48.Course Specification of System Modeling and Identification

I.Course Identification and General Information:

.1	Course Title:	System Modeling and Identification.				
.2	Course Code & Number:	MT309.				
.3	Credit hours:	C.H.				TOTAL CR. HRS.
		Th.	Seminar	Pr.	Tu.	
		2	--	2	--	3
.4	Study Level/ Semester at which this Course is offered:	Fourth Year - Second Semester.				
.5	Pre –Requisite (if any):	Computer Programming (1), Computer Programming (2), Analog Control System and Digital Control System.				
.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. Hatem Al-Dois.				
11.	Date of Approval:					

II.Course Description:

This course provides students with an overview of modeling and simulation methods of dynamic systems. The contents of the course are distributed into three main areas: principles for physical modeling, simulation, and system identification. Therefore, approaches for building mathematical models based on physical principles and measured data are provided. In addition, numerical and computer-based solution techniques are examined for various engineering problems. Software tools, such as MATLAB/Simulink and/or LABVIEW, are employed to simulate and analyze systems performance. Case studies in industrial applications are exploited to illustrate the studied methods.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Describe methods to obtain mathematical models of technical systems from different domains based on fundamental physical relations and measured output data.	A1
a2.	Depict knowledge of how differential-algebraic equations (DAEs) arise in modeling of various physical systems.	A8
b1.	Construct different types of models for mechatronics applications.	B1
b2.	Analyze the statistical properties of basic estimation techniques, and explain the practical significance of these results.	B2
c1.	Employ systematic and object-oriented based modeling and simulation tools to the design and analysis problems of mechatronics systems.	C2
d1.	Assess results of different modeling and simulation tools successfully.	D1
d2.	Review problem solving skills to basic real world situations through appropriate modeling and simulation techniques.	D2
d3.	Evaluate simulation and modeling tools to assist in finding graphical, numerical, statistical and analytic solutions to practical problems.	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
Describe methods to obtain mathematical models of technical systems from different domains based on fundamental physical relations and measured output data.	**a1.**	• Active Lectures. • Tutorials.	• Written Assessment.
Depict knowledge of how differential-algebraic equations (DAEs) arise in modeling of various physical systems.	**a2.**	• Active Lectures. • Tutorials. • Independent Applications of Engineering Analysis.	• Written Assessment. • Presentations.

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

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1. Construct different types of models for mechatronics applications.	• Group Learning and Problem-Based Learning. • Design Work and Projects. • Case Studies.	• Written Assessment. • Laboratory Reports.
b2. Analyze the statistical properties of basic estimation techniques, and explain the practical significance of results. these	• Case Studies.	• Written Assessment. • Case Studies.

(C) 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. Employ systematic and object-oriented based modeling and simulation tools to the design and analysis problems of mechatronics systems.	• Computer and Web-Based Learning. • Independent Applications of Engineering Analysis. • The use of Communication and Information Technology.	• Simulations. • Laboratory 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. Assess results of different modeling simulation tools and successfully.	• Seminars. • Design Work and Projects	• Project Reports. • Laboratory Reports. • Presentations.

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d2.	Review problem solving skills to basic real world situations through appropriate modeling and simulation techniques.	• Group Learning and Problem-Based Learning. • Case Studies. • Design Work and Projects.	• Project Reports. • Laboratory Reports. • Case Studies.
d3.	Evaluate simulation and modeling tools to assist in finding graphical, numerical, statistical and analytic solutions to practical problems.	• Seminars. • Computer and Web-Based Learning.	• Project Reports. • Laboratory Reports. • Presentations.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	a1, a2	• Physical Modeling. • Systems and Models. • What is a Model? • Types of Mathematical Models. • What is a System? • Models and Simulation. • How to Build Models? • How to Verify Models ?	1	2
2.	Examples of Models from Different Areas.	a1, a2	• An Ecological System. • A Flow System. • An Economic System.	1	2
3.	Models for Systems and Signals.	a1, a2	• Block Diagram Models. • Differential Equations. • D-Operator Notation. • The transfer function. • Conversions from Model to Model. • Examples.	1	2
4.	Review on Basic	a1, a2	• Basic Electrical Relations.	1	2

	Relationships in Physics.		• Basic Mechanical Relations (Translational & Rotational). • Modeling of Fluid Elements. • Modeling of Thermal Elements.		
5.	Modeling of Electrical and Mechanical Systems.	a1, a2, b1	• Modeling Electrical Networks. • Modeling of Linear & Rotational Mechanical Systems. • Mechanical System Transfer Functions TF. • TF for Systems with Gears. • TF for Electromechanical System. • Electric Circuit Analogs.	1	2
6.	Principles of Physical Modeling.	a1, a2, b1	• Phases to Construct Physical Models. • Example: Modeling the Head Box of a Paper Machine. • Multi-domain Example: Loudspeaker Dynamics. • Model Simplification.	1	2
7.	State Space Modeling.	a1, b1	• General State-Space Representation (SSR). • Applying the SSR. • Techniques for Selecting State Variables. • SSR for Mechanical Systems. • Conversion between a Transfer Function and State Space Model.	1	2
8.	Mid-Term Exam.	a1, a2, b1	• The First 7 Chapters.	1	2
9.	Bond Graph.	a1, b1	• Bond Graph Elements. • Examples of Simple Bond Graphs. • Simplifications.	1	2

