31.Course Specification of Analog and Digital Signals

I.Course Identification and General Information:						
.1	Course Title:	Analog and Digital Signals.				
.2	Course Code & Number:	MT204.				
.3	Credit hours:	C.H.				TOTAL Cr. Hrs
		Th.	Seminar	Pr	Tu.	
		2	-	2	2	4
.4	Study level/ semester at which this course is offered:	Third Year -First Semester.				
.5	Pre –requisite (if any):	Electrical Circuits (2) and Computer Programming (1).				
.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	Location of teaching the course:	Mechatronics Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Muhammad Al-Yadoumi.				
11.	Date of Approval:					

II.Course Description:

The course provides strong foundation on analog and digital signals, and systems analysis which is necessary for creating good foundations in analyzing, interpreting, and evaluating the performance of basic Mechatronics Systems. The students will learn the basic Analog and discrete time signals, Analog and discrete time systems. Students will understand the application of various mathematical transforms techniques (Laplace, Fourier analysis, and Z-Transform) for signals analysis and system designs both continuous time and discrete time. Students will be introduced to the conversion from analog to digital and vice versa (ADC and DCA) techniques and to the design and analysis of digital filters.

MATLAB is a required software package for this course. Students who will be studying the course must have installed the package on their laptops. The student version of MATLAB is available online atwww.mathworks.com

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Depict knowledge and understanding of the theoretical and mathematical aspects of analog and digital signals relevant to Mechatronics Engineering.	A1

a2.	Describe an understanding of the fundamental properties of linear systems and their mathematical models required to calculate, analyse, estimate, study the response of such systems and evaluate their stability	A2
b1.	Analyze results achieved by mathematical solutions and computer simulation to evaluate the behavior of basic mechatronic systems.	B1, B2
b2.	Compare between alternative mathematical technics used in signal and system analysis and select the appropriate one according to the needed specifications.	B2
c1.	Apply the Sampling theorem i time and frequency domain analysis.	C2
c2.	Implement basic Matlab and Simulink tools for analysis and simulation of continuous and discrete-time systems.	C2
d1.	Estimate student's cooperative work though efficient team works.	D1
d2.	Examine presentations and students communication skills.	D6

(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. Depict knowledge and understanding of the theoretical and mathematical aspects of analog and digital signals relevant to Engineering. Mechatronics	• Active Lectures. • Tutorials. • Computer Analysis • Discussion.	• Written Exams. • Homework. • Computer Analysis Results.
a2. Describe an understanding of the fundamental properties of linear systems and their mathematical models required to calculate, analyze, estimate, study the response of such systems and evaluate their stability	• Active Lectures. • Tutorials. • Computer Analysis • Discussion.	• Written Exams. • Homework. • Class Activities. • Computer Analysis Results.

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

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1. Analyze results achieved by mathematical solutions and computer simulation to evaluate the behavior of basic mechatronic systems.	• Active Lectures. • Tutorials. • Brainstorming • Computer Analysis Discussion.	• Written Exams • Homework • Class Activities. • Computer Analysis Results.

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b2. Compare between alternative mathematical technics used in signal and system analysis and select the appropriate one according to the needed specifications.	• Active Lectures. • Tutorials. • Computer Analysis Discussion.	• Written Exams. • Homework. • Class Activities. • Lab. reports.

© **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. Apply the Sampling theorem in time and frequency domain analysis.	• Active Lectures. • Analysis and Problem Solving. • Computer Simulations.	• Written Exams. • Homework. • Class Activities. • Lab. Reports.
c2. Implement basic Matlab and Simulink tools for analysis and discrete-simulation of continuous and time systems.	• Laboratory Works. • Computer Simulations.	• Homework. • Lab. Activities. • Simulations Reports.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1. Estimate student's cooperative work though efficient team works.	• Group Works. • Projects.	• Project Reports. • Presentation.
d2. Examine presentations and students communication skills.	• Group Works. • Projects.	• Presentations. • Project Reports.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	a1, d1	Overview of the course: • Learning objectives and outcomes. • Course organization. • Methods and measures of assessment.	1	2

			• Course requirements, guidelines to comply with the course, and • Course policies: Basic definitions: • Signal definition, and • system definition.		
2.	Basic Signals.	a1, b2	• Analog signals: step and unit step, ramp, pulse, sinusoids, triangular, signum. rectangular, and sync signals. • Discrete signals: step, ramp, complex exponentials, and sinusoidal sequences • Impulse (dirac-delta), and unit impulse.	1	2
3.	Signal Classifications.	a1, b2	• Analog, discrete time, periodic, non-periodic signals, deterministic & random, energy & power, even, and odd signals.	1	2
4.	Signal Operations.	a_1, b_2,c_2	• Amplitude scaling, time scaling, time shifting, time folding, multiplication, addition, differentiation, and integration.	1	2
5.	Systems: Definition, Classification	a_1, a2, b1, b_2, c_2	• Systems: definitions, • Systems classification: linear and non-linear, time variant and invariant, LTI systems, causal and non- causal, static and dynamic, stable and unstable, invertible.	1	2
6.	Block Diagrams and Transfer Function Representation.	a_1, a2, b_2, c_2	• Transfer function (input output relation). • Open loop system. • Closed loop (system with feedback). • Block diagrams reduction.	1	2

7.	Convolution and Correlation of Signals.	a_1, a2, b1, b_2, c_2	• Impulse response. • Concept of convolution in time domain and frequency domain, convolution integral and convolution sum. • Graphical representation of convolution, convolution. property. • Auto-correlation, cross-correlation.	1	2
8.	Mid-Term Exam.	a1,a2, b1, b2, c1, d2	• Topics covered in the previous lectures.	1	2
9.	Fourier Series Application on Non-Sinusoidal System Inputs.	a_1, a2, b1, b_2, c_2	• Non-sinusoidal periodic signals. • Review of Fourier series analysis. • Frequency spectrum of periodic signals. • Electric circuit response to a nonsinusoidal Input. (calculation of voltage and current effective values, and active power). • Addition and subtraction of nonsinusoidal waveforms.	1	2
10.	Laplace Transform.	a1,a2, b1, b2, c2	• The Laplace transform. • Laplace transform properties. • The region of convergence. • The inverse Laplace. transform. • Use of tables of Laplace transform pairs. • Transfer function. • Partial-fraction expansion: • Poles and zero concept. • Simple poles, multiple poles, and complex poles cases. • Convolution. • Application of Laplace. transform in solving electric circuits.	1	2

11.	Fourier Transform.	a1, a_2, b_1, b_2, c_2	• Definition of Fourier transform. • Fourier transformation of continuous and discrete time signals and their properties.; convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems. • Fourier transform of: unit rectangular, a unit triangle, unit impulse, δ(t), interpolation function. • Fourier transform of periodic signals. • sinc(x), • Inverse Fourier transform.	1	2
12.	ADC and DAC:	a1, a_2, b_1, b_2, c_2	• Signal conditioning • The sampling theorem (Shannon's theorem). • Sampling process. • Signal quantization. • Aliasing, anti-aliasing filters. • Encoding. • Signal reconstruction. • D/A converters.	1	2
13.	Z-Transforms.	a1, a_2, b_1, b_2, c_2	• Z-transform definition. • Standard forms. • Z-transform properties. • Transfer function. • Poles and zeros. • Region of convergence R(OC). • Damping rule. • Shifting rule. • Inverse Z-transform. • Solutions to difference equations.	1	2

14.	Digital Filters (FIR and IIR).	a_1,a_2,b_2,c_2, d_1	• Finite impulse response (FIR) filters. • Infinite impulse response (IIR) filters. • Structures and properties of FIR and IIR filters. • Realization of digital filters. • Transfer function of FIR digital filters. • Transfer function of IIR digital filters. • Solution of difference equations of digital filters. • Frequency response. • Digital filters stability.	2	4
15.	Final Exam.	a1,a2,b1,b2 ,c1, d2	Topics covered throughout the course.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Tutorial Aspect:

Order	Tutorial	Learning Outcomes	Number of Weeks	Contact Hours
1.	**Basic Signals** • Analog signals: Step and unit step, Ramp, Pulse, sinusoids, triangular, signum. rectangular, and sync signals. • Discrete signals: Step, ramp, Complex exponentials, and Sinusoidal Sequences • Impulse (dirac-delta), and Unit Impulse	a1, b2	1	2
2.	**Signal Classifications** • Analog, Discrete time, Periodic, non-periodic signals, Deterministic & Random, Energy & power, even, and odd signals	a1, b2	1	2
3.	**Signal Operations** • Amplitude scaling, time scaling, time shifting, time folding, multiplication, addition, differentiation, and integration.	a_1, b_2,,c_2	1	2

