe oblem, A e quotien uations have a cl elated to 13 (Theo ns and ap ots and alue pro s of sol ns: Lay ligenfun hear ell: larities olem an	ppics: nee and u ence of we Adjoint E nts, secon lear under o some par ory of Part oplications some fro oblems utions to x-Milgra nctions, iptic equ of soluti ad apply	niqueness of eak solutions. Boundary-value ad-order scala standing of so tial differential ial Differential of initial value undamental o Dirichlet p um lemma nations ons of PDE. the suitable	solutions, le problem, r equations ne methods that l equations. Mor Equations I). Fu e problems results in par coblem of PD and Garding	t uses properties of reover, students are rthermore, students rtial differential E. s Inequality in nter it through a
Assessment	Assignme Ouizzes.	ents,	1/5 A	1.1	MLAC		
Policy	Presentat Project/ H	ions Report		20%		Lab	NA
	Midterm	30	% <b>F</b>	inal	50%	Others	NA
Textbook	<ul> <li>F. Tre 2006.</li> <li>M. Re Equat</li> <li>V. P.</li> <li>J. Rau</li> <li>J. Jos</li> </ul>	eves. Basic Lin enardy, R. C. I ions, Springen Mikhailov. Pa uch. Partial Di t. Partial Diffe	near Pa Rogers. ;; 2nd e urtial Di fferential	rtial Diff An Intr dition, 2 ifferentia ial Equat Equatio	ferential Equ oduction to 2 004. al Equations tions, Spring ns, Springer	ations, Dover Partial Differe Central Bool er, 1991. 2010.	r Publications , ential ks Ltd, 1979.
References							
Electronic Materials	http://www	.math.math.com					

Other Learning Materials						
Course Name	Boundary \	/alue Problems				
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Information	Math0817	1615	5th/6th	4	08171614	
Course Track	Universit	ty Requirement 🗌 C	College Requ	uirement 🗌 S	Specialized Core	Electives
Course Descripti This course deals v linear integral equat symmetric Hilbert-S second order differe Course Objective This course provide	on: with boundary with boundary with sons, and the N Schmidt kernel, ential operator, es. s a clear unders	value problems using r leumann series. In add approximation metho the regular boundary v standing of the main m	nethods such ition, finding ds, Nonsymm ralue problem uethods related	as Green's fund the solution of hetric Hilbert-Sc and the general d to the boundar	ctions, the theory of the inhomogeneou chmidt operator, sp l singular problems	of distributions, is equation with bectral theory of such as Green's
functions, the theory of distributions, linear integral equations, and the Neumann series.						
<ol> <li>State the bas value problem</li> <li>Apply the C Neumann sen</li> <li>Compute the</li> <li>Apply the ap</li> <li>Use the spect and the gener</li> <li>Make a prese</li> </ol>	ic definition ms Green's funct ties of bound solution of t proximation tral theory of ral singular p entation on a	tions, the theory of lary value problem the inhomogeneous methods and Nons second order diffe problem topic in Mathemat	l results re of distribut s equation v symmetric l prential oper ics.	elated to the tions, linear with symmetr Hilbert-Schm rator, the regu	main concepts integral equati- ic Hilbert-Schn idt operator ilar boundary v	of boundary ons, and the nidt kernel alue problem
Assessment Policy	As <mark>sig</mark> nme Quizzes, Presentat Project/ H	nts, ions Report	20%	L	ab	NA
	Midterm	30%	Final	50% O	)thers	NA
Textbook	• Stakg	old:"Boundary Va	lue Problen	ns of Mathem	natical Physics"	,
References	<ul> <li>M. A. Applic</li> <li>A. Tik</li> </ul>	Pinsky:"Partial Differe ations" honov and A. A. Sama	ential Equatio urski: "Equatio	ns and Boundar ons of Mathema	y Value Problems ttical Physics"	with
Electronic Materials						
Other Learning Materials						

Course Name	Approxima	tion Theory				
Course	Course Code	Course No.	Course Level	Credit Hour	Prere	equisite(s)
Information	Math0817	1616	5th/6th	4	08171614	
Course Track	Universit	y Requirement 🗌 (	College Requ	uirement 🗌 S	pecialized Co	ore 🛛 Electives
Course Description This course is mainterpolation piecew	on: inly concerne ise-polynomia	d with uniform appr l approximation and sp	oximation, b plines, and app	est approximati	on, least squa solutions of dif	are approximation, fferential equations
<b>Course Objective</b> This course provide with the technical t differential equation	<b>s.</b> s understanding pols enabling s.	g of fund <mark>amental meth</mark> them to solve practica	nods and theor al problems in	etical basis of a	pproximation, plation piecewi	to provide students se-polynomial and
<ol> <li>Courses Learning</li> <li>To state not approximation</li> <li>To compute view</li> <li>To apply piece</li> <li>To estimate estimate estimate</li> <li>To apply the</li> <li>Make a present</li> </ol>	g Outcomes: ions of bes n. weak and cla cewise polyr errors analys approximati ntation on a	at approximation assical solutions of aomial approximat is. on theory on the so topic in Mathema	in differen elliptic bou ion in two c olutions of c tics.	t norms and indary value j limensions. differential ec	be able to problems quations	o find the best
Assessment Policy	Assignments, Quizzes, Presentations Project/ Report			NA		
	Midterm	30%	Final	50% O	others	NA
Textbook	<ul> <li>P. J. I Comp</li> <li>N. K Szaba Grouj</li> <li>G. G. Ed., 19</li> <li>M. J. 1981.</li> </ul>	DAVIS. Interpolationary, Ltd., Canada . Govil, H. N. Mha ados, Frontiers in I o, LLC, 2007. Lorentz. Approxim 986. D. Powell. Approx	ion And Ap , 1975. askar, Ram nterpolatior mation of F ximation Th	proximation, N. Mohapatra and Approxi unctions, AM aeory and Met	General Pub a, Zuhair Nas imation , Ta <u>y</u> IS Cheilsea H thods, Dover	olishing shed and J. ylor & Francis Publishing, 2nd r Publications,
References	Mathe	ematical program	as Maple pr	ogram		
Electronic Materials	http://www	.math.math.com				
Other Learning Materials						

Course Name	Numerical	Methods	For Ordir	ary Differe	ntial Equatio	ons	
Course	Course Code	Cour	se No.	Course Level	Credit Hour	Prer	equisite(s)
Information	Math0817	16	17	5th/6th	4	None	
Course Track	Universit	ty Require	ement 🗌 (	College Req	uirement	Specialized Co	ore 🛛 Electives
Course Description This course is mainling begins with a discuss covers topics such a with some projection Course Objective This course provide	on: y concerned w sion of some n s stability and n methods s. es a clear und	ith numeric numerical n instability, erstanding	cal methods nethods for linear syste of various	for solving o solving initia ems and nonl	ordinary differe l value problen inear differenti nethods and th	ntial equations ( ns and boundary al equations. Th eir applications	ODEs). The course value problems. It e course concludes to solve ordinary
differential equation	s (ODEs).	-					
Courses Learning 1. Recogniz ODEs 2. Apply set 3. Discuss t 4. Apply nu 5. Compute 6. Make a p	g Outcomes: e the basic d veral of the r he stability a merical met numerical s resentation o	lefinitions most imp and error hods for s olutions f on a topic	s and fund ortant nur estimates solving bo for some ( a in Mathe	damental re nerical mer of ODEs oundary va ODEs using matics.	esults related thods for sol <sup>4</sup> lue problems g computer p	to the numeri ving initial va programs	cal methods for lue problems
Assessment Policy	As <mark>sig</mark> nme Quizzes, Presentat Project/ H	ents, ions Report		20%		Lab	NA
	Midterm	10	30%	Final	50%	Others	NA
Textbook	G. H. Equat York	Golub an tions: An ,1992, (te	nd J. M. C Introduct ext book).	Ortega," Sci ion to Nun	ientific Comp perical Metho	puting and Di ods", Academ	fferential ic Press, New
References	<ul> <li>J.C. Bit Ltd, 20</li> <li>A. H. S Spring</li> <li>J. D. L 1974.</li> <li>G. Sew John W</li> </ul>	utcher, Nur )03. Stroud. Nur er, 1974. .ambert . C vell. The N Viley & So	merical Met merical Qua omputation umerical So ns, Inc 20	hods for Ord adrature and s al Methods in plution of Ord 05.	inary Different Solution of Ord n Ordinary Diff linary and Part	ial Equations , Jo inary Differentia erential Equation ial Differential E	ohn Wiley & Sons, al Equations , ns, UK, Wiley, Equations , 2nd Ed.
Electronic Materials	http://www	.math.math	n.com				
Other Learning Materials						_	