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			• Systems with Mixed Physical Variables. • Causality. • Ill-Posed Modeling. • State Equations from Bond Graphs. • Controlled Elements.		
10.	Simulation.	a1, c1	• Block Diagrams. • Numeric Methods. • Classification of Simulation Languages. • Desirable Software Features. • General-Purpose Simulation Packages. • Object Oriented Modeling.	1	2
11.	Model Identifications.	a1	• Basic Definitions. • Stationary Solutions. • Stability. • Static Relationships. • Disturbances in Dynamic Models. • Description of Signals in Time Domain and Frequency Domain. • Links between Continuous Time and Discrete Time Models. • Linear Systems. • Linearization.	1	2
12.	Identification Methods for Modeling Purposes: Non-Parametric Identification.	a1, b1, b2	• System Identification. • Types of model. • Mathematical modeling and system identification. • Non-Parametric Identification Methods.	1	2
13.	Parametric Estimation in Dynamic Models.	a1, b1, b2	• How System Identification is Applied? • Tailor-made Models. • Linear, Ready-made Models.	1	2

			• Fitting Parameterized Models to Data. • Model Properties.		
14.	System Identification as a Tool for Model Building.	a1, b1, b2	• Program Packages for Identification. • Design of Identification Experiments. • Post Treatment of Data. • Choice of Model Structure. • Model Validation. • Conclusions: Possibilities and Limitations of Identification.	1	2
15.	Simulation of Manufacturing Systems.	c2	• Objectives of Simulation in Manufacturing. • Simulation Software for Manufacturing Applications. • Modeling System Randomness. • Case Studies: UAV Quadrotor. • Case Studies: Hard Discs.	1	2
16.	Final Exam.	a1, a2, b1, b2	• All the Chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Practical Aspect: **(Modeling & Simulation Lab.)**				
Order	**Tasks/ Experiments**	**Learning Outcomes**	**Weeks**	**Contact Hours**
1.	Introduction: MATLAB, Simulink, Modelica, LabView, and SimElectronics.	c1, d2	3	6
2.	Computer Exercise: Develop a physical model of an industrial servo and illustrate the differences between block diagram-oriented modeling and object-oriented modeling tools.	c1, d2, d3	3	6

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3.	Computer Exercise: Develop a physical model of an industrial robot. This laboratory exercise is a continuation of the first one, in which we extend the servo model to a more complete model of an industrial robot.	c1, d1, d2, d3	3	6
4.	Computer Exercise: A system identification project (System Identification), A project in system identification in which data are collected from a simple real process. System identification techniques are used to construct a model.	b2, c1, d1, d2, d3	3	6
5.	Final Practical Exam.	b1, b2, c1, d1, d2	2	4
Number of Weeks /and Units Per Semester			**14**	**28**

V.Teaching Strategies of The Course:

- Active Lectures.
- Tutorials.
- Independent Applications of Engineering Analysis.
- Group Learning and Problem-Based Learning.
- Design Work and Projects.
- Computer and Web-Based Learning.
- The use of Communication and Information Technology.
- Case Studies.
- Seminars.

VI.Assessment Methods of the Course:

- Written Assessment.
- Presentations.
- Laboratory Reports.
- Case Studies.
- Simulations.
- Project Reports.
- Presentations.

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VII.Assignments:				
No	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	Physical Modeling Assignment.	a1, a2, b1, c1	5th	3.75
2.	Identification Assignment.	a1, a2, b1, b2, c1	11th	3.75
Total				**7.5**

VIII.Schedule of Assessment Tasks for Students During the Semester:					
No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned CILOs
1.	Assignments.	5th & 11th	7.5	5%	a1, a2, b1, b2, c1
2.	Quizzes.	4th & 10th	7.5	5%	a1, a2, b1, b2
3.	Mid-Term Exam.	8th week	15	10%	a1, a2, b1
4.	Lab. Reports & Experiments Including System Identification Project.	Weekly	15	10%	b1, b2, c1, d1, d2, d3
5.	Final Exam (Practical).	13th week	15	10%	b1, b2, c1, d1, d2, d3
6.	Final Exam (Theoretical).	15th week	90	60%	a1, a2, b1, b2
	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).

1- L. Ljung and T. Glad, 1994, Modeling of Dynamic Systems, N.J., USA, Prentice Hall.
2- Georg Pelz, 2003, Mechatronic Systems: Modelling and Simulation with HDLs, N.Y., USA, Wiley.

2- Essential References.

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1- P.P.J. van den Bosch and A.C. van der Klauw, 1994, Modeling, Identification and Simulation of Dynamic Systems, Florida, USA, CRