Sana'a University
Faculty of Engineering
Mechatronics Engineering Department
Mechatronics Engineering Program

Course Specification of Mathematics 1

I. Course Identification and General Information:

1-	Course title:	Mathematics (1).				
2-	Course Number & Code:	FR001.				
3-	Credit hours:	**C.H**				**Total Cr. Hr.**
		Th.	**Seminar**	**Pr.**	**Tu.**	
		2	-	-	2	3
4-	Study level/year at which this course is offered:	First Year-First Semester.				
5-	Pre –requisite (if any):	None.				
6-	Co –requisite (if any):	None.				
7-	Program (s) in which the course is offered	Mechatronics Engineering Program.				
8-	Language of teaching the course:	English Language.				
9-	System of Study:	Semesters.				
10-	Mode of delivery:	Lectures and Tutorials.				
11-	Location of teaching the course:	Mechatronics Engineering Department.				
12-	Prepared by:	Dr. Adnan Khalid Al-Salihi.				
13-	Date of approval:					

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Dr. Adnan Khalid Al-Salihi	Ass. Prof. Dr. Abdul-Malik Momin	Ass. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Ass. Prof. Dr. Huda Al-Emad

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II. Course Description:

This course prepared to be a primary education in the first branch of the calculus (differential calculus), whereas focus on the fundamental concepts of: Real functions, Limits of the functions, Continuity of the functions, Derivatives of the functions, The complex numbers, Matrices and determinants and how to use them to get solution of simultaneous linear equations, Study properties of functions by using algebra and graphical methods that include plotting points, determining symmetry,
and making horizontal or vertical shifts.
The Calculus was invented as a tool for investigating problems that involve motion, Algebra and trigonometry, may be used to study objects that move at constant speed along linear or circular paths. Modern day applications of the derivative include investigating the rate of growth of bacteria in the culture, predicating the outcome of a chemical reaction, measuring instantaneous change in electrical current, describing the behavior of atomic particles, forecasting economic profits and losses and analyzing vibrations mechanical systems, and it is also useful in solving problems that involving maximum or minimum values, So mathematics is necessary to underpin education in mechatronics engineering.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Characterize the real functions, and how to solve linear inequality, quadratic inequality, modulus equation in the domain of the set of real numbers.	A1, A3.
a.2	Classify the properties of the limits and continuity and basic rules of differentiation and how can deal with their calculations.	A1, A3.
b.1	Combine different methods of differentiation to solve applied problems.	B1, B2.
b.2	Create a smooth transition into the interactive problem solving.	B1, B2.

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c.1	Demonstrate the graphs of the algebraic and transcendental functions by using properties, rigid and non-rigid transformations.	C2.
c.2	Compute a mathematical model use the elementary functions and estimate its solution as engineering applications.	C2.
d.1	Examine applications such as apply mathematical concepts, principles and methods in practical engineering problems within the required time efficiently.	D1, D3.
d.2	Cooperate and work effectively in group or individually.	D3.

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1. Characterize the real functions, and how to solve linear inequality, quadratic inequality, modulus equation in the domain of the set of real numbers.	Lecture and tutorial class.	Assignments (Quizzes & Homework).
a2. Classify the properties of the limits and continuity and basic rules of differentiation and how can deal with their calculations.	Lecture and tutorial class.	Assignments (Quizzes & Homework).

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b2. Combine different methods of differentiation to solve applied problems.	Lecture and tutorial class.	Assignments (Quizzes & Homework).

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b2. Create a smooth transition into the interactive problem solving.	Lecture and tutorial class	Assignments (Quizzes & Homework).

© **Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:**		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Demonstrate the graphs of the algebraic and transcendental functions by using properties, rigid and non-rigid transformations.	Lecture and tutorial class.	Assignments (Quizzes & Homework).
c2. Compute a mathematical model use the elementary functions and estimate its solution as engineering applications.	Lecture and tutorial class	Assignments (Quizzes & Homework).

