Sana'a University
Faculty of Engineering
Electrical Engineering Department
B.Sc. of Computer and Control Engineering

31. Course Specification of Signals and Systems

I. Course Identification and General Information:

1.	Course Title:	Signals and Systems				
2.	Course Code & Number:	CNE216				
3.	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	-	2	-	3
4.	Study level/ semester at which this course is offered:	Third Year/ First Semester				
5.	Pre –requisite (if any):	Electrical circuits2 (PME112) Differential equations (BR122)				
6.	Co –requisite (if any):	Electrical Machines 2 (PME224)				
7.	Program (s) in which the course is offered:	Electrical Power and Machines Engineering				
8.	Language of teaching the course:	English				
9.	Location of teaching the course:	Class &Lab				
10.	Prepared By:	Asst. Prof. Dr. Amin Abdelghani Mahyob				
11.	Date of Approval					

II. Course Description:

This course introduces the basic signal principles necessary to understand, analyze, and enhance analog and digital signals by students. Its topics include basic analog and digital signals in time and frequency domains, sampling, Laplace, Fourier and z-Transforms and their applications in signal processing and control systems. The course also addresses the mathematical modeling of dynamic systems. The Students will learn how to model

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mechanical, electrical, electromechanical, thermal and liquid level systems as differential equation, transfer function and state variable models

	III. Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1	Classify analog and digital signals and Understand the mathematical transformations (Laplace and Z transforms) their properties and uses in system analysis.	A1,A3
a2	Identify the components, the inputs and the outputs of physical systems	A1,A3
b1	Analyzing different signals and interpret results achieved by mathematical solutions	B1,B2,B3
b2	Build a mathematical model from a real-life problem related to signals and systems.	B1,B2,B3
c1	Simulate of the continuous and discrete-time systems using basic Matlab and Simulink tools.	C1,C2,C3,C4
c2	Obtain transfer functions of physical systems by drawing block diagrams and signal flow graphs	C1,C2,C3,C4
d1	Interact effectively with peers in the group	D1,D3,D4,D5
d2	Present project results to a technical audience and subdivide a project into relevant sub problems and solve it in a given time frame as a team.	D1,D3,D4,D5

(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. Classify analog and digital signals and Understand the mathematical	Lectures, Demonstrations,	Assignments, Oral Presentations,

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uses	transformations (Laplace and Z transforms) their properties and in system analysis.	Software Simulation, Lab Experiments, Interactive class discussion.	Quizzes, Tests, Written Exams.
a2. inputs systems	Identify the components, the and the outputs of physical	Lectures, Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes, Tests, Written Exams.

(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 different signals and interpret results achieved by mathematical solutions	Lectures, Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes, Tests, Written Exams.
b2. and Build a mathematical model from a real-life problem related to signals systems.	Lectures, Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes, Tests, Written Exams.

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

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Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Simulate continuous and discrete-time systems using basic Matlab and Simulink tools.	Lectures, Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes, Tests, Written Exams.
c2. Obtain transfer functions of physical systems by drawing block diagrams and signal flow graphs.	Lectures, Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes, Tests, Written Exams.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Interact effectively with peers in the group	Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes,
d2. Present project results to a technical audience and subdivide a project into relevant sub problems and solve it in a given time frame as a team.	, Demonstrations, Software Simulation, Lab Experiments, Interactive class discussion.	Assignments, Oral Presentations, Quizzes,.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours

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1.	Introduction to signals	a1,a2, b1,b2,	▪ Definition of signal ▪ Typical signals ▪ Signal representation ▪ Classification of signals and their applications ▪ Power and energy of signals	1	2
2.	Systems	a1,a2, b1,b2,	▪ Representation of a system ▪ Classification of systems: time-invariant and time-varying systems, instantaneous and dynamic systems causal and non-causal systems, continuous-time and discrete-time systems, analog and digital systems, stable and unstable systems, linear and nonlinear system ▪ System models: input-output description, transfer function model, differential equation model, state variable model	1	2
3.	Continuous-time system analysis using the Laplace Transform	b1,b2, d1,d2	▪ Laplace Transform definition ▪ The properties of Laplace Transform ▪ Region of convergence, ▪ Theorems of Laplace Transform ▪ Inverse Laplace transform ▪ Differential equation model and transfer function model ▪ Use Laplace transform to solve differential equations	1	2

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4.	Modeling of physical system	b1,b2, c1,c2, d1	▪ Definition of modeling ▪ Develop the models of physical systems: ▪ Electrical system ▪ Mechanical system ▪ Electromechanical system ▪ Thermal system ▪ Liquid level system ▪ Block Diagram and Signal Flow Graph ▪ Transfer Function model ▪ Differential equation model ▪ Transformers and gears ▪ Sensors ▪ Simulation of systems model using Matlab ▪ Linearization of physical system	3	6
5.	State variable models	b1,b2, c1,c2,	▪ Definition ▪ General form of state variable model (definitions of vectors and matrices) ▪ Develop the state variable models from physical system differential equations ▪ Obtain state model from the transfer function and differential equation ▪ Simulation diagrams and flow graphs ▪ Solution of state equations	2	4