Course Name	Numerical	Methods	s for Partia	I Different	ial Equations		
Course	Course Code	Cour	rse No.	Course Level	Credit Hour	Prere	equisite(s)
Information	Math0817	16	518	5th/6th	4	None	
Course Track	Universit	ty Require	ement 🗌 (	College Red	uirement	Specialized Co	ore 🛛 Electives
Course Description This course is main discussion of stabilit differential equation applications for solve	Dn: ly concerned w ity and conver is is studied . ring partial diff	with nume gence of n The course ferential ec	rical method numerical sc e concludes puations of a	ls for partia hemes. The with variou pplied math	differential equ n, initial and bo s finite element ematics	ations . The co undary value pr and difference	urse begins with a roblems for partial methods and their
Course Objective This course provide methods, and their a	<b>s.</b> s a clear under pplications to	rstan <mark>ding</mark> o solve parti	of various n al differentia	umerical me al equations	thods ,such as <mark>f</mark> of applied mathe	inite difference ematics.	and finite element
<ol> <li>Courses Learning</li> <li>1. To recog differenti</li> <li>2. To apply various p</li> <li>3. To analyz</li> <li>4. To analyz</li> <li>5. To comp programs</li> <li>6. Make a p</li> </ol>	y Outcomes: nize the bas al equations numerical artial differe ze finite diffe ze finite elen ute numeric resentation o	sic define solution ential equi- erence ment method cal solution a topic	itions and methods, lations wit hethods for hods for y on for ya c in Mathe	concepts finite dit h associat various par arious par rious part ematics.	relating to n ference and ed boundary/ artial differentia tial differentia	umerical met finite elemer initial conditi tial equations l equations . l equations .	thods of partial nt methods, for ions s. using computer
Assessment Policy	Assignments, Quizzes, Presentations Project/ Report			-ab	NA		
	Midterm		30%	Final	50%	Others	NA
Textbook	• L. La Equat	pidus, G tions in S	. F. Pinder Science and	<mark>. Numeric</mark> d Enginee	al Solution of ring , Wiley-I	Partial Diffe	rential 1st Ed, 1999
References	<ul> <li>G. D. Differ</li> <li>S.S. F 2005</li> <li>L. A. Public</li> <li>T. Me Equat</li> <li>C. G Equat</li> </ul>	Smith. M rence Me Rao, The Hagema cations , 2 eis, T Me tions , Sp rossmanu tions , Sp	Numerical ethods, O: finite eler an and D. N 2004. eis, U. Man pringer, 19 n H. Roos. pringer-Ve	Solution of xford Univ nent meth M. Young. rcowitz. N v81. . Numerica prlag Berlin	of Partial Diffe versity Press, ods In Engine Applied Itera umerical Solu al Treatment on Heidelberg 2	erential Equa 1985 ering, 4th Ed tive Methods ttions of Parti of Partial Diff 2007	tionsFinite . Elsevier Inc. , s , Dover ial Differential ferential
Electronic Materials							

Materials	Materials
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Course Name	Mathemati	cal Logic I				
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Information	Math0817	1621	5th/6th	4	None	
Course Track	Universit	y Requirement 🗌 C	College Requ	uirement 🗌 S	Specialized Core 🛛 Electives	
Course Descripti This course is main completeness. First order logic, complet for arithmetic, prime Course Objective At the end of the com	on: nly concerned order logic, qu teness and deci itive recursive a es. urse, students a	with the propositional antifiers and interpre dability, normal forms and recursive functions re expected to have a c	l logic, conn tations, struct , categoricity s, Goedel's in clear understa	ectives and trut sures, first order , ultraproducts a completeness, r nding of the bas	th value, proofs, axiom systems, t theories, proof systems for first and nonstandard analysis. Axioms ecursive undesirability ic notions in Mathematical Logic.	
Courses Learnin1.To recog logic.2.To expre3.To constr4.To use G5.To evalue	g Outcomes: nize and star ss a logic ser ruct abstract oedel's First	te some of the bas ntence in terms of j mathematical proo and Second incom	ic definitio predicates, o fs. pleteness 7	ns of concep quantifiers, a Theorem and	ts concerning Mathematical nd logical connectives related technical results.	
<ol> <li>To evaluate the development of 20th century Mathematical Logic in terms of its relation to the foundations of mathematics.</li> <li>Act in a group to solve diverse problem related to the contents of the course.</li> </ol>						
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nts, ions Report	20%	NORM	ab NA	
	Midterm	30%	Final	50% O	others NA	
Textbook	Midterm30%Final50%OthersNA• E. Mendelson, Introduction to Mathematical Logic, Fourth Edition, CRC Press, 1997• J. D. Monk, Mathematical Logic, Springer Science & Business Media, 2012• J. D. Monk, Mathematical Logic, Springer Science & Business Media, 2012• J. L. Bell and M. Machover, A Course in Mathematical Logic, Elsevier, 1977.					
References						
Electronic Materials						
Other Learning Materials						

Course Name	Mathemati	cal Logic II				
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(	( <b>s</b> )
Information	Math0817	1622	5th/6th	4	None	
Course Track	Universit	y Requirement 🗌 (	College Requ	uirement 🗌 S	pecialized Core 🛛 E	Electives
Course Descripti This course is main the axiom of choice computation, partial Course Objective This course provide	on: by concerned w , the axiom of recursive func es. s a clear unders	ith axiomatic set theor regularity, alternative tions, unsolvable prob	ry, an axiom s axiom systen lems, recursiv oncepts relate	system for set th ns for set theorie vely enumerable d to the basic no	eory, ordinals, ordinal as es. Recursion theories, m sets, decision problems ptions in Mathematical L	rithmetic, nodels for Logic.
Courses Learnin	g Outcomes:	200		the second		
<ol> <li>To recog logic.</li> <li>To under</li> <li>To write</li> <li>To prove</li> <li>To Deter examples</li> <li>Act in a g</li> <li>Presentat</li> </ol>	stand, Expla and analyze some theory mine proper group to solv ion a project	te some of the bas in and interpret a g axiomatic set theo of initial and arith ties Computable, e diverse problem on a subject relate	ic definitio general know ry. metic ordin recursive fu related to the ed to the con	ns of concep wledge of set nals. unctionals an he contents o ntents of the o	ts concerning Mathe s. d functions, a stock f the course course	ematical
Assessment Policy	Assignme Quizzes, Presentat Project/ H	nts, ions Report	20%	L	ab N	NA
	Midterm	30%	Final	50% O	thers N	ΝA
Textbook	<ul> <li>E. Me Press</li> <li>J. D. 1</li> <li>J. L. 1</li> <li>1977.</li> </ul>	endelson, Introduct , 1997 Monk, Mathematic Bell and M. Macho	tion to Math cal Logic, S over, A Cou	nematical Log pringer Scien rse in Mather	ric, Fourth Edition, C ce & Business Medi natical Logic, Elsev	CRC ia, 2012 ier,
References						
Electronic Materials						
Other Learning Materials						

Course Name	Set Theory								
Course	Course Code	Cour	rse No.	Cours Level	e l	Credit Hour	Prer	equisite(s)	
Information	Math0817	10	523	5th/6t	h	4	None		
Course Track	k University Requirement College Requirement Specialized Core Electives								
Course Description This course starts by of calculation of orce groups and the axion	<b>Course Description:</b> This course starts by presenting the basic concept of set theory, the ZF axioms of set theory, group theory, the realization of calculation of ordinals and original numbers, cardinals, and absoluteness, reflection theorems, constructible sets and groups and the axiom of constructability and forcing.								
Course Objective At the end of the co theory, group theor cardinals, and absol forcing.	es. Durse, the stud y, the ZF axio luteness, reflec	ents are entry of set	xpected to h t theory, the ems, constru	ave a clea realizatio actible set	ar ur on o s an	nderstanding f calculation d groups and	of the fundamer of ordinals and the axiom of c	ntals concept of set original numbers, constructability and	
Courses Learning	g Outcomes:	Y	-						
<ol> <li>State the</li> <li>Recogniz</li> <li>To under of reflect</li> <li>State the</li> <li>Interpret</li> <li>Analyze to</li> <li>Apply the</li> <li>Work effi- or as a m</li> <li>Take resp attention</li> <li>Express to</li> <li>Collect ir subject at</li> <li>Communi- orally and</li> </ol>	<ol> <li>State the basic definitions, concepts and some fundamental results in set theory.</li> <li>Recognize the notion of infinity and arithmetic of the cardinals and ordinals.</li> <li>To understand the Axiom of Choice, Zorn's Lemma and well-ordering principle, the theories of reflection</li> <li>State the Axiom of Choice, Zorn's Lemma and well-ordering principle</li> <li>Interpret Constructible Sets and the axiom of constructability.</li> <li>Analyze the hypotheses of a given problem</li> <li>Apply the postulates of ZF of group theory</li> <li>Work effectively and constructively in group or team situations, whether in a leadership role or as a member of a group.</li> <li>Take responsibility for continuing learning, take initiative in identifying issues requiring attention and benefit from opportunities for personal and career development.</li> <li>Express understanding or conclusion by writing an essay or a thesis</li> <li>Collect information from a variety of sources in order to gain a coherent understanding of the subject area and produce a concise summary of the information</li> </ol>						pry. ple, the theories a leadership role issues requiring t. erstanding of the engagingly both		
Assessment Policy	Assignme Quizzes, Presentat Project/ I	ents, ions Report		20%			Lab	NA	
	Midterm		30%	Final		50%	Others	NA	
Textbook	<ul> <li>K. Devlin, "The Joy of sets: Foundation of Centemporary Set Theory", Undergraduate Text in Mathematics, Second edition, Springer-Verlag (1994).</li> </ul>							et Theory", er-Verlag	
References	<ul> <li>T. Jec Verla</li> <li>K. Ku in Lo</li> </ul>	ch, "Set 7 g (2006) inen, "Se gic and t	Theory", S et Theory: he Founda	pringer An Intro tion of N	Mon oduc Matl	nograph in ction to Ind hematics-N	Mathematics, ependence Pr orth Holland	Springer- oofs", Studies (1983).	