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4.	**Systems Classification** • Systems Classification: linear and non-linear, time variant and invariant, LTI systems, causal and non- causal, static and dynamic, stable and unstable, invertible	a_1, a2, b1, b_2, c_2	1	2
5.	**Block Diagrams and Transfer Function Representation** • Transfer Function (input output relation) • Open Loop System • Closed Loop (System with feedback) • Block Digrams Reduction	a1,a2, b1, b2	1	2
6.	**Convolution and Correlation of Signals** • Impulse Response • Concept of convolution in time domain and frequency domain, convolution integral and convolution Sum • Graphical representation of convolution. Convolution property • Auto-correlation, cross-correlation	a_1, a2, b1, b_2, c_2	1	2
7.	**Fourier Series Application on Non-Sinusoidal System Inputs** • Non-Sinusoidal Periodic signals • Review of Fourier series Analysis • Frequency spectrum of periodic signals • Electric Circuit Response to a Nonsinusoidal Input (Calculation of Voltage and Current Effective Values, and active power) • Addition and Subtraction of Nonsinusoidal Waveforms	a_1, a2, b1, b_2, c_2	1	2
8.	**Laplace Transform** • The Laplace Transform • Laplace Transform properties • The Region of Convergence • The Inverse Laplace Transform • Use of Tables of Laplace Transform Pairs: • Transfer Function • Partial-Fraction Expansion: • Poles and Zero Concept	a1,a2, b1, b2, c2	1	2

	• Simple poles, Multiple poles, and complex Poles Cases • Convolution • Application of Laplace Transform in solving Electric Circuits:			
9.	**Fourier Transform** • Definition of Fourier transform • Fourier transformation of continuous and discrete time signals and their properties.; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems. • Fourier Transform of: unit rectangular, a unit triangle, unit impulse, δ(t), • Fourier Transform of periodic signals • sinc(x), • Inverse Fourier Transform Inverse Fourier Transform.	a1, a_2, b_1, b_2, c_2	1	2
10.	**ADC and DAC** • Signal Conditioning • The sampling theorem (Shannon's Theorem) • sampling process, • Signal quantization • aliasing, anti-aliasing filters • Encoding • Signal reconstruction • D/A converters	a1,a2,b1,b 2,,c1, c2.	2	4
11.	**Z-Transforms** • Z-transform definition • standard forms • Z-transform properties • Transfer Function • Poles and Zeros • Region of Convergence R(OC) • damping rule • shifting rule • Inverse Z-transform solutions to difference equations	a1, a_2, b_1, b_2, c_2	1	2

12.	**Digital Filters (FIR and IIR)** • Finite impulse response (FIR) filters • Infinite impulse response (IIR) filters • Structures and properties of FIR and IIR filters • Realization of digital filters • Transfer Function of FIR digital Filters • Transfer Function of IIR digital Filters • Solution of difference equations of Digital filters	a_1,a_2,b1,b_2, c_2, d_1	2	4
Number of Weeks /and Units Per Semester			**14**	**28**

C - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	**Lab. No. 1 Orientation:** • Safety regulations, • Requirements for effective lab work, • Matlab Installation • Lab-Report Construction • Lab Policy and Grading • Student Responsibilities	1	2	d1,d2.
2.	**Lab. No.2 Getting started with Matlab:** • General Commands • Arithmetic Operations • Display Formats • Elementary Math Built-in Functions • Variables • Arrays • Operations with Arrays • Script Files • Functions • Programming in MATLAB • Dealing with Graphics (Continuous and Discrete) • Polynomials • Differential Equations	2	4	b_1, c_2
3.	**Lab. No. 3 Introduction to GUI**: • Elements of GUI Design • GUI Programming • Dynamic GUI	1	2	b_1, c_2,

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Assoc. Prof. Dr. Abdul-Malik Momin	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