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			▪ Obtain the transfer function from state model ▪ Similarity transformation ▪ Simulation of systems model using Matlab		
6.	Continuous-time signal analysis: The Fourier Transform	, b1,b2, c1,c2,	▪ Definition of Fourier ▪ Relation between Fourier Transform and Laplace Transform ▪ Linearity and conjugate properties ▪ Duality of Fourier Transform, ▪ Scaling property, ▪ Inverse Fourier ▪ Transform of several functions, ▪ Fourier Transform of periodic signal	2	4
7.	Sampling and signal reconstructio n	c1,c2, d1,d2	▪ Definition of sampling ▪ Continuous time vs discrete time ▪ Sampling theorem ▪ Practical sampling ▪ Effects of sampling ▪ Selection of sampling time Effects of sampling ▪ Signal reconstruction	2	4
8.	Discrete-time system analysis using z-Transform	b1,b2, c1,c2, d2	▪ Z-Transform definition ▪ Linearity and region of convergence ▪ examples of z-Transform for some functions	2	4

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			▪ Comparison between Laplace and z-Transforms, ▪ Theorems of z-Transform (Initial and Final Value theorems, real and complex translation theorems…) ▪ Inverse z-Transform ▪ Difference equations. ▪ simulation diagrams and flow graphs ▪ State equations		
Number of Weeks /and Units Per Semester				**14**	**28**

B - Practical Aspect:

No.	Tasks/ Experiments	No. of Weeks	Contact Hours	Learning Outcomes
1.	MATLAB fundamentals and Complete MATLAB exercises.	3	6	c1
2.	Write a Program for generation of unit impulse, unit step, ramp, exponential, sinusoidal and cosine sequence.	2	4	c1,c2, d1
3.	Write a Program for plotting discrete and continuous signals.	1	2	c1,c2, d1
4.	Mid-Term Exam (Practical)	1	2	c1, c2, d1
5.	Write a Program for computing Fourier Series of several functions.	1	2	c1,c2
6.	Write a Program for computing Fourier Transform of several functions.	1	2	c1,c2,d1
7.	Write a Program for computing z-transform and inverse z-transform of a rational transfer function.	1	2	c1,c2,d1
8.	Write a Program for linear convolution	1	2	c1,c2, d1

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9.	Write a Program for performing sampling.	1	2	c1,c2, d1
10.	Write a Program for computing Laplace transform and its inverse of several signals.	1	2	c1,c2, d1
11.	Review	1	2	c1,c2, d1
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lectures.
- Demonstrations,
- Software Simulation,
- Interactive class discussion.
- Some of laboratory experiment (Matlab).

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Problems in Fourier series	a2, b2	4th	2.5
2.	Problems in Fourier Transform	a1, b2	6th	1.5
3.	Problems in Laplace Transform	a1,a2, b2,	10th	1.5
4.	Problems in z-transform	a2,b1, b2	14th	2
Total				**7.5**

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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.	Assignment	4^{th}, 6^{th} ,10^{th} ,14^{th}	7.5	5%	a1,a2,b1,b2,
2.	Quizzes	4^{th} , 8^{th} ,12^{th}	7.5	5%	a1,a2,b1,b2,
3.	Class participation, Presentation and Seminars	Weekly	15	10%	c1,c2,d1,d2
4.	Midterm Exam	8^{th}	20	13%	a1,a2,b1,b2,
5.	Practical Final Exam	15^{th}	20	13%	b1,b2,c1,c2
6.	Final Exam	16^{th}	80	54%	a1,a2,b1,b2,
	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. B. P. Lathi, 2005, Linear Systems and Signals, 2nd edition, Oxford University Press, New York. USA.
2. Charles L..Philips and Royce Harbor "Feedback control systems", fourth edition, Prentice Hall.

2- Essential References.

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

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5. Alex palamides. Anastasia Veloni, 2010, Signals and Systems Laboratory with Matlab, 1st edition, Taylor & Fancis Inc. Bosa Roca, USA.
6. Richard C. Dorf and Robert H. Bishop, Modern Control Systems (12th Edition), Prentice Hall.

3- Electronic Materials and Web Sites etc.

1. Modelica Association (2000). ModelicaTM - A Unified Object-Oriented Language for Physical Systems Modeling. Tutorial Version 1.4 (ModelicaTutorial14.pdf). Available from: https://modelica.org/documents/
2. MapleSim Video Tutorial: Modelica Video lectures available form: http://www.youtube.com/watch?v=reehU1dzeDc.
3. Simulink-Matlab tutorial for beginners Video lectures available form:
4. http://www.youtube.com/results?search_query=simulink+tutorial+for+beginners&oq=simulink&gs_l=youtube.1.9.0l10.337429.342148.0.351270.8.8.0.0.0.0.738.2481.3j3-2j2j0j1.8.0...0.0...1ac.1.11.youtube.iIK7kMX6hfo
5. http://www.engineeringvideos.org/
6. www.jhu.edu/signals
7. www.ece.gatech.edu/users/bonnie/book
8. https://sites.google.com/a/asu.edu/signals-and-systems/-

IX. Course Policies:

1.	**Class Attendance:** -A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic
2.	**Tardy:** - For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent.
3.	**Exam Attendance/Punctuality:**

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	- A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in 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**: - For cheating in exam, a student will be considered as failure. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6.	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7.	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. Lecture notes and assignments my given directly to students using soft or hard copy

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Assoc. Prof. Dr. Radwan Al bouthigy**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

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