Course Outlines

BS(MA)

SEMESTER I

Department of Mathematics
School of Science
University of Management and Technology, Lahore

Course Outline
Course Code: MA-107
Course Title: Calculus and Analytical Geometry

Program	BS Electrical Engineering/ Mathematics
Credit Hours	3
Duration	One Semester
Prerequisites	
Resource Person (s)	
Class Timing: Counseling Timing:	
Contacts	

Chairman / Director Signature…….

Dean's Signature…… Date…….

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to:

CLO 1: Apply core algebraic techniques—including operations with polynomials, factoring, rational expressions, equations, inequalities, exponents, radicals, and fundamental functions—to solve problems and compute related antiderivatives and basic integrals. (Level C3)

CLO 2: Compute limits using standard limit laws, analyze function behavior and continuity, and determine corresponding antiderivatives and integrals where applicable. (Level C3)

CLO 3: Differentiate algebraic, exponential, logarithmic, trigonometric, composite, product, and quotient functions, and apply integration techniques to find their antiderivatives. (Level C3)

Semester	**Course Code**	**Title**	**ırse Learning Outcomes**	**PLO 1** Eng. Knowledge	**PLO 2** Problem Analysis	**PLO 3** Solution Design	**PLO 4** Investigation	**PLO 5** Mod. Tool Usage	**PLO 6** Engr. & Society	**PLO 7** Env. & Sust.	**PLO 8** Ethics	**PLO 9** Team Work	**PLO 10** Communication	**PLO 11** Proj. Management	**PLO 12** Lifelong Learning
Ist	**MA107**	**Calculus & Analytical Geometry**	CLO 1	✓											
			CLO 2	✓											
			CLO 3	✓											

Grade Evaluation Criteria:

Components	**Marks**
Quizzes & Assignments	30
Mid Term Exam	30
Final Exam	40
Total	**100**

Textbook:

- Lial, Greenwell, Ritchey, Calculus with Applications – Global Edition, 11th Edition (2016)

Course Contents

Lectures	Topics	CLOs
1.	Polynomials	1
2.	Factoring	1
3.	Rational expressions	1
4.	Equations	1
5.	Inequalities	1
6.	Exponents	1
7.	Radicals	1
8. & 9.	Slopes and equations of lines	1
10.	Linear functions	1
11.	Quadratic functions	1
12.	Exponential functions	1
13.	Logarithmic functions	1
14.	Calculating limits using the limit laws	2
	Midterm Examination	1 & 2
17.	Definition of the derivative	3
18.	Techniques for finding derivatives	3
19. & 20.	Derivatives of products and quotients	3
21.	Composite functions	3
22.	Derivatives of exponential functions	3
23.	Derivatives of logarithmic functions	3
24.	Extreme values of functions	3
25. & 26.	Antiderivatives	2 & 3
27.	Substitution	3
28.	The area between the curves	3
29.	The fundamental theorem of calculus	2 & 3
30.	Derivatives of trigonometric functions	3
31.	Integrals of trigonometric functions	3
	Final Term Examination	1, 2 & 3

Mapping of assessments to CLO's

CLOs ▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Quiz 7	Quiz 8	Midterm	Final
1	✓	✓	✓	✓	✓				✓	✓
2				✓	✓	✓				✓
3							✓	✓		✓

Course Outline

Course Code	QM-111
Course Title	**Quantitative Skills and Reasoning Tools**
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 semester
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course 1: Exploring Quantitative Skills

COURSE DESCRIPTION

Since ancient times, numbers, quantification, and mathematics has played a central role in scientific and technological development. In the 21st century Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues an individual now faces in daily life. The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student's attitude about mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

COURSE OBJECTIVES

- Students will be introduced to the above concepts and they will be prepared to apply these concepts to analyze and interpret information in different walks of life.
- Students will get familiarized with the importance of quantitative reasoning skills in the modern age.
- This course will improve their ability to deal with scenarios involving numbers related issues in a logical manner.
- It will provide students an opportunity to appreciate the intellectual beauty of quantitative reasoning skills.
- It will prepare students to apply the quantitative reasoning skills in solving quantitative problems which they will experience in their practical lives.
- Students will be introduced to the above listed concepts, and they will be prepared to apply these concepts to practical life scenarios.
- This course will enhance their ability to deal with scenarios involving quantitative reasoning skills in a logical manner which they can face in their practical lives.
- It will prepare students to deal with different forms of data occurring in professional, social and natural sciences.
- Students will be introduced to scenarios involving functions and probability in different disciplines.
- This course will prepare the students to apply the quantitative reasoning skills in other disciplines.
- This course will provide solid foundation for students to use the quantitative reasoning skills in solving practical life problems.

STUDENT LEARNING OUTCOMES:

After completing this course successfully, students will be able to:

1. create and develop quantitative reasoning skills and apply to daily life challenges involving social and economic issues.
2. apply the learned principles of quantitative reasoning skills in other disciplines.
3. acquire and use the quantitative reasoning skills in different disciplines.
4. make decisions in a logical manner.
5. apply geometrical models to solve real life problems.
6. apply the quantitative reasoning skills in any real-world situation.
7. strengthen their quantitative reasoning skills and apply to daily life problems.
8. draw the inferences from the data given in numeric, graphs, tables and functions
9. strengthen their quantitative reasoning skills while making decisions.
10. apply the concepts of functions in social and economic issues and formulate and solve the problems.
11. understand the principal concepts of probability and its applications.demonstrate the application of the learned principles of quantitative reasoning skills in different professional activities, social and natural sciences.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			
4: -			
5: -			
6: -			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Attendance & Class Participation	----%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ Bennett, J. & Briggs, W. (2015). Using and understanding mathematics (6th Edition). Pearson Education, Limited. http://xn--webducation-dbb.com/wp-content/uploads/2019/09/Jeffrey-Bennett-William-Briggs-UsingUnderstanding-Mathematics_-A-Quantitative-Reasoning-Approach-Pearson-2015.pdf
- ✓ Blitzer, R. (2014). Precalculus. (5th Edition). Pearson Education, Limited. https://www.ilearnacademy.net/uploads/3/9/2/2/3922443/precalculus__edition_5f.pdf

WEEKLY BREAKDOWN

Module Name	Time (weeks)	Goal	Topics
Exploring importance of quantitative reasoning skills	1	Introduce students to importance of quantitative reasoning skills, history of mathematics and numbers in the real World.	What is quantitative reasoning? Overview of history of mathematics and contributions of Muslim scholars. Different types of standard numbers and their role in practical life scenarios.

Problem solving techniques	2	Introduce students to problem solving skills using mathematical modelling and unit analysis.	Understanding relationship between parts and whole Practical life scenarios involving parts & whole Practical life scenarios involving units and rate Unit analysis as a problem solving tool.
Numbers & the Universe	3	Expose students to the notions of estimation, scientific notation, absolute & relative errors, and their applications.	Understanding our World through numbers Dealing with very big and small numbers & their applications Understanding uncertainty and its applications
Financial issues	4	Students will be introduced to an important tool percentage, and its use in different social, economic, and professional scenarios.	Stock exchange and economy Money management (profit, loss, discount, zakat, simple interest, compound interest and taxation) Money management in practical life scenarios like investments and federal budget
Exploring expressions	5	Students will be introduced to the algebraic expressions, linear and quadratic equations in one variable and their use in practical problems	Practical scenarios involving expressions Equating two expressions in one variable & using it to solve practical problems Social and economic problems involving expressions
Exploring beauty in	6	Students will learn about perimeter and	Introduce geometrical objects through architecture and landscape
Architecture & landscape		area of some geometrical figures and their applications	Dealing with social and economic issues involving geometrical objects
Venn diagrams	7	Students will be introduced to sets, Venn diagrams and their applications	Practical scenarios involving sets and Venn diagrams Ven diagrams and their applications in different disciplines.
Exploring graphical information	8	Introduce students to functions, graphing tools and their applications in different disciplines.	Investigating relationships between variables Exploring tools to find relationship between variables Resources and population growth Dealing with Economical, environmental and social issues

Building blocks of a plane	9	Introduce students to simultaneous linear equations in two variables and their applications.	Graphical and analytical approaches to solve a problem Applications of graphical & analytical approaches in social & economic problems
Exploring inequalities	10	Students will be introduced to the absolute value and inequalities.	Understanding inequalities around us. Dealing with practical problems involving inequalities in different disciplines
Comparing quantities	11	Students will be introduced to important tools ratio and proportion and sequences	Golden ratio in sculptures Comparison of statements and their use in social and economic problems Number patterns and their applications

Thinking Logically	12	Equip students to solve practical problems involving logic.	• Survival in the modern World • Propositions and truth values • Applications of logic
Understanding data	13 and 14	Students will be introduced to the important statistical tools for data analysis and applications, personal health & democracy.	Exploring and summarizing data, misleading graphs Finding a representative value in a data Measure and spread of a data, measuring degree of relationship among variables Counting the odds

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

SEMESTER II

Course Outlines

Course Code	MA-100
Course Title	Calculus-I
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Calculus-I is an introductory course designed to provide a strong foundation in differential and integral calculus. The course focuses on the fundamental concepts of limits, continuity, derivatives, and integrals of single-variable functions. Students will explore various applications of differentiation and integration in solving real-world problems, laying the groundwork for advanced mathematical studies and applications in science, engineering, and economics.

Course Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand and apply the concept of limits and continuity to analyze the behavior of functions.
2. Differentiate functions of a single variable and use derivatives to solve problems involving rates of change, optimization, and curve sketching.
3. Integrate functions using basic techniques and apply integration to compute areas, volumes, and solve practical problems.
4. Develop problem-solving skills and critical thinking by applying calculus concepts to real-life scenarios.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: To define the basics of limits, derivative, and integration	✔	✔	✔
2: To understand the concepts related to limits, derivative, and integration and a few important theorems			
3: Apply limits, derivative, and integration in practical scenarios			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Thomas' Calculus, 12th edition, 2006, Addison-Wesley

Reference Material

- Erwin Kreyzing, Advanced Engineering Mathematics, 7thedition,1993, John Wiley and Sons.
- CALCULUS EARLY TRANSCENDENTALS, 10th edition, by H. Anton, I. Bivens, S. Davis, 2012, John Wiley and Sons

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Domain and range of functions			
2.	Composites of functions			
3.	Calculating limits using limit laws			
4.	One-sided limits and limits at infinity			
5.	Continuity			
6.	Limits involving infinity			
7.	Derivative as a function			
8	Differentiation rules			
9	Derivatives of trigonometric functions			
10	The chain rule of differentiation			
11	Implicit differentiation			
12	Derivatives of natural logarithmic functions			
13	Derivatives of exponential functions			
14	Derivatives of inverse trigonometric functions			
15	Derivatives of hyperbolic functions			

16	l'Hôpital's rule			
17	Extreme values of functions			
18	The fundamental theorem of calculus			
19	Indefinite integrals and the substitution rule			
20	Natural logarithmic functions (Integration Qs)			
21	Exponential functions (Integration Qs)			
22	Integration by parts			
23	Trigonometric integrals			
24	Inverse trigonometric functions (Integration Qs)			
25	Trigonometric substitutions			
25	Hyperbolic functions (Integration Qs)			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

University of Management and Technology

Course Outline

Course code: CC111

Course Title: Programming Fundamentals

Program	BS Mathematics
Credit Hours	3
Duration	16 Weeks
Prerequisites	
Resource Person	
Counseling Timing (Room#)	
Contact	

Chairman/Director signature……

Dean's signature…… Date……..

Learning Objective:

- An ability to understand the problem clearly
- An ability to analyze the problem in detail
- An ability to design algorithms
- An ability to convert the algorithm into program/code

- An ability to think and understand the flow of instructions while implementing an algorithm
- The decision and thinking capability to write an efficient code in the C++ compiler
- An ability to find any bug and error with the usage of compiler error messages
- An ability to choose data types according to the data to be processed
- An analytical ability to use variables w .r .t. its scope and life lifetime to know how when a variable will be created in memory and when destroyed from memory.
- An ability to know practically about the impact of the scope and lifetime of variables
- An ability to use relevant operators and expressions according to the nature of the problem and precedence
- An ability to develop a simple/complex condition using suitable operators.
- An ability to differentiate, choose and use suitable and appropriate selection and repetition statements for an efficient coding
- An ability to decide why, when, and where a programmer needs to use which type of selection and repetition control structures
- An ability to decide why and where a programmer needs to use simple and/or nested selection and repetition control structures

Learning Methodology:

- Analyze the problem and design an algorithm.
- Understand the concept of variables, operators, and expressions.
- Understand the concept of selection and repetition statements.
- Understand the concept of arrays and strings.
- Understand to modularize a program using functions.
- Understand to write efficient programs using pointers and dynamic memory allocation.
- Understand the concept of structures.
  Understand the concept of file handling

Grade Evaluation Criteria

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

Marks Evaluation	**Marks in percentage**
Quizzes	10%
Assignments	10%
Mid Term	30%
Attendance & Class Participation	5%
Term Project	
Presentations	5%
Final exam	40%
Total	100%

Recommended Text Books:

1. Starting out with C++, 9th Edition by Tony Gaddis.
2. C++ How to Program, 10/E (Harvey & Paul) Deitel & Deitel,

Reference Books:

1. Computer Science: A Structured Programming Approach Using C++ by Behrouz A. Forouzan, Richard Gilberg.
2. C++ Programming by DS Malik
3. Object-Oriented Programming Using C++ by IT-Series

Calendar of Course contents to be covered during the semester

Course code…… **Course title** Programming Fundamentals

Week	Course Contents	Reference Chapter(s)
1	Introduction to Programming, History of Languages (Machine Language to High-Level Languages), Introduction to C++ language, C++ Character Set (Constants, Variables, Keywords), Types of C++ Constants (Memory representation for different types of constants), Rules for constructing Integer, Real and Character Constants), Negative Numbers Representation in Memory (1's Complement, 2's Complement)	
2	Types of C++ Variables, Rules for Constructing Variable Names, Hello World Program, Compilation Process of a C++ Program, C++ Instructions (Type Declaration, Arithmetic), Hierarchy of Operations, Associativity of Operators	
3	Writing Pseudocode for a program, Some Basic C++ Programs Decision control using if, if-else, nested if-structures	
4	Logical Operators, Relational Operators, Practice of Decision Control using if-else structures Switch-Case structure, Break Statement	
5	The practice of Switch-Case, Conditional Operator, Introduction to Loops For Loops (Without Nesting), Practice of For Loop	
6	Nested-For Loops Practice, Break and Continue Statements	
7	While Loop, Do-While Loop	
8	While & Do-While Practice	
9	**MID-TERM EXAMINATION**	
10	**Introduction to 1-D Arrays and Arrays Searching**	
11	**Use of 2-D Arrays in matrix operations**	
12	**Pointers, Pointer arithmetic, Handling 1-D & 2-D Arrays with pointers, Pointer to arrays, Array of**	

	pointers	
13	**Strings and Operations on strings (Concatenation, Comparison, Finding Substring, etc.). Introduction to Functions. Passing Arguments and Returning Values from Functions**	
14	**Passing Arguments by Value & Reference, Inline Functions, Default Arguments, Function Overloading**	
15	**Structures, Structure variables, Public and private members, Accessing members of the structure, passing structures through a function.**	

Course Outlines

Course Code	MA105
Course Title	Discrete Mathematics
Resource Person(s)	
Semester	Fall 2024
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	---

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course introduces preliminaries concepts of counting and graphs theory. The main objective of this course is to prepare students to learn basic counting principles and their applications to graph theory and other areas.

Course Learning Outcomes:

Able to understand and solve different counting problem.

Able to understand and apply the ideas of relations on sets.

Able to understand and apply graph theory techniques to different problems.

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

K. H. Rosen, Discrete Mathematics and Applications, McGrah Hill, 2007.

Reference Material

1. A. Tucker, Applied Combinatorics, John Wiley and Sons, Inc New York, 2002.
2. Discrete Mathematics, Schaum's Series 3rd Edition, McGrah Hill.5. J. B. Fraleigh,

Course Calendar

Lectures	Topics	Reference Chapter(s)	Assignments & Tasks	CLO
1-2	Basic Counting Methods: Product Rule, Sum Rule,			
3-5	Inclusion-Exclusion Principle.			
6-7	Pigeonhole Principle and application			
8-10	Permutation and Combination			
11-12	Recurrence Relation and their solutions			
13-14	Generation Functions, Double Counting and applications.			
15	**Mid Term Exam**			
16	Binary Relations, n-array Relations,			
17-18	Closure of Relations, Inverse Relations.			
19-20	Graph Terminology and Special Types of Graphs, Complete graphs, Bipartitie graphs			
21-22	Incidence Matrix, Connectivity, planar graph			
23-24	Representations of Graphs, Graph Isomorphism			
25-26	Eulerian and Hamilton Paths, Shortest Path method,			
27-28	Trees Spanning trees,			
29-30	Minimal Spanning trees			
	Final Exam			

Course Outlines

Course Code	MA150
Course Title	Probability and Statistics
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This undergraduate course provides a comprehensive introduction to probability and statistics, fundamental for understanding data and uncertainty. Students will explore topics such as probability rules, random variables, probability distributions, and statistical inference. Key statistical methods, including descriptive statistics, hypothesis testing, confidence intervals, regression analysis, and analysis of variance, are covered. The course emphasizes practical problem-solving, supported by real-world applications and data analysis using computational tools. By developing a solid foundation in probability and statistical techniques, students will gain essential skills for analyzing and interpreting data, applicable across disciplines such as science, engineering, economics, and social sciences.

Course Learning Outcomes:

- To understand the statistics tools for data analysis.
- To apply the idea of probability theory in problem solving
- To analyze the concept of distribution functions

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- Introduction to Statistical Theory by Prof. Sher Muhammad Chaudhry Prof. Dr. Shahid Kamal, Publisher: ILMI Kitab Khana

Reference Material

- Elementary Statistics by Bluman
- Lay L. Devore, Probability and statistics for engineering and the sciences, 2003, Duxbury Publishers.
- G. Cowan, Statistical Data Analysis, 1998, Clarendon, Oxford.
- Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, Publisher,

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction to Statistics, Descriptive Statistics, Presentation of data in tabular form			
2.	Graphical representation of Data, Stem-Leaf Plot, Box-Cox Plots, Measures of Central Tendencies, The Arithmetic Mean and their Properties, Change of Origin and Scale			
3.	The Geometric and The Harmonic Mean, The Median, The Mode, Empirical Relation between Mean, Median and Mode			
4.	Problem solution related 1st to 3rd week. Measures of Dispersion			
5.	Moments, Skewness and Kurtosis, Counting techniques, Sample Space.			
6.	Algebra of Events and Types of events, Introduction to Probability, Laws of Probability			
7.	Laws of Probability, Conditional probability			
8	Baye's theorem and its Application, Problem solution related 4th to 7th week.			
9	**Mid Term Week**			
10	Probability Distribution Function and its Properties, Binomial Probability Distribution			
11	Geometric Probability Distributions, Negative-Binomial Probability Distributions			
12	Problem solution related 10th to 11th week, Poisson Probability Distribution			
13	Exponential, Gamma distribution, Normal distribution			
14	Normal distribution, Regression			

15	Correlation			
16	Revisions and Q/A session			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

SEMESTER III

University of Management and Technology

Course Outline

Course code: CC112 . Course title **Object Oriented Programming**

Program	BS Mathematics

Credit Hours	3+1
Duration	1 Semester
Prerequisites	Programming fundamentals
Resource Person	
Counseling Timing (Room#)	
Contact	

Chairman/Director signature……

Dean's signature…… Date……..

Learning Objective:

- Students should be able to design classes using dynamic allocation of resources to solve programming problems
- Students should be able to devise member functions to solve tasks of linear complexity
- Students should be able to relate classes using concepts of inheritance to minimize duplication of code
- Correctly incorporate polymorphism concepts to amplify reusability of programming code
- Dry run OOP based code to validate its correctness

- Correctly apply OOP concepts in business problems

Learning Methodology:

Lectures, Semester Project, Quizzes, Assignments

Grade Evaluation Criteria

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

Marks Evaluation

Assignments	10%
Quizzes	15%
Mid Term	25%
Project	10%
Final Term	40%
Total	**100.00%**

Recommended Text Books

Deitel, P. J., &Deitel, H. M. (2008). C++ how to program. PearsonPrentice Hall.

Reference Books:

An Introduction to Object-Oriented Programming in C++ with Applications in Computer Graphics
Authors: Seed, Graham M.

Calendar of Course contents to be covered during semester

Course title Object Oriented Programming

Week #	Contents	Reference Chapter(s
1	Introduction to Objects and Classes	Chapter 1,2,3,4
2	Classes and Constructors in C++	Chapter 5
3	Operator Overloading in C++	Chapter 8
4	Static Objects	

5	Friend Function	Chapter 9
6	Inheritance in C++	Chapter 9
7	C++ Polymorphism C++ PolymorphismC++ OverloadingC++ OverridingC++ Virtual Function	Chapter 11
8	C++ Abstraction C++ InterfacesC++ Data Abstraction	Chapter 12
9	C++ Namespaces C++ Namespaces	
10	C++ Exceptions C++ Exception HandlingC++ try/catchC++ User-Defined	
11	C++ File & Stream C++ File & StreamC++ getline()	
12	C++ Enumerations	
13	Unit Testing in C++	

Course Outlines

Course Code	MA103
Course Title	Calculus II
Resource Person(s)	
Semester	

Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

MA 103 is a one-semester three credit-hours course. This course provides a comprehensive introduction to multivariate calculus and vector analysis. Topics include multivariate functions, their domains and ranges, limits, continuity, and partial derivatives. Students will explore gradients, level curves, tangent planes, and extreme values. Integration techniques include double and triple integrals in rectangular, polar, cylindrical, and spherical coordinates, with

applications to area and volume. The course also covers line integrals, vector fields, path independence, Green's Theorem, and introduces Fourier Transforms for periodic functions, emphasizing applications in engineering and advanced mathematics.