Electronic Materials	
Other Learning Materials	

Course Name	Model Theo	pry						
Course	Course Code	Course No.	Course Level	Credit Hour	Prer	equisite(s)		
Information	Math0817	1624	5th/6th	4	None			
Course Track	Universit	y Requirement 🗌	College Re	quirement 🗌	Specialized Co	ore 🛛 Electives		
Course Description This course deals with	<b>Course Description:</b> This course deals with the relation between a formal language and its interpretations, or models.							
Course Objective This course provide structures in pure ma	<b>s.</b> s a clear under athematics.	standing of the main	concepts re	lated to shows	how to apply lo	ogic to the study of		
Courses Learning	g Outcomes:	6						
<ol> <li>State the main con- main con- 2. Recall an sentential</li> <li>Demonstrisets in pa for partia theorem.</li> <li>Apply monther appl</li> <li>Demonstricet</li> <li>Use satur</li> <li>Make a partial</li> </ol>	e the basic notions and definitions of model theory and fundamental results related to the n concepts of model theory. all and refine some definitions from the entries on classical logic and model theory for ential logic, languages, theories and examples of theories. nonstrate models constructed from constants to analyze compactness-like properties of in partial metric spaces and obtain the equivalence of several forms of the compactness partial metric spaces. Generalizations of omitting type's theorem and interpolation rem. dy model-theoretic constructions such as elementary extensions, elementary chains and r applications, indiscernible and model completeness. nonstrate ultra products fundamental theorem and measurable cardinals. saturated and special models for applications to field theory.							
Assessment Policy	Assignmer Quizzes, Presentati Project/ R	nts, ons eport	20%		Lab	NA		
	Midterm	30%	Final	50%	Others	NA		
Textbook	• Chang	g and Keisler: "Mo	odel Theor	у"				
References	• W. Ho	odges: "A Shorter	Model Th	eory"				
Electronic Materials								
Other Learning Materials								

Course Name	Proof Theo	Ŷ							
Course	Course Code	Cour	rse No.	Course Level	Credit Hour	Prer	equisite(s)		
Information	Math0817	10	525	5th/6th	4	None			
Course Track	Universit	y Require	ement 🗌 (	College Red	quirement	Specialized Co	ore 🛛 Electives		
<b>Course Descripti</b> To grasp the basic u	<b>Course Description:</b> To grasp the basic understanding of proof theory and its relation to other parts of logic and computer science.								
Course Objective At the end of the co logic and its role in programming langu	<b>Course Objectives.</b> At the end of the course, students are expected to have a clear understanding of Proof theory for sentential and first order logic and its role in logic, the resolution systems for proof, the cut elimination theorem and the use of logic as a programming language.								
<b>Courses Learnin</b>	g Out <mark>com</mark> es:								
<ol> <li>State the</li> <li>Perform s         <ul> <li>of set ope</li> <li>Write sol</li> <li>content, of</li> <li>Determini</li> <li>To under</li> <li>Create in</li> <li>Analyze s</li> <li>Interpret</li> <li>Make a p</li> </ul> </li> </ol>	<ol> <li>State the logical structure of proofs.</li> <li>Perform set operations on finite and infinite collections of sets and be familiar with properties of set operations</li> <li>Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support, and style and mechanics.</li> <li>Determine equivalence relations on sets and equivalence classes.</li> <li>To understand the nature of a formal system</li> <li>Create intuition-forming examples or counterexamples, and prove conjectures.</li> <li>Analyze resolution and its use in proofs.</li> <li>Interpret the theoretical underpinning of logic programming</li> <li>Make a presentation on a topic in Mathematics</li> </ol>								
Assessment Policy	Assignme Quizzes, Presentati Project/ R	nts, ions teport		20%		Lab	NA		
	Midterm		30%	Final	50%	Others	NA		
Textbook	<ul> <li>Jean H. Gallier, Logic for computer science: Foundation of automatic theorem proving, Courier Dover Publications, 2015.</li> <li>Zbigniew Stachniak, resolution proof systems: An algebraic theory, Springer Science &amp; Business Media, 2012.</li> <li>A. S. Troelstra, and H. Shwichtenberg: 'Basic proof theory, Cambridge University Press, 2000.</li> </ul>								
References	•								
Electronic Materials									

Other Learning	
Materials	

Course Name	Theory of c	omputation						
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)			
Information	Math0817	1626	5th/6th	4	None			
Course Track	Universit	y Requirement 🗌 C	College Requ	uirement 🗌 S	Specialized Core 🛛 Electives			
<b>Course Description:</b> This course deals with various models of computation such as Turing machines, recursive functions, Markov algorithm, Lambda calculus. It concerned also with undecidable problems, strong reducibility and weak reducibility.								
Course Objective This course provide of problems	es. s a clear unders	standing of the main c	oncepts relate	ed to the concer	ots of computation, and solvability			
<ol> <li>State the</li> <li>Perform s         <ul> <li>of set ope</li> <li>Write sol</li> <li>content, of</li> <li>Determini</li> <li>To under</li> <li>Create in</li> <li>Analyze s</li> <li>Interpret</li> <li>Make a p</li> </ul> </li> </ol>	<ol> <li>Courses Learning Outcomes:         <ol> <li>State the logical structure of proofs.</li> <li>Perform set operations on finite and infinite collections of sets and be familiar with properties of set operations</li> <li>Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support, and style and mechanics.</li> <li>Determine equivalence relations on sets and equivalence classes.</li> <li>To understand the nature of a formal system</li> <li>Create intuition-forming examples or counterexamples, and prove conjectures.</li> <li>Analyze resolution and its use in proofs.</li> <li>Interpret the theoretical underpinning of logic programming</li> <li>Make a presentation on a topic in Mathematics</li> </ol> </li> </ol>							
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nts, ions Report	20%	NUMER	ab NA			
	Midterm	30%	Final	50% C	Others NA			
Textbook	<ul> <li>Jean H. Gallier, Logic for computer science: Foundation of automatic theorem proving, Courier Dover Publications, 2015.</li> <li>Zbigniew Stachniak, resolution proof systems: An algebraic theory, Springer Science &amp; Business Media, 2012.</li> <li>A. S. Troelstra, and H. Shwichtenberg: 'Basic proof theory, Cambridge University Press, 2000.</li> </ul>							
References	•							
Electronic Materials								
Other Learning Materials								

Course Name	Commutati	ve Algebra								
Course	Course Code	Course No.	Cours Level	e Credi Hour	t Prer	equisite(s)				
Information	Math0817	1633	5th/6t	n 4	None					
Course Track	Universit	University Requirement College Requirement Specialized Core Electives								
<b>Course Description:</b> This course deals with the commutative rings and modules, prime ideals, localization, noetherian rings, primary decomposition, integral extensions and Noetherian normalization, the Nullstellensatz, dimension, flatness, Hensel's lemma, graded rings, Hilbert polynomials, valuations, regular rings, singularities, unique factorization, homological dimension, depth, completion.										
Course Objective This course provide	s a clear under	standing of the main	n concepts re	ated to comm	itative rings and m	odules.				
<b>Courses Learning</b>	g Outcomes:	1	1							
<ol> <li>State the modules,</li> <li>State the Hensel's</li> <li>Classify the homologi</li> <li>Apply so</li> <li>Make a p</li> </ol>	he basic definitions and fundamental results related to the commutative rings and es, prime ideals, and localization the basic definitions and fundamental results related to the dimension , flatness , l's lemma, graded rings, Hilbert polynomials fy the primary decomposition. the some basic theorem valuations, regular rings, singularities, unique factorization , ogical dimension , depth ,completion some basic theorem in integral extensions and Noetherian normalization									
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nts, ions Report	20%	UNIVER	Lab	NA				
	Midterm	30%	Final	50%	Others	NA				
Textbook	• M. P.	Atiyah. and I. C	6. MacDon	ald:"Introdu	ction to Comm	utative Algebra"				
References	<ul> <li>I. Kaplansky: "Commutative Rings"</li> <li>O. Zariski and P. Samuel: "Commutative Algebra" (2 vols)</li> </ul>									
Electronic Materials										
Other Learning Materials										