4.	**Lab. No. 4 MATLAB Simulink:** • Introduction to Simulink • The Commonly Used Blocks Library • The Math Operations Library • Basic Functions blocks • Display on Simulink	1	2	a_1, a_2, b_1, b_2, c_2, d_1,
5.	**Lab. No. 5 Signal Generation (Continuous and Discrete)**: • Basic functions • Piecewise functions • Other Functions	1	2	a_1, b_1, b_2, c_1, c_2, d_1
6.	**Lab. No. 6 Signal Operations (Continuous and Discrete):** • Scaling • Shifting • Time Reverse • Adding and subtracting signals • Convolution and Deconvolution	1	2	a_1, b_1, b_2, c_2, d_1, d_2
7.	**Lab. No 7 Mathematical Operations:** • Laplace Transform and Inverse of Laplace • Fourier Series • Fourier Transform and Inverse of Fourier • Discrete and Fast Fourier Transform • Z Transform	2	4	a_1, a_2, b_1, b_2, c_2, d_1, d_2
8.	**Lab. No. 8 Systems:** • Introduction • Transfer Function • Step Response • Impulse Response	1	2	a_1, a_2, b_1, b_2, c_2, d_1, d_2
9.	**Lab. No. 9 ADC and DCA:** • Sampling • Quantization • Coding • DCA in Simulink	2	4	a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2
10.	**Lab. No. 10 Filter Design:** • Analog Filters (Active and Passive) • Digital Filters (FIR and IIR)	2	4	a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2

11.	Projects Discussions.	1	2	a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2
12.	Lab. Exam.	1	2	a_1, a_2, b_1, b_2, c_1, c_2, d_2
Number of Weeks /and Units Per Semester		**16**	**32**	

V.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The Use of Computer and Web-Based Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- Laboratory Works.
- Self and Cooperative Learning.
- Dialogue, Discussion and Class Activities.
- Analysis and Problem Solving.
- Project Work.
- Design Exercises.
- Simulation Tools (Matlab with Simulink).
- Brainstorming.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	**Problem Set NO. 1**: Basic Signals.	a1, b2, d_1	Second Week.	2
2.	**Problem Set NO. 2:** Signal Classifications.	a1, b2, d_1	Third Week.	2
3.	**Problem Set NO. 3**: Signal Operations.	a_1, b_2,,c_2, d_1	Fourth Week.	2
4.	**Problem Set NO. 4**: Systems Classification.	a_1, a2, b1, b_2, c_2, d_1	Fifth Week.	2
5.	**Problem Set NO. 5**: Block Diagrams and Transfer Function Representation.	a1,a2, b1, b_2, d_1	Sixth Week.	2
6.	**Problem Set NO. 6**:	a_1, a2, b1, b_2, c_2, d_1	Seventh Week.	2

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	Convolution and Correlation of Signals.			
7.	**Problem Set NO. 7**: Fourier Series Application on Non-Sinusoidal System Inputs.	a_1, a2, b1, b_2, c_2, d_1	Eight and. Week.	2
8.	**Problem Set NO. 8**: Laplace Transform Applications.	a1,a2, b1, b2, c_2, d_1	Ninth Week.	2
9.	**Problem Set NO.9**: Fourier Transform.	a1, a_2, b_1, b_2, c_2, d_1	Tenth and Eleventh Weeks.	2
10.	**Problem Set NO. 10**: ADC and DAC.	a1,a2,b1,b2,,c1, c2, d_1	Twelfth and Thirteenth Weeks.	2
11.	**Problem Set NO. 11:** Z-Transforms.	a1, a_2, b_1, b_2, c_2 , d_1	Fourteenth week	2
12.	**Problem Set NO. 12:** Digital Filters (FIR and IIR)	a_1,a_2,b1,b_2,c_2, d_1	Fifteenth week	2
Total				**24**

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.	Attendance.	Every Class	6	3%	a1, b1,b2, c1, d1,d2.
2.	Assignments.	Weekly	24	12 %	a1, a_2, b1,b2, c1, d1,d2.
3.	Lab Work and Reports.	Weekly	20	10 %	a1, b1,b2, c1, d1,d2.
4.	Course Project.	15	20	10%	a1, b1,b2, c1, c2, d1,d2.
5.	Mid-Term Exam.	8	20	10%	a1, b1,b2, d1,d2.
6.	Lab. Exam.	15	10	5%	a1, b1,b2, c1, d1,d2.
7.	Final Exam.	16	100	50%	a1, b1,b2, c1, c2 d1,d2.
	Total		**200**	**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- B. P. Lathi, 2005, Linear Systems and Signals, 2nd edition, Oxford University Press, New York. USA