(D) **Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:**		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Examine applications such as apply mathematical concepts, principles and methods in practical engineering problems within the required time efficiently.	Lecture and tutorial class	Assignments (Quizzes and Home works).
d2. Cooperate and work effectively in group or individually.	Lecture and tutorial class	Assignments (Quizzes and Home works)

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IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	Arithmetic and Introduction to Algebra.	a1, d2.	• Types of number and powers. • Inequalities and absolute value. • Introduction to algebra (powers, logarithms, factorization of algebraic expressions). • Algebraic expressions, equations and functions.	1	2
2.	Functions and their Graphs.	a1,b2,c1, c2,d1	• Rectangular coordinates. • Graphs of equations. • Linear equations in two Variables. • Functions and their Graphs. • Combinations of functions: composite functions and inverse functions.	1	2
3.	Polynomial and Rational Functions.	a1,a2,b2,c1, c2,d1,d2	• Quadratic and polynomial functions of higher degree. • Polynomial and synthetic division • Complex numbers and zeros of polynomial functions. • Rational functions. • Non-linear inequalities.	1	2

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4.	Exponential and Logarithmic Functions.	a1,a2, b2,c1,c2, d1,d2.	• Exponential functions, properties and graphs. • Logarithmic functions, properties and graphs. • Exponential and logarithmic equations. • Exponential and logarithmic models.	1	2
5.	Trigonometric and Inverse Trigonometric Functions.	a1,a2, b2,c1,c2, d1,d2	• Trigonometric functions, properties and graphs. • Inverse trigonometric functions, properties and graphs.	1	2
6.	Hyperbolic and Inverse Hyperbolic Functions.	a1,a2, b2,c1,c2, d1,d2	• Hyperbolic functions, properties and graphs. • Inverse hyperbolic functions, properties and graphs.	1	2
7.	Limits and Continuity.	a1,a2 , b2,c1,c2, d1,d2.	• Limits and their properties. • Techniques for evaluating limits. • Continuity of a function.	1	2
8.	Mid-Term Exam.	a1, a2, b1, b2, c1, c2.	• The First 7 Chapters.	1	2
9.	Differentiation	a1,a2, b1,b2,c1,c2, d1,d2.	• The Derivative and the tangent, line problem. • Basic differentiation rules.	1	2
10.	Differentiation.	a1,a2, b1,b2,c1,c2, d1,d2.	• Higher-order derivatives. • The chain rule. • Implicit differentiation.	1	2

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11.	Differentiation.	a1,a2, b1,b2,c1,c2, d1,d2.	• Derivatives of exponential, logarithmic, trigonometric and inverse trigonometric function.	1	2
12.	Differentiation.	a1,a2, b1,b2,c1,c2, d1,d2.	• Derivatives of hyperbolic and inverse hyperbolic functions.	1	2
13.	Applications of Differentiation.	a1,a2,b1, b2,c1,c2, d1,d2.	• Extrema on an interval. • Rolle's theorem and the mean value theorem. • Increasing and decreasing functions and the first. • Concavity and the 2nd derivative test.	1	2
14.	Matrices and. Determinants.	a1,a2,b2, c1,c2, d1,d2.	• Operations with matrices. • The inverse of a matrix. • The determinant of a matrix. • Properties of determinants.	1	2
15.	Solving Systems of Linear Equations by using Matrices and Determinants.	a1,a2,b2, c1,c2, d1,d2.	• Matrices and systems of equations. • Cramer's rule. • Use Gauss-Jordan and Gaussian elimination to solve systems of linear equations.	1	2
16.	Final Exam.	a1, a2, b1, b2, c1, c2.	• All the Chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

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B- Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1.	Arithmetic and Introduction to Algebra.	1	2	a1, d2.
2.	Functions and their Graphs.	1	2	a1,b2,c1, c2,d1
3.	Polynomial and Rational Functions.	1	2	a1,a2,b2,c1, c2,d1,d2
4.	Exponential and Logarithmic Functions.	1	2	a1,a2, b2,c1,c2, d1,d2.
5.	Trigonometric and Inverse Trigonometric Functions.	1	2	a1,a2, b2,c1,c2, d1,d2
6.	Hyperbolic and Inverse Hyperbolic Functions.	1	2	a1,a2, b2,c1,c2, d1,d2
7.	Limits and Continuity.	1	2	a1,a2 , b2,c1,c2, d1,d2.
8.	Differentiation	1	2	a1,a2, b1,b2,c1,c2, d1,d2.
9.	Differentiation.	1	2	a1,a2, b1,b2,c1,c2, d1,d2.
10.	Differentiation.	1	2	a1,a2, b1,b2,c1,c2, d1,d2.
11.	Differentiation.	1	2	a1,a2, b1,b2,c1,c2, d1,d2.
12.	Applications of Differentiation.	1	2	a1,a2,b1, b2,c1,c2, d1,d2.
13.	Matrices and Determinants.	1	2	a1,a2,b2, c1,c2, d1,d2.

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14.	Solving Systems of Linear Equations by using Matrices and Determinants.	1	2	a1,a2,b2, c1,c2, d1,d2.
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

1. Lectures
2. Tutorial class.
3. Interactive class discussion.
4. Presentations.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Quizzes and class activities (exercises and discussions).	a1,a2,b1,b2, c1,c2, d1, d2.	Every 2 weeks	10
2.	Homework .	a1,a2,b1,b2, c1,c2,d1,d2.	Every 2 weeks	10
Total				**20**

VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Quizzes and class activities (exercises and discussions).	Every 2 weeks	15	10%	a1,a2,b1,b2, c1,c2, d1, d2.

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2	Homework.	Every 2 weeks	15	10%	a1,a2,b1,b2, c1,c2, d1, d2.
3	Mid-Term Exam.	On the 8th week	15	10%	a1,a2,b1,b2, c1,c2.
4	Final exam.	On the 16th week	105	70%	a1,a2,b1,b2, c1,c2.
Total			**150**	**100%**	

VIII. Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

1- Required Textbook(s) (maximum two).

1- Essential Calculus Early Transcendental Functions, Ron Larson, Robert Hostetler and Bruce H. 2008 Edwards, Houghton Mifflin Company Boston New York.
2- Thomas' , 2014.Calculus by George B. Thomas, Jr. Thirteenth Edition, Pearson Education, Inc.

2- Essential References.

1- Higher Engineering Mathematics, 2006, Fifth Edition by John Bird, Elsevier Ltd.

3- Electronic Materials and Web Sites *etc*.

1-
2-

IX. Course Policies:

1.	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the faculty.
2.	**Tardy**:

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	The students should respect the timing of attending the lectures. They should attend within 1 minute from starting of the lecture.
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam.
4.	**Assignments & Projects:** The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
5.	**Cheating**: If any cheating occurred during the examination, the student is not allowed to continue and he/she has to face the examination committee for enquires.
6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attends the exam on another behalf according to the policy, rules and regulations of the university.
7.	**Other policies:** • All the teaching materials should be kept out the examination hall. • The mobile phone is not allowed. • There should be a respect between the student and his teacher.

Reviewed By	Vice Dean for Academic Affairs and Post Graduate Studies: Dr. Tarek A. Barakat President of Quality Assurance Unit: Ass. Prof. Dr. Mohammed Algorafi Head of Mechatronics Engineering Department: Ass. Prof. Dr. Abdul-Malik Momin Ass. Prof. Dr. Riyadh Muharam.
	Deputy Rector for Academic Affairs Dr. Ibrahim AlMutaa Ass. Prof. Dr. Ahmed Mujahed Dr. Munaser Alsubri

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Template for Course Plan of Mathematics 1

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Dr. Adnan Khalid Al-Salihi	**Office Hours**					
Location& Telephone No.	00967770499879	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Adnans2000@gmail.com						

II. Course Identification and General Information:						
1.	**Course Title:**	Mathematics (1)				
2.	**Course Number & Code:**	FR001.				
3.	**Credit hours:**	**C.H**				**Total Cr. Hr.**
		Th.	**Seminar**	**Pr.**	**Tu.**	
		2	-	-	2	3
4.	**Study level/year at which this course is offered:**	First Year-First Semester.				
5.	**Pre –requisite (if any):**	None.				
6.	**Co –requisite (if any):**	None.				
7.	**Program (s) in which the course is offered**	Mechatronics Engineering Program.				
8.	**Language of teaching the course:**	English Language.				
9.	**System of Study:**	Semesters.				
10.	**Mode of delivery:**	Lectures and Tutorials.				
11.	**Location of teaching the course:**	Mechatronics Engineering Department.				

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III. Course Description:

This course prepared to be a primary education in the first branch of the calculus (differential calculus), whereas focus on the fundamental concepts of: Real functions, Limits of the functions, Continuity of the functions, Derivatives of the functions, The complex numbers, Matrices and determinants and how to use them to get solution of simultaneous linear equations, Study properties of functions by using algebra and graphical methods that include plotting points, determining symmetry,
and making horizontal or vertical shifts.
The Calculus was invented as a tool for investigating problems that involve motion, Algebra and trigonometry, may be used to study objects that move at constant speed along linear or circular paths. Modern day applications of the derivative include investigating the rate of growth of bacteria in the culture, predicating the outcome of a chemical reaction, measuring instantaneous change in electrical current, describing the behavior of atomic particles, forecasting economic profits and losses and analyzing vibrations mechanical systems, and it is also useful in solving problems that involving maximum or minimum values, So mathematics is necessary to underpin education in mechatronics engineering.

IV. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Characterize the real functions, and how to solve linear inequality, quadratic inequality, modulus equation in the domain of the set of real numbers.	A1, A3.
a.2	Classify the properties of the limits and continuity and basic rules of differentiation and how can deal with their calculations.	A1, A3.
b.1	Combine different methods of differentiation to solve applied problems.	B1, B2.
b.2	Create a smooth transition into the interactive problem solving.	B1, B2.

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c.1	Demonstrate the graphs of the algebraic and transcendental functions by using properties, rigid and non-rigid transformations.	C2.
c.2	Compute a mathematical model use the elementary functions and estimate its solution as engineering applications.	C2.
d.1	Examine applications such as apply mathematical concepts, principles and methods in practical engineering problems within the required time efficiently.	D1, D3.
d.2	Cooperate and work effectively in group or individually.	D3.

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact hours
1.	Arithmetic and Introduction to Algebra.	• Types of number and powers. • Inequalities and absolute value. • Introduction to algebra (powers, logarithms, factorization of algebraic expressions). • Algebraic expressions, equations and functions.	1	2
2.	Functions and their Graphs.	• Rectangular coordinates. • Graphs of equations. • Linear equations in two Variables. • Functions and their Graphs. • Combinations of functions: composite functions and inverse functions.	2	2
3.	Polynomial and	• Quadratic and polynomial functions of higher degree.	3	2

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	Rational Functions.	• Polynomial and synthetic division • Complex numbers and zeros of polynomial functions. • Rational functions. • Non-linear inequalities.		
4.	Exponential and Logarithmic Functions.	• Exponential functions, properties and graphs. • Logarithmic functions, properties and graphs. • Exponential and logarithmic equations. • Exponential and logarithmic models.	4	2
5.	Trigonometric and Inverse Trigonometric Functions.	• Trigonometric functions, properties and graphs. • Inverse trigonometric functions, properties and graphs.	5	2
6.	Hyperbolic and Inverse Hyperbolic Functions.	• Hyperbolic functions, properties and graphs. • Inverse hyperbolic functions, properties and graphs.	6	2
7.	Limits and Continuity.	• Limits and their properties. • Techniques for evaluating limits. • Continuity of a function.	7	2
8.	Mid-Term Exam.	• The First 7 Chapters.	8	2
9.	Differentiation	• The Derivative and the tangent, line problem. • Basic differentiation rules.	9	2
10.	Differentiation.	• Higher-order derivatives. • The chain rule. • Implicit differentiation.	10	2
11.	Differentiation.	• Derivatives of exponential, logarithmic, trigonometric and inverse trigonometric function.	11	2

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12.	Differentiation.	• Derivatives of hyperbolic and inverse hyperbolic functions.	12	2
13.	Applications of Differentiation.	• Extrema on an interval. • Rolle's theorem and the mean value theorem. • Increasing and decreasing functions and the first. • Concavity and the 2nd derivative test.	13	2
14.	Matrices and. Determinants.	• Operations with matrices. • The inverse of a matrix. • The determinant of a matrix. • Properties of determinants.	14	2
15.	Solving Systems of Linear Equations by using Matrices and Determinants.	• Matrices and systems of equations. • Cramer's rule. • Use Gauss-Jordan and Gaussian elimination to solve systems of linear equations.	15	2
16.	Final Exam.	• All the Chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B- Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1.	Arithmetic and Introduction to Algebra.	1	2	a1, d2.
2.	Functions and their Graphs.	2	2	a1,b2,c1, c2,d1
3.	Polynomial and Rational Functions.	3	2	a1,a2,b2,c1, c2,d1,d2
4.	Exponential and Logarithmic Functions.	4	2	a1,a2, b2,c1,c2, d1,d2.

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5.	Trigonometric and Inverse Trigonometric Functions.	5	2	a1,a2, b2,c1,c2, d1,d2
6.	Hyperbolic and Inverse Hyperbolic Functions.	6	2	a1,a2, b2,c1,c2, d1,d2
7.	Limits and Continuity.	7	2	a1,a2 , b2,c1,c2, d1,d2.
8.	Differentiation	8	2	a1,a2, b1,b2,c1,c2, d1,d2.
9.	Differentiation.	9	2	a1,a2, b1,b2,c1,c2, d1,d2.
10.	Differentiation.	10	2	a1,a2, b1,b2,c1,c2, d1,d2.
11.	Differentiation.	11	2	a1,a2, b1,b2,c1,c2, d1,d2.
12.	Applications of Differentiation.	12	2	a1,a2,b1, b2,c1,c2, d1,d2.
13.	Matrices and Determinants.	13	2	a1,a2,b2, c1,c2, d1,d2.
14.	Solving Systems of Linear Equations by using Matrices and Determinants.	14	2	a1,a2,b2, c1,c2, d1,d2.
Number of Weeks /and Units Per Semester		**14**	**28**	

VI. Teaching strategies of the course:

5. Lectures
6. Tutorial class.
7. Interactive class discussion.
8. Presentations.

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VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Quizzes and class activities (exercises and discussions).	a1,a2,b1,b2, c1,c2, d1, d2.	Every 2 weeks	10
2.	Homework .	a1,a2,b1,b2, c1,c2,d1,d2.	Every 2 weeks	10
Total				**20**

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Quizzes and class activities (exercises and discussions).	Every 2 weeks	15	10%	a1,a2,b1,b2, c1,c2, d1, d2.
2	Homework.	Every 2 weeks	15	10%	a1,a2,b1,b2, c1,c2, d1, d2.
3	Mid-Term Exam.	On the 8th week	15	10%	a1,a2,b1,b2, c1,c2.
4	Final exam.	On the 16th week	105	70%	a1,a2,b1,b2, c1,c2.
Total			**150**	**100%**	

IX. Learning Resources:

- Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

1- Required Textbook(s) (maximum two).

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Dr. Adnan Khalid Al-Salihi	Ass. Prof. Dr. Abdul-Malik Momin	Ass. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Ass. Prof. Dr. Huda Al-Emad

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	3- Essential Calculus Early Transcendental Functions, Ron Larson, Robert Hostetler and Bruce H. 2008 Edwards, Houghton Mifflin Company Boston New York. 4- Thomas' , 2014.Calculus by George B. Thomas, Jr. Thirteenth Edition, Pearson Education, Inc.
2- Essential References.	
	2- Higher Engineering Mathematics, 2006, Fifth Edition by John Bird, Elsevier Ltd.
3- Electronic Materials and Web Sites *etc*.	
	1- 2-

X. Course Policies:

1.	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the faculty.
2.	**Tardy**: The students should respect the timing of attending the lectures. They should attend within 1 minute from starting of the lecture.
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam.
4.	**Assignments & Projects:** The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
5.	**Cheating**: If any cheating occurred during the examination, the student is not allowed to continue and he/she has to face the examination committee for enquires.

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6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attends the exam on another behalf according to the policy, rules and regulations of the university.
7.	**Other policies:** • All the teaching materials should be kept out the examination hall. • The mobile phone is not allowed. • There should be a respect between the student and his teacher.

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