Course Name	Arithmetic	algebra									
Course	Course Code	Course No.	Course Level	Credit Hour	Preree	quisite(s)					
Information	Math0817	1634	5th/6th	4	None						
Course Track	Universit	University Requirement College Requirement Specialized Core Electives									
<b>Course Description:</b> The course is mainly concerned with: the Properties of affine and projective varieties on algebraically closed field, compatibility (harmonic) of Ideals and localization, measurable map, measurable Paired geometry, Division on curves and surfaces, Introduction to schemes, The Riemann-Roch theorem for projective curves.											
<b>Course Objective</b> At the end of the algebraically clo	es: course, stud sed field, and	ents are expected d algebraic geome	to have a cl etry.	ear understar	nding of <mark>var</mark> iet	ties on					
<ol> <li>State the Ideals an</li> <li>Classify :</li> <li>Apply the</li> <li>Apply Ri</li> <li>Make a p</li> </ol>	<ul> <li>Courses Learning Outcomes: <ol> <li>State the basic definitions and fundamental results related to compatibility (harmonic) of Ideals and localization</li> <li>Classify measurable map, and measurable Paired geometry.</li> <li>Apply the properties of affine and projective varieties on algebraically closed field.</li> <li>Apply Riemann-Roch theorem for projective curves.</li> <li>Make a presentation on a topic in Mathematics.</li> </ol> </li> </ul>										
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nts, ions Report	20%	L	ab	NA					
	Midterm	30%	Final	50% C	Others	NA					
Textbook	• R. Mi Algeb	nes, F. Richman, ora"	W. Ruitenb	urg: " A Cou	rse in Constru	ctive					
References	<ul> <li>W. V. Vasconcelos:" Computational Methods in Commutative Algebra and Algebraic Geometry"</li> <li>D. Cox, J. Little, and D. O'Shea" Ideals Varieties and Algorithms"</li> </ul>										
Electronic Materials											
Other Learning Materials											

Course Name	Rings and N	Aodules					
Course	Course CodeCourse No.Course LevelCredit HourPrerequisite(s						
Information	Math0817	1635	5th/6t	h	4	None	
Course Track	Universit	ty Requirement 🗌	College F	equiren	nent 🗌 S	pecialized Co	ore 🛛 Electives
Course Description This course deals we Schmidt theorem. Of Projective modules, Density theorems. A Course Objective At the and of the co	Course Description: This course deals with Artinian and Noetherian modules. Schreier theorem and the JordanHolder theorem. The Krull- Schmidt theorem. Completely reducible modules. Invariance of dimension. Tensor products, and the Hom functor. Projective modules, Injective modules and the injective hull. Primitivity and semiprimitivity. The radicals of a ring. Density theorems. Artinian rings. The Wedderburn-Artin theorem. Special rings. Course Objectives:						
Injective modules an	nd th <mark>e in</mark> jective	hull, and the main the	eorem that	ar <mark>e rel</mark> at	ted to Mod	ules	Tojective modules,
<ol> <li>Courses Learning</li> <li>State the</li> <li>Understat</li> <li>Become a proofs of</li> <li>Understat</li> <li>Understat</li> <li>Understat</li> <li>Become a algebras</li> <li>Analyze t a homew</li> </ol>	g Outcomes: basic definit nd the defini familiar with properties o nd the Weed the concept o familiar with the hypothes ork	ions, concepts and tion of Artinian rin h the tensor produ f injective and pro- erburn-Artin theor f radical of a ring and h the structure the es of a given probl	l some funds and the some function of the solution of the solu	heir ba heir ba he Hon hodules imple r its impo gebras	ntal resul sic prope n functor s rings ortance and appl	ts in Module rty and use the y it to the st e results enco	e theory. eir properties in tudy of Clifford ounter it through
Assessment Policy	Assignme Quizzes, Presentat Project/ H	ents, ions Report	20%		L	ab	NA
	Midterm	30%	Final	509	% 0	others	NA
Textbook	<ul> <li>F. W. Anderson, and K. R. Fuller: Rings and categories of Module, Springer-Verlag, 1973.</li> <li>T. W. Hungerford: Algebra, Springer-Verlag, 1974.</li> </ul>						
References	<ul> <li>K. R Dekk</li> <li>R. W Londo</li> <li>J. Lat</li> </ul>	. Goodearl: Ring T er inc., 1976 'isbauer: Foundation, 1991 nbek: "Lectures on	Theory, r on of mc n Rings a	on-sing dules, a and Mo	gular ring and Ring dules"	s and modul theory, Goro	les, Marcel don and Breach

	<ul> <li>M. Gray.: "A Radical Approach to Algebra"</li> <li>N. J. Divinsky:" Rings and Radicals"</li> <li>I. N. Herstein.:" Noncommutative Rings"</li> </ul>
Electronic Materials	
Other Learning Materials	

Course Name	Fields and (	Galois The	eory					
Course	Course Code	Cour	se No.	Cours Level	e	Credit Hour	Prer	equisite(s)
Information	Math0817	16	36	5th/6t	h	4	None	
Course Track	Universit	ty Require	ement 🗌 (	College R	equire	ment 🗌 S	pecialized Co	ore 🛛 Electives
Course Description It is mainly concern Algebraic extension correspondence, not algebraic functions	<b>Course Description:</b> It is mainly concerned with discussing Fields, Fields extensions, transcendental extensions and transcendental basis. Algebraic extensions, separable and radical extensions, normal and Galois extension. Classical Galois theory, the Galois correspondence, norm and trace, cyclotomic extensions, solvable extensions, the theory of equations. Introduction to algebraic functions							
Course Objective At the end of the cou extensions and solva	es: urse, students a able extensions	re expected	l to have a c	clear under	rstandin	ng of normal	and Galois ext	tension, cyclotomic
<ol> <li>State the extension</li> <li>Interpret and radic</li> <li>Discuss c</li> <li>Apply Cl</li> <li>Judge condition</li> <li>Solve give</li> </ol>	basic defin transcendent al extension concepts of n assical Galo ncepts of c ion to algebra en problems	itions, co tal extens s, ormal an is theory, yclotomic raic funct s through	oncepts a ions and t d Galois o the Galo c extensions a homew	nd some transcend extension is corres ons, sol <sup>y</sup> ork	e fund lental n ponder vable	lamental r basis. Alg nce, norm extensions	esults in Fi ebraic exten and trace, s, the theor	elds and Fields sions, separable y of equations.
Assessment Policy	Assignme Quizzes, Presentat Project/ H	ents, ions Report		20%		$\mathbf{L}_{i}$	ab	NA
	Midterm		30%	Final	50	0% O	thers	NA
Textbook	<ul><li>H. M</li><li>I. Ster</li></ul>	. Edwards ward: "G	s: " Galoi alois The	s Theory ory"	,,,			
References	<ul> <li>D. Winter: "The Structure of Fields"</li> <li>E. Artin: "Galois Theory</li> </ul>							
Electronic Materials								
Other Learning Materials								

Course Name	Group Theo	ory						
Course	Course Code	Course 1	No.	Cours Leve	se 1	Credit Hour	Prer	equisite(s)
Information	Math0817	<mark>1637</mark>		5th/6	h	4	None	
Course Track	Universit	<mark>y Req</mark> uireme	ent 🗌 (	College I	Requir	ement	Specialized C	ore 🛛 Electives
<b>Course Descripti</b> It is mainly concerner, nilpotent groups. If the general linear g relations. Represent	<b>Course Description:</b> It is mainly concerned with discussing groups, Sylow theorems, normal series, Jordan-Holder theorem, solvable groups, nilpotent groups. Extensions and semidirect products, factor sets, the Schur-Zassenhaus lemma, some simple groups, the general linear group, the special linear group, groups of projective transformations. Free groups, generators and relations. Representations of groups and the group algebras, characters. Induced representations, Representations of Sn.							
<b>Course Objective</b> At the end of the co algebras, characters	es: urse, students a . Induced repres	re expected to sentations and	have a represe	clear und	erstand of Sn	ding of repr	esentations of gr	oups and the group
<ol> <li>Courses Learning</li> <li>State the theory</li> <li>Discuss of groups ni</li> <li>Apply the</li> <li>Interpret of project</li> <li>Represen Represen</li> <li>Solve give</li> </ol>	g Outcomes: basic definit concepts of lipotent group e Schur-Zass the Some sin tive transforn tations of g tations of Sm ven problems	ions, concep Sylow theo ps. solvable enhaus lem nple groups nations Free roups and through a h	ots and orems, group ma , the g group the gr the gr	l some fr Normal s , Exter eneral li ps, gene roup alg	indan serie nsions near rators ebras	nental res es , Jorda s and sem group , th and relat s, charact	ults in groups an-Holder the idirect produc ie special lines ions ers. Induced	and basic group orem , solvable ets, factor sets. ar group, groups representations.
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nts, ions Report		20%			Lab	NA
	Midterm		30%	Final	4	50%	Others	NA
Textbook	• 1. J. F	Rotman: "Th	e The	ory of G	roups	;"		
References	<ul><li>J. S. F</li><li>M. Ha</li></ul>	Rose: "A Co all: " The Th	ourse ir neory o	n Group of Group	Theo s	ry"		
Electronic Materials								

Other Learning	
Materials	

Course Nome									
Course Name	Introduction To Harmonic Analysis								
Course	Course Code	Cour	se No.	Course Level	Credi Hour	it ·	Prere	equisite(s)	
Information	Math0817	16	45	5th/6th	4		None		
Course Track	University	Require	ement	College Re	equirement	🗆 Sp	pecialized Co	re 🛛 Electives	
<b>Course Description:</b> This course deals Fourier transforms on locally compact abelian groups, Haar measure, PaleyWiener and Tauberian theorems, dual groups, commutative Banach algebra.									
<b>Course Objectives:</b> At the end of the course, students are expected to have a clear understanding of Harmonic analysis on the torus, on the real line, on R^d, and on finite abelian groups.									
<ol> <li>State the basic definitions, concepts and some fundamental results in Harmonic Analysis.</li> <li>State the basic Formulate and prove main propositions related to Fourier series and Fourier transform.</li> <li>Apply Paley-Wiener and Tauberian Theorems.</li> <li>Apply Fourier analysis on uncertainty principles.</li> </ol>									
Assessment Policy	Assignmer Quizzes, Presentati Project/ R	nts, ons eport		20%		La	ıb	NA	
	Midterm		30%	Final	50%	Ot	thers	NA	
Textbook	Midterm30%Final50%OthersNA• Y. Katznelson: An Introduction to Harmonic Analysis. Cambridge Press, 2004.Third edition (Textbook).• R. E. Edwards, Fourier Series: A Modern Introduction. Inc. New York, 1967.• H. Reieter and J. D. Stegeman: Classical Harmonic Analysis on Locally Compact Groups. Oxford Science Publications, 1968.• W. Rudin: Fourier Analysis on Groups. Interscience Publishers.Inc.1962.• Robert Strichartz: A Guide to Distribution Theory and Fourier Transforms (Studies in Advanced Mathematics) 1994								

References	• Y. Katznelson. An Introduction to Harmonic Analysis. Cambridge Press, 2004. Third edition (Textbook).
Electronic Materials	
Other Learning Materials	

Course Name	Functional A	nalysis(I)							
Course	Course Code	Course N	lo.	Cours Leve	se I	Credit Hour	Prer	equisite(s)	
Information	Math0817	1646		5th/6	th	4	None		
Course Track	University Requirement College Requirement Specialized Core Electives								
<b>Course Description:</b> Normed linear spaces. Bounded and unbounded linear operators. Linear functionals. Duality. Hilbert spaces. Open mapping theorem. Closed graph theorem. Uniform boundedness principle. Bilinear forms and the Lax-Milgram lemma. Adjoints and closed range theorem. Banach algebras. Maximal ideals and multiplicative functionals. Commutative Banach algebras. The spectral theory of normal operators on Hilbert spaces									
Course Objective This course provide and Banach algebra.	<b>Course Objectives:</b> This course provides a clear understanding of the main concepts related to Banach and Hilbert spaces, spectral theory and Banach algebra.								
<ol> <li>Courses Learning Outcomes:         <ol> <li>To state the basic definitions, concepts and some fundamental results on Banach and Hilbert spaces, spectral theory and Banach algebra.</li> <li>Identify normed spaces and examine linearity, boundedness of operators</li> <li>Apply Functional theorems (Baire-theorem, Uniform boundedness theorem, closed graph theorem and Lax Milgram Theorem).</li> <li>Identify Hilbert spaces and show the familiarity with the basic notions defined on Hilbert spaces.</li> <li>Identify Banach algebra and show the familiarity with the basic notions of maximal ideals and multiplicative functionals</li> <li>Apply the theoretical results to find the spectrum of a linear bounded operator</li> <li>Analyze the hypotheses of a given problem and apply the suitable results encounter it through a homework</li> </ol> </li> </ol>									
Assessment Policy	Assignmer Quizzes, Presentati Project/ R	nts, ons eport	20% Lab NA						
	Midterm	3	0%	Final	5	0%	Others	NA	
Textbook	<ul> <li>W. Ru 1991.</li> <li>K. You</li> </ul>	din .Functio	onal Ai onal A	nalysis. nalysis.	McGi Berli	raw-Hill n .Spring	Science, Secon ger-Verlag. thin	nd edition rd edition 1971.	

	<ul> <li>- E. Kreyszig. Introductory Functional Analysis with Applications. John Wiley&amp;Sons,Inc. Second edition 1989.(Text book).</li> <li>F. Riesz and B. Sz-Nagy . Functional Analysis. New-York. Ungar 1955</li> </ul>
References	<ul> <li>A. P. Robertson and W. Robertson. Topological Vector Spaces. Cambridge University Press.1964.</li> <li>H.H.Schaefer and M.P.Wolff. Topological vector spaces. Berlin. Springer- Verlag Second edition 1991.</li> <li>A.N.Kolmogorov and S.V.Fomin. Introductory Real Analysis.Dover Publications,Inc.New York.1970.</li> </ul>
Electronic Materials	
Other Learning Materials	

Course Name	Functional Analysis(II)								
Course	Course Code	Cours	e No.	Cours Leve	se 1	Credit Hour	Prer	equisite(s)	
Information	Math0817	164	7	5th/6	h	4	None		
Course Track	University	University Requirement College Requirement Specialized Core Electives							
<b>Course Description:</b> Topological vector spaces. Locally convex spaces. The Hahn-Banach theorem. Duality. Topologies on the dual space. The spaces of test functions and distributions. Generalized derivatives. Sobolev spaces. Applications to partial differential equations.									
Course Objective This course provides	<b>Course Objectives:</b> This course provides a clear understanding of the main concepts related to topological spaces and Sobolev spaces.								
<ul> <li>Courses Learning Outcomes: <ol> <li>State the basic definitions, concepts and some fundamental results in topological vector</li> <li>Realize basic properties of topological vector spaces</li> <li>Realize the properties of locally convex spaces</li> <li>Realize the properties the Sobolev spaces</li> <li>Apply Hann Banah Theorem</li> <li>Analyze the hypotheses of a given problem and apply the suitable results encounter it through a homework</li> </ol> </li> </ul>									
Assessment Policy	Assignmen Quizzes, Presentatio Project/ R	nts, ons eport	20% <b>Lab</b> NA					NA	
	Midterm		30%	Final	4	50%	Others	NA	
Textbook	<ul> <li>W. Rudin .Functional Analysis. McGraw-Hill Science, Second edition 1991.</li> <li>K. Yosida. Functional Analysis. Berlin .Springer-Verlag. third edition 1971.</li> </ul>								
References	• A. P. I Univer	Robertson rsity Pres	n and W. s.1964.	Roberts	son. T	`opologica	l Vector Spac	ces. Cambridge	

Electronic Materials	
Other Learning Materials	

Course Name	Theory of Operators								
Course	Course Code	Cour	rse No.	Course Level	Credit Hour	Prer	equisite(s)		
Information	Math0817	16	548	5th/6th	4	None			
Course Track	University Requirement College Requirement Specialized Core Electives								
<b>Course Description:</b> Brief idea on the spectral of a bounded linear operator, Hilbert-adjoint of linear bounded operator, spectral theory of bounded linear operators, spectral properties of compact operators in Hilbert spaces, operator equations involving compact operators, Fredholm alternative, spectral properties of self-adjoint linear operators. Spectral theory in Banach algebra.									
<b>Course Objectives:</b> At the end of the course, students are expected to have a clear understanding the spectral theory of different kind of linear bounded operators such as self-adjoint and compact operators. Moreover, the properties of unbounded linear operators									
<ol> <li>To state different</li> <li>To recog</li> <li>To realiz</li> <li>To apply compact</li> <li>Solve give</li> </ol>	<ol> <li>To state the basic definitions, concepts and some fundamental results in spectral theory for different kind of operators</li> <li>To recognize some properties of linear bounded or unbounded operators</li> <li>To realize the spectrum of different kind of operators.</li> <li>To apply the properties of compact operators. in studying the solutions of equations involving compact operators</li> <li>Solve given problems through a homework.</li> </ol>								
Assessment Policy	Assignme Quizzes, Presentat Project/ I	ents, ions Report	14/3	20%	MORES	Lab	NA		
	Midterm		30%	Final	50%	Others	NA		
Textbook	<ul> <li>Gohberg and S. Goldberg. Basic Operator Theory. Birkhauser. Boston sel.Stuttgart.1981</li> <li>E. Keyszig: Introductory; Functional Analysis with Applications. John Wiley &amp;Sons (1978).</li> </ul>								
References	S. Go McG	oldberg. U raw-Hill,	Jnbounde New-Yo	d Linear C rk.1966	Operators: Th	eory and App	lications.		
Electronic Materials									
Other Learning Materials									

Course Name	Banach Alg	Banach Algebras									
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)						
Information	Math0817	1649	5th/6th	4	None						
Course Track	Universit	University Requirement College Requirement Specialized Core Electives									
<b>Course Description:</b> This course deals with Banach Algebras, their essential properties, Gelfand transform, algebras of operators on Hilbert spaces, spectral theorem, W* and C* algebras.											
Course Objectives: This course provides a clear understanding of the main concepts related to Banach Algebras											
<ol> <li>State the basic definitions and fundamental results related to the main concepts in Banach algebras.</li> <li>Compute the Gelfand transform.</li> <li>Analyse operator algebras on Hilbert spaces.</li> <li>Find the spectrum of some operators.</li> <li>Apply the properties of W* and C* algebras.</li> <li>Make a presentation on a topic in Mathematics</li> </ol>											
Assessment Policy	Assignme Quizzes, Presentati Project/ R	nts, ions Report	20%	NULL	ab NA						
	Midterm	30%	Final	50% C	others NA						
Textbook	Textbook       • W. Rudin .Functional Analysis. McGraw-Hill Science, Second edition 1991.										
References	Brow     W. At	der: "Introduction veson: "An Invita	to Function ation to C* 1	n Algebras" Algebras"							
Electronic Materials											
Other Learning Materials											

Course Name	Numerical Methods for Linear Algebra										
Course	Course Code	Course No.	Course Level	Credit Hour	Prer	equisite(s)					
Information	Math0817	1651	5th/6th	4	None						
Course Track	Universit	University Requirement College Requirement Specialized Core Electives									
<b>Course Description:</b> This course is mainly concerned with direct methods, iterative methods, error analysis for solving linear systems. Generalized inverses orthogonalization and least square. The eigenvalue problem, iterative methods for eigenvalue problems, reductions, the QR method, tridiagonal forms, The Rayleigh-Ritz procedure.											
<b>Course Objectives:</b> Definition and properties of matrices- Matrix norms, sequences and series- Linear systems, direct methods - Linear systems, Iterative methods - Methods for computing eigenvalues and eigenvectors - Generalized Inverse of matrices and least square problems.											
<ol> <li>Courses Learning Outcomes:         <ol> <li>To state the basic definitions, concepts, and some fundamental results in numerical linear algebra.</li> <li>Recognize matrices of important special classes, such as normal, unitary, Hermitian, positive definite</li> <li>Approximate eigenvalues and eigenvectors of matrices</li> <li>Solve least square problems using Generalized Inverse of matrices and singular value decomposition.</li> </ol> </li> </ol>											
Assessment Policy	Assignme Quizzes, Presentat Project/ I	ions Report	20%	Note:	ab	NA					
	Midterm	30%	Final	50%	Others	NA					
Textbook	G. H. Servi	G. and C. F. Van ce; 3rd Ed. , 1996	Loan . Ma (Textbook	trix Computat )	ions Hopkins	s Fulfillment					
References	<ul> <li>G. Allaire S. M. Kaber. Numerical Linear Algebra , Springer Science+Business Media, LLC, 2008 3</li> <li>Harue Yanai, Kei Takeuchi, Yoshio Takane, Projection Matrices, Generalized Inverse Matrices, and Singular Value Decomposition, Springer New York Dordrecht Heidelberg London, Springer Science+Business Media, LLC 2011</li> </ul>										
Electronic Materials	http://www	.mathworks.com/help	/symbolic/lin	near-algebra-1.ht	ml						
Other Learning Materials	Ť										

Course Name	Special functions in Applied Mathematics									
Course	Course CodeCourse No.Course LevelCredit HourPrerequisite(s)									
Information	Math0817	1653	5th/6th	4	None					
Course Track	University Requirement College Requirement Specialized Core Electives									
<b>Course Description:</b> This course deals with Gamma function, Beta function, the Hypergeometric function, Bessel functions, Legendre polynomials, Orthogonal polynomials, Elliptic functions.										
<b>Course Objective</b> At the end of the condifferential equation the Gamma, Beta, I then essentially a c Legendre, Hermite	<b>Course Objectives:</b> At the end of the course, students are expected to have a clear understanding of certain ideas concerning advanced partial differential equations and their solutions in real life. This enables us to define more clearly some special functions like the Gamma, Beta, Hypergeometric, Bessel, and Generalized hypergeometric functions. The remainder of the course is then essentially a catalogue of "prototype" solutions of these equations. We also give special theorem in orthogonal, Legendre, Hermite and Leguerre polynomials.									
Courses Learnin	g Outcomes:	1 1								
<ol> <li>To revisi</li> <li>To comp</li> <li>To analy Bessel, h</li> <li>To expla application</li> <li>To solve</li> <li>To apply problems</li> </ol>	<ol> <li>To revisit the basic definitions, concepts and fundamentals of Partial Differential Equations.</li> <li>To compute some special integrations by using the definitions of Gamma and Beta functions</li> <li>To analyze the PDE problems and develop the solutions using some special functions like Bessel, hypergeometric, Generalized hypergeometric and Legendre polynomials</li> <li>To explain the use of these special functions and their properties and develop some applications.</li> <li>To solve problems related to the concepts of the course.</li> <li>To apply the special functions and their use in the solution of pure and applied mathematics problems.</li> </ol>									
Assessment Policy	Assignme Quizzes, Presentat Project/ H	ions Report	20%	L	ab NA					
	Midterm	30%	Final	50% O	others NA					
Textbook	• E. D. Rainville: "Special Functions"									
References	<ul> <li>H. Hochstadt: "The Functions of Mathematical Physics"</li> <li>N. N. Lebedev: "Special Functions and Their Applications"</li> </ul>									
Electronic Materials										
Other Learning Materials										

Course Name	Integral Tra	ntegral Transforms and Operational Methods								
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)					
Information	Math0817	1654	5th/6th	4	None					
Course Track	Universit	University Requirement College Requirement Specialized Core Electives								
Course Descripti This course deals w and Hankel transfor	<b>Course Description:</b> This course deals with the different integral transforms such as Fourier transform, Laplace transform, Mellin transform and Hankel transform as well as their applications in operational calculus.									
<b>Course Objective</b> This course provide applications.	es: es a clear unde	rstanding of the main	n concepts rela	ated to the com	mon integral transforms and their					
<b>Courses Learnin</b>	g Outcome <mark>s:</mark>	1 -	-	1 C						
<ul> <li>transform</li> <li>8. Compute</li> <li>9. Apply the functiona</li> <li>10. Apply the 11. Use the larelated to related to the functional</li> </ul>	<ol> <li>State the basic definitions and fundamental results related to the main concepts of integral transforms</li> <li>Compute the integral transforms of several functions using different analytical methods.</li> <li>Apply the Fourier and Laplace transforms in computing improper integrals, solving functional equations and ordinary or partial differential equations</li> <li>Apply the Mellin transform in studying the zeta function and computing some series sums</li> <li>Use the Hankel transform in studying and computing some definite and improper integrals related to the Bessel function</li> </ol>									
Assessment Policy	A <mark>ssig</mark> nme Quizzes, Presentat Project/ H	ents, ions Report	20%		ab NA					
	Midterm	30%	Final	50% C	)thers NA					
Textbook	• B. Da	• B. Davies: "Integral Transforms and Their Applications"								
References	• R. V.	Churchill: "opera	tional Mathe	ematics"						
Electronic Materials										
Other Learning Materials										

Course Name	Applied Fur	Applied Functional Analysis I							
Course	Course Code	Course No.	rse No. Course Level		Prerequisite(s)				
Information	Math0817	1655	5th/6th	4	None				
Course Track	Universit	y Requirement	College Requ	uirement 🗌 S	opecialized Core 🛛 Electives				
<b>Course Description:</b> This course is intended to familiarize the students with the basic concepts, principles and methods of functional Analysis and its applications.									
<b>Course Objectives:</b> This course is mainly concerned with: the spectral theory of compacts linear operators on normed spaces, the spectral theory of unbounded linear operators on Hilbert space, and the Sturm-Liouville theory and its applications to differential equations									
<b>Courses Learnin</b>	g Outcome <mark>s:</mark>	1 1		2					
<ol> <li>Use the r</li> <li>Study co.</li> <li>Apply the</li> <li>Apply the equations</li> <li>Make a p</li> </ol>	nain properti mpact self-ac e theory of sp e theory of S spresentation c	es of Hilbert space ljoint operators an pectral decomposi turm-Liouville the on a topic in Mathe	es ad their spec tion of unbo eory to the sp ematics.	etral propertie bunded self-ac tudy of the pr	s djoint operators operties of some differential				
Assessment Policy	A <mark>ssig</mark> nme Quizzes, Presentat Project/ F	nts, ions Report	20%	L	ab NA				
	Midterm	30%	Final	50% O	thers NA				
Textbook• H. Brezis: "Functional Analysis, Sobolev Spaces and Partial Differential Equations". Springer New York Dordrecht Heidelberg London									
References	• M.A. (SUM	• M.A. Al-Gwaiz: "Sturm-Liouville Theory and its Applications". Springer (SUMS).							
Electronic Materials									
Other Learning Materials									

Course Name	Applied Fu	nctional Analysis II						
Course	Course Code	Course No.	Course Level	Credit Hour	Prer	equisite(s)		
Information	Math0817	1656	5th/6th	4	None			
Course Track	Universit	ty Requirement 🗌 O	College Requ	uirement 🗌 S	pecialized Co	ore 🛛 Electives		
<b>Course Description:</b> At the end of the course, students are expected to have a clear understanding of the distribution theory, the Fourier analysis and their properties.								
<b>Course Objectives:</b> This course is mainly concerned with: Distribution theory, convolutions, Fourier transforms, Sobolev spaces, variational methods for boundary value problems, various variational methods of approximation.								
<ol> <li>State the basic definitions and fundamental results related to the main concepts of the course</li> <li>Calculate the convolution of two functions.</li> <li>Interpret the Fourier transform of a function (or a distribution).</li> <li>Evaluate the variational methods for boundary value problems and variational methods of approximation</li> <li>Make a presentation on a topic in Mathematics</li> </ol>								
Assessment Policy	Assignme Quizzes, Presentat Project/ F	nments, zes, 20% Lab NA				NA		
	Midterm	30%	Final	50% O	others	NA		
Textbook	• S. L. Sobolev: "Applications of Functional Analysis in Mathematical Physics".							
References	• I. Stal	• I. Stakgold: "Boundary Value Problems of Mathematical Physics".						
Electronic Materials								
Other Learning Materials								

Course Name	Theory of D	istributions						
Course	Course Code	Course No.	Course Level	Credit Hour	Prereq	uisite(s)		
Information	Math0817	1657	5th/6th	4	None			
Course Track	Universit	y Requirement 🗌 (	College Requ	uirement 🗌 S	specialized Core	Electives		
<b>Course Description:</b> In this course we will introduce the notions of distributions and study their main properties and applications								
<b>Course Objectives:</b> The main objective of this course is to study the main properties of the distribution theory and its applications in the field of partial differential equations								
<ol> <li>To state the basic definitions, concepts and some fundamental results in Distributions</li> <li>Justify that a given functional on test functions space is a distribution</li> <li>Apply the different operations on distributions to solve some ODE</li> <li>Examine the convergence of a sequence or a series of distributions</li> <li>Apply distribution theory to solve some PDE</li> <li>To examine some operations (convergence, multiplication,, derivation,) on Sobolev spaces</li> </ol>								
Assessment Policy	Assignme Quizzes, Presentat Project/ H	Assignments, Quizzes, Presentations Project/ Report						
	Midterm	30%	Final	50% O	thers	NA		
Textbook	• Gerrit Van Dijk: Distribution Theory 2013 Gruyter Gmbtt/ Berlin/Boston							
References	• M.A. Appli	• M.A. Al-Gwaiz: Theory of Distributions (Chapman & Hall/CRC Pure and Applied Mathematics						
Electronic Materials								
Other Learning Materials								

Course Name	Algebraic To	nology (I)					
Course	Course Code	Course No.	Course Level	Credit Hour	Prere	equisite(s)	
Information	Math0817	1661	5th/6th	4	None		
Course Track	Universit	y Requirement 🗌	College Requ	uirement	Specialized Co	ore 🛛 Electives	
<b>Course Description:</b> This course is mainly concerned with Homology groups of a simplicial complex, relative homology, homeomorphisms induced by simplicial maps, simplicial approximation, the topological invariance of the homology groups, homomorphism induced by homotopic maps. The Eilenberg-Steenrod axioms. Singular homology theory, excision in singular homology, the isomorphism between singular and simplicial homology, the homology of CW complexes							
At the end of the co maps and the homol	urse, students a logy groups.	are expected to have	a clear unders	tanding of the	simplicial compl	lex, the homotopic	
<ol> <li>To recognize and state some of the basic definitions of concepts concerning Algebraic topological such as Homology groups and Homotopy</li> <li>To compute the Homology groups of a simplicial complex, the homology of CW complexes and the relative homology</li> <li>To examine the topological invariance of the homology groups and the homomorphism induced by homotopic maps</li> <li>To recognize homeomorphisms induced by simplicial maps and the simplicial approximation</li> <li>To recognize the Eilenberg-Steenrod axioms., excision in singular homology.</li> </ol>							
Assessment Policy	ent Assignments, Quizzes, Presentations Project/ Report					NA	
	Midterm	30%	Final	50%	Others	NA	
<ul> <li>M. J. Greenberg and J. R. Harper: "Algebraic Topology: A First Course"2018, Taylor, Francis group</li> <li>J. R. Munkres, Elements of Algebraic Topology, Addison-Wesley, 1984.</li> <li>J. W. Vick:" Homology Theory: An Introduction To Algebraic Topology" Academic Press, New York 1973</li> </ul>							
References	• M. J Cours	Greenberg and e"2018,Taylor, Fi	d J. R. H rancis group	arper: "Alg	gebraic Topo	ology: A First	
Electronic Materials	http://pi.n	nath.cornell.edu/~	hatcher/				
Other Learning							

Materials

Course Name	Algebraic T	Algebraic Topology (II)							
Course	Course Code	Course No.	Course Level	Credit Hour	Prere	equisite(s)			
Information	Math0817	1662	5th/6th	4	None				
Course Track	Universit	y Requirement	College Red	quirement 🗌 S	Specialized Co	ore 🛛 Electives			
<b>Course Description:</b> This course is mainly concerned with Cohomology, relative cohomology, the cohomology of a CW complex, cup products. Homology with arbitrary coefficients. Homological algebra , the universal coefficient theorems, the Kunneth formula, the Eilenberg-Zilber theorem. Duality in manifolds, homology of manifolds, Pioncare duality, the cap product, Lefschitz duality, Alexander duality, Alexander-Pontryagin duality									
Course Objective At the end of the cour coefficients and Pio	es: rse, students ar ncare duality	e expected to have a	clear understa	nding of the Coho	omology, Homo	ology with arbitrary			
Courses Learning	g Outcomes:	-	(La b)	ALC: NO					
<ol> <li>To recognize and state some of the basic definitions of concepts concerning Algebraic topological such as Cohomology groups , Pioncare duality, the cap product and homology of manifolds</li> <li>To compute the Cohomology, relative cohomology, the cohomology of a CW complex</li> <li>To examine cup products and cap product</li> <li>To recognize the Homology with arbitrary coefficients, Homological algebras and homology of manifolds</li> <li>To recognize the universal coefficient theorems, the Kunneth formula, the Eilenberg-Zilber theorem. Duality in manifold.</li> <li>To examine Pioncare duality, Lefschitz duality, Alexander duality, Alexander-Pontryagin duality</li> <li>Make a presentation on a topic in Mathematics</li> </ol>									
	Project/ H	Report 30%	Final	50%	)thers	ΝΔ			
Textbook• M. J. Greenberg and J. R. Harper: "Algebraic Topology: A First Course"2018, Taylor, Francis group • J. R. Munkres, Elements of Algebraic Topology, Addison-Wesley, 1984. • J. W. Vick:" Homology Theory: An Introduction To Algebraic Topology" Academic Press, New York 1973									
References	• M. J Cours	. Greenberg as se"2018,Taylor,	nd J. R. Francis grou	Harper: "Alg p	ebraic Topo	ology: A First			
Electronic Materials	http://pi.r	nath.cornell.edu/	~hatcher/						
Other Learning Materials									

Course Name	Differentia	Differential Geometry (I)							
Course	Course Code	Course No.	Cours Level	e Credit Hour	Prer	equisite(s)			
Information	Math0817	1671	5th/6tl	n 4	None				
Course Track	Universit	y Requirement	College R	equirement 🗌	Specialized Co	ore 🛛 Electives			
Course Description: It is mainly concerned with two parts: Study of curves in Euclidean spaces: arc length, tangent, normal and binomial vectors, curvature and torsion. Frenet formulas. Isoperimetric inequality. Study of surfaces in Euclidean spaces: Local differential geometry of surfaces, the first and second fundamental forms. Local isometries. Geodesics. Gaussian and mean curvature of surfaces. The Gauss-Bonnet theorem. Course Objectives: This course provides a clear understanding of the main concepts related.									
<ol> <li>Courses Learning Outcomes:         <ol> <li>Define the regular curves - Arc Length, tangent, normal and binomial vectors</li> <li>State the theory of curves in R<sup>3</sup>, the Local theory of surfaces</li> <li>Define the curvature and torsion of curves. Serret-Frenet equations.</li> <li>Outline the First and second fundamental forms- Gaussian and mean curvatures-Geodesics.</li> </ol> </li> <li>Reorganize whether a given curve (resp. surface) is regular or not.</li> <li>Estimate the curvature and torsion of a regular curve.</li> <li>Calculate the first and second fundamental forms of surfaces.</li> <li>Find the Gaussian and mean curvature of surfaces.</li> <li>Work as part of a team and independently.</li> <li>The ability of managing different knowledge resources and the ability managing time.</li> <li>Use computer for graphing some curves and surfaces in the three-dimensional space.</li> <li>Make a presentation and discuss results of work.</li> </ol>									
Assessment Policy	Assignme Quizzes, Presentat Project/ I	nts, ions Report	20%	UNTRA	Lab	NA			
	Midterm	30%	Final	50%	Others	NA			
Textbook	<ul> <li>M.P. do Carmo, "Differential Geometry of Curves and Surfaces: Revised and Updated Second Edition". Dover Publications, 2016 ISBN-13: 978-0486806990, ISBN-10: 0486806995</li> <li>D. J. Struik: "Lectures on Classical Differential Geometry". Dover Publications 1988. ISBN-13: 978-0486656090 ISBN-10: 0486656098</li> </ul>								
References	• D. J Publi	Struik: "Lec cations 1988. IS	tures on BN-13: 978-0	Classical Dif 486656090 ISBN	ferential Geo I-10: 048665609	metry". Dover			
Electronic Materials	http://pi.r	nath.cornell.edu	/~hatcher/						

Other Learning	
Materials	

Course Name	Differentia	Geometry (II)					
Course	Course Code	Course No.	Course Level	Credit Hour	Prereg	uisite(s)	
Information	Math081 7	1672	5th/6th	4	None		
Course Track	Universi	ty Requirement 🗌 (	College Req	uirement 🗌 S	Specialized Cor	e 🛛 Electives	
Course Description It is mainly concerned and cotangent bund geodesics, and comp	Course Description: It is mainly concerned with definitions and properties of differentiable manifolds and maps. Also, Vector bundles, tangent and cotangent bundles, differential forms, and exterior derivatives. Riemannian manifolds. Curvature equations, geodesics, and completeness. Special manifolds and constructions.						
Course Objectives: This course provides a clear understanding of the main concepts related.							
<ol> <li>Courses Learning Outcomes:         <ol> <li>Define the Differentiable Manifolds, the Tangent Space, the tangent bundle and submanifolds.</li> <li>State the theories on Riemannian manifolds.</li> <li>Recognize the tensors and tensor fields, cotangent bundle, tensor bundles.</li> <li>Recognize the Riemann curvature tensor.</li> <li>Recognize the geodesics.</li> <li>Calculate the Differential forms, and exterior derivatives</li> <li>Estimate the Tensors and tensor fields, cotangent bundle, tensor bundles.</li> <li>Compute the Riemannian metrics. Curvature equations.</li> <li>Recognize the Levi-Civita Connection</li> <li>Work as part of a team and independently.</li> <li>The ability of managing different knowledge resources and the ability managing time.</li> <li>Use computer for computing tensors and graphing 1-dimensional and 2- dimensional manifolds (curves and surfaces).</li> </ol> </li> <li>Make a presentation and discuss results of work.</li> </ol>							
Assessment Policy	Assignme Quizzes, Presentat Project/ I	ents, ions Report	20%	L	ab	NA	
	Midterm	( <b>s</b> ) 30%	Final	50% <b>O</b>	others	NA	
<ul> <li>M. P. Do Carmo: "Riemannian Geometry", Birkhäuser (1992)</li> <li>J. Lee, Riemannian Manifolds, An Introduction to curvature, Springer (1997), ISBN-13: 978-0387983226, ISBN-10: 0387983228</li> <li>N. J. Hicks, "Notes on Differential Geometry", Van Nostrand Reinhold Co. (1965). ISBN-10: 0442034059, ISBN-13: 978-0442034054</li> <li>M. Spivak: "A Comprehensive Introduction to Differential Geometry", Publish or Perish, 1979, ISBN-13: 978-0914098836, ISBN-10: 0914098837</li> </ul>							
References	<ul> <li>F. Wa (1983)</li> <li>B. A. and A Fields</li> </ul>	arner, "Foundations ). ISBN-13: 978-038 Dubrovin, A. T. Fon pplications: Part I: ", Springer (1991).	s of Differe 37908946, IS nenko, and S The Geomet ISBN-13: 97	ntiable Manifo SBN-10: 03879 S. P. Novikov:' try of Surfaces '8-0387976631	olds and Lie g 908943 " Modern Geon s, Transformatic I, ISBN-10: 038	roups, Springer netry - Methods on Groups, and 37976639	

Electronic Materials	Several we Riemannia examples, https://per	Several web sites are already exists concerning Differentiable Manifolds and Riemannian manifolds, which have provided students with some lecture notes, examples, and exercises. https://personalpages.manchester.ac.uk/staff/theodore.voronov/manifolds.html						
Other Learning Materials								
Course Name	Algebraic Ge	ometry						
Course	Course Code	Course No.	Course Level	Credit Hour	Prere	quisite(s)		
Information	Math0817	1673	5th/6th	4	None			
Course Track	University	Requirement 🗌 (	College Requ	uirement 🗌 S	Specialized Co	re 🛛 Electives		
Course Description Algebraic Geometry schemes. One of the use of sophisticated	on: is a course design e principles of the algebra-geometric	gned to study affine a nis cour <mark>se is</mark> to start ic techniques such a	and projective from easily f s sheaves and	e algebraic varie ormulated prob Cohomology.	eties and introduc lems whose solu	ce the language of ations requires the		
Course Objective This course aims to of schemes.	s: give good unde	rstanding of the affin	ne and project	ive algebraic va	arieties and intro	duce the language		
<ol> <li>To know</li> <li>To know</li> <li>To know</li> <li>To know</li> <li>Find the of</li> <li>Construct</li> <li>Find the of</li> <li>Find the of</li> <li>Work as</li> <li>The ability</li> <li>Discuss r</li> </ol>	<ol> <li>To know affine and projective varieties, sheaves and rational maps.</li> <li>To know the Tangent space and singular points</li> <li>To know the Tangent space and singular points</li> <li>Find the coordinate ring associated to an algebraic variety and study the converse.</li> <li>Construct rational maps</li> <li>Find the intersection of algebraic varieties</li> <li>Work as part of a team and independently.</li> <li>The ability of managing different knowledge resources and the ability managing time.</li> </ol>							
Assessment Policy	Assignments, Quizzes, Presentations Project/ Report							
	Midterm(s)	30%	Final	<u>50%</u> C	Others	NA		
<ul> <li>Daniel Perrin, Algebraic Geometry: An Introduction, <u>Universitext</u>. Berlin: Springer; Les Ulis: EDP Sciences (ISBN 978-1-84800-055-1), 258 p. (2008).</li> </ul>								
References	• Robin 52. Ne	Hartshorne, Alg w York-Heidelb	ebraic Geo erg-Berlin:	metry, Grad Springer-Ver	uate Texts in rlag. XVI, 496	Mathematics. 5 p. (1977).		
Electronic Materials								
Other Learning Materials	Computer-ba	sed programs/CD, p	professional st	andards or regu	lations and softv	vare.		

## Useful Links

- 1. Deanship of Postgraduates Studies, King Faisal University
- 2. Deanship of Scientific Research, King Faisal University
- 3. Deanship of Library Affairs, King Faisal University
- 4. <u>College of Science, King Faisal University</u>
- 5. <u>Department of Mathematics and Statistics</u>

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*Prepared by Department Of Mathematics and Statistics*