	2- MATTHEW N. O. SADIKU and WARSAME H. ALI, 2016 , Systems and Signals, CRC Press, 2016 by Taylor & Francis Group, LLC, Boca Raton London New York
	2- Essential References.
	1- Alan V. Oppenheim, Alain S. Willsky with S. Hamid Nawab, 1997, Signals & Systems, 2nd edition, revised, illustrated Prentice Hall, Michigan University. USA. **2-** Dr. J. S. Chitode, 2009, Signals and systems, 1st edition, Technical publication Pune. **3-** G. E. Carlson, 1998, Signal and linear system analysis-2nd Edition. John Wiley and Sons Ltd., New York. USA.
	3- Electronic Materials and Web Sites *etc*.
	All About : Matlab Package **www.mathworks.com**

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

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:** The students should respect the timing of attending the lectures. They should attend within 10 minutes 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 mid-term 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 has to face the examination committee for enquiries .
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

Template for Course Plan of Analog and Digital Signals

I.Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Asst. Prof. Dr. Muhammad Al-Yadoumi	**Office Hours**					
Location& Telephone No.	Electrical Engineering Department 777811668	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Alyadoumi@hotmail.com						

II.Course Identification and General Information:						
1.	Course Title:	Analog and Digital Signals.				
2.	Course Number & Code:	MT204.				
3.	Credit hours:	C.H				Total Credit Hours
		Th.	Seminar	Pr.	Tu.	
		2	-	2	2	4
4.	Study level/year at which this course is offered:	Third Year-First Semester.				
5.	Pre –requisite (if any):	Electrical Circuits (2) and Computer Programming (1).				
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, Tutorials, and Labs.				
11.	Location of teaching the course:	Mechatronics Engineering Department.				

III.Course Description:

The course provides strong foundation on analog and digital signals, and systems analysis which is necessary for creating good foundations in analyzing, interpreting, and evaluating the performance of basic Mechatronics Systems. The students will learn the basic Analog and discrete time signals, Analog and discrete time systems. Students will understand the application of various mathematical transforms techniques (Laplace, Fourier analysis, and Z-Transform) for signals analysis and system designs both continuous time and discrete time. Students will be introduced to the conversion from analog to digital and vice versa (ADC and DCA) techniques and to the design and analysis of digital filters.

MATLAB is a required software package for this course. Students studying the course must have installed the package on their laptops. The student version of MATLAB is available online atwww.mathworks.com

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Depict knowledge and understanding of the theoretical and mathematical aspects of analog and digital signals relevant to Mechatronics Engineering.	A1
a2.	Describe an understanding of the fundamental properties of linear systems and their mathematical models required to calculate, analyze, estimate, study the response of such systems and evaluate their stability	A2
b1.	Analyze results achieved by mathematical solutions and computer simulation to evaluate the behavior of basic mechatronic systems.	B1, B2
b2.	Compare between alternative mathematical technics used in signal and system analysis and select the appropriate one according to the needed specifications.	B2
c1.	Apply the Sampling theorem i time and frequency domain analysis.	C2
c2.	Implement basic Matlab and Simulink tools for analysis and simulation of continuous and discrete-time systems.	C2
d1.	Estimate student's cooperative work though efficient team works.	D1
d2.	Examine presentations and students communication skills.	D6

V.Course Content:

- Distribution of Semester Weekly Plan of Course Topics/Items and Activities.

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	Overview of the course: • Learning objectives and outcomes. • Course organization. • Methods and measures of assessment. • Course requirements, guidelines to comply with the course, and	1	2

		• Course policies: Basic definitions: • Signal definition, and • system definition.		
2.	Basic Signals.	• Analog signals: step and unit step, ramp, pulse, sinusoids, triangular, signum. rectangular, and sync signals. • Discrete signals: step, ramp, complex exponentials, and sinusoidal sequences • Impulse (dirac-delta), and unit impulse.	2	2
3.	Signal Classifications.	• Analog, discrete time, periodic, non-periodic signals, deterministic & random, energy & power, even, and odd signals.	3	2
4.	Signal Operations.	• Amplitude scaling, time scaling, time shifting, time folding, multiplication, addition, differentiation, and integration.	4	2
5.	Systems: Definition, Classification	• Systems: definitions, • Systems classification: linear and non-linear, time variant and invariant, LTI systems, causal and non- causal, static and dynamic, stable and unstable, invertible.	5	2
6.	Block Diagrams and Transfer Function Representation.	• Transfer function (input output relation). • Open loop system. • Closed loop (system with feedback). • Block diagrams reduction.	6	2
7.	Convolution and Correlation of Signals.	• Impulse response. • Concept of convolution in time domain and frequency domain, convolution integral and convolution sum. • Graphical representation of convolution, convolution. property. • Auto-correlation, cross-correlation.	7	2
8.	Mid-Term Exam.	• Topics covered in the previous lectures.	8	2
9.	Fourier Series Application on Non-	• Non-sinusoidal periodic signals. • Review of Fourier series analysis. • Frequency spectrum of periodic signals.	9	2

	Sinusoidal System Inputs.	• Electric circuit response to a nonsinusoidal Input. (calculation of voltage and current effective values, and active power). • Addition and subtraction of nonsinusoidal waveforms.		
10.	Laplace Transform.	• The Laplace transform. • Laplace transform properties. • The region of convergence. • The inverse Laplace. transform. • Use of tables of Laplace transform pairs. • Transfer function. • Partial-fraction expansion: • Poles and zero concept. • Simple poles, multiple poles, and complex poles cases. • Convolution. • Application of Laplace. transform in solving electric circuits.	10	2
11.	Fourier Transform.	• Definition of Fourier transform. • Fourier transformation of continuous and discrete time signals and their properties.; convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems. • Fourier transform of: unit rectangular, a unit triangle, unit impulse, δ(t), interpolation function. • Fourier transform of periodic signals. • sinc(x), • Inverse Fourier transform.	11	2
12.	ADC and DAC:	• Signal conditioning • The sampling theorem (Shannon's theorem). • Sampling process. • Signal quantization. • Aliasing, anti-aliasing filters. • Encoding. • Signal reconstruction.	12	2

		• D/A converters.		
13.	Z-Transforms.	• Z-transform definition. • Standard forms. • Z-transform properties. • Transfer function. • Poles and zeros. • Region of convergence R(OC). • Damping rule. • Shifting rule. • Inverse Z-transform. • Solutions to difference equations.	13	2
14.	Digital Filters (FIR and IIR).	• Finite impulse response (FIR) filters. • Infinite impulse response (IIR) filters. • Structures and properties of FIR and IIR filters. • Realization of digital filters. • Transfer function of FIR digital filters. • Transfer function of IIR digital filters. • Solution of difference equations of digital filters. • Frequency response. • Digital filters stability.	14,15	4
15.	Final Exam.	Topics covered throughout the course.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Tutorial Aspect:

Order	Tutorial	Learning Outcomes	Number of Weeks	Contact Hours
1.	**Basic Signals** • Analog signals: Step and unit step, Ramp, Pulse, sinusoids, triangular, signum. rectangular, and sync signals. • Discrete signals: Step, ramp, Complex exponentials, and Sinusoidal Sequences • Impulse (dirac-delta), and Unit Impulse	a1, b2	1	2
2.	**Signal Classifications**	a1, b2	2	2

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	• Analog, Discrete time, Periodic, non-periodic signals, Deterministic & Random, Energy & power, even, and odd signals			
3.	**Signal Operations** • Amplitude scaling, time scaling, time shifting, time folding, multiplication, addition, differentiation, and integration.	a_1, b_2,,c_2	3	2
4.	**Systems Classification** • Systems Classification: linear and non-linear, time variant and invariant, LTI systems, causal and non- causal, static and dynamic, stable and unstable, invertible	a_1, a2, b1, b_2, c_2	4	2
5.	**Block Diagrams and Transfer Function Representation** • Transfer Function (input output relation) • Open Loop System • Closed Loop (System with feedback) • Block Digrams Reduction	a1,a2, b1, b2	5	2
6.	**Convolution and Correlation of Signals** • Impulse Response • Concept of convolution in time domain and frequency domain, convolution integral and convolution Sum • Graphical representation of convolution. Convolution property • Auto-correlation, cross-correlation	a_1, a2, b1, b_2, c_2	6	2
7.	**Fourier Series Application on Non-Sinusoidal System Inputs** • Non-Sinusoidal Periodic signals • Review of Fourier series Analysis • Frequency spectrum of periodic signals • Electric Circuit Response to a Nonsinusoidal Input (Calculation of Voltage and Current Effective Values, and active power) • Addition and Subtraction of Nonsinusoidal Waveforms	a_1, a2, b1, b_2, c_2	7	2
8.	**Laplace Transform** • The Laplace Transform • Laplace Transform properties • The Region of Convergence	a1,a2, b1, b2, c2	8	2

	• The Inverse Laplace Transform • Use of Tables of Laplace Transform Pairs: • Transfer Function • Partial-Fraction Expansion: • Poles and Zero Concept • Simple poles, Multiple poles, and complex Poles Cases • Convolution • Application of Laplace Transform in solving Electric Circuits:			
9.	**Fourier Transform** • Definition of Fourier transform • Fourier transformation of continuous and discrete time signals and their properties.; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems. • Fourier Transform of: unit rectangular, a unit triangle, unit impulse, δ(t), • Fourier Transform of periodic signals • sinc(x), • Inverse Fourier Transform Inverse Fourier Transform.	a1, a_2, b_1, b_2, c_2	9	2
10.	**ADC and DAC** • Signal Conditioning • The sampling theorem (Shannon's Theorem) • sampling process, • Signal quantization • aliasing, anti-aliasing filters • Encoding • Signal reconstruction • D/A converters	a1,a2,b1,b2,,c1, c2.	10,11	4
11.	**Z-Transforms** • Z-transform definition • standard forms • Z-transform properties • Transfer Function • Poles and Zeros • Region of Convergence R(OC) • damping rule	a1, a_2, b_1, b_2, c_2	12	2

	• shifting rule • Inverse Z-transform solutions to difference equations			
12.	**Digital Filters (FIR and IIR)** • Finite impulse response (FIR) filters • Infinite impulse response (IIR) filters • Structures and properties of FIR and IIR filters • Realization of digital filters • Transfer Function of FIR digital Filters • Transfer Function of IIR digital Filters • Solution of difference equations of Digital filters	a_1,a_2,b1,b_2, c_2, d_1	13,14	4
Number of Weeks /and Units Per Semester			**14**	**28**

C - Practical Aspect:				
Order	**Tasks/ Experiments**	**Number of Weeks**	**Contact hours**	**Learning Outcomes**
1.	**Lab. No. 1 Orientation:** • Safety regulations, • Requirements for effective lab work, • Matlab Installation • Lab-Report Construction • Lab Policy and Grading • Student Responsibilities	1	2	d1,d2.
2.	**Lab. No.2 Getting started with Matlab:** • General Commands • Arithmetic Operations • Display Formats • Elementary Math Built-in Functions • Variables • Arrays • Operations with Arrays • Script Files • Functions • Programming in MATLAB • Dealing with Graphics (Continuous and Discrete) • Polynomials • Differential Equations	2,3	4	b_1, c_2

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3.	**Lab. No. 3 Introduction to GUI**: • Elements of GUI Design • GUI Programming • Dynamic GUI	4	2	b_1, c_2,
4.	**Lab. No. 4 MATLAB Simulink:** • Introduction to Simulink • The Commonly Used Blocks Library • The Math Operations Library • Basic Functions blocks • Display on Simulink	5	2	a_1, a_2, b_1, b_2, c_2, d_1,
5.	**Lab. No. 5 Signal Generation (Continuous and Discrete)**: • Basic functions • Piecewise functions • Other Functions	6	2	a_1, b_1, b_2, c_1, c_2, d_1
6.	**Lab. No. 6 Signal Operations (Continuous and Discrete):** • Scaling • Shifting • Time Reverse • Adding and subtracting signals • Convolution and Deconvolution	7	2	a_1, b_1, b_2, c_2, d_1, d_2
7.	**Lab. No 7 Mathematical Operations:** • Laplace Transform and Inverse of Laplace • Fourier Series • Fourier Transform and Inverse of Fourier • Discrete and Fast Fourier Transform • Z Transform	8,9	4	a_1, a_2, b_1, b_2, c_2, d_1, d_2
8.	**Lab. No. 8 Systems:** • Introduction • Transfer Function • Step Response • Impulse Response	10	2	a_1, a_2, b_1, b_2, c_2, d_1, d_2
9.	**Lab. No. 9 ADC and DCA:** • Sampling • Quantization • Coding • DCA in Simulink	11,12	4	a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2

10.	**Lab. No. 10 Filter Design:** • Analog Filters (Active and Passive) • Digital Filters (FIR and IIR)	13,14	4	a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2
11.	Projects Discussions.	15	2	a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2
12.	Lab. Exam.	16	2	a_1, a_2, b_1, b_2, c_1, c_2, d_2
Number of Weeks /and Units Per Semester		**16**	**32**	

VII.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	**Problem Set NO. 1**: Basic Signals.	a1, b2, d_1	Second Week.	2
2.	**Problem Set NO. 2:** Signal Classifications.	a1, b2, d_1	Third Week.	2
3.	**Problem Set NO. 3**: Signal Operations.	a_1, b_2,,c_2, d_1	Fourth Week.	2
4.	**Problem Set NO. 4**: Systems Classification.	a_1, a2, b1, b_2, c_2, d_1	Fifth Week.	2
5.	**Problem Set NO. 5**: Block Diagrams and Transfer Function Representation.	a1,a2, b1, b_2, d_1	Sixth Week.	2
6.	**Problem Set NO. 6**: Convolution and Correlation of Signals.	a_1, a2, b1, b_2, c_2, d_1	Seventh Week.	2
7.	**Problem Set NO. 7**: Fourier Series Application on Non-Sinusoidal System Inputs.	a_1, a2, b1, b_2, c_2, d_1	Eight and. Week.	2
8.	**Problem Set NO. 8**: Laplace Transform Applications.	a1,a2, b1, b2, c_2, d_1	Ninth Week.	2
9.	**Problem Set NO.9**: Fourier Transform.	a1, a_2, b_1, b_2, c_2, d_1	Tenth and Eleventh Weeks.	2
10.	**Problem Set NO. 10**: ADC and DAC.	a1,a2,b1,b2,,c1, c2, d_1	Twelfth and Thirteenth Weeks.	2

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11.	**Problem Set NO. 11:** Z-Transforms.	a1, a_2, b_1, b_2, c_2 , d_1	Fourteenth week	2
12.	**Problem Set NO. 12:** Digital Filters (FIR and IIR)	a_1,a_2,b1,b_2,c_2, d_1	Fifteenth week	2
Total				**24**

VI.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The Use of Computer and Web-Based Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- Laboratory Works.
- Self and Cooperative Learning.
- Dialogue, Discussion and Class Activities.
- Analysis and Problem Solving.
- Project Work.
- Design Exercises.
- Simulation Tools (Matlab With Simulink).
- Brainstorming.

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.	Attendance.	Every Class	6	3%	a1, b1,b2, c1, d1,d2.
2.	Assignments.	Weekly	24	12 %	a1, a_2, b1,b2, c1, d1,d2.
3.	Lab Work and Reports.	Weekly	20	10 %	a1, b1,b2, c1, d1,d2.
4.	Course Project.	15	20	10%	a1, b1,b2, c1, c2, d1,d2.
5.	Mid-Term Exam.	8	20	10%	a1, b1,b2, d1,d2.
6.	Lab. Exam.	15	10	5%	a1, b1,b2, c1, d1,d2.
7.	Final Exam.	16	100	50%	a1, b1,b2, c1, c2 d1,d2.
		Total	**200**	**100**	

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IX.Learning Resources:

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

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

1- B. P. Lathi, 2005, Linear Systems and Signals, 2nd edition, Oxford University Press, New York. USA
2- MATTHEW N. O. SADIKU and WARSAME H. ALI, 2016 , Systems and Signals, CRC Press, 2016 by Taylor & Francis Group, LLC, Boca Raton London New York

2- Essential References.

1- Alan V. Oppenheim, Alain S. Willsky with S. Hamid Nawab, 1997, Signals & Systems, 2nd edition, revised, illustrated Prentice Hall, Michigan University. USA.
2- Dr. J. S. Chitode, 2009, Signals and systems, 1st edition, Technical publication Pune.
3- G. E. Carlson, 1998, Signal and linear system analysis-2nd Edition. John Wiley and Sons Ltd., New York. USA.

3- Electronic Materials and Web Sites *etc*.

All About : Matlab Package, **www.mathworks.com**

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 minutes 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 enquiries .
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 during classes and exam periods. -There should be a respect between the student and his teacher.

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