Course Learning Outcomes:

- Explain multivariate functions with their domains, ranges, and graphical representations.
- Apply partial derivatives and multiple integrals to multivariate functions.
- Apply Fourier Series to periodic functions

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔		
2: Problem Analysis		✔	✔
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ Thomas Calculus, 12th edition by George_B._Thomas,_Maurice_D._Weir,_Joel_Hass, published by Pearson USA.

Reference Material

- ✓ Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Multivariate Functions, Domain and Range			
2.	Limit and continuity			
3.	Partial Derivatives.			
4.	The Chain Rule for Multivariate Functions.			
5.	Gradients and Level Curves.			
6.	Tangent planes and Differentials.			
7.	Extreme Values and the saddle points.			
8	Double Integrals over Rectangular Regions; Fubini's 1st Theorem.			
9	Double Integrals over Non Rectangular Regions; Fubini's 2nd Theorem.			
10	Area by Double Integrals.			

11	Double Integrals in Polar Forms.			
12	Triple Integrals.			
13	Triple integrals in cylindrical and spherical coordinates.			
14	Line Integrals.			
15	Vector fields			
16	Path independence, Greens Theorem and Applications. Introduction to Fourier Transforms of periodic functions from Advanced engineering mathematics by Erwin Kreyszig, Latest edition			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1	✔						✔	
2		✔	✔	✔			✔	✔
3					✔	✔		✔

University of Management and Technology

School of Science

Department of Mathematics

Course Code: MA-210 Course Title: Linear Algebra

Schedule	As per time table	Pre-requisite	MA-100
Course Coordinator	Dr. Ghulam Murtaza	Contact	ghulammurtaza@umt.edu.pk
Course Description	Linear Algebra is an important course for mathematics, physics, economics and computer-science majors. Students apply the concepts and methods described in the syllabus and will become capable to solve problems using linear algebra, they will know a number of applications of linear algebra, and they will be able to understand the logic (proof) behind a particular phenomenon. The text and class discussion will introduce the concepts, methods, applications, and proofs; students will practice them and solve problems on assignments, and they will be tested on quizzes, midterms, and the final. For physics majors this subject has applications in quantum mechanics, economics majors will find it useful in courses like econometrics, computer-science students will see its application in computer graphics.		
Expected Outcomes	Understand, read and write the elementary results of Linear Algebra and acquire basic Mathematical knowledge. Apply course knowledge creatively and critically to develop problem-solving skills based on logical and abstract explanation. Students will be able to see the connections between the abstract topics like vector spaces/subspaces and applied topics like rotation matrices/inner product spaces which will further help them to see the similarities between Linear Algebra and other courses e.g. Computer Graphics and Quantum Mechanics and feel confident to study those courses in the future. Value the group learning environment by demonstrating ability for working in a group and help each other to develop interest in retaining and using the results throughout the course.		
Text Book	Elementary Linear Algebra, Applications Version, 10th edition by Howard Anton and Chris Rorres		

Reference Book:	1) Linear Algebra, 4th edition, by Friedberg, Insel, and Spence, published by Pearson, 2003. ISBN-10: 0130084514, ISBN-13: 9780130084514 2) Larson, Ron and David C. Falvo. Elementary Linear Algebra. 6th edition. 2009.Type: Textbook, ISBN: 9780618783762		
Assignments	As per UMT policy	Quizzes	As per UMT policy
Mid Term	As per UMT policy	Final	As per UMT policy
Examination		Examination	
Attendance Policy	As per UMT policy		
Grading Policy	As per UMT policy		

Course Plan of MA-210 Linear Algebra (Spring 2021)

Book: Linear Algebra by Howard Anton, 10th Edition		
Chapter	Topics	Exercises to be covered with Practice questions
1	Introduction to Systems of Linear Equations Gaussian Elimination Method for Finding inverse A^{-1} More on Linear Systems and Invertible Matrices Applications of Linear Systems	Ex 1.1 (1-14) Ex 1.2 (1-30) Ex 1.5 (9-24) Ex 1.6 (13-17) Ex 1.8 (1-8)
2	Evaluating determinants by Cofactor expansion row reduction	Ex 2.1 (1-26) Ex 2.2 (10-17)
3	Vector in plane Norm and Dot product of Vectors Orthogonality	Ex 3.1 (7-15) Ex 3.2 (1-23) Ex 3.3 (1-40)
4	Real Vector Spaces Subspaces Linear Independence Coordinates and Basis Dimension Rank, Nullity, and the Fundamental Matrix Spaces Dynamical Systems and Markov Chains	Ex 4.1 (1-9, 11, 12) Ex 4.2 (1-13, 15) Ex 4.3 (1-9) Ex 4.4 (1-15) Ex 4.5 (1-6) Ex 4.8 (2) 4.12 (1-4)
5	Eigenvalues and Eigenvectors Diagonalization	Ex 5.1 (1-14) Ex 5.2 (7-25)
6	Inner Products Gram–Schmidt Process; QR-Decomposition	Ex 6.1 (1-20) Ex 6.3 (21-29)
8	General Linear Transformations Isomorphism	Ex 8.1 (1-22) Ex 8.2 (1-11)

SEMESTER IV

Course Outlines

Course Code	MA300
Course Title	Calculus III
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

MA 300 is a one-semester three credit-hours course. This course explores advanced mathematical concepts involving sequences, series, and calculus in alternative coordinate systems. Students will analyze the convergence and divergence of sequences and infinite series using various tests, including the Integral, Comparison, Ratio, and Root Tests. The course

delves into power series, Taylor and Maclaurin series, and their applications, such as function approximation and binomial expansions. Additionally, students will study parametric and polar coordinate systems to graph curves, compute areas and lengths, and investigate the properties of conic sections. Emphasis is placed on developing problem-solving skills and applying these concepts to real-world and theoretical scenarios.

Course Learning Outcomes:

- Apply convergence tests to analyze sequences and infinite series for their behavior
- Use power series, Taylor and Maclaurin series, to approximate functions and solve problems
- Analyze parametric and polar curves to compute areas, lengths, and study conic sections.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔		
2: Problem Analysis		✔	✔
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

✓ Thomas Calculus, 12th edition by George_B._Thomas,_Maurice_D._Weir,_Joel_Hass, published by Pearson USA.

Reference Material

✓ Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Sequences			
2.	Infinite Series			
3.	The Integral Test			
4.	Comparison Tests			
5.	The Ratio and Root Tests			
6.	Alternating Series			
7.	Absolute and Conditional Convergence			
8	Power Series			
9	Taylor and Maclaurin Series			
10	Convergence of Taylor Series			
11	The Binomial Series and Applications of Taylor Series			
12	Parametrizations of Plane Curves			
13	Calculus with Parametric Curves			
14	Polar Coordinates			
15	Graphing in Polar Coordinates			
16	Areas and Lengths in Polar Coordinates, Conic Sections, Conics in Polar Coordinates			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1	✔						✔	
2		✔	✔	✔			✔	✔
3					✔	✔		✔

AC 130- Financial Accounting

Resource Person:	
Email:	
Contact Hours:	

Office Address:	Department of Banking and Finance
Programme:	BS Accounting and Finance
Section:	
Semester:	
Course Pre-requisites:	
Credit Hours:	
Course Type:	
Venue/Day/Time:	
Course URL (if any):	

Course Description:
The course emphasizes the theoretical foundations of accounting and analytical skills needed by business and accounting students. This course emphasis is on the application of Generally Accepted Accounting Principles (GAAP) to the recording and reporting of financial information, the underlying theoretical foundations of accounting, and the analytical skills needed by business and accounting students.

Course Teaching Methodology:
The resource person shall explain and discuss a topic in accordance with course outline & students shall be asked to solve various exercises, problems & cases based on those discussions. Guidance in this respect will be provided by the instructor in and outside the class during counseling hours.

Program Objectives/Goals (POs)	
1. To develop effective Teamwork and Leadership Skills	
2. To inculcate Critical Thinking and effective Decision-Making skills	
3. To develop Effective Communication Skills	
4. To polish Core Business Knowledge and Competence	
5. To expose and inculcate Ethical Behavior and Social Responsibility	
6. To provide real-life work experiences.	
7. To provide global perspectives.	
Program Learning Outcomes (PLOs): **After completing this degree program, students shall be able to:**	**Mapping the PLOs with POs**
1 Work effectively in teams and understand group processes, leadership, conflict, power and culture in organization.	PO1, PO5, PO6
2 Use analytical and reflective thinking techniques.	PO2, PO4, PO6

3	Apply appropriate quantitative and qualitative techniques in solving business problems.	PO2, PO3, PO4, PO5, PO6
4	Draft effective business documents and prepare and deliver effective oral business presentations using the variety of appropriate technologies.	PO1, PO3, PO6
5	Demonstrate competency in the underlying concepts, theory and tools taught in the core undergraduate curriculum.	PO4, PO5, PO6, PO7
6	Identify and analyze ethical conflicts and social responsibility issues involving different stakeholders.	PO5, PO6
7	Understand the dynamics of industry and understand business as an integrated system and apply strategic planning tools.	PO2, PO3, PO6
8	Identify and analyze relevant global factors that influence decision making in an international business setting.	PO6, PO7

Course Learning Outcomes (CLOs): **After completing this course, students shall be able to:**	
CLO-1	Explain the purpose and role of accounting.
CLO-2	Recognize and discuss the major users of financial statements
CLO-3	Demonstrate an understanding of the principles of accrual accounting
CLO-4	Describe how basic business economic events affect accounts and financial statements.
CLO-5	Use Journals, ledgers, and trial balance to accumulate corporate information
CLO-6	Use the accounting cycle to develop financial statements from business transactions

Program Learning Outcomes	**Course Learning Outcomes**
1. Work effectively in teams and understand group processes, leadership, conflict, power and culture in organization.	
2. Use analytical and reflective thinking techniques.	CLO4, CLO5
3. Apply appropriate quantitative and qualitative techniques in solving business problems.	CLO3, CLO4, CLO5
4. Draft effective business documents and prepare and deliver effective oral business presentations using the variety of appropriate technologies.	CLO5,
5. Demonstrate competency in the underlying concepts, theory and tools taught in the core undergraduate curriculum.	CLO1, CLO2, CLO3,
6. Identify and analyze ethical conflicts and social responsibility issues involving different stakeholders.	
7. Understand the dynamics of industry and understand business as an integrated system and apply strategic planning tools.	CLO2, CLO6

8. Identify and analyze relevant global factors that influence decision making in an international business setting.	CLO6

Assurance of Learning and Assessment Items: *Specify Assessment Items that will assure student learning through application and achieve objectives of specific PLOs / COs / CLOs*	
Assessment Item	**Application/ Objectives PLO / CO / CLO**
Presentation	CO1, CLO-1,
Assignments	CO2, CO3, CLO2, CLO 3,
Class Activities	CO2, CO3, CLO2, CLO 3,
Quizzes	CO2, CO3, CLO2, CLO 3,
Mid Term Exam	CO2, CO3, CLO2, CLO 3,
Final Term Exam	CO2, CO3, CLO2, CLO 3,

Assessment Structure and Grading Policy*:		
Assessment Item	**Weight (%)**	**Execution Plan**
Class Activities	10%	
Assignments	10%	
Quizzes	20%	
Mid-term exam	25%	One-time assessment
Final exam	35%	One-time assessment
Total	**100**	

Notes – Norms and Important Class Policies:
(such as submission guidelines, academic honesty, make-up policy, code of conduct)

- Be On Time
  You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.

- Mobile Policy
  TURN OFF YOUR MOBILE PHONE! It is unprofessional to be texting or otherwise.

- Email Policy
  READ YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email.
  Participants should regularly check their university emails accounts regularly and respond accordingly.

- Class Attendance Policy
  A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddings are absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade 'F' (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise, they could reach short attendance.

- Withdraw Policy

  Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student. A Student withdrawing after the 12th week shall be automatically awarded "F" grade which shall count in the GPA.

- Moodle
  UMT –LMS (Moodle) is an Open-Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using LMS, visit http://umt.edu.pk/LMS.

- Harassment Policy
  Sexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.

- Use of Unfair Means/Honesty Policy

  Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.

- Plagiarism Policy

  All students are required to attach a "Turnitin" report on every assignment, big or small. Any student who attempts to bypass "Turnitin" will receive "F" grade which will count towards the CGPA. The participants submit the plagiarism report to the

resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.

- Communication of Results

  The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.

**Rubrics for all assessments (including mid and final exams) will be provided separately to the students.*

Weekly Sessions Plan:		
Week	**Topics / Contents**	**Application/Objectives CLO**
1,2	⇒ General Business Environment; Local& International o Sole Proprietorship o Partnership o Corporations ⇒ Concept & Characteristics of Business Transactions ⇒ Nature or Kinds of Businesses o Merchandizing/Trading o Manufacturing o Services ⇒ Definition & Purpose of Accounting o Identifying o Classifying o Recording o Summarizing o Interpretation ⇒ Types of Accounting o Financial Accounting o Cost Accounting o Management Accounting ⇒ Ethics in Accounting ⇒ Financial Reporting Process ⇒ Overview of IFRS ⇒ Financial Statements o Balance Sheet- Measuring Financial Position o Income Statement- Measuring Financial Performance o Statement of Owners Equity o Statement of Cash Flows ⇒ Annual Reports of Listed Companies ⇒ Users of Financial Statements and their specific needs o Internal Users o External Users	CLO1, CLO2,CLO3,CLO4.CLO5
3,4	⇒ Accounting Terminologies o Assets, Liabilities and Equity o Expenses & Revenues o Accounting Equation o Depreciation	CLO1, CLO2

	○ A/R, A/P, N/R, N/P ○ Liquidity and Solvency ○ Cash Vs. Credit Transactions ○ Credit Terms &Cash Discount ○ Merchandize Inventory ○ Residual Claim in case of Equity ⇒ Cash Vs. Accrual System of Accounting ⇒ Manual Vs. Computerized Accounting systems ⇒ Internal Controls within Organizations ⇒ Audits of Financial Statements	
4-5	⇒ Accounting / Business Entity Concept ⇒ Going Concern Concept ⇒ Money Measurement Concept ⇒ Accounting Period Concept ⇒ Historical Cost Concept ⇒ Realization Principle ⇒ Matching Principle ⇒ Objectivity ⇒ Materiality ⇒ Consistency ⇒ Disclosure ⇒ Conservatism ⇒ Internationalization and harmonization of financial accounting standards ⇒ IFRS and standardized international accounting Practices	CLO1, CLO2,CLO3
6-7	⇒ Accounting Equation ⇒ Double Entry System ⇒ Accounting Cycle ⇒ Categories & Title of Accounts ⇒ Creating Charts of Accounts ⇒ Rules of Debit & Credit ⇒ Single Entry Vs. Double Entry ⇒ Recording of Transactions; Journal ⇒ Posting of Transactions; Ledger ⇒ Summarization; Trial Balance ⇒ Financial Statements: Income Statement, Balance sheet, Statement of Stockholders' Equity	CLO1, CLO2,CLO3,
8	Mid Term Exam	
9,10	⇒ Revenue and Expense Measurement and Recognition ⇒ Concept of Net Income	CLO4.CLO5

	⇒ Income Statement ⇒ Accounting for Dividends and Retained Earnings ⇒ Operating Cycle ⇒ Depreciation ⇒ Investments & Withdrawals by owner ⇒ Statement of Owners Equity ⇒ Balance Sheet ⇒ Articulation of Financial Statements ⇒ Notes to the Accounts ⇒ Disclosure requirements ⇒ Some popular Ratios	
11,12,13,	⇒ Concept & Purpose of Adjustments ⇒ Adjusting Entries; Categories & Examples ⇒ Adjusted Trial Balance ⇒ Post Adjustments Financial Statements: ⇒ Classified Income Statement and Balance Sheet	CLO4.CLO5
14,15	Revision	
Final Term Examination		

Primary Text Book (s):

- Financial & Managerial Accounting by Jerry J. Weygandt PhD, CPA

Reference / Supplementary Reading (s):

- Fundamentals of Accounting by Paul D. Kimmel PhD and Donald E. Kieso PhD, CPA
- Accounting by Warren, Reeve & Fees
- Business Accounting by Frank wood (Volume 1)
- Modern Accounting by Mukherjee (Volume 1)

Course Outlines

Course Code	MA250
Course Title	Abstract Algebra
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	-
Counselling Hours	----------

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course introduces the fundamental concepts of Abstract Algebra, combining key topics from group theory and ring theory. Students will study groups, rings, and fields, along with their homomorphisms and quotient structures. Emphasis is on developing abstract reasoning, constructing proofs, and solving problems. The course prepares students for advanced studies in Rings and Modules, Linear Algebra, Group Representation, Galois Theory, and related areas.

Course Learning Outcomes:

- Define and give examples of groups, rings, and fields.
- Apply fundamental theorems of group theory and ring theory.
- Construct and write mathematical proofs involving algebraic structures.
- Solve problems involving quotient structures, homomorphisms, and factorization.
- Recognize the role of algebra in advanced mathematics and applications.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Joseph A. Gallian, *Contemporary Abstract Algebra*, 9th Edition, Cengage.
David M Burton, A first course in rings and ideals, Addison-Wisley

Reference Material

John B. Fraleigh, A First Course in Abstract Algebra*, 7th Edition, Addison-Wesley.
David S. Dummit and Richard M. Foote, *Abstract Algebra*, 3rd Edition, Wiley.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction to algebraic structures, definition of a group, examples.			
2.	Subgroups, cyclic groups, subgroup generated by a set.			
3.	Cosets, Lagrange's theorem, normalizer, centralizer, the center of a group.			
4.	Equivalence relations, conjugacy classes, normal subgroups.			
5.	Quotient groups, group homomorphisms, kernel and image.			
6.	Isomorphisms, automorphisms, First Isomorphism Theorem.			
7.	Permutation groups, Cayley's theorem, cyclic decomposition.			
8	Direct product of groups, Midterm Review.			

9	Definition of a ring, examples, subrings, units, zero divisors			
10	Ideals: prime and maximal ideals, quotient rings, ring homomorphisms.			
11	Isomorphism theorems for rings, polynomial rings.			
12	Integral domains, divisibility, GCD, Euclidean domains.			
13	Euclidean algorithm, principal ideal domains, irreducible and prime elements.			
14	Unique factorization domains, finite fields.			
15	Applications of finite fields, preparation for final exam.			
16	Final review and connections to advanced topics (linear algebra, coding theory).			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA352
Course Title	**Introduction to Cryptography**
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course is an introduction to the basic theory and practice of cryptographic techniques. It is self-contained; however, a basic understanding of number theory and probability theory will be helpful. The course is intended for BS students

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Cryptography (Springer Mathematics Series) 1st ed. 2018 Edition
by Simon Rubinstein-Salzedo

Reference Material

Introduction to Cryptography by Johannes Buchmann Springer; 2nd editio2004

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Cryptosystem Basic Definitions and Notations			
2.	Historical Cryptosystems and their Cryptanalysis			
3.	Caesar Cryptosystem Subsitution Cryptosystem			
4.	Vigenere Cryptosystem Four square Cryptosystem			
5.	Hill Cryptosystem			
6.	Criteria to secure your cryptosystem Perfect security in Cryptosystem			
7.	Verman one Time pad			
8	Shanon's Theorem and its applications			
9	Diffie-Helleman problem and Key exchange Algorithm			
10	Discrete Logrithm Problem and some techniques to solve it			
11	Shank's Algorithm			
12	Modern Cryptosystems and their Cryptanalysis Public key Cryptosystem			
13	Elgamal Cryptosystem			
14	RSA Cryptosystem Hastad's Broadcast Attack Common Modules Attack			
15	Merkle–Hellman Knapsack Cryptosystem			

Course Outlines

Course Code	MA 263
Course Title	Programing for DS
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course introduces programming concepts and computational tools widely used in data science. Students will learn programming fundamentals, data structures, libraries, and workflows for data analysis, visualization, and machine learning. The course emphasizes problem-solving through coding, with hands-on projects using real datasets.

Course Learning Outcomes:

Course Learning Outcomes (CLOs)

1. **CLO1–Programming Foundations:**
   Apply programming concepts (variables, control structures, functions, and data structures) to develop efficient solutions for computational and data science problems.
2. **CLO2 – Data Handling and Analysis:**
   Utilize modern data science libraries and tools (NumPy, Pandas, Matplotlib/Seaborn) for data cleaning, transformation, visualization, and exploratory data analysis.
3. **CLO3 – Applied Data Science & Communication:**
   Implement basic machine learning models, apply statistical reasoning, and communicate results effectively through reproducible workflows and collaborative projects.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔		
2: Problem Analysis		✓	
3: Designing Skills			✓

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Deep Learning and Machine Learning — Python Data Structures and Mathematics Fundamental: From Theory to Practice (2024) by Silin Chen et al. arxiv.org/pdf/2410.19849

Python Data Science 2024: Explore Data, Build Skills, and Make Data-Driven Decisions in 30 Days (Machine Learning and Data Analysis for Beginners) (2024) Amazon.com: Python Data Science 2024: Explore Data, Build Skills, and Make Data-Driven Decisions in 30 Days (Machine Learning and Data Analysis for Beginners): 9798873946112: Wilson, Stephen: Books

Reference Material

Resource	What It Covers / Why Useful	Link
W3Schools – Data Science Tutorial	Introductory-level guides and examples (Python, DataFrames, data preparation etc.). Good for beginners. (W3Schools)	https://www.w3schools.com/datascience/ (W3Schools)
GeeksforGeeks – Data Science for Beginners	Covers fundamentals: Python/R, NumPy, Pandas, statistical analysis, visualization, ML basics. (GeeksforGeeks)	https://www.geeksforgeeks.org/data-science/data-science-for-beginners/ (GeeksforGeeks)

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1	Introduction to Programming for Data Science: Python basics, Jupyter, GitHub, variables, operators			
2	Control Structures and Functions			
3	Data Structures & File Handling (lists, dictionaries, strings, CSV/JSON)			
4	NumPy & Pandas for Data Analysis			
5	Data Cleaning & Preprocessing (missing values, feature engineering, time series basics)			
6	Data Visualization with Matplotlib & Seaborn			
7	Statistical Programming: descriptive statistics, probability distributions, hypothesis testing			
8	Machine Learning Overview: supervised vs. unsupervised, train-test split, evaluation			
9	Machine Learning Algorithms: linear regression, logistic regression, clustering			
10	Advanced Tools: Web scraping (APIs, BeautifulSoup), regex, large datasets			
11	Version Control & Collaboration (Git, GitHub workflows, documentation)			
12	Reproducibility & Automation: pipelines, Jupyter notebooks, reproducible research			
13	Applied Project – Data Wrangling & Modeling			
14	Applied Project – Visualization & Reporting			
15	Project Presentations			
16	Final Review & Exam (comprehensive coding tasks)			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1	✓	✓					✓	
2			✓	✓			✓	✓
3					✓	✓		✓

SEMESTER V

AC 300- Cost Accounting

Course Teaching Methodology:
The resource person shall explain and discuss a topic in accordance with course outline & students shall be asked to solve various exercises, problems & cases based on those discussions. Guidance in this respect will be provided by the instructor in and outside the class during counseling hours.

Resource Person:	
Email:	
Contact Hours:	
Office Address:	Department of Banking and Finance
Programme:	BBA
Section:	C
Semester:	Fall 2022
Course Prerequisites:	Fundamentals of Accounting
Credit Hours:	3
Course Type:	Core
Venue/Day/Time:	
Course URL (if any):	

Course Description:
Cost Accounting is the “Process of identifying, measuring, accumulating, analyzing, preparing, interpreting and communicating information to help the managers to fulfil organizational objectives”. This course is designed to enable students to learn the management accounting techniques to achieve a level of proficiency sufficient to guide management for effective utilization of economic resources. This course capitalizes the accounting techniques and a method covered in the previous courses and develops a conceptual foundation for establishing a result – oriented mechanism of administrative controls. It also discusses the role of management in the financial reporting process, the impact of the accounting information system on management’s strategic decisions and explores the tools and concepts of cost management systems. The practices of accounting information systems are analyzed to determine their management implications.

Program Objectives/Goals (POs)
1. To develop effective Teamwork and Leadership Skills
2. To inculcate Critical Thinking and effective Decision-Making skills
3. To develop Effective Communication Skills

4. To polish Core Business Knowledge and Competence
5. To expose and inculcate Ethical Behavior and Social Responsibility
6. To provide real-life work experiences.
7. To provide global perspectives.

Program Learning Outcomes (PLOs): **After completing this degree program, students shall be able to:**		**Mapping the PLOs with POs**
1.	Work effectively in teams and understand group processes, leadership, conflict, power and culture in organization.	PO1, PO5, PO6
2.	Use analytical and reflective thinking techniques.	PO2, PO4, PO6
3.	Apply appropriate quantitative and qualitative techniques in solving business problems.	PO2, PO3, PO4, PO5, PO6
4.	Draft effective business documents and prepare and deliver effective oral business presentations using the variety of appropriate technologies.	PO1, PO3, PO6
5.	Demonstrate competency in the underlying concepts, theory and tools taught in the core undergraduate curriculum.	PO4, PO5, PO6, PO7
6.	Identify and analyze ethical conflicts and social responsibility issues involving different stakeholders.	PO5, PO6
7.	Understand the dynamics of industry and understand business as an integrated system and apply strategic planning tools.	PO2, PO3, PO6
8.	Identify and analyze relevant global factors that influence decision making in an international business setting.	PO6, PO7

Course Learning Outcomes (CLOs): **After completing this course, students shall be able to:**	
CLO-1	Understand the need and scope of cost accounting within an organization.
CLO-2	Calculate production costs and interpret them for decision-making purpose.
CLO-3	Recognize the basics of attaching products to services, activity-based costing and process costing.
CLO-4	Define cost concepts, managerial accounting and the basics of cost volume profit analysis.
CLO-5	Understand joint allocation principles and develop decision making skills needed by managerial accountants.

Program Learning Outcomes	**Course Learning Outcomes**
1. Work effectively in teams and understand group processes, leadership, conflict, power and culture in organization.	
2. Use analytical and reflective thinking techniques.	

3. Apply appropriate quantitative and qualitative techniques in solving business problems.	CLO2, CLO4, CLO5,
4. Draft effective business documents and prepare and deliver effective oral business presentations using the variety of appropriate technologies.	CLO3
5. Demonstrate competency in the underlying concepts, theory and tools taught in the core undergraduate curriculum.	CLO1, CLO2,
6. Identify and analyze ethical conflicts and social responsibility issues involving different stakeholders.	CLO3,
7. Understand the dynamics of industry and understand business as an integrated system and apply strategic planning tools.	CLO1, CLO4, CLO5,
8. Identify and analyze relevant global factors that influence decision making in an international business setting.	CLO4, CLO5

Assurance of Learning and Assessment Items:
Specify Assessment Items that will assure student learning through application and achieve objectives of specific PLOs / COs / CLOs

Assessment Item	Application/ Objectives PLO / CO / CLO
Presentation	CO1, CLO-1,
Assignments	CO2, CO3, CLO2, CLO 3,
Class Activities	CO2, CO3, CLO2, CLO 3,
Quizzes	CO2, CO3, CLO2, CLO 3,
Mid Term Exam	CO2, CO3, CLO2, CLO 3,
Final Term Exam	CO2, CO3, CLO2, CLO 3,

Assessment Structure and Grading Policy*:

Assessment Item	Weight (%)	Execution Plan
Class Activities	10%	
Assignments	10%	
Quizzes	20%	
Mid-term exam	25%	One-time assessment
Final exam	35%	One-time assessment
Total	**100**	

Notes – Norms and Important Class Policies:
(such as submission guidelines, academic honesty, make-up policy, code of conduct)

- Be On Time
  You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.

- Mobile Policy
  TURN OFF YOUR MOBILE PHONE! It is unprofessional to be texting or otherwise.

- Email Policy
  READ YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email.
  Participants should regularly check their university emails accounts regularly and respond accordingly.

- Class Attendance Policy
  A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddings are absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade 'F' (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise, they could reach short attendance.

- Withdraw Policy

  Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student. A Student withdrawing after the 12th week shall be automatically awarded "F" grade which shall count in the GPA.

- Moodle
  UMT –LMS (Moodle) is an Open-Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using LMS, visit http://umt.edu.pk/LMS.

- Harassment Policy

  Sexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.

- Use of Unfair Means/Honesty Policy

  Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.

- Plagiarism Policy

  All students are required to attach a “Turnitin” report on every assignment, big or small. Any student who attempts to bypass “Turnitin” will receive “F” grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.

- Communication of Results

  The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.

** Rubrics for all assessments (including mid and final exams) will be provided separately to the students.*

Week	Weekly Sessions Plan	Application/Objectives CLO
1	○ Differentiating Cost, Expense and Loss ○ Manufacturing costs, Direct and Indirect costs. ○ Fixed and Variable costs. ○ Product and period costs. ○ Flow of Manufacturing Cost ○ Cost of goods manufactured statement ○ Cost of goods sold statement ○ Income statement.	CLO1 CLO2
2 3	○ Job Order Costing System ○ Job Order Costing in Service Organizations ○ Job cost sheet ○ Batch Costing	CLO3
4	○ Cost accounting cycle ○ Journal entries and ledger accounts.	CLO3
5	○ Characteristics and Procedures of Process Costing ○ Product Flow ○ Procedures for Material, Labor and Overheads ○ Cost of production Report	CLO2
6	○ Normal and Abnormal losses ○ Normal and Abnormal Gain ○ Beginning WIP (Weighted Average Method)	CLO3
7	○ Planned, Applied and Actual ○ Calculation of Applied Rates ○ Analysis of variance ○ Reasons of Variance ○ Controlling the Variance ○ Departmentalization and Responsibility Accounting ○ Producing and Service Departments ○ Direct and Indirect Departmental Expenses ○ Overhead Departmentalization for non-profit and non-manufacturing organizations	CLO3, CLO4
8	MIDTERM	
9	○ Activity Based Costing ○ Overhead Activities	CLO3

	○ Cost Driver ○ Cost Pool ○ Comparing ABC with Conventional Methods	
10	○ Procedures for Material Procurement and Use ○ Materials Costing Methods ○ Costing Procedures for Scrap, Spoiled Goods and defective work ○ Managing inventory levels	CLO3, CLO4
11 12	○ Human resource Accounting ○ Labour cost control ○ Procedure for labour costing, Overtime and Bonuses ○ Incentive wage plan ○ Labour related deduction ○ Recording labor cost ○ Direct costing and Contribution margin ○ Impact on Stock valuation under absorption and marginal costing	CLO4, CLO5
13	○ Nature of Break-Even Analysis ○ Pricing and Profitability Decisions	CLO2
14	○ Nature of By-products ○ Methods of costing By-products Methods of allocating the Joint Product Costs	CLO4
15	Revision of the course	

Primary Text Book (s):

 Financial & Managerial Accounting by Jerry J. Weygandt PhD, CPA

Reference / Supplementary Reading (s):

- Fundamentals of Accounting by Paul D. Kimmel PhD and Donald E. Kieso PhD, CPA
- Accounting by Warren, Reeve & Fees
- Business Accounting by Frank wood (Volume 1)
- Modern Accounting by Mukherjee (Volume 1)

Computational Physics and Numerical Analysis

Program	**BS (MA)**
Credit Hours	**Three**
Duration	**One semester**
Prerequisites	
Resource Person	
Counseling Timing	
Contact	

Chairman/Director Programme signature…….

Dean's signature……

Date……

Learning Objective

In accordance with HEC curriculum **outcomes** a, b, d, e, g, h & i, students at the end of the course should be able to

- Participants have begun to appreciate the role of reasoning in mathematics and computer programming.

- They have become familiar with the tools used in counting.

They have started understanding the difference between a general proof and verification in particular cases.

Learning Methodology

The purpose of numerical analysis is two-fold: (1) to find acceptable approximate solutions when exact solutions are either impossible or so tough and time-consuming as to be impractical, and (2) to devise alternate methods of solution better suited to the capabilities of computers.

While this course will involve the student in considerable computation in order to apply techniques and obtain acceptable answers, the main emphasis will be on the underlying theory. It will be necessary to draw upon a good bit of calculus, linear algebra, computer science and other branches of mathematics during the course.

To understand the basic techniques of numerical analysis for solving nonlinear algebraic equations, interpolation, for numerical differentiation and integration.

To be able to set up computational algorithms for the solution of above problems.

To be able to use MATLAB software package.

Grade Evaluation Criteria

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

Marks Evaluation	**Marks in percentage**
Qizzes	15
Assignments	05
Mid Term	25
Attendance & Class Participation	
Term Project	
Presentations	05
Final exam	50
Total	100

Recommended /Reference Text Books

- Burden, R.L. and Faires, D.F., Numerical Analysis, Latest ed. PWS-Kent, Boston, MA
- Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers," Fifth Edition, 2006, McGraw-Hill, ISBN: 0073101567.
- Curtis F. Gerald, "Applied Numerical Analysis," Seventh Edition, 2003, Addison Wesley, ISBN: 0321133048
- Saeed Bhatti and Naeem Bhatti :A First Course in Numerical Analysis , Fourth edition,

- 2003, Shahryar Publishers, Urdu Bazar Lahore.)
- Dr. Faiz Ahmad and Muhammad Afzal Rana, "Elements of Numerical Analysis" National Book Foundation (Latest Edition)

Dr. V. N Vedamurthy and Dr. N Ch S N Iyengar "Numerical Analysis" Vikas Publishing House PVT LTD (Latest Edition)

Calendar of Course contents to be covered during semester

Lectures, Reading Assignments, Homework Assignments

Wk	Chapter	Activity 1st Lecture Topic to Cover	Reference	Activity 2nd Lecture Topic to Cover	Reference
	1	Review of Calculus. What is Numerical Analysis? Why Numerical Techniques? Floating point number systems	1.1	Definition of error; Relative and Absolute errors. Sources of Errors. Classification of errors: Gross errors, Rounding errors, Truncation errors.	1.2
	2	Various methods of root-finding: graphical and iteration methods. Graphical representation of iteration method.	2.1	Bisection method and its Computational algorithms	2.1
	2	The method of false position and secant method. Computational algorithms for these methods.	2.2,2.3	The derivation of the Newton-Raphson formula, error in N-R method. Limitations of N-R method. Computational algorithm for N-R method.	2.3
	2,6	Error Analysis for Iterative Methods	2.4	Linear Systems of Equation, Pivoting Strategies	6.1, 6.2
	7	The Jacobi Method, Illustration of the method by examples; Design an algorithm for Jacobi's method	7.3	Gauss-Seidel method, Illustration of the method by examples; Design an algorithm for Gauss-Seidel's method	7.3
		Method of least squares		Eigen value and Eigen vectors	
	3	Introduction to interpolation. Interpolation using equally-spaced data points.	3.1	Difference table. Detection and correction of errors in difference table. Difference operator.	3.1
	3	Relationships between Difference operators.	3.2	Interpolation using unequally-spaced data points.	3.2
	3	Newton's forward difference, backward difference and central difference interpolation formulas.	3.2	Cubic Spline interpolation.	3.3

0	4	Cubic Spline interpolation.	3.3	Introduction to Numerical Differentiation	4.1
1	4	Approximation of derivatives using Newton's forward, backward and central difference formulas.	4.3	Introduction to numerical integration, Trapezoidal Rule and its Algorithms.	4.3
2	4	Simpson's 1/3 method with algorithm.	4.3	Simpson's 3/8 method with algorithm	4.3
3	4	Exercises on Numerical differentiation and integration	4.1, 4.2	Exercises on Numerical differentiation and integration	4.3,4.4
4	4	Numerical solution ordinary Differential Equations	4.1, 4.2	Numerical solution ordinary Differential Equations	4.3,4.4
		Numerical solution partial Differential Equations		Numerical solution partial Differential Equations	
5	Revision				

Course Code	MA-218
Course Title	Ordinary Differential Equations
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

The aim of this introductory course is to familiarize students to the subject of differential equations and their applications in simple physical situations. The student is supposed to understand how DEs arise in mathematics, physics and engineering and the importance of initial and boundary conditions in solving an equation. Standard methods for solving first order DE's. In addition, student able to understand general method for solving second order DEs with constant coefficients and its applications. Laplace and Fourier transform techniques will introduce in this course and applied in simple cases. The method of solution in series will discuss and exemplify.

Course Learning Outcomes:

- Able to understand the basic concepts and terms of differential equations and their applications in simple physical situations.
- Understand how DEs arise in mathematics, physics and engineering.
- Appreciate the importance of initial and boundary conditions in solving an equation
- Able to classify a given DE and be able to analyze which method to apply.
- Familiar with Laplace and Fourier transform techniques.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

D.G. Zill: Differential Equations and their Applications, Latest edition

Reference Material

1. Erwin Kreyzig, Advanced Engineering Mathematics, Latest edition.
2. C.H. Edwards, David E. Penney, Elementary Differential Equations with applications, Latest edition.
3. Michael Greenberg, Advanced Engineering Mathematics, Latest edition.
4. Zill, Prindle Weber and Schmidt, A first Course in Differential Equations, Latest edition.
5. Differential Equations by (Paul Dawkins)

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction to the subject, how DEs arise; classification of DEs with particular reference to linearity and nonlinearity, Introduction to Ordinary Differential Equations, Solution of ODEs			
2.	Differential equations as a Mathematical Model, Separable Equations			

3.	Equations Reducible to Separable form, Exact Differential Equations			
4.	Integrating Factors (Non-Exact Differential Equations), Bernoulli, Ricatti's Differential Equations			
5	Linear first order Ordinary Linear DE, Homogeneous Linear DE of Second Order			
6	Homogeneous Second Order Equations with constant Coefficients, Differential Operators			
7	Cauchy Equations (with Variable Coefficients), Variation of parameters			
8	Homogeneous Linear Equations of Arbitrary Order with constant coefficients, method of reduction of order			
9	Undetermined Coefficients, Nonlinear homogeneous equations			
10	Introduction to method of solution in series, Illustrative examples on the method of solution in series			
11	Introduction to Laplace transform, Calculation of Laplace transforms in simple cases. Inverse Laplace Transforms, Calculation of Inverse Laplace Transforms			
12	Application of LT to solution of initial-value problems.			
13	Further Application of LT to solution of initial-value problems			
14	Application of Differential equations to real life problems			
15	Review and revision of material covered			
16	Review and revision of material covered			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA-312
Course Title	Real Analysis I
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	

Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course introduces the fundamental concepts of real analysis, including the real number system, sequences, and continuity. Students develop mathematical proof and reasoning skills, preparing them for further study in analysis.

Course Learning Outcomes:

1- To understand the basic and fundamental properties of real numbers, sequences, and functions that is necessary for the formal development of rigorous notions in real analysis.
2- To apply the theory to problem solving.

3- To analyze the relationship between various theoretical tools for their refinement and for further problem solving in mathematics.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: To understand the basic and fundamental properties of real numbers, sequences, and functions that is necessary for the formal development of rigorous notions in real analysis	✔	✔	✔
2: To apply the theory to problem solving.			
3: To analyze the relationship between various theoretical tools for their refinement and for further problem solving in mathematics.			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

R.G. Bartle, D.R. Sherbert: Introduction to real analysis (4th edition), 1999, John Wiley & Sons

Reference Material

1. W. Rudin, Principles of mathematical analysis, 3 New York: McGraw-hill, 1964.
2. S.G. Krantz, Real analysis and foundations, Chapman and Hall/CRC, 2004.
3. R.B. Ash, Real Variables with Basic Metric Space Topology, Courier Corporation, 2009.
4. Real Analysis by Finnur Lárusson
5. Understanding Analysis by Stephen Abbott,

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Sets and functions, Mathematical induction, finite and infinite sets			
2.	The algebraic and order properties of real numbers Absolute value of real numbers			
3.	The completeness property of real numbers Applications of the supremum property Intervals,			
4.	Sequences and their limits			
5.	Limit theorems, Monotone sequences			
6.	Subsequences and the Bolzano-Weistrass theorem, The Cauchy criterion			
7.	Properly divergent sequences			

8	Introduction to series			
9	Limit theorems, Examples,			
10	Some extensions of the limit concepts			
11	Continuous functions, Combinations of continuous functions			
12	Continuous functions on intervals, Uniform continuity			
13	Monotone and inverse functions			
14	The derivative			
15	The mean value theorem			
16	Applications of derivatives			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA-330
Course Title	**Vector and Tensor Analysis**
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

The **o**bjectives of this course are to: introduce students to the Fundamentals of vector and tensor algebra; and expose students to mathematical applications of vector and tensor algebra to handle diverse problems, which occur in real life situations.

Course Learning Outcomes:

The student should be able to differentiate in scalar and vector quantities..
The student is supposed to understand how to find vector and scalar product of vectors.
The student should be comfortable in applications of line integral, surface integral and volume integral.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

M. R. Spiegel, Vector Analysis, (Schaum's Outline McGraw Hill Book Company, 1981)

Reference Material

1. G. E. Hay, Vector and Tensor Analysis, (Dover Publications, Inc., 1979)
2. D. C. Kay, Tensor Calculus, (McGraw Hill Book Company, 1988)
3. E. C. Young, Vector and Tensor Analysis, (Marcel Dekker, Inc., 1993)
4. A. W. Joshi, *Matrices and Tensors in Physics*, (Wiley Eastern Limited, 1991)
5. Hwei P. Hsu, *Applied Vector Analysis*, (Harcourt Brace Jovanovich Publishers, San Diego, New York, 1984)
6. 1. F. Chorlton, *Vector and Tensor Methods*, (Ellis Horwood Publisher, Chichester, U.K., 1977)

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Scalars and Vectors			
2.	Vector Calculus			
3.	Line integrals			
4.	Surface area and surface integrals			
5.	Volume integrals			
6.	Green's theorem (Applications)			
7.	Gauss divergence theorem (Applications)			
8	Orthogonal coordinates			
9	Unit vectors in curvilinear systems			
10	The gradient, divergence and curl In curvilinear coordinates			
11	Coordinate transformations, Einstein summation convention			
12	Symmetric and skew symmetric tensors. Addition, subtraction, inner and outer products of tensors. Contraction theorem, quotient law. The line element and metric tensor			
13	Christoffel symbols (1^{st} and 2^{nd} kind)			
14	Covaraint Derivative			
15	Review			
16	Review and revision of material covered			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

SEMESTER VI

Course Outlines

Course Code	MA324
Course Title	Complex Analysis
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	---

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This is an introductory course in complex analysis, giving the basics of the theory along with applications, with an emphasis on applications of complex analysis and especially conformal mappings. Students should have a background in real analysis (as in the course Real Analysis I), including the ability to write a simple proof in an analysis context

Course Learning Outcomes:

Upon completion of this course, students will be able to:
CLO 1: Solve problems related to analytic functions, complex integration, residue theory and series of complex numbers (Level C3)
CLO 2: Solve problems related to Laplace, Fourier & z-transforms applying basic concepts of complex numbers & functions (Level C3)

CLO 3: Solve differential equations arising from practical applications in the fields of electro-statistics, heat flow and fluid mechanics (Level C3)

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

R. V. Churchill, J. W. Brown, *Complex Variables and Applications* , 5th edition, McGraw Hill, New York, 1989.

Reference Material

1. J. H. Mathews and R. W. Howell, *Complex Analysis for Mathematics and Engineering*, 2006.
2. S. Lang, *Complex Analysis*, Springer-Verlag, 1999.
3. R. Remmert, *Theory of Complex Functions*, Springer-Verlag, 1991.
4. W. Rudin, *Real and Complex Analysis*, McGraw-Hill, 1987.

Course Calendar				
Lectures	**Course Outline/Topic**	**Textbook Chapter(s)**	**Assignments & Tasks**	**CLO**
1 - 4	Properties of complex numbers, conjugates, De Moivre's Theorem and its applications, Roots of complex numbers, regions in the complex plane, functions of complex variables,			
5 - 8	Limit, continuity, and derivatives of complex valued functions, CR equations, Analytic functions, singular points, Entire function, Harmonic function and its harmonic conjugate			
9-12	Elementary functions, Exponential, Trigonometric, and Hyperbolic			
13-16	Complex integration, Contour integration, Path independence, Cauchy theorem, Cauchy integral formula and its consequences			
	Mid Term Exam			
17 - 20	Complex sequence and series, Taylor series, power series, radius of convergence			
21-24	Laurent series, residues and poles, Cauchy residue theorem, applications of residues, applications of residue theory to evaluate different types of integrals			
25-28				

	Laplace transformations with its properties and applications, inverse Laplace transformation, Fourier transformations, inverse Fourier transform, z-transform			
29 - 30	Electrostatic fields, heat problems, fluid flow			
	Final Term Exam			

University of Management and Technology

Course Outline

Course code: CS371 Course title: Artificial Intelligence

Program	BS MAth
Credit Hours	3
Duration	16 Weeks (1 Semester)
Prerequisites	
Resource Person	
Counseling Timing (Office#24)	
Contact	

Chairman/Director signature……

Dean's signature…… Date……

Learning Objective:

On successful completion of this course students will be able to:

- Explain what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.
- Explain how Artificial Intelligence enables capabilities that are beyond conventional technology, for example, chess-playing computers, self-driving cars, robotic vacuum cleaners.
- Use classical Artificial Intelligence techniques, such as search algorithms, min max algorithm, neural networks, tracking, robot localization.
- Ability to apply Artificial Intelligence techniques for problem solving.
- Explain the limitations of current Artificial Intelligence techniques.

Learning Methodology:

- Lectures,
- Self-study
- Class Activity
- Book exercises

Grade Evaluation Criteria

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

Marks Evaluation **Marks in percentage**

Quizzes 10%
Assignments 10%
Mid Term 20%
Term Project 20%
Final exam 40%
Total 100%

Recommended Text Books:

Artificial Intelligence by George F. Luger

Reference Books:

Artificial Intelligence: A Modern Approach Russell & Norvig
Machine Learning: Tom Mitchell (handouts)

Calendar of Course contents to be covered during semester

Course code: CS360 **Course title:** Artificial Intelligence

Week	Course Contents	Reference Chapter(s)
1	Introduction & Applications	Ch#1 Artificial Intelligence By G.F.Luger
2	Knowledge & Reasoning	Ch#2 Artificial Intelligence By G.F.Luger
3	Propositional & Predicate Calculus	Ch#2 Artificial Intelligence By G.F.Luger
4	State Space Search: Graph Theory	Ch#3 Artificial Intelligence By G.F.Luger

5	Blind Search Vs Heuristic Search	Ch#4 Artificial Intelligence By G.F.Luger
6	Min Max search	Ch#4 Artificial Intelligence By G.F.Luger
7	Data and its types Numeric, Categorical, Nominal, ordinal	
8	Supervised Learning • Artificial Neural Network (Perceptron Algorithm)	
9	WEKA Training session for ANN learning and training	

10	Unsupervised Learning K-Means Clustering	

11	Genetic Algorithm I	
12	Genetic Algorithm II	
13	Uncertainty handling Fuzzy Systems	
14	Term Project Presentation	
15	Revision	

Course Outlines

Course Code	MA-311
Course Title	Differential Geometry
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course is an introduction to differential geometry. Students should have a good knowledge of multivariable calculus and linear algebra, as well as tolerance for a definition–theorem–proof style of exposition. The course itself is mathematically rigorous, but still emphasizes concrete aspects of geometry, centered on the notion of curvature.

Course Learning Outcomes:

Recall the concepts of lines and curves in three-dimensional space.
Identify the curvature and torsion of curves and surfaces
Apply the concept of differential geometry to solve the problems related to curves and surfaces.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

M.M Lipschutz, *Schaum's Outline of Differential Geometry (McGraw, 1969).*

Reference Material

Curvature of Space and Time, with an Introduction to Geometric Analysis" by Iva Stavrov (2020).

A. Goetz , *Introduction to differential Geometry* (Addison-Wesley, 1970).
E.Kreyzig, *Differential Geometry* (Dover, 1991).
M.M Lipschutz, *Schaum's Outline of Differential Geometry (McGraw, 1969).*

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction, index notation and summation convention.			
2.	Space curve, arc length, tangent normal and binormal.			
3.	Osculating, normal and rectifying planes.			
4.	Curvature and Torsion.			
5.	The Frenet-Serret Theorem.			
6.	Natural Equation of Curve.			
7.	Involutes and evolutes, helices.			
8	Fundamental Existance theorem of space curve.			
9	Introduction, index notation and summation convention.			
10	Space curve, arc length, tangent normal and binormal.			
11	Coordinate Transformation.			
12	Tangent plane and surface normal			
13	The first fundamental form and the metric tensor			
14	Christoffel symbols of first and second kinds			
15	The second fundamental form			
16	Principle, Gaussian, mean, geodesic and normal curvature			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Resource Person:	
Email:	
Contact Hours:	
Office Address:	
Programme:	BS Accounting and Finance
Section:	
Semester:	
Course Pre-requisites:	
Credit Hours:	3
Course Type:	Introductory Course in the field of Finance
Venue/Day/Time:	
Course URL (if any):	

Course Description:
The course introduces the key concepts of Finance to the students. By teaching the students time value of money, risk and return analysis, cash flow analysis, capital budgeting techniques, asset allocation, and diversification and the capital asset pricing model, the course help to align student thought processes so that they can understand and delve into deeper concepts of finance. Since this is the first course in the sequence of finance subjects offered and it develops the mindset for understanding financial concepts it is suitable not only for students wishing to pursue further studies in finance but also for students from other disciplines who are interested in a single course in finance.

Course Teaching Methodology:
The course will boost student learning and interest by having: • Interactive Classes • Case-based teaching • Class activities • Applied Projects

Programme Educational Objectives (POs):	
PO-1	To develop effective Teamwork and Leadership Skills
PO-2	To inculcate Critical Thinking and effective Decision Making skills
PO-3	To develop Effective Communication Skills
PO-4	To polish Core Business Knowledge and Competence
PO-5	To expose and inculcate Ethical Behavior and Social Responsibility
PO-6	To provide real-life work experiences.
PO-7	To provide global perspectives.

Programme Learning Outcomes (PLOs): After completing this degree programme, students shall be able to:		
		Mapping the PLOs with POs
PLO-1	Work effectively in teams and understand group processes, leadership, conflict, power and culture in organization.	PO1,PO5, PO6
PLO-2	Use analytical and reflective thinking techniques.	PO2,PO4, PO6
PLO-3	Apply appropriate quantitative and qualitative techniques in solving business problems.	PO2,PO3, PO4,PO5, PO6
PLO-4	Draft effective business documents and prepare and deliver effective oral business presentations using the variety of appropriate technologies.	PO1, PO3, PO6
PLO-5	Demonstrate competency in the underlying concepts, theory and tools taught in the core undergraduate curriculum.	PO4,PO5, PO6, PO7
PLO-6	Identify and analyze ethical conflicts and social responsibility issues involving different stakeholders.	PO5, PO6
PLO-7	Understand the dynamics of industry and understand business as an integrated system and apply strategic planning tools.	PO2,PO3, PO6
PLO-8	Identify and analyze relevant global factors that influence decision making in an international business setting.	PO6, PO7

Course Objectives (COs)	
CO-1	To understand the basic concepts and principles used in Finance
CO-2	To understand how the financial market and banking system work in terms of internationalization

CO-3	To understand how to manage environmental and social risks
CO-4	To understand the significance of ethical decision making in the financial world
CO-5	To interpret financial statements of a company and thereafter perform financial analysis
CO-6	To calculate the present and future value of money

Course Learning Outcomes (CLOs): **After completing this course, students shall be able to:**		
		Mapping the CLOs with PLOs
CLO-1	Students will be able to understand the role of financial managers in corporations and the role of corporate governance.	PLO1,
CLO-2	The student will be able to assess the difference between cash flows and income and perform cash flow valuations.	PLO2 and PLO3 and PLO4
CLO-3	Students will be able to identify the purpose of each financial statement and conduct basic analysis.	PLO5 and PLO6
CLO-4	Determine the cost of financial assets.	PLO5 and PLO 7
CLO-5	Identify and calculate the time value of money and its various aspects.	PLO5,PLO7 and PLO8
CLO-6	Identify and calculate return and risk methodologies.	PLO8

Assurance of Learning and Assessment Items: *Specify Assessment Items that will assure student learning through application and achieve objectives of specific PLOs / COs / CLOs*	
Assessment Item	**Application/ Objectives** **PLO / CO / CLO**
Quizzes	CLO1, CLO2, CLO3, CLO4, CLO5, CLO6
Assignments and Case Studies	CLO1, CLO2, CLO3, CLO4, CLO5, CLO6

Projects	CLO2, CLO3, CLO4, CLO5, CLO6
Midterm	CLO1, CLO2, CLO3
Final exam (comprehensive)	CLO1, CLO2, CLO3, CLO4, CLO5, CLO6

Assessment Structure and Grading Policy*:		
Assessment Item	**Weight (%)**	**Execution Plan**
Assignments/ Class activities	10	3 Assignments & 1 class activity each 10 (average)
Quizzes	10	4 Quiz each 10
Project & Presentation	20	Project submission & each Class Presentation (All students' participation is mandatory)
Mid-term exam	25	One-time assessment
Final exam	35	One-time assessment
Total	**100**	
Notes – Norms and Important Class Policies: *(such as submission guidelines, academic honesty, make-up policy, code of conduct)*		
• Be OnTime		• You need to be in class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.
• Mobile Policy		• TURN OFF YOUR MOBILE PHONE! It is unprofessional to be texting or otherwise.
• Email Policy		• READ YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email. • Participants should regularly check their university emails accounts regularly and respond accordingly.
• Class Attendance Policy		• A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddings are absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given a grade 'F' (Fail) and will not be allowed to take end-term exams. International students who will be leaving for a visa during the

• Withdraw Policy		semester should not use any days off except for visa trips. Otherwise, they could reach short attendance.
• Moodle		• Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student.A Student withdrawing after the 12th week shall be automatically awarded an "F" grade which shall count in the GPA. • UMT –LMS (Moodle) is an Open Source Course Management System (CMS), also known as a Learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system and fully benefit from its capabilities. If you are facing any problem using moodle, visit http://oit.umt.edu.pk/moodle. For further query send your queries to moodle@umt.edu.pk
• Harassment Policy • Use of Unfair Means/Honesty Policy • Plagiarism Policy		• Sexual or any other harassment is prohibited and is constituted as a punishable offense. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc. • Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.
• Communication of Results.		• All students are required to attach a "Turnitin" report on every assignment, big or small. Any student who attempts to bypass "Turnitin" will receive an "F" grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every

		assignment, report, project, thesis etc. If a student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook. • The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.

**Rubrics for all assessments (including mid and final exams) will be provided separately to the students.*

Weekly Sessions Plan:			
Week	**Topics / Contents**	**Activity**	**Application/Objectives PLO / CO / CLO**
1	**An overview of Finance (Chapter 1)** Understand the financial concepts associated with • financial management • good governance • financial ethics.	Lecture Discussion Assignment	CLO-1
2	**International Financial Markets and Banking System (Chapter 2)** • Understand how the financial market and banking system works in terms of internationalization? • Perform valuations of financial bond instruments • Assess the most viable investment bond options available	Lecture CaseStudyDocumentary Quiz Assignment	CLO-2
3	**Overview of Financial Statements (Chapter 3)** • Modify Accounting data for Managerial Decisions • Assess the difference between cash flows and income	Lecture Case Study Project on the PSX Index stocks Assignment	CLO-2 CLO-3
4	**Calculating Cash Flows (Chapter 3)** • Calculate NOWC, NCF, NOPT, OCF, MVA, EVA, etc. • Perform cash flow valuations	Lecture Case Study with ExcelApplications Assignment Quiz	CLO-2
5	**Analysis of Financial Statements (Chapter 4)** • Develop an Understanding with Stockholder's Report • Make Common size balance sheets income statements • Understand the fundamentals of using Financial Ratios. • Calculate Liquidity Ratios, Activity Ratios, Debt Ratios,and Profitability Ratios	Lecture Case Study Assignment Quiz	CLO-3
6	**Analysis of Financial Statements**	Lecture	CLO-3

	(Chapter 4) • Calculate the Market Ratios • Analyze entities using Ratio analysis • Apply DuPont System of Analysis • Uses and limitations of Ratio Analysis	Articles Assignment Quiz	
7	**The Cost of Money** **(Chapter 6)** • Understand the factors that affect the Cost Of Money. • Understand Interest RatesFundamentals • Understand the determinants of Market Interest Rate. • Calculate the cost of different financial assets	Lecture Articles Assignment	CLO-4
8	Midterm		CLO1, CLO2, CLO3
9	**Time Value of Money** **(Chapter 5)** • Understand the role of Time Value of Money in Finance. • Understand the difference between Future and Present Value. • Calculate the Present and Future Value of a Single amount. • Evaluate the outcomes based on the present value and/future values of cash flows	Lecture Articles Assignment Quiz	CLO-5
10	**Time Value of Money** **(Chapter 5)** • Calculate the Present & Future Value of Annuities • Calculate the Future & Present Values of Mixed streams • Understand and use Compounding Interest • Understand and apply Loan Amortization principles	Lecture Articles Assignment Quiz	CLO-5
11	**Risk and Return** **(Chapter 8)**	Lecture Articles	CLO-6

	• Understand Investment returns, and the associated expected rate of return • Calculate the Stand-alone risk: standard deviation & CV • Apply Risk aversion concepts to calculate the required returns • Calculate the risk and return of individual assets	Assignment	
12	**Risk and Return (Chapter 8)** • Understand Portfolio risk. • Differentiate between Diversifiable and Market risk • Find the Security Market Line and CAPM. • Calculate the risk and return of portfolios and the role of the market in risk and return	Lecture Articles Assignment Quiz	CLO-6
13	**Sustainability and Ethics** • How to manage environmental and social risks? • How to identify and take advantage of environmental business opportunities? • What is the significance of ethical decision-making in the financial world? • Identify the significance of ethical decision-making in an increasingly complex market.	Lecture Articles Assignment	CLO-1 CLO-6
14	**Presentations**		CLO2, CLO3, CLO4, CLO5, CLO6
15	**Revision**		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6
16			
17	**Final Term Examination**		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6

Primary Text Book (s):
• Principles of Managerial Finance by Lawrence J. Gitman (11th Edition).

Reference / Supplementary Reading (s):
• Essentials of Finance by Ross, Jordan&Westerfield (10th Edition)

- Principles of Finance by Scott Besley and Eugene Brigham
- Fundamentals of Financial Management by Brigham & Houston, 12th Edition
- Fundamentals of Corporate Finance by Brealey, Myers, Marcus (Latest)

Useful Online / Web Resources:

- https://investopedia.com/
- secp.gov.pk
- khistocks.com

University of Management and Technology

School of Science

Department of Physics

Course Code: ME-105/PH-101
Course Title: APPLIED MECHANICS/MECHANICS
Program: BS (H/CS/SE/PH/CH/MA/IE/EPE/TN)

Course Outline

Schedule		**Pre-requisite**	NIL
Course Coordinator		**Contact**	
Class Schedule & Room No:		**Counselling Hours:**	
Course Description	Measurement and vectors. Motion in one, two and three dimensions. Newton's laws of motions. Work and energy principles. Laws of conservation of momentum and energy. One- and two-dimensional collisions. Rotational kinematics and dynamics. Conservation of angular momentum. Static equilibrium and elasticity. The learning in this course is strengthened by related lab work.		
Expected Outcomes	Participants will learn calculus based applied mechanics.		
Text Book	Physics for Scientist and Engineers, John W. Jewett, Jr., Raymond A. Serway, 7thEdition, Thomson Brooks/Cole, US, 2008. Second Indian Reprint 2011		
Reference Book:	Fundamentals of Physics, 8th Edition by Halliday, Resnick, and Walker.		
Assignments	Problems will be assigned at regular intervals as an assignment.	**Quizzes**	All quizzes will be announced well before time. No make-ups will be offered for missed quizzes.
Mid Term Examination	A 60-minutes exam will cover all the material covered during the first 14-16 lectures.	**Final Examination**	A 120-minutes exam will cover all the material covered during the semester. Combined Final exam for all

	Combined Mid Term exam for all multiple sections.		multiple sections
Attendance Policy	Students missing more than 20% of the lectures will receive an "SA" grade in the course and will not be allowed to take Final exam.		
Grading Policy	Assignment + Quizzes: 20% Mid Term Examination: 20% Final Examination: 60%		

Lecture Plan

Week	Lecture #	TOPICS	CH	SECTIONS
1	1	Standards of length, mass, time and dimensional analysis	1	1,3
	2	Conversion of units and significant figures	1	4,6
2	1	Motion in one dimension	2	1 – 3
	2	The particle under constant acceleration	2	4 – 6
3	1	Freely falling objects	2	7
	2	Vectors and scalar quantities	3	2 – 3
4	1	Addition of vectors and components of a vector	3	4
	2	Motion in two-dimension, velocity and acceleration	4	1 – 2
5	1	Projectile and uniform circular motions	4	3 – 4
	2	Tangential and radial acceleration	4	5 – 6
6	1	The concept of force and Newton's laws of motion	5	1 – 6
	2	Applications of Newton's laws of motion	5	7
7	1	Forces of friction	5	8
	2	Circular motion: Uniform and non uniform	6	1 – 2
8	1	Motion in accelerated frames	6	3
	2	Work done by a constant and variable force	7	1 – 4
9	1	Kinetic energy and the work–energy theorem	7	5 – 8
	2	Conservation of energy	8	1 – 2
10	1	Situations involving kinetic friction	8	3 – 4
	2	Power	8	5
11	1	Linear momentum and its conservation	9	1 – 2
	2	Collisions in one and two dimensions	9	3 – 4
12	1	Centre of mass and rocket propulsion	9	5 – 6,8
	2	Angular position, velocity and acceleration	10	1 – 3
13	1	Rotational kinetic energy and torque	10	4 – 7
	2	Energy considerations in rotational motion	10	8 – 9
14	1	The vector product and angular momentum	11	1 – 3
	2	Conservation of angular momentum	11	4 – 5
15	1	Static equilibrium	12	1 – 2
	2	Center of gravity	12	3

Department of Physics

Applied Mechanics Lab / Mechanics Lab

(ME-105/PH-101)

Lab Work

Lab Policy	Students are expected to perform experiments (as per attached list) related to the course work, analyze the data, draw conclusions, and write a report. Grades will be awarded based on student's lab reports and a final exam in the lab.
Grading Policy for Lab work	Laboratory Reports 12 Marks Final Examination 08 Marks
Make-up Labs	If due to an unavoidable circumstance a student has to miss a Lab, then he/she should obtain an excuse for this from the instructor. The instructor will accept an excuse only if he feels that the student had a genuine reason. In an accepted case the instructor may allow the student to take a make-up session.
Attendance Policy for Lab	Students missing more than 20% of the Labs. (excused or unexcused) will receive an "F" grade in the Lab work.

OVERALL POLICY:

- **Student has to pass both Course work and Lab work separately.**
- **Student failing in the Course work but passing in the Lab work, has to repeat both Course work and Lab work.**
- **Student failing in the Lab work but passing in the Course work, has to repeat Lab work alone.**

Department of Physics

Applied Mechanics Lab / Mechanics Lab
(ME-105/PH-101)
List of Experiments

Week	Exp No.	Title of Experiment
1st		**Lab Orientation Week**
2nd	1	**Graphing** To learn to quickly and accurately plot a graph; how to use graphical techniques to represent and analyze laboratory data.
3rd	2	**An Empirical Law** To find the empirical relation between T and d for a disk, where T is the period of oscillation and d is the average diameter.
4th	3	**Packing density: signification figures** To study the packing density of steel balls of different diameters in a cylindrical tube. Main aim is to understand the number of significant figures that need to be reported for various measurements.
5th	4(a)	**Uniformly accelerated motion (using air track)** To measure the acceleration of a body acted upon by a constant force.
		OR
5th	4(b)	**Acceleration as a function of the accelerated mass (using air track)** Determination of acceleration as a function of the accelerated mass.
6th	5(a)	**Collision in one dimension-I** To study elastic and inelastic collision on a linear air track and to compare the observed results with those predicted theory.
		OR
6th	5(b)	**Collision in one dimension-II** To study elastic collisions on a linear air track and to compare the observed results with those predicted by theory.
7th	6	**Uniform angular Acceleration** To measure the angular acceleration of a body acted upon by a constant torque.
8th	7	**The spring** To measure the spring constant of a spring, and study the conservation energy in a spring –mass system.
9th	8	**Static equilibrium** To determine the mass of a meter rod by using conditions of equilibrium.
10th	9	**Vector analysis of forces in equilibrium** Vector analysis of forces in equilibrium.
11th	10	**Motion of two masses over a pulley** Motion of two masses connected by a string passing over a pulley depends on the difference between the two masses.

*

12th	11	**Projectile motion of a bullet (Analysis of data)** A method to measure the initial velocity of a bullet fired by a gun.
13th	**Revision Week**	
14th	**Lab Final Examination**	
15th	Week for Preparation of Theory Final Examination	

The listed sequence of the experiments may vary from student-to-student. However, each student must perform all the listed experiments.

Course Outlines

Course Code	MA321
Course Title	Partial differential Equations
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	
Counselling Hours	

Chairperson/Director signature……..

Dean's signature……

Date……..

Course Description:

Partial Differential Equations (PDEs) are at the heart of applied mathematics and many other scientific disciplines. The course aims at developing understanding about fundamental concepts of PDEs theory, identification and classification of their different types, how they arise in applications, and analytical methods for solving them. Special emphasis would be on wave, heat and Laplace equations.

Course Learning Outcomes:

- To understand the fundamental concepts and classification of partial differential equations.
- To solve classical PDEs like heat, wave, and Laplace equations using analytical techniques.
- To apply numerical methods and computational tools for solving complex PDEs.
- To analyze and interpret the physical significance of solutions to PDEs.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis	✔	✔	
3: Designing Skills		✔	✔

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. Myint UT, *Partial Differential Equations for Scientists and Engineers*, 3rd edition, North Holland, Amsterdam, 1987.
2. Dennis G. Zill, Michael R. Cullen, *Differential equations with boundary value problems,* Brooks Cole, 2008.
3. John Polking, Al Boggess, *Differential Equations with Boundary Value Problems*, 2nd Edition, Pearson,July 28, 2005.

Reference Material

1. J. Wloka, *Partial Differential Equations*, Cambridge University press, 1987

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction to PDEs, Formation of PDEs, Solutions of First-Order PDEs			1
2.	The Cauchy's Problem for Quasilinear First-Order PDEs, Nonlinear Equations			1
3.	Special Types of First-Order Equations			1
4.	Second-Order PDEs: Basic Concepts, Mathematical Problems, Linear Operators, Superposition			2
5.	Mathematical Models: Vibrating String, Vibrating Membrane, Heat Conduction			2
6.	Mathematical Models: Vibrating String, Vibrating Membrane, Heat Conduction			1,3
7.	Cauchy's Problem for Second-Order PDEs in Two Independent Variables			1,3
8	Mid Term Exam			
9	Method of Separation of Variables: Elliptic, Parabolic, and Hyperbolic PDEs			2,3

10	Cartesian and Cylindrical Coordinates			2,3
11	Laplace Transform: Introduction, Properties, Transform of Elementary Functions			2
12	Inverse Laplace Transform, Convolution Theorem, Solution of PDEs Using Laplace Transform			2,3
13	Fourier Transform: Representation, Transform Pairs, Finite Fourier Transforms			2
14	Solutions of Heat, Wave, and Laplace Equations Using Fourier Transforms			2,3
15	Applications and Advanced Topics in PDEs			3
16	Final Term Exam			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA-314
Course Title	Real Analysis II
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course continues the study of real analysis, focusing on differentiation, integration, and sequences of functions. Topics include uniform convergence, interchange of limits, and the Fundamental Theorem of Calculus, with an emphasis on rigorous proof and mathematical reasoning.

Course Learning Outcomes:

1. To understand the basics of differentiation, integration and sequence and series of functions and some results about functions of several variables.
2. To apply various tools from the theory of differentiation and integration to problem solving
3. To analyze the relationship between various tools for their refinement and for further problem solving.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: To understand the basics of differentiation, integration and sequence and series of functions and some results about functions of several variables	✔	✔	✔
2: To apply various tools from the theory of differentiation and integration to problem solving			
3: To analyze the relationship between various tools for their refinement and for further problem solving.			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Rudin, Walter, Principles of mathematical analysis, 3 New York: McGraw-hill, 1964.

Reference Material

- Krantz, Steven G, Real analysis and foundations, Chapman and Hall/CRC, 2004
- Royden, Halsey Lawrence, Real Analysis, 3rd Edition, 1988.
- Bartle, Robert Gardner, and Donald R. Sherbert, Introduction to real analysis, Hoboken, NJ: Wiley, 2011.
- Ash, Robert B, Real Variables with Basic Metric Space Topology, Courier Corporation, 2009.
- Real Analysis by Finnur Lárusson
- Understanding Analysis by Stephen Abbott,

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	The derivative of real valued functions and some related results,			
2.	Mean Value Theorem and its application			
3.	Continuity of the derivatives,			
4.	Exercises and applications related to differentiation			
5.	Taylor's theorem			
6.	Riemann-Steiltjes integral			
7.	Riemann-Steiltjes integral continue			
8	Existence of Riemann-Steiltjes integral			
9	Properties of Riemann-Steiltjes integral			
10	Integration and differentiation			
11	Fundamental theorem of calculus and integration by parts			
12	Pointwise and uniform convergence			
13	Uniform convergence and continuity			
14	Uniform convergence and differentiation			
15	Uniform convergence and integration			
16	Some applications			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

SEMESTER VII

School of Science

Department of Physics

Course Code PH-311

Course Title: Classical Mechanics

Program: BS (Physics) Spring 2021

Course Outline

Schedule		**Pre-requisite**	PH-101 Mechanics
Course Coordinator		**Contact**	
Course Description	Newton's Law, Equation of motion for a particle, Conservation Theorems, Simple Harmonic Oscillator, Harmonic Oscillator in two Dimensions, Phase Diagram, Damped Oscillation, Sinusoidal driven forces, Gravitational Potential, Equipotential Surfaces, Hamilton's Principle, Generalized coordinates, Lagrange's equations of motion in generalized coordinates, Lagrange's equations with undermined multiples, Equivalence of Lagrange's and Newton's equations, Kepler's Problems, Orbital Dynamics		
Expected Outcomes	Participants will learn calculus based Classical Mechanics approach. They will also be ready for Quantum Mechanics, Statistical Mechanics and Relativity courses.		
Text Book	Classical Dynamics of Particles and Systems, By Marion Thornton, 5th Edition		
Assignment	Problems will be assigned at regular intervals as an assignment.	**Quizzes**	All quizzes will be announced well before time. No make-ups will be offered for missed quizzes.
Mid Term Examination	A 60-minutes exam will cover all the material covered during the first 14-16 lectures.	**Final Examination**	A 120-minutes exam will cover all the material covered during the semester.
Attendance Policy	Students missing more than 20% of the lectures will receive an "SA" grade in the course and will not be allowed to take final exam.		

Classical Mechanics

Lecture Plan

Week	Lecture #	TOPICS	CH	Sections
1	1 2	Newton's Law, Equation of motion for a particle Conservation Theorems	02 02	1 – 4 5
2	1 2	Energy Rocket Motion, Limitation of Newtonian Mechanics	02 02	6 7 – 8
3	1 2	Simple Harmonic Oscillator, Harmonic Oscillator in two Dimensions, Phase Diagram Damped Oscillation, Sinusoidal driven forces	03 03	1 – 4 5 – 7
4	1 2	Electrical Oscillations Principle of Superposition	03 03	8 9
5	1 2	Gravitational Potential Equipotential Surfaces	05 05	1 – 2 3 – 4
6	1 2	Ocean Tides Calculus of Variations	05 06	5 1 – 2
7	1 2	Euler's Equation Second Form of Euler's Equation	06 06	3 4 – 5
8	1 2	Euler's equation with auxiliary condition Hamilton's Principle, Generalized coordinates	06 07	6 – 7 1 – 3
9	1 2	Lagrange's equations of motion in generalized coordinates Lagrange's equations with undermined multiples, Equivalence of Lagrange's and Newton's equations	07 07	4 5 – 7
10	1 2	Conservation theorems, Canonical equation, Dynamical variables	07 07	8 – 10 11
11	1 2	Reduced Mass, Conservation Theorem, Equation of motion Orbits in central fields, Centrifugal energy	08 08	1 – 4 5 – 6
12	1 2	Kepler's Problems Orbital Dynamics	08 08	7 8
13	1 2	Center of mass, Linear and Angular momentum of system Energy of system, Elastic Collision	09 09	1 - 4 5 – 7
14	1 2	Inelastic Collision, Cross section Rutherford Scattering Formula	09 09	8 – 9 10
15	1 2	Revision Revision		

Course Outlines

Course Code	MA445
Course Title	Topology
Resource Person(s)	
Semester	
Program	BS (MA)
Credit Hours	3
Duration	16 Week
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course provides an introduction to the fundamental concepts of topology, including topological spaces, continuous functions, compactness, connectedness, and separation axioms. It emphasizes theoretical rigor and practical

applications, preparing students for advanced studies and research in topology and related fields. The course also explores connections between topology and other areas of mathematics and science, fostering critical thinking and problem-solving skills.

Course Learning Outcomes(CLO):

By the end of this course, students will be able to:

1. Understand and apply the basic concepts of topological spaces, open and closed sets, and continuity.
2. Analyze and construct examples of topologies and their properties, including compactness and connectedness.
3. Develop proficiency in using bases and subbases to generate topologies.
4. Explore and explain key separation axioms and their implications.
5. Investigate advanced topics such as product topology, metric spaces, and compactification.
6. Apply topological concepts to solve theoretical and practical problems.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	10%
Quizzes	15%
Presentation	5%
Mid Term Exam	25%
Final Exam	45%
Total	100%

Recommended Text Books:

- ✓ Topology for beginners By Noor Muhammad, Asghar Qadir and Imran Pervez Khan (Publisher Oxford University Press)
- ✓ General Topology Book by Seymour Lipschutz.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Definition of topology, examples of topological spaces, general properties.	CH: 5	Research and report on the historical development and basic applications of topology.	
2.	Discrete topology, indiscrete topology, coarser and finer topology, cofinite topology, open and closed sets.	CH: 5	Solve basic problems on constructing and analyzing different types of topologies.	
3.	Accumulation points, closure, interior, exterior, and boundary points; applications and properties.	CH: 5	Analyze examples and prove properties related to closure and boundary points.	
4.	Neighborhoods, neighborhood systems, subspaces (relative topology).	CH: 5	Identify and analyze subspaces of given topological spaces.	
5.	Bases, subbases, and topologies generated by classes of sets.	CH: 6	Practice constructing topologies using bases and subbases.	
6.	Local bases and their properties.	CH: 6	Prepare and deliver a presentation on bases and subbases.	
7.	Continuous functions, continuity and arbitrary closeness.	CH: 7	Study and prove continuity of functions using examples.	
8	Continuity at a point, sequential continuity, open and closed functions, homeomorphic spaces, topology induced by functions.	CH: 7	Explore and analyze homeomorphic spaces and their properties.	
9	Review all topics covered so far.		Midterm exam.	
10	Introduction to metric spaces; separation axioms (T1, T2, T3, T4 spaces).	CH: 10	Solve exercises on identifying separation properties in topological spaces.	
11	Urysohn's Lemma, metrication theorem, functions separating points, completely regular spaces.	CH: 10	Study and analyze proofs of Urysohn's Lemma and related topics.	
12	Covers, Heine-Borel theorem, compact sets.	CH: 11	Research and solve problems involving	

			compactness and its properties.	
13	Subsets of compact spaces, finite intersection property, compactness in Hausdorff spaces, sequentially compact sets, compactification.	CH: 11	Explore compactification techniques and related properties.	
14	First countable space, second countable space, Lindelöf spaces, separable spaces, hereditary properties.	CH: 9	Solve exercises on countability and separability axioms	
15	Product topology, Tychonoff's product theorem, Cantor set.	CH: 12	Analyze examples of product topology and its applications.	
16	Connected spaces, disconnected spaces, totally disconnected spaces, components of topological spaces.	CH: 13	Identify and prove properties of connected and disconnected spaces.	

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

SEMESTER VIII

Course Outlines

Course Code	MA-461
Course Title	Artificial Neural Network
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	16 Week
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

The topics of deep learning and artificial intelligence have become very popular due to their potential applications in many practical situations. The reason for the surge in these areas is the availability of huge computing power and large volumes of data. The key architectures used in these applications are deep neural networks and recurrent neural networks. The objective of this course is to trace the historical developments of artificial intelligence leading to artificial neural networks (ANN). The course introduces the basic concepts and models of ANN for solving simple pattern recognition problems. In particular, it includes analysis of feedforward and feedback neural networks, involving the key concepts of backpropagation learning and Boltzmann machine, and the pattern recognition tasks they perform. The course concludes with a discussion on the evolution of ANN architectures from learning to deep learning.

Course Learning Outcomes:

CLO-1 Understand the fundamentals of neural networks in AI. C2 (Understand)

CLO-2 Explain how simple ANNs can be designed. C2 (Understand)

CLO-3 Apply ANN for complex problems. C3 (Apply)

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔		
2: Problem Analysis		✔	
3: Designing Skills			✔

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

• Neural Network Design, 2nd Edition, Martin T. Hagan, Howard, B. Demuth, Mark Hudson Beale and Orlando De Jesus, Publisher: Martin Hagan; 2 edition (September 1, 2014), ISBN-10: 0971732116
• An Introduction to Neural Networks, James A Anderson, Publisher: A Bradford Book (March 16, 1995), ISBN-10: 0262011441
• Fundamentals of Artificial Neural Networks, Mohammad Hassoun, Publisher: A Bradford Book (January 1, 2003), ISBN-10: 0262514672

Reference Material

• Fundamentals of Artificial Neural Networks, Mohammad Hassoun, Publisher: A Bradford Book (January 1, 2003), ISBN-10: 0262514672

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction and history of neural networks,			
2.	Basic architecture of neural networks		Quiz#1	1
3.	Perceptron and Adaline (Minimum Error Learning) for classification.			
4.	Gradient descent (Delta) rule			1,2
5.	Hebbian, Neo-Hebbian and Differential Hebbian Learning		Quiz#2	1,2
6.	Drive Reinforcement Theory		Quiz#3	3
7.	Kohonen Self Organizing Maps			3

8	Associative memory		Quiz#4	1
9	Bi-directional associative memory (BAM),			1
10	Energy surfaces		Assign-3	1,2
11	The Boltzmann machines		Quiz#5	3
12	Backpropagation Networks,		Assign-4	3
13	Feedforward Networks;			2,3
14	Introduction to Deep learning and its architecture of index operator 20 Two-D arrays, Mapping formulae for 1-D and 2-D array Character Arrays Array of character arrays (2-D character arrays)		Quiz#6	2,3

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1	✔			✔			✔	✔
2	✔	✔					✔	✔
3			✔		✔	✔	✔	✔

FN-440 Financial Management

Resource Person:	
Email:	
Contact Hours:	
Office Address:	
Programme:	BS
Section:	
Semester:	
Course Pre-requisites:	
Credit Hours:	3
Course Type:	Theoretical
Venue/Day/Time:	
Course URL (if any):	

HSM Vision

Developing holistic leaders having the capability to transform and influence the society at large through knowledge acquired from the management school

HSM Mission

Our Mission is underpinned by two facets: The development of those who create value for institutions and business organizations. We accomplish this through our degree programs (BBA, BS, and MBA, MS). We also seek to develop scholars who can generate and disseminate cutting edge knowledge. We accomplish this through our faculty research and PhD programs. This mission is realized by motivating students and faculty to pursue excellence within an all-inclusive environment, built upon equitable actions, trust, mutual respect, and unwavering transparent integrity.

Course Description:
The course aims to provide students with an understanding of finance theory and the ability to implement effective financial strategies. It will develop in students the abilities to use various financial

models and tools for economic decision-making, and they will gain expertise in financial decision making of businesses in an environment for investments, credit, business and management decisions. The course integrates ethics, internationalization and sustainability within the context of finance.

Course Teaching Methodology:
Interactive Classes Case based teaching Class activities Experiential Learning Applied Projects

Programme Educational Objectives (POs):	
PO-1	To develop effective Teamwork and Leadership Skills
PO-2	To inculcate Critical Thinking and effective Decision Making skills
PO-3	To develop Effective Communication Skills
PO-4	To polish Core Business Knowledge and Competence
PO-5	To expose and inculcate Ethical Behavior and Social Responsibility
PO-6	To provide real-life work experiences.
PO-7	To provide global perspectives

Programme Learning Outcomes (PLOs): **After completing this degree programme, students shall be able to:**		
		Mapping the PLOs with POs
PLO-1	Work effectively in teams and understand group processes, leadership, conflict, power and culture in organization.	PO1, PO5, PO6
PLO-2	Use analytical and reflective thinking techniques.	PO2, PO4, PO6
PLO-3	Apply appropriate quantitative and qualitative techniques in solving business problems	PO2, PO3, PO4, PO5, PO6

PLO-4	Draft effective business documents and prepare and deliver effective oral business presentations using the variety of appropriate technologies.	PO1, PO3, PO6
PLO-5	Demonstrate competency in the underlying concepts, theory and tools taught in the core undergraduate curriculum	PO4, PO5, PO6, PO7
PLO-6	Identify and analyze ethical conflicts and social responsibility issues involving different stakeholders.	PO5, PO6
PLO-7	Graduates should be able to understand the dynamics of industry and understand business	PO2, PO3, PO6
PLO-8	Graduates should be able to identify and analyze relevant global factors that influence	PO6, PO7

Course Objectives (COs)	
CO-1	To understand & analyze capital markets and various financial instruments
CO-2	To understand the different financial tools for effective investment analysis
CO-3	To analyze cash flows and different methods of firm valuation
CO-4	Understand the financial concepts behind present value, future value, annuities, perpetuities, and loan amortization
CO-5	Learn the techniques of stock valuation and be able to assess the value and performance of bonds.
CO-6	To understand financial problems and their impacts and to be able to effectively communicate financial solutions and alternatives.

Course Learning Outcomes (CLOs): **After completing this course, students shall be able to:**		
		Mapping the CLOs with PLOs
CLO-1	Be able to understand the environment of financial markets	PLO-4
CLO-2	Be able to conduct efficient valuation of financial instruments analysis.	PLO-4
CLO-3	Be able to analyze firm risk through the assessment of the firm's cost of capital.	PLO-6
CLO-4	Be able to make efficient capital budgeting decisions.	PLO-6
CLO-5	Be able to make sensible investment decisions.	PLO-6

Assurance of Learning and Assessment Items: *Specify Assessment Items that will assure student learning through application and achieve objectives of specific PLOs / COs / CLOs*	
Assessment Item	**Application/ Objectives**

	PLO / CO / CLO
Quiz/Assignment/Project	**PLO-4 & 6 / CO-1 to 6 / CLO-1 to 5**
Mid Term	**PLO-4 & 6 / CO-1 to 3 / CLO-1 to 3**
Final examinations	**PLO-4 & 6 / CO-4 to 6 / CLO-2 to 5**

Assessment Structure and Grading Policy*:

Assessment Item	Weight (%)	Execution Plan
Class Participation	5	
Quiz/Assignment/Project	30	Multiple assessments
Mid-term exam	30	One-time assessment
Final exam	35	One-time assessment
Total	**100**	

Notes – Norms and Important Class Policies:
(such as submission guidelines, academic honesty, make-up policy, code of conduct)

- Be On Time: You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.
- Mobile Policy: TURN OFF YOUR MOBILE PHONE! It is unprofessional to be texting or otherwise.
- Email Policy: READ YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email.
- Participants should regularly check their university emails accounts regularly and respond accordingly.
- Class Attendance Policy: A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddings are absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade 'F' (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise they could reach short attendance.
- Withdraw Policy: Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student.A Student withdrawing after the 12th week shall be automatically awarded "F" grade which shall count in the GPA.
- Moodle: UMT –LMS (Moodle) is an Open Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using moodle, visit http://oit.umt.edu.pk/moodle. For further query send your queries to moodle@umt.edu.pk
- Harassment Policy: Sexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done

physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.

- Use of Unfair Means/Honesty Policy: Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.
- Plagiarism Policy: All students are required to attach a “Turnitin” report on every assignment, big or small. Any student who attempts to bypass “Turnitin” will receive “F” grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.
- Communication of Results: The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.

**Rubrics for all assessments (including mid and final exams) will be provided separately to the students.*

Weekly Sessions Plan:

Week	Topics / Contents	Activity	Application/Objectives PLO / CO / CLO

1-2	• Course Outline
	• Introduction
	• Time Value Money
	  • Present value
	  • Future value
	  • Annuities
	  • Perpetuities
	• Loan Amortization
		Assignment Activities	PLO-1/CO-1&2/CLO-1&2

3-4	Bonds and their valuation • Bond valuation • Yield to maturity • Calls, puts • Other options	Assignment	PLO-2/CO-2/CLO-2
5-6	Stocks and their valuations • Stock valuation • DCF method • Constant growth stocks • TV method • Legal rights and privileges of common stockholders • Types of common stock, stock market equilibrium, • Non-constant growth stocks • Preferred stock	Assignment	PLO-3/CO-3/CLO-3
7,9,10	Determining the cost of capital • Weighted average cost of capital • Cost of debt • Cost of preferred stock • Cost of common stock • Cost of retained earnings • CAPM	Assignment	PLO-3/CO-3&4/CLO-3&4
8	Mid Term		
11,12,13	Capital budgeting decision criteria • Importance of capital budgeting. • Cash flow calculations. • Capital budgeting decision rules. • Payable period, NPV, IRR, • MIRR, NPV vs IRR. • Optimal Capital Structure • Capital Rationing	Mid Term	PLO-4/CO-5/CLO-5
14	International finance • Introduction to international finance	Assignment	PLO-4/CO-5/CLO-5
15	Sustainability, Ethics & Bankruptcy	Assignment	PLO-5/CO-6/CLO-6

	• Sustainability in finance and bankruptcy issues		
16	Final Term Examination		

Primary Text Book (s):
• Principles of Managerial Finance by Lawrence J. Gitman (14th Edition).

Reference / Supplementary Reading (s):
• Fundamentals of Financial Management by Brigham & Houston, 12th Edition • Essentials of Finance by Ross, Jordan & Westerfield (10th Edition) • Principles of Finance by Scott Besley and Eugene Brigham

Useful Online / Web Resources:
• www.psx.com.pk • hbr.org

ELECTIVE COURSES

Course Outlines

Course Code	MA309
Course Title	Affine and Euclidean Geometry
Resource Person(s)	
Semester	Fall 2024
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	---

Chairperson/Director signature……

Dean's signature……

Date……

<u>Course Description:</u>

This course is an introduction to the basic theory and practice of Affine and Euclidean Geometry The course is intended for undergraduate students.

Course Learning Outcomes:

Able to understand and the ideas of Euclidean Geometry and Euclidean transformations

Able to understand and the ideas of Isometries in Euclidean Geometry

Able to understand and the ideas of Affine Geometry and Affine transformations

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Methods for Euclidean Geometry By Owen Byer, Felix Lazebnik, and Deirdre L. Smeltzer

Reference Material

i. Advanced Euclidean Geometry by Roger A. Johonson
ii. Transformation Geometry, C.C. Remsing, Rhodes University, Lectures.

Course Calendar

Weeks	Topics	Reference Chapter(s)	Assignments & Tasks	CLO
1	Geometric Transformations, The Euclidean Plane E^2			
2	Transformations , Properties of Transformations			
3	Translations and Halfturns			
4	Reflections and Rotations, Equations for a Reflection			
5	Properties of a Reflection, Rotations			
6	Isometries, Isometries as Product of Reflections			
7	The Product of Two Reflections			
8	Fixed Points and Involutions			
9	Even and Odd Isometries			
10	Classification of Plane Isometries			
11	Equations for Isometries			
12	Symmetry, Symmetry and Groups			
13	, The Cyclic and Dihedral Groups, Finite Symmetry Groups			
14	Classification of Similarities Equations for Similarities			
15	Affine Transformations, Collineations, Affine Linear Transformations			
16	**Final Exam**			

Course Outlines

Course Code	MA-481
Course Title	AI Ethics and Responsible AI
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Responsible AI and AI Ethics involve the careful consideration of ethical, social, and legal principles in the development and deployment of AI technologies. As AI becomes more embedded in various aspects of society, ensuring that these technologies are fair, transparent, and accountable is crucial for fostering trust and preventing harm.

Course Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Understand core principles of responsible AI, including fairness, accountability, and transparency.
- Identify and mitigate biases within AI systems.
- Implement ethical frameworks and conduct AI audits for compliance.
- Apply governance strategies to manage ethical risks in AI deployment.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Apply knowledge of ethical principles to analyze the societal impact of AI technologies.	✔	✔	✔
2: Design and evaluate AI systems with a focus on fairness, transparency, and accountability.			
3: Recognize and address professional, ethical, and legal responsibilities in AI development and usage.			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. Coeckelbergh, M. (2020). *Artificial intelligence ethics*. MIT Press.
2. Dignum, V. (2019). *Responsible AI: Designing AI for human values*. Springer.

Reference Material

- O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. Crown Publishing Group.
- Craig, T., & Ludloff, M. E. (2011). *Privacy and big data*. O'Reilly Media.
- Barocas, S., Hardt, M., & Narayanan, A. (2019). *Fairness and machine learning: Limitations and opportunities*. fairmlbook.org.
- Russell, S. (2019). *Human compatible: Artificial intelligence and the problem of control*. Viking.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Defining responsible AI and AI ethics			
2.	Importance of ethical considerations in AI applications			
3.	Key principles: fairness, accountability, transparency			
4.	Understanding bias in AI models and data			
5.	Types of biases and their impacts on AI outcomes			
6.	Bias mitigation techniques: pre-processing, in-processing, and post-processing			
7.	Introduction to AI auditing frameworks and tools			
8	Conducting audits to assess fairness and transparency			
9	Implementing accountability measures in AI systems			
10	Overview of ethical frameworks like the EU AI Act and IEEE standards			
11	Legal and regulatory compliance in AI systems			
12	Case studies on responsible AI regulations and industry standards			
13	Introduction to explainable AI techniques			
14	Building interpretable models for greater transparency			
15	Using tools for model explainability and decision traceability			
16	Developing governance frameworks for responsible AI			
17	Risk management and ethical considerations in AI deployment			
18	Strategies for stakeholder engagement and oversight			
19	Emerging trends and challenges in AI ethics			
20	Adapting governance frameworks for future AI technologies			

21	Promoting an ethical AI culture within organizations			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	**MA-484**

Course Title	AI Healthcare
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	Calculus, Linear Algebra, Discrete Mathematics, Probability theory, Specialized Healthcare-Specific Mathematical Skills, Numerical Methods
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This is a one-semester three credit-hours course designed to explore the role of Artificial Intelligence (AI) and Machine Learning (ML) in the healthcare service system. The course examines the adoption of intelligent technologies by healthcare providers in developing countries to address the extensive demands of human life. It focuses on advancements in AI-driven, human-centered healthcare intelligent systems and their applications in intensive care and supervisory activities in hospitals and clinics. Students will learn how AI technologies influence healthcare operations, improve decision-making processes, and support resource optimization. The course aims to provide a comprehensive understanding of the integration of AI into healthcare practices, with a focus on research and practical implementations.

Course Learning Outcomes:

Understand the role and significance of Artificial Intelligence (AI) and Machine Learning (ML) in addressing healthcare challenges.
Analyze the adoption of intelligent technologies by healthcare providers, particularly in developing countries.
Explore advancements in human-centered healthcare intelligent systems and their practical applications.
Evaluate the impact of AI on intensive care, supervisory activities, and decision-making in hospitals and clinics.
Apply AI-driven techniques to optimize healthcare operations and improve patient outcomes.
Investigate research-based solutions for integrating AI technologies into modern healthcare systems.
Develop insights into the ethical, technical, and operational challenges associated with AI in healthcare.
Critically assess the potential of AI in transforming traditional healthcare practices to meet contemporary demands.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. *Ranschaert ER, Morozov S, Algra PR, editors. Artificial Intelligence in Medical Imaging: Opportunities, Applications, and Risks. Springer; 2019 Jan 29.*
2. *Agah A. Introduction to Medical Applications of Artificial Intelligence. CRC Press; 2013 Nov 6.*

Reference Material

- Artificial Intelligence in Healthcare: The AI Revolution in Medicine by Parag Mahajan, Elsevier; 1st Edition, 2021.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	**Week 1:** Introduction to AI in Healthcare: Overview, significance, and challenges in integrating AI into healthcare systems.			
2.	**Week 2:** Healthcare Data: Types of medical data, data collection, preprocessing, and ethical considerations in handling patient data.			
3.	**Week 3:** Machine Learning in Healthcare: Basics of supervised and unsupervised learning techniques with healthcare applications.			
4.	**Week 4:** Deep Learning in Healthcare: Introduction to neural networks and their applications in imaging, diagnosis, and decision-making.			
5.	**Week 5:** Natural Language Processing (NLP) in Healthcare: Applications of NLP in medical record analysis, chatbot development, and clinical documentation.			
6.	**Week 6:** AI in Medical Imaging: Role of AI in radiology, pathology, and diagnostic imaging (X-rays, MRIs, and CT scans).			
7.	**Week 7:** AI for Diagnosis and Prediction: Case studies on disease detection, predictive analytics, and early warning systems.			
8	**Week 8:** Intelligent Systems for Intensive Care: AI applications in monitoring, resource allocation, and patient management in ICUs.			
9	**Week 9:** AI in Supervisory Activities: Automation of administrative tasks, scheduling, and optimizing hospital workflows using AI.			
10	**Week 10:** Decision Support Systems in Healthcare: Development and use of AI-driven decision-making tools for doctors and healthcare administrators.			
11	**Week 11:** AI for Personalized Medicine: AI's role in tailoring			

	treatments to individual patients based on genetic and environmental factors.			
12	**Week 12:** Wearable Technology and IoT in Healthcare: Role of AI in analyzing data from wearables and connected health devices.			
13	**Week 13:** AI in Drug Discovery and Development: Accelerating the process of drug discovery and clinical trials using AI.			
14	**Week 14:** Research Trends in AI for Healthcare: Discussion of recent advancements and challenges based on research papers.			
15	**Week 15:** Case Studies and Real-World Applications: Practical examples of AI implementation in hospitals, clinics, and healthcare industries.			
16	**Week 16:** Final Review and Project Presentations: Summary of course content, project presentations, and discussions on future trends.			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA-479
Course Title	Big Data Analytics
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	Calculus, Linear Algebra, Discrete Mathematics
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

<u>Course Description:</u>

This is a one-semester three credit-hours course designed to provide a comprehensive understanding of Big Data Analytics. The course explores the process of examining large datasets to uncover hidden patterns, unknown correlations, and actionable insights for informed decision-making. Students will learn about the storage, organization, and processing

of data at scales that exceed the capabilities of traditional information technologies. The course covers state-of-the-art platforms, models, and programming languages used in Big Data analytics. Real-world applications involving massive data analysis will be examined, with hands-on implementation on Big Data platforms. A key focus of the course is its research component, where students will critically analyze and discuss research papers relevant to weekly topics, enabling them to stay abreast of advancements in the field. This course equips students with the skills needed to tackle complex data challenges and conduct impactful research in Big Data analytics.

Course Learning Outcomes:

Understand the fundamental concepts of Big Data Analytics, including the processes of examining large datasets to uncover patterns, correlations, and insights.
Explore the storage, organization, and processing of data at a scale beyond traditional information technologies.
Gain proficiency in using state-of-the-art platforms, tools, and programming languages for Big Data Analytics.
Analyze real-world applications of massive data analysis and implement them on Big Data platforms.
Critically review and discuss research papers on advanced topics in Big Data Analytics to gain insights into current trends and methodologies.
Apply Big Data techniques to solve complex problems across various domains, demonstrating the ability to make data-driven decisions.
Develop research skills to explore innovative approaches in Big Data Analytics and contribute to advancements in the field.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%

Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. Mining of Massive Datasets" by Anand Rajaraman and Jeffrey Ullman. 3rd edition, 2020, Cambridge University Press. 2. Hibbeler, Russell Charles. Mechanics of materials, Latest Available Edition Pearson
2. Data Mining Concepts and Techniques" - Jiawei han & Micheline Kamber Harcourt.

Reference Material

1. Big data analytics: from strategic planning to enterprise integration with tools, techniques, NoSQL, and graph". Elsevier by Loshin, D.2. Arthur P Boresi "Advanced Mechanics of Materials", 6th Edition, John Wiley &Sons Inc., 2003
2. Learning Spark_ Lightning-Fast Data Analytics by Jules S. Damji, Brooke Wenig, Tathagata Das, Denny Lee.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	**Week 1:** Introduction to Big Data Analytics: Definition, importance, and challenges of Big Data.			
2.	**Week 2:** Big Data Technologies: Overview of storage, organization, and processing systems, including distributed systems.			
3.	**Week 3:** Big Data Platforms: Introduction to Hadoop, HDFS, and the MapReduce programming model.			
4.	**Week 4:** Big Data Tools: Overview of tools such as Apache Spark, Hive, and Pig for data processing and analytics.			
5.	**Week 5:** Data Preprocessing: Cleaning, transformation, and integration of large-scale datasets.			
6.	**Week 6:** Big Data Storage and Management: NoSQL databases, including MongoDB and Cassandra.			
7.	**Week 7:** Data Analysis Techniques: Descriptive, predictive, and prescriptive analytics on Big Data.			
8	**Week 8:** Real-World Applications of Big Data: Use cases in healthcare, finance, social media, and e-commerce.			
9	**Week 9:** Machine Learning on Big Data: Introduction to scalable machine learning algorithms using Spark MLlib.			
10	**Week 10:** Streaming Data Analytics: Processing real-time data streams using tools like Apache Kafka and Spark Streaming.			
11	**Week 11:** Big Data Visualization: Tools and techniques for visualizing large datasets.			
12	**Week 12:** Big Data Security and Privacy: Challenges and techniques for ensuring data security and privacy in Big Data.			

13	**Week 13:** Research Trends in Big Data Analytics: Discussion of research papers on emerging topics.			
14	**Week 14:** Advanced Topics: Graph analytics, recommendation systems, and deep learning on Big Data platforms.			
15	**Week 15:** Case Studies: Analysis and implementation of complex real-world problems using Big Data platforms.			
16	**Week 16:** Final Review and Project Presentations: Comprehensive review of course topics and student project presentations.			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA103
Course Title	Calculus II
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

MA 103 is a one-semester three credit-hours course. This course provides a comprehensive introduction to multivariate calculus and vector analysis. Topics include multivariate functions, their domains and ranges, limits, continuity, and partial derivatives. Students will explore gradients, level curves, tangent planes, and extreme values. Integration techniques include double and triple integrals in rectangular, polar, cylindrical, and spherical coordinates, with applications to area and volume. The course also covers line integrals, vector fields, path independence, Green's Theorem, and introduces Fourier Transforms for periodic functions, emphasizing applications in engineering and advanced mathematics.

Course Learning Outcomes:

- Explain multivariate functions with their domains, ranges, and graphical representations.
- Apply partial derivatives and multiple integrals to multivariate functions.
- Apply Fourier Series to periodic functions

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔		
2: Problem Analysis		✔	✔
3: Designing Skills			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ Thomas Calculus, 12th edition by George_B._Thomas,_Maurice_D._Weir,_Joel_Hass, published by Pearson USA.

Reference Material

- ✓ Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Multivariate Functions, Domain and Range			
2.	Limit and continuity			
3.	Partial Derivatives.			
4.	The Chain Rule for Multivariate Functions.			
5.	Gradients and Level Curves.			
6.	Tangent planes and Differentials.			
7.	Extreme Values and the saddle points.			
8	Double Integrals over Rectangular Regions; Fubini's 1st Theorem.			
9	Double Integrals over Non Rectangular Regions; Fubini's 2nd Theorem.			
10	Area by Double Integrals.			
11	Double Integrals in Polar Forms.			
12	Triple Integrals.			
13	Triple integrals in cylindrical and spherical coordinates.			
14	Line Integrals.			
15	Vector fields			
16	Path independence, Greens Theorem and Applications. Introduction to Fourier Transforms of periodic functions from Advanced engineering mathematics by Erwin			

	Kreyszig, Latest edition			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1	✔						✔	
2		✔	✔	✔			✔	✔
3					✔	✔		✔

Course Outlines

Course Code	MA480
Course Title	Computer Vision and Image Processing
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course covers the fundamentals of computer vision, including image formation, feature detection, stereo vision, motion estimation, and tracking. Students learn about image processing techniques such as filtering and segmentation, as

well as algorithms for object detection, recognition, and tracking using methods like template matching and CNNs. Hands-on projects in Python and MATLAB enhance programming skills and understanding of real-world applications. Evaluation includes metrics like precision, recall, and accuracy. Advanced topics include deep learning for image classification and 3D vision. By the end of the course, students are equipped to solve vision problems in various domains like autonomous vehicles, surveillance, medical imaging, and augmented reality etc.

Mapping of CLOs to Program Learning Outcomes (PLOs):

No	CLO Statement	Domain	Taxonomy Level	PLO
1	Understand the basic principles and techniques of image processing and computer vision.	Cognitive	2	1
2	Apply Image Processing Techniques: Students will demonstrate proficiency in applying fundamental image processing techniques such as filtering, edge detection, image enhancement, and segmentation using MATLAB to preprocess and manipulate digital images for various computer vision tasks.	Cognitive	3	2
3	Implement Computer Vision Algorithms: Students will be able to implement and customize computer vision algorithms using programming languages and libraries commonly used in the field, such as MATLAB, Python with OpenCV to solve real-world vision problems such as object detection, recognition, and tracking.	Cognitive	4	3
4	Analyze and Evaluate Computer Vision Systems: Students will develop the ability to analyze and evaluate the performance of computer vision systems by processing relevant data, and using appropriate metrics to assess the effectiveness and robustness of their algorithms	Cognitive	4	3
5	Understand Advanced Computer Vision Concepts: Students will gain an understanding of advanced computer vision concepts and techniques, including but not limited to Machine Learning for image classification and object detection and motion, 3D computer vision for depth estimation and reconstruction	Cognitive	2	4

Teaching Methodology:

Classroom Lectures, Assignments, In-Class exercises on Google Coalb/MATLAB, Presentations, Case Study or Semester Project and Complex Computing Problem (CCP).

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	10%

Quizzes	10%
Project	10%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ **[RS] Szeliski, R. (2022). Computer Vision: Algorithms and Applications. 2nd ed.**

Springer. http://szeliski.org/BookReference Material

- ✓ Davies, E.R. (2018). Computer Vision Principles, Algorithms, Applications, Learning. 5th ed. Academic Press.
- ✓ Forsyth, D.A., & Ponce, J. (2003). Computer Vision: A Modern Approach. Prentice Hall. ISBN-10: 0-13-085198-1
- ✓ Umbaugh, S.E. (2010). Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIPtools. 2nd ed. CRC Press.
- ✓ Gonzalez, R., & Woods, R. (2017). Digital Image Processing. 4th ed.
- ✓ Pearson. Corke, P., Jachimczyk, W., & Pillat, R. (2023). Robotics, Vision and Control: Fundamental Algorithms in MATLAB®. 3rd ed. Springer.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction to Computer Vision Definition and scope of computer vision History and evolution of computer vision Importance and applications of computer vision in various fields			1
2.	Image Formation Basic concepts of image formation Pixel manipulation and color spaces, Overview of 2D and 3D transformations			2
3.	Image Processing-1(Image filtering and Image enhancement)			2
4.	Image Processing-2 Spatial filtering Linear Filtering (Image transformations, point image processing, linear shift-invariant image filtering, convolution, image gradients)			2
5.	Image Pyramids (Gaussian image pyramid, Laplacian image pyramid)			2
6.	Feature detection and matching (corner detection, blob detection, and feature descriptor extraction (e.g., SIFT, SURF) Feature matching and Hough Transform (Finding boundaries, line fitting, line parameterization, Hough transform, Hough circles. Generalized Hough Transform)			3
7.	Detecting Corners (Harris corner detector, multi-scale detection)			3
8	Feature Detectors and Descriptors (HOG descriptor, SIFT), Model fitting and RANSAC, Image Homographies			3
9	Geometric Camera Models (Pinhole camera model, camera matrix, Estimate Intrinsic and Extrinsic parameters, Lens distortion, OpenCV and MATLAB functions)			3
10	Two-View Geometry (Triangulation, Epipolar geometry, essential matrix, fundamental matrix, 8-point algorithm)			3
11	Stereo (Revisiting triangulation, disparity, stereo rectification, stereo matching, improved stereo matching)			3
12	Image Recognition-1 (Introduction to learning-based vision, image classification, K-nearest neighbors and support vector machines (SVM))			4

13	Image Recognition-2 (Introduction to learning-based vision, image classification with support vector machines (SVM))			4
14	Motion Estimation Techniques: Optical Flow (Intro to vision for video, optical flow, constant flow, Horn-Schunck flow, Optical Flow and its applications, Brightness constancy equation, Lucas-Kanade method),			4
15	Convolutional Neural Networks (CNN) for image classification, object detection, and image segmentation. Medical image analysis -practical labs			5
16	Advance Topics: image registration, image-based rendering, visual tracking in robotics, and medical image analysis. (if time permits)			5

Mapping of CLOs to Direct Assessments

CLOs	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Assignment 1	Assignment 2	Assignment 3	Assignment 4	Project	Mid Term Exam	Final Exam
1	✓									✓	
2		✓	✓	✓	✓	✓	✓		✓	✓	✓
3								✓	✓		✓
4									✓		✓
5									✓		✓

Course Outlines

Course Code	MA-407
Course Title	Fluid Mechanics

Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……..

Dean's signature……..

Date……..

Course Description:

The main purpose of this course is to develop the understanding of the fundamental principles and the ability to solve, quickly and efficiently, a variety of real fluid mechanics problems from basic principles. The lectures demonstrate the basic principles, methods and modeling approximations that form the basis of fluid mechanics.

Course Learning Outcomes:

- Obtaining a solid understanding of the fundamentals of Fluid Mechanics.
- Developing concepts and physical intuitions of fluids at rest and in motions
- Formulating basic equations and laws of fluids in rest and in motion.
- Modeling various fluid flow problems mathematically and solve them using the mathematical techniques.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

Introduction to fluid mechanics By Robert W Fox & Alant McDonald John Wiley & Sons 2001
Fluid Mechanics Frank M. White McGraw-Hill

Reference Material

1. An introduction to fluid dynamics by G.K. Batchelor Cambridge University Press 1969
2. Fluid Mechanics by L.D. Landau & E.M. LIfshitz Pergmon Press 1966

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	A Brief Historical Introduction to fluid mechanics			
2.	Definition of fluid, Difference between a solid and a fluid			
3.	Some Basic definitions			
4.	Description of method			
5.	A brief introduction of Newtonian and non-Newtonian fluids			
6.	Newton's law of viscosity			
7.	Lagrange's and Euler's form of field representation			
8	Types of flow			
9	Equations of stream lines and stream tubes			
10	Basic Hydrostatic Equations			
11	Continuity equation			
12	Bernoulli equation			
13	Euler equation of motion			
14	General analysis of fluid motion			
15	Navier-Stokes equations and its applications			
16	Exact solution of first and second problems of Stokes'			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								

2								
3								

Course Outlines

Course Code	MA-476
Course Title	Fractional Calculus
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

MA 476 is a one-semester three credit-hours course. This course is consisting of basic notion, definitions, modelling and applications. We will develop the basic concepts of the various fractional differential and integral operators including relevant examples. Several computational techniques will be applied to solve different fractional order differential

equations appearing in real world applications.

Course Learning Outcomes:

- Demonstrate an understanding of fractional calculus and its basic notions
- Demonstrate an understanding of the different types of fractional differential and integral operators
- Apply some computational techniques for solving initial value problems
- Solve process and materials related problems using fractional and fractal fractional derivatives

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- Podlubny Fractional differential equations. New York Academic Press, Cambridge

Reference Material

- R. L., Bagley A theoretical basis for the application of fractional calculus to viscoelasticity. J Rheol.

1. Caputo M, Fabrizio M. A new definition of fractional derivative without 413 singular kernel. Progr Fract Differ Appl (2015); 1 (2):1–13. 414

2. Atangana A. On the new fractional derivative and application to 415 nonlinear Fisher's reaction–diffusion equation. Appl Math Comput 416 (2016); 273:948–56. 417

3. D. Vieru, C. Fetecau, C. Fetecau, Time fractional free convection flow near a vertical plate with Newtonian heating and mass diffusion, Int. J. Thermal Science. 19 (2015) 85–98.

4. J. Hristov, Response functions in linear visoelastic constitutive equations and related fractional operators, Mathematical Modelling of Natural Phenomena, DOI: 10.1051/mmnp/2018067, (2018).

5. J. Hristov, Derivatives with non-singular kernels from the Caputo-Fabrizio definition and beyond: Appraising analysis with emphasis on diffusion models, Frontiers in Fractional Calculus, 1, pp. 270-342, (2017).

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	History of fractional Calculus and its advantage			
2.	Properties of fractional Calculus, basic definitions, differential and integral representation of fractional derivatives operators			
3.	Types of fractional derivative operators, relation between fractional derivatives operators, advantage of derivative operators, fractional derivatives of polynomials, trigonometric and exponential functions			
4.	Generalized special functions like, Gamma function, Beta functions, relation between Gamma and Beta functions, Mittage Leffler functions of one and two parameters, G-functions, Hartely function, generalized G-function, Fox-H function, M-functions and their properties			
5.	Modeling of some real-world problems with fractional derivatives operators,			
6.	Fractal fractional derivatives operators, history of fractal fractional derivatives, difference between fractional and fractal differential operators, generalized fractional operators, and examples,			
7.	Conformable fractional derivatives, Laplace of conformable fractional derivatives, examples of conformable fractional derivatives			
8	Elementary introduction to derivative in mathematical modeling, Derivatives / antiderivatives of Polynomial and Exponential functions			
9	Definition of Laplace and modified Laplace transforms, difference between them, Application of Laplace and modified transforms along with fractional derivatives,			
10	Definition of Fourier transform with examples, Applications of Fourier transform with fractional derivatives			
11	Applications in heat transport processes, chemical industry, electronics industry,			
12	Applications in fluid dynamics, like drilling fluids from the ground, electrical circuits			
13	Applications in Cancer therapy, nanofluids and nanotechnology			
14	Exact and numerical solutions of fractal differential equations, three different approaches of fractional derivatives and draw some comparison between these models.			
15	At the end, some more applications of fractional calculus in solving real life problems like Science including theory of			

	fractals, numerical analysis, physics, engineering, biology, Mathematical physics, economics and finance etc			
16	Revision			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA-426
Course Title	Functional Analysis
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	Calculus-I,II, Linear Algebra
Counselling Hours	

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Dean's signature……

Date……

Course Description:

This course MA 426 extends methods of linear algebra and analysis to spaces of functions, in which the interaction between algebra and analysis allows powerful methods to be developed. The course will be mathematically sophisticated and will use ideas both from linear algebra and analysis.

Course Learning Outcomes:

- To be able to understand the topological properties and completeness of distance spaces
- apply the notions of metric and normed spaces in problem solving.
- To be able to analyze the relationship between various notions in distance spaces.

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ E. Kreyszig, *Introduction to Functional Analysis with Applications*, John Wiley and Sons, 2004

Reference Material

- ✓ Pre A. V. Balakrishnan, Applied Functional Analysis, 2nd edition, Springer-Verlag, Berlin, 1981.
- ✓ J. B. Conway, A Course in Functional Analysis, 2nd ed., Springer-Verlag, Berlin, 1997. K. Yosida, Functional Analysis, 5th ed., Springer-Verlag, Berlin, 1995.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1	Metric Spaces	1		1
2	Complete metric spaces, Completion of metric	1		1
3	Normed Spaces, Properties of normed spaces	2	Assignment 01 and Quiz 01	1
4	Banach spaces, Equivalent norms	2		1
5	Compactness and finite dimension, Linear operator	2		1
6	Bounded linear operators, Continuity and boundedness	2		2
7	Linear functionals, Linear operators and linear functionals on finite dimensional spaces	2	Assignment 02 and Quiz 02	2
8	**Mid Term Week**			

9	Dual spaces, Inner product spaces and Hilbert spaces	**3**		**2**
10	Properties of inner product spaces, Orthogonal complements and direct sums	**3**		**3**
11	Orthogonal sets and sequences, Bessel inequality	**3**		**3**
12	Total orthonormal sets and sequences, Representation of functionals on Hilbert spaces	**3**	Assignment 03and Quiz 03	**3**
13	Hibert adjoint operator	**3**		**3**
14	The Hahn-Banach Theorem,	**4**	Assignment 04 and Quiz 04	**3**
15	The Hahn-Banach Theorem	**4**		**3**
16	Final Term Exam			

Course Outlines

Course Code	MA-413
Course Title	Fuzzy Set Theory
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Fuzzy logic allows translating statements from natural language into a mathematical form. Once we have this mathematical form of knowledge, we are able to draw upon hundreds of years of recent history in technology to manipulate this knowledge.

Course Learning Outcomes:

No	CLO Statement	Domain	Taxonomy Level	PLO
1	Understand how extensions of mathematical theories work.	Cognitive	2	1
2	Apply the concepts of Fuzzy Set Theory to both classical and modern mathematical frameworks.	Cognitive	3	2
3	Analyze, model, and apply these concepts to real-life problems.	Cognitive	3	4

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. Fuzzy logic with Engineering applications, Timothy J. Ross, *University of New Mexico, USA, Third Edition*

Reference Material

- ✓ Fuzzy Logic by H.T. Nguyen and E. A. Walker, 3rd Edition.
- ✓ Fuzzy Set Theory and its Applications by H. J. Zimmermann.
- ✓ Fuzzy Theory and Applications by Kwang H. Lee.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1	Fuzzy Sets, Examples of Fuzziness	**1,1**		**1**
2	Modeling of Fuzziness	**1,1**		**1**
3	Operations on Fuzzy Sets	**1,2**	Assignment 01 and Quiz 01	**1**
4	Level Sets, Alpha Cuts, Images of alpha level sets, Fuzzy Relation	**1,3**		**1**
5	t-norm	2,3		**1**
6	t-conorm	2,3		**2**
7	Negations	**2,3**	Assignment 02 and Quiz 02	**2**
8	**Mid Term Week**			
9	Fuzzy Numbers, Fuzzy Intervals, Interval Arithmetic, Triangular Fuzzy Numbers	**2,2**		**2**
10	Trapezoidal Fuzzy Numbers, Fuzzy Convexity	**2,2**		**3**
11	Fuzzy Implication, Lattices	**2,5**		**3**
12	Zadeh's Extension Principle	**2,5**	Assignment 03and Quiz 03	**3**
13	Applications of fuzzy logic	**1,6**		**3**
14	Different extensions of fuzzy sets		Assignment 04 and Quiz 04	**3**
15	Different extensions of fuzzy sets			**3**
16	Final Term Exam			

Course Outlines

Course Code	MTH-403
Course Title	Graph Theory and Combinatorics
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	Basic knowledge of discrete mathematics, including set theory, logic, and combinatorics. Understanding of elementary graph theory concepts like vertices, edges, paths, and cycles is also essential.
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Graph theory and combinatorics are foundational branches of mathematics with diverse applications in science, technology, and engineering. Graph theory studies networks of interconnected nodes, called vertices, linked by edges. It explores concepts like paths, cycles, connectivity, and graph colouring, offering tools to model relationships and optimize processes such as communication networks, transportation, and social systems. Combinatorics, on the other hand, focuses on counting, arrangement, and combination of discrete objects. It addresses problems related to permutations, combinations, and partitions, providing methods for analyzing patterns and structures. Together, these fields are pivotal in solving problems in computer science, biology, chemistry, and cryptography, contributing to advancements in algorithms, optimization, and modelling of complex systems. Their synergy drives innovation across theoretical and applied domains.

Course Learning Outcomes:

- Understand fundamental graph theory and combinatorial principles.
- Implement and analyze key graph algorithms.
- Apply graph coloring and analyze planar graphs.
- Explore real-world applications of graph theory and combinatorics.

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	10%
Quizzes	10%
Mid Term Exam	30%
Presentations	10%
Final Exam	40%
Total	100%

Recommended Books:

1. Recent Advancements in Graph Theory by N. P. Shrimali and B. K. Shah, CRC press, 2021.
2. Graph Theory (6th Edition) by Reinhard Diestel, Springer, 2024.
3. Introduction to Graph Theory" by Douglas B. West, ISBN-10: 0130144002, Prentice Hall, 200.
4. Graph Theory with Applications to Engineering and Computer Science" by Narsingh Deo, ISBN-10: 0486807932, Dover Publications, 2001.
5. Graphs, Networks and Algorithms" by Dieter Jungnickel, ISBN-10: 3642322778, Springer, 2012.
6. Spectral Graph Theory" by Fan R. K. Chung, ISBN-10: 0821803158, American Mathematical Society, 1996.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1	**Graphs:** What is a graph? Directed and undirected graphs, Basic terminologies, Types of graphs, Subgraphs.			1
2	**Degrees:** The degree of a vertex, Isolated and pendant vertices, Degree sequences, non-regular and regular graphs			1
3	**Graphs and matrices:** The adjacency matrix, The incidence matrix, The cycle matrix			1
4	**Isomorphic graphs:** The definition of isomorphism, Isomorphism as a relation, Graphs and groups			1
5	**Trees:** Bridges, Trees, Characterization of trees, Spanning trees, Rooted tree, Binary tree, The minimum spanning tree problem, The number of spanning trees			
6	**Subdivision and line graphs:** Some properties of line graphs, Characterization of line graphs, Special line graphs		Assignment 01 and Quiz 01	1
7	**Coloring graphs:** Coloring vertices, Coloring maps, Coloring edges, Chromatic polynomial		Assignment 02 and Quiz 02	2
8	Mid Term Week			
9	**Enumeration:** Labeled graphs, Vertex labeled graphs, Edge labeled graphs, Total labeled graphs, Solved and unsolved graphical enumeration problems			2
10	**Resolving and doubly resolving sets:** Minimal resolving sets, Minimal doubly resolving sets, Basis and metric dimension			3
11	**Topological indices:** Degree based topological indices; Distance based topological indices		Assignment 03and Quiz 03	3
12	Fuzzy Graph: Concept of Fuzzy graphs and their basic properties			3
13	**Domination:** The domination number of a graph and some solved and unsolved problems		Assignment 04 and Quiz 04	3
14	**Applications:** Some calculating techniques using Matlab / Python / Maple			3
15	Project Presentation			
16	Final Term Exam			

Course Outlines

Course Code	MA464
Course Title	Advanced Group Theory
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……..

Course Description:

MA464 is a one-semester three credit-hours course. This is a course in advanced group theory, which builds on the concepts learnt in Algebra I. The objectives of the course are to introduce students to some advanced ideas and methods introduced in advanced group theory, and be aware of examples of defined structures in mathematics. The course contents mainly cover The orbit stablizer theorem, series in groups, solvable groups, nilpotent groups and linear groups.

Course Learning Outcomes:

- Students will be able to define and differentiate between various types of groups, including soluble and nilpotent groups, and explain their significance in group theory.
- Students will demonstrate the ability to construct and analyze composition series for groups, identifying factors such as simplicity and solvability.
- Students will develop problem-solving skills by applying advanced group theory concepts to solve theoretical problems and prove relevant theorems.
- Students will critically analyze the properties of various group classes, understanding how these properties influence group behavior and structure.

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. J. B. Fraleigh, A First Course in Abstract Algebra, 7th edition, Addison-Weseley Publishing Co., 2003
2. D. J. S. Robinson, *A course in the theory of groups*, 2nd edition Springer Science & Business Media, 1996

Reference Material

1. J. B. Fraleigh, A First Course in Abstract Algebra, Addison-Wesley Publishing Company, 2002
2. J. Rose, A Course on Group Theory, Cambridge University Press, 1978
3. J. A. Gallian, Contemporary Abstract Algebra, 4th edition, Narosa Publishers, 1998
4. J. F. Humphreys, A Course on Group Theory, Oxford University Press, 2004

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Normal products of groups, Holomorph of a group			
2.	Stablizer, Orbit, A group with p2 elements			
3.	Simplicity of A*n, n* ≥ 5, Classification of Groups with at most 8 elements			
4.	Sylow theorems (with proof)			
5.	Applications of Sylow Theory			
6.	Series in a group			
7.	Subnormal and normal series			
8	Composition series, Zassenhaus lemma			
9	The Jordan Holder Theorem			
10	Solvable groups, Definition and examples			
11	Theorems on solvable groups			
12	Characterization of finite nilpotent groups			
13	Frattini subgroups			
14	Linear groups, types of linear groups			
15	Representation of linear groups			
16	The projective special linear groups			

Mapping of CLOs to Direct Assessments

CLOs	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

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Course Outlines

Course Code	MA-472
Course Title	Mathematical Economics
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	Basic understanding of microeconomics, macroeconomics, calculus, and linear algebra. Familiarity with statistics and introductory mathematical methods for economic analysis.
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Mathematical Economics applies mathematical methods and models to analyze and solve economic problems. It uses tools from calculus, linear algebra, and statistics to formulate theories, optimize decision-making, and predict economic outcomes. This field emphasizes precision and rigor, allowing economists to study concepts like supply and demand, market equilibrium, and economic growth quantitatively. By employing mathematical models, researchers can simulate real-world scenarios, test hypotheses, and derive actionable insights. Mathematical economics plays a critical role in policy-making, financial analysis, and strategic planning, bridging the gap between theoretical economics and practical applications in industries and governance.

Course Learning Outcomes:

- Mathematical Tools: Master key mathematical techniques like calculus and linear algebra.
- Economic Modelling: Build and analyse economic models using mathematical methods.
- Optimization: Solve constrained and unconstrained optimization problems in economics.
- Economic Dynamics: Apply dynamic models to understand economic behaviour over time.
- Quantitative Analysis: Use quantitative methods to analyse and interpret economic problems.

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	10%
Quizzes	10%
Mid Term Exam	30%
Presentations	10%
Final Exam	40%
Total	100%

Recommended Books:

- "Mathematics for Economics, Fourth Edition" by Michael Hoy, John Livernois, et al., ISBN: 978-0262046626, MIT Press, 2022.
- "Essential Mathematics for Economics" by Alexis Akira Toda, ISBN: 978-0367331612, Routledge, 2024.
- "Mathematical Models in Economics" by Frank Ramsey, ISBN: 978-1793587978, Cognella Academic Publishing, 2022.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1	Introduction to Mathematical Economics: Overview, importance of mathematics in economics, basic concepts.			1
2	Review of Calculus: Functions, limits, derivatives, integrals, and their applications in economics.			1
3	Linear Algebra in Economics: Matrices, determinants, and systems of linear equations.		Assignment 01	1
4	Optimization without Constraints: Univariate and multivariate optimization techniques.		Quiz 01	1
5	Constrained Optimization: Lagrange multipliers, Kuhn-Tucker conditions, and economic applications.			1
6	Comparative Statics: Partial derivatives, total derivatives, and applications in economic analysis.		Assignment 02	1
7	Consumer Theory: Utility functions, budget constraints, and optimization of consumer behavior.		Quiz 02	2
8	Mid Term Week			
9	Production Theory: Production functions, cost minimization, and profit maximization.			2
10	Market Equilibrium: Equilibrium analysis in competitive and non-competitive markets.		Assignment 03	3
11	Dynamic Models: Differential equations, difference equations, and dynamic stability.		Quiz 03	3
12	Game Theory and Strategic Behavior: Nash equilibrium, mixed strategies, and applications in economics.			3
13	Input-Output Analysis: Leontief models and applications in economic sectors.		Assignment 04	3
14	Econometrics and Statistical Methods: Introduction to econometrics, regression analysis, and hypothesis testing.		Quiz 04	3
15	Applications of Mathematical Economics: Case studies and real-world applications of mathematical models in economics.			3
16	Final Term Exam			

Course Outlines

Course Code	MA400
Course Title	Measure Theory
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

The Measure Theory course provides a foundational understanding of measure theory, focusing on the Lebesgue measure and its applications in analysis. Students will explore essential concepts such as outer measure, measurability, and the properties of measurable sets and functions. Key topics include the definition and significance of Lebesgue measurable functions, which preserve the structure of measurable sets and are integral to Lebesgue integration. The course also covers important theorems related to measurable functions, including closure properties under limits and operations, and the distinction between Lebesgue and Riemann integration. Through rigorous theoretical frameworks and practical examples, participants will develop the skills necessary to analyze functions and integrals within modern mathematical analysis, preparing them for advanced studies in mathematics.

Mapping of CLOs to Program Learning Outcomes (PLOs):

No	CLO Statement	Domain	Taxonomy Level	PLO
1	To define the basics of measure, measurable functions	Cognitive	1	1
2	To understand Lebesgue integrals and explain the Lebesgue integral of various functions	Cognitive	2	1
3	To apply some major theorems in Measure Theory	Cognitive	3	2

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ H.L. Royden, *Real Analysis,* 4th ed, Macmillan.

Reference Material

- ✓ Marek Capinski and Ekkehard Kopp, *Measure, Integral and Probability,* Springer-Verlag, 1998
- ✓ W. Rudin, *Real and Complex Analysis,* McGraw Hill, New York.
- ✓ D. H. Fremlin, *Measure Theory,* vol. 1, Torres Fremlin, 2000.
- ✓ A.R. Khan, *Introduction to Lebesgue Integration,* Ilmi Kitab Khana, 1993.
- ✓ 5. D.L. Cohn, *Measure Theory,* Birkhauser, 1980.

Course Calendar

Week	Topics	CLO	Book Chapter
1	Introduction to Measure Theory	1	Chapter 1
2	Lebesgue Outer measure	1	Chapter 2
3	The sigma-Algebra of Lebesgue Measurable sets	1	Chapter 2
4	Outer and Inner Approximation of Lebesgue Measurable sets	1	Chapter 2
5	Non measurable sets	1	Chapter 2
6	Lebesgue Measurable Functions	1	Chapter 3
7	Sums, Products, and Compositions, simple functions	1	Chapter 3
8	Littlewood's Three Principles, Egoroffs Theorem, and Lusin's Theorem	1	Chapter 3
Mid Examination			
9	The Riemann integral	2	Chapter 4
10	The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure	2	Chapter 4
11	The Lebesgue Integral of a Measurable Nonnegative Functions	2	Chapter 4
12	The General Lebesgue integral	2	Chapter 4
13	The Lebesgue Dominated Convergence Theorem	3	Chapter 4
14	General Lebesgue Dominated Convergence Theorem	3	Chapter 4
15	The Vitae Convergence Theorem	3	Chapter 4
16	The Vitae Convergence Theorem	3	Chapter 4
Final Examination			

Mapping of CLOs to Direct Assessments

CLOs	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Assignment	Mid Term Exam	Final Exam
1	✓	✓	✓				✓	✓	
2				✓			✓	✓	✓
3					✓	✓	✓		✓

Course Code	MA-411
Course Title	Number Theory and its Application
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course provides an introduction to the fundamental concepts and techniques of number theory, a branch of mathematics that deals with the properties and behavior of integers.

Course Learning Outcomes:

4. To define the basics of numbers, prime numbers and Euclidean algorithm
5. To understand functions related to numbers, study their properties and proof some major theorems like Fermat, Euler and Wilson
6. Apply the number-theoretic techniques to study different applications in the field of computer science and data security.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: To define the basics of numbers, prime numbers and Euclidean algorithm	✔	✔	✔
2: To understand functions related to numbers, study their properties and proof some major theorems like Fermat, Euler and Wilson		✔	
3: Apply the number-theoretic techniques to study different applications in the field of computer science and data security			✔

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

D.M. Burton, Elementary Number Theory, McGraw-Hill, 2007. 2.

Reference Material
K.H. Rosen, Elementary Number Theory and its Applications, 5th edition, Addison-Wesley, 2005.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	The Pigeonhole Principle The Principle of Mathematical Induction			
2.	Divisibility and the Division Algorithm Integer Divisibility The Division Algorithm			
3.	Algebraic Operations With Integers The Well Ordering Principle and Mathematical Induction The Well Ordering Principle			
4.	Representations of Integers in Different Bases The Greatest Common Divisor			
5.	The Euclidean Algorithm The Sieve of Eratosthenes The infinitude of Primes			
6.	The Fundamental Theorem of Arithmetic The Fundamental Theorem of Arithmetic More on the Infinitude of Primes			
7.	Least Common Multiple Linear Diophantine Equations Theorems and Conjectures involving prime numbers			
8	Congruences Residue Systems and Euler's Function			
9	Linear Congruencies The Chinese Remainder Theorem Theorems of Fermat, Euler, and Wilson			
10	Multiplicative Number Theoretic Functions The Sum-of-Divisors Function			
11	The Number-of-Divisors Function Perfect, Mersenne, and Fermat Numbers			

12	Primitive Roots and Quadratic Residues The order of Integers and Primitive Roots			
13	Primitive Roots for Primes The Existence of Primitive Roots			
14	Introduction to Quadratic Residues and Nonresidues			
15	Legendre Symbol			
16	The Law of Quadratic Reciprocity Jacobi Symbol .			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1	✔	✔					✔	
2		✔	✔	✔			✔	✔
3				✔	✔	✔		✔

Course Outlines

Course Code	MA-301
Course Title	Operation Research
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	Acquiring knowledge of linear algebra (matrices, systems of equations), basic calculus (differentiation, optimization), and graphical skills (plotting and interpreting equations), mathematical modeling are essential.
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Operations Research (OR) is a field of study that uses mathematical models and algorithms to solve complex decision-making problems. It applies analytical methods to help organizations make better decisions in areas such as resource allocation, inventory management, production scheduling, and logistics. OR techniques are widely used in various industries such as transportation, manufacturing, healthcare, finance, and telecommunications, among others. They help in improving efficiency, reducing costs, and making informed decisions that ultimately lead to better business outcomes.

Course Learning Outcomes:

- Formulate Real world problem into mathematical models.
- Solve these models using appropriate optimization algorithm techniques.
- Interpret the results and make informed decisions based on them.

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	10%
Quizzes	10%
Mid Term Exam	25%
Presentations	5%
Term Project	10%
Final Exam	40%
Total	100%

RecommendedBooks:

1. H. A. Taha, Operations Research, 8th edition, Pearson Prentice Hall India 2007.
2. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research, 9th edition, McGraw-Hill, 2012.
3. H.A. Eiselt& C. L. Sandblan, Operations Research, A model based approach, Springer, 2010.
4. L. Kandiller, Principles of mathematics in Operations Research, Springer, 2007.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1	Introduction to linear programming, foundation of linear programming			1
2	Linear programming model formulation		Assignment 01 and Quiz 01	1
3	Graphical solution of two variable problems			1
4	Graphical sensitivity analysis		Projects and Presentation Announcement	1
5	Simplex method and its algorithm			2
6	Method of penalty		Assignment 02 and Quiz 02	2
7	Two phase technique			
8	Unbounded solutions			2

9	Alternative optima			3
10	Infeasible solution		Assignment 03and Quiz 03	3
11	Degeneracy and cycling			3
12	Definition of dual problem, relations between primal and dual problem		Assignment 04 and Quiz 04	3
13	Interpretation of dual variables and dual constraints, Dual simplex method			3
14	Sensitivity analysis in simplex method.			3
15	Project Presentation			
16	Final Term Exam			

Course Outlines

Course Code	**MA-483**
Course Title	Recommender Systems
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	Calculus, Linear Algebra, Discrete Mathematics, Probability and Statistics
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

This course provides an in-depth understanding of recommender systems, focusing on their design, implementation, and evaluation. The course begins with foundational concepts in linear algebra and progresses to content-based recommendation techniques, covering system architectures, advantages, limitations, and user profiling methods. Collaborative recommendation approaches, including user-based and item-based methods, are explored alongside privacy challenges and countermeasures. Students will also study knowledge-based recommendations, hybridization techniques, and opportunities for system enhancements. In the final modules, evaluation methods for recommender systems, community-based web search, and trust-enhanced systems are discussed. Practical applications and case studies reinforce the theoretical foundations, equipping students to develop innovative and effective recommender systems.

Course Learning Outcomes:

Understand the fundamental concepts and mathematical foundations, such as linear algebra, essential for designing recommender systems.
Analyze and implement content-based recommendation systems, including item representation and methods for learning user profiles.
Develop collaborative recommendation systems using user-based and item-based nearest neighbor approaches, while addressing privacy and security challenges.
Evaluate the strengths and weaknesses of knowledge-based recommendation systems and apply hybridization techniques to enhance system performance.
Assess recommender systems using evaluation metrics and designs, including historical dataset analysis and alternate evaluation approaches.
Explore and apply community-based web search and trust-enhanced recommendation systems in real-world scenarios.
Design, implement, and evaluate advanced recommender systems to address practical challenges in various application domains.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. **"Recommender Systems: The Textbook"** by **Charu Aggarwal**11.
2. Pawlak, Z: Rough sets. Int. J. Comput. Inf. Sci. 11, 341-356 (1999)
3. "Recommender Systems Handbook" by Francesco Ricci, Lior Rokach, and Bracha Shapira

Reference Material

- "Collaborative Filtering for Recommender Systems" by Jannach, A., & Adomavicius, G.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	**Week 1:** **Introduction to Recommender Systems**			

2.	**Week 2:** **Basic Math for Recommender Systems**			
3.	**Week 3:** **Content-Based Recommendation**			
4.	**Week 4:** **User-Based Collaborative Filtering**			
5.	**Week 5:** **Item-Based Collaborative Filtering**			
6.	**Week 6:** **Privacy in Recommender Systems**			
7.	**Week 7:** **Knowledge-Based Recommender Systems**			
8	**Week 8:** **Hybrid Recommender Systems**			
9	**Week 9:** **Evaluating Recommender Systems**			
10	**Week 10:** **Web Search and Recommender Systems**			

11	**Week 11:** **Trust in Recommender Systems**			
12	**Week 12:** **Real-World Applications of Recommender Systems**			
13	**Week 13:** **Challenges in Recommender Systems**			
14	**Week 14:** **Recent Trends in Recommender Systems**			
15	**Week 15:** **Case Studies and Practical Examples**			
16	**Week 16:** **Final Review and Project Presentations**			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA402
Course Title	Simulation and Modeling
Resource Person(s)	
Semester	

Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

The Simulation and Modeling course provides a comprehensive foundation in the principles and techniques used to create mathematical models of real-world phenomena. Students will explore key concepts such as linear and nonlinear equations, differential equations, and partial differential equations, applying these to various applications including population dynamics, heat conduction, and wave phenomena. The course emphasizes both theoretical understanding and practical skills through hands-on experience with computational tools like MATLAB or Python. By the end of the course, students will be equipped to develop, analyze, and validate models, preparing them for challenges in engineering and scientific

research.

Mapping of CLOs to Program Learning Outcomes (PLOs):

No	CLO Statement	Domain	Taxonomy Level	PLO
1	Explain the model classification at different levels.	Cognitive	2	1
2	Analyze mathematic fundamentals using modeling and simulation techniques	Cognitive	4	4
3	Apply mathematic fundamentals with understanding of real-life application.	Cognitive	3	2
4	compile the simulation results of a medium sized Math problems and basic sciences problems.	Cognitive	6	7

Teaching Methodology:
Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

- ✓ **Giordano, Frank R., Fox, William P., & Horton, Steven B. (2013).** *A First Course in Mathematical Modeling* (5th ed.). Cengage Learning.

Reference Material

- ✓ Giordano FR, Weir MD (1994), "*Differential Equations: A Modeling Approach"*, 1994,
- ✓ Jerri AJ (1985), "*Introduction to Integral Equations with Applications"*, 1985, Marcel Dekker, New York
- ✓ Myint UT, Debnath L (1987), "*Partial Differential Equations for Scientists and Engineers"*(3rd edition), North Holland, Amsterdam.
- ✓ Zill, Prindle Weber and Schmidt, A first Course in Differential Equations, Latest edition.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Fundamental concepts of models, modeling, and simulation; importance in various fields.			1
2.	Overview of functions; introduction to linear equations and their applications in modeling.			1
3.	Introduction to linear differential equations; first-order linear differential equations.			2
4.	Characteristics and applications of nonlinear differential equations.			2
5.	Introduction to integral equations; applications in modeling.			2
6.	Modeling with first-order ODEs; applications in Newtonian mechanics and gravitational fields.			3
7.	Modeling with first-order ODEs; applications in Newtonian mechanics and gravitational fields.			3
8	Introduction to second-order differential equations; modeling vibrations and biological systems.			2
9	Modeling with periodic or impulse forcing functions; applications in various systems.			2
10	Introduction to systems of first-order differential equations; predator-prey models and competitive hunter models.			4
11	Modeling of Coupled systems			4
12	Introduction to partial differential equations; methodologies for mathematical modeling.			4
13	Applications of the wave equation; shallow water waves, traffic flow, and RC circuits modeling.			3
14	Introduction to the heat equation; applications in heat conduction problems in rods, laminae, cylinders, etc.			3
15	heat equation (continue)			3
16	Review of key concepts covered throughout the course; final project presentations.			

Mapping of CLOs to Direct Assessments

CLOs	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Assignment	Mid Term Exam	Final Exam
1	✓	✓	✓				✓	✓	
2				✓			✓	✓	✓
3					✓	✓	✓		✓

Course Outlines

Course Code	MA-406
Course Title	Special Relativity
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	
Prerequisites	-
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

<u>Course Description:</u>

This course is fundamental in the field of relativity. Introduction and development of special relativity is essential for the learners of relativistic theories. The main objective of the course is to make participants comfortable with the concept of relativity and its implications.

Course Learning Outcomes:

Recall the concepts of Classical and Special Relativity with co-ordinate transformations
Identify the concepts of relativistic kinematics of basic and complex functions.
Apply mathematical concepts for the solution of math and physics education, research institutions, and related engineering practical fields.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis			
3: Designing Skills			

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

M. Saleem and M. Rafique, Special Relativity (Ellis Horwood, 1992)

Reference Material

1. W. G. V. Rosser, Introductory Special Relativity (Taylor & Francis, 1991)
2. W. Ringler, Introduction to Special Relativity (Oxford, 1991)
3. A. Qadir, An Introduction to Special Theory of Relativity (World Scientific 1989)
4. G. Barton, Introduction to the Relativity Principle (Wiley, 1999)
5. W. Rindler, Introduction to Special Relativity (Clarendon Press, Oxford, 1991)

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Derivation of Special Relativity , Einstein's formulation of special relativity			
2.	The Lorentz transformation			
3.	Length contraction			
4.	Time dilation and simultaneity			
5.	Three dimensional Lorentz transformations.			
6.	**The four-vector formalism**			
7.	The Lorentz and Poincare groups, The null cone structure.			
8	Proper time.			
9	Relativistic kinematics			
10	The Doppler shift in relativity			
11	The Compton effect, Particle scattering			
12	Binding energy, particle production			
13	Review of electromagnetism,			
14	The electric and magnetic field intensities, The electric current, Maxwell's equations and electromagnetic waves.			
15	The four-vector formulation of Maxwell's equations.			
16	Review and revision of material covered			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

Course Outlines

Course Code	MA 475
Course Title	Stochastic Calculus
Resource Person(s)	
Semester	
Program	BS
Credit Hours	3
Duration	1 Semester
Prerequisites	Probability and Statistics
Counselling Hours	

Chairperson/Director signature……

Dean's signature……

Date……

Course Description:

Stochastic processes form the foundation of probabilistic modeling of random systems evolving over time. This course covers the basic concepts and techniques, including Markov chains, Poisson processes, Brownian motion, and applications in queueing theory, finance, and engineering. Students will explore theoretical underpinnings as well as practical applications, with emphasis on understanding and simulating real-world random phenomena.

Course Learning Outcomes:

- Understand the fundamental concepts and classifications of stochastic processes.
- Analyze and model real-world phenomena using stochastic processes.
- Solve problems involving Markov chains, Poisson processes, and Brownian motion.

Mapping of CLOs to Program Learning Outcomes (PLOs):

CLO's/PLO's	CLO 1	CLO 2	CLO 3
1: Computing Knowledge	✔	✔	✔
2: Problem Analysis	✔	✔	
3: Designing Skills		✔	✔

Teaching Methodology:

Classroom lectures and discussions, problem solving exercises and assignments.

Grade Evaluation Criteria

Components	Marks in Percentage
Assignments	15%
Quizzes	15%
Mid Term Exam	30%
Final Exam	40%
Total	100%

Recommended Text Books:

1. Sheldon M. Ross, *Introduction to Probability Models*, Academic Press, 2019.
2. J. Medhi, *Stochastic Processes*, New Age International, 2nd Edition, 1994.
3. 3. Samuel Karlin, Howard M. Taylor, *A First Course in Stochastic Processes*, Academic Press, 2nd Edition, 1975..

Reference Material

1. Geoffrey Grimmett, David Stirzaker, *Probability and Random Processes*, Oxford University Press, 3rd Edition, 2001.

Course Calendar

Week	Topics	Reference Chapter(s)	Assignments & Tasks	CLOs
1.	Introduction to Stochastic Processes and Applications			1
2.	Basics of Probability Theory and Random Variables			1
3.	Markov Chains: Definition, Examples, and Properties			1,2
4.	Classification of States, Transition Matrices, and Steady-State Distributions			2
5.	Poisson Processes: Definition and Properties			2
6.	Applications of Poisson Processes in Modeling and Queueing Theory			2,3
7.	Renewal Processes and Applications			2,3
8	Midterm Exam			
9	Brownian Motion and its Applications			2,3
10	Introduction to Stochastic Differential Equations			2,3
11	Simulation of Stochastic Processes			3
12	Time Series and Forecasting Models			2,3
13	Applications of Stochastic Processes in Financial Mathematics			3
14	Advanced Topics: Hidden Markov Models			3
15	Revision and Problem-Solving Sessions			3
16	Final Exam			

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Midterm Exam	Final Exam
1								
2								
3								

University of Management and Technology

Dr Hasan Murad School of Management (HSM)

Course Title: Accountant in Business
Course Code: MG-221 Resource Person:
Department: Banking and Finance

HSM Vision

HSM envisions its success in the sustainable contribution that it will make to the industry, academia and research in public and private sector. HSM will lead by providing professionally competent and ethically conscious human resources engaged in the global and local context to foster socio-economic growth and sustainability for the society.HSM envisages having facultywith high research potential and a deep desire for cutting edge research including collaboration with national and international partners.

HSM Mission

Being a research-oriented and student-centric business school, we emphasize research publications in impact journals as well as state-of -the-art learning methodologies. We will prepare our students to become the future ethical business leaders and the guiding post for the society, while equipping them with the knowledge and skills required by world-class professionals. We will be the leading choice for organizations seeking highly talented human resource. HSM will foster internationalization with key stakeholders and actively work to exchange best practices with business schools across Pakistan through collaborations, workshops, conferences and other means.

Program Objectives

Critical Thinking and Decision Making; Effective Communication Skills; Ethics and Sustainability; Core Business Knowledge and Competence; Effective Teamwork and Leadership Skills; Global Perspective (Internationalization).

Course Objectives

All business organizations aim to achieve some objectives in order to grow and succeed in a competitive environment. To perform well, managers need to achieve high productivity from their employees, and at the same time, low absenteeism and turnover. These goals are difficult to achieve if people in the organization are not satisfied and less motivated. This course helps us understanding management functions and how organizational goals can be achieved by studying the impact that individuals, groups, and organizational structure have on behaviour within organizations, for the purpose of applying such knowledge towards improving an organizations' effectiveness.

Learning Objectives

- Understand the purpose and types of business and how they interact with key stakeholders and the external environment.
- Understand business organization structure, function and the role of corporate governance.
- Recognize the function of accountancy and audit in communicating, reporting and assuring financial information and in effective financial controls and compliance.
- Recognize the principles of authority and leadership and how teams and individuals are recruited, managed, motivated and developed.
- Understand the importance of personal effectiveness as the basis for effective team and organizational behaviour.
- Recognise that all aspects of business and finance should be conducted in a manner which complies with and is in spiritof accepted professional ethics and professional values.

Learning Outcomes

By the end of the course, students will possess a clear understanding of management functions and the foundation of individual and group behavior in organizations. They will also learn foundations of organization structure, and organizational culture. In particular, the students are expected to have attained proficiency in the following areas:

Management Functions: planning, organizing, leading, and controlling

Personality and emotions

Perception and decision making

Motivation and Leadership

Power and politics
Conflict and negotiation

Organization structure and culture

Teaching Methodology (List methodologies used –example are given below)

The resource person shall explain and discuss a topic in accordance with course outline & students shall be asked to solve various exercises, problems & cases based on those discussions. Guidance in this respect will be provided by the instructor in and outside the class during counseling hours.

STUDENTS ARE REQUIRED TO READ AND UNDERSTAND ALL ITEMS OUTLINED IN THE PARTICIPANT HANDBOOK

Class Policy:-

- Be On Time

  You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.

- Mobile Policy

  TURN OFF YOUR MOBILE PHONE!It is unprofessional to be texting or otherwise.

- Email Policy

  READ YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email. Participants should regularly check their university emails accounts regularly and respond accordingly.

- Class Attendance Policy

  A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddingsare absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade 'F' (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise they could reach short attendance.

- Withdraw Policy

  Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student.A Student withdrawing after the 12th week shall be automatically awarded "F" grade which shall count in the GPA.

- Moodle

  UMT –LMS (Moodle) is an Open Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using Moodle, visit http://oit.umt.edu.pk/moodle. For further query send your queries to moodle@umt.edu.pk

- Harassment Policy

  Sexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment

when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.

Use of Unfair Means/Honesty Policy

Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.

Plagiarism Policy

All students are required to attach a “Turnitin” report on every assignment, big or small. Any student who attempts to bypass “Turnitin” will receive “F” grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.

Communication of Results

The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.

Course Outline

Course code: MG-221 Course title: Accountant in Business

Program	BS Accounting and Finance
Credit Hours	3
Duration	15 Weeks/30 sessions
Prerequisites (If any)	
Resource Person Name and Email	S
Counseling Timing (Room#)	
Contact no.	
Web Links:- (Face book, Linked In, Google Groups, Other platforms)	NA

Chairman/Director Programme signature……Date……..

Dean's signature…… ……Date……..

Grade Evaluation Criteria

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

Marks Evaluation	Marks in percentage
Quizzes	20 %
Assignments	10%
Mid Term	25 %
Project/Presentation	20 %
Final exam25%	
Total	100 %

Recommended Text Books:

Paper F1: Accountant in Business, BPP Learning Media

Reference Books:

Management, 10/e by Stephen. P Robbins (Prentice Hall, 2009)

Organizational Behaviour, 11/e by Stephen. P Robbins (Prentice Hall, 2009)

Course: Accountant in Business-Course code: MG-221Book: F1, Accountant in Business, BPP Learning Media

No	Topics to be covered in the course	Learning Objective of this topic	Expected Outcomes from Students	Teaching Method	Assessment Criteria	Deadlines and Homework
1 2	**Business organizations and their stakeholders** ○ Purpose of business organizations ○ Types of business organizations ○ Stakeholders	.In this topic we will look at the different types of organization, their operations and procedures.	After this lecture students should be familiar withdifferent types of organization and how they operate.	Lecture and Handouts	Assignment	Within a week
3 4	**The business environment** ○ Analysing the business environment ○ Political and legal environment ○ Employment protection ○ Data protection and security ○ Health and safety ○ Consumer protection ○ Internationalization: Social, demographic and cultural Trends ○ Impact of technology on organizations ○ Competitive advantage ○ Sustainability	Sustainability and Internationalization	After this lecture students should be well familiar with need and purpose of sustainability and internationalization in Business	Lecture and Case studies	Class Activity	Within a week

5 6	**The macro-economic environment** ○ Structure and objectives of economy ○ Factors affecting economy ○ Determination of national income ○ Business cycle ○ Inflation and its consequences ○ Unemployment ○ Objective of economic growth ○ Fiscal and monetary policies ○ Balance of payments	In this chapter we present an overview of the goals of macroeconomic policy concentrating on fiscal policy and monetary policy. .	Students should be able to define macroeconomic policy and explain its objectives. Also explain the main determinants of the level of business activity in the economy.	Lecture and Handouts	Class Activity +Assignment	Within a week

7 8	**Micro-economic factors** ○ The micro environment ○ Internal and external micro and macro environments ○ Concept of a market ○ Demand schedule ○ Supply schedule ○ Equilibrium price ○ Demand and supply analysis ○ Maximum and minimum prices	We will look at the microeconomic level of the individual firm, individual markets and consumers (or households).	After this lecture students should Define the concept of demand and supply for goods and services. Explain elasticity of demand and the impact of substitute and complementary goods.	Lecture and Problem sets	Class Activity + Assignment	Within a week
9 10	**Business organization, structure and strategy** ○ The informal organization ○ Organizational structure ○ Levels of strategy in the organization ○ Centralization and decentralization	We will examine the importance of informal networks in shaping organizational culture. Also look into various types of organizational structures	Students should be able to explain the informal organization and its relationship with the formal organization and Describe different ways in which organizations may be structured:	Lecture and Problem sets	Quiz	Within a week

11 12	**Organizational culture and committees** ○ What is culture ○ Organizational culture ○ Culture and structure ○ Committee	We look at how Organization's use cultures to for a distinctive way to do things. The topic concludes with a discussion of the work of committees	Students should be able to define organizational culture and explain the types, roles and purposes of committees	Lecture and Problem sets	Assignment	Within a week
13 14	**Corporate governance and social responsibility** ○ Principles of corporate governance ○ Developments in corporate governance ○ Role of the board ○ Reporting on corporate governance ○ Corporate social responsibility ○ Ethics, law, governance and social responsibility	In this topic we discuss the underlying principles of corporate governance and understand the role of the board and how it communicates with shareholders.	Students should be able to describe the concept of agency in relation to corporate governance, good corporate governance, nomination, selection of the board.	Lecture and Problem sets	Quiz	Within a week

15	NA	NA	NA	NA	Mid-term Exam	Within a week

16 17	**The role of accounting** ○ Purpose of accounting information ○ Nature, principles and scope of accounting ○ Regulatory system ○ Internal and external financial information ○ Control over business transactions ○ Main business financial systems ○ Manual and computerized accounting systems ○ Database and spreadsheets	We will introduce some basic ideas about accounts and look at the types of accounting information, examine the main transactions and financial systems undertaken by a business, before going on to consider manual and computerised financial data.	Students should be able to explain the contribution of the accounting function to the formulation, implementation, and control of the organization's policies, procedures, and performance have comprehensive knowledge of overhead allocation.	Lecture and Problem sets	Class Activity	Within a week
18 19	**Control, security and audit** ○ Internal control systems ○ Internal control environment and procedures ○ Internal audit and internal control ○ External audit ○ IT systems security and safety ○ Building controls into an information system	We will look at the main elements of internal control systems that organizations operate	After this lecture student should be able to understand Internal controls, authorization, security and compliance within business.	Lecture and Problem sets	Assignment	Within a week
20 21	**Identifying and preventing fraud** ○ What is fraud? ○ Potential for fraud	In this topic we consider the various types of fraud that an organisation may be	After this lecture student should be able to Identify different types of	Lecture and Problem sets	Assignment	Within a week

	○ Implications of fraud for the organization ○ Systems for detecting and preventing fraud ○ Responsibility for detecting and preventing fraud ○ Money laundering	prone to and which may have to be investigated by internal audit.	fraud in the organization, Explain the implications of fraud and Identify methods for detecting and preventing fraud			
22 23	**Leading and managing people** ○ Purpose and process of management ○ Writers on management ○ Management and supervision ○ What is leadership? ○ Leadership skills and styles	In this chapter, we attempt to get an overview of the manager's task. What is management? What do managers actually do to manage resources, activities and projects?	Students should be able to Define leadership, management and supervision and understand the different theories of management	Lecture and Problem sets	Quiz	Within a week
24 25	**Recruitment and selection** ○ Recruitment and selection ○ Responsibility for recruitment and selection ○ Recruitment process ○ Evaluating recruitment and selection **Diversity and equal opportunity** ○ Discrimination at work ○ Equal opportunity ○ The practical implications ○ Diversity	In this chapter, we look at the process of recruitment, which is about obtaining candidates and advertising the vacancy in the labor market. Discuss diversity as a challenge in Recruitment and selection	Students should be able to Describe the recruitment and selection process and explain the stages in this process.Explain the purposes and benefits of diversity and equal opportunities policies within the human resources plan.	Lecture and Problem sets	Quiz	Within a week

	○ The ethical environment ○ Ethics in organizations ○ Accountants and ethics ○ A code of ethics ○ Resolution of ethical conflicts	for businesses.	importance of ethics to the organization and to the individual			
28 29	**Project Presentations**	NA	NA	NA	Project/Presentation	Within a week
30	**Revision of the course**	NA	NA	NA	NA	NA
26 27	**Performance appraisal** ○ Performance management and assessment ○ Purpose and process of performance management ○ Barriers to effective appraisal **Ethical considerations** ○ A framework of rules ○ Management accountability	This chapter discusses process of appraisal or competence assessment: the measurement and evaluation of the individual's performance. We will also look at ethical codes	Students should be able to explain how organizations assess the performance of human resources.Define business ethics and explain the	Lecture and Problem sets	Class Activity	Within a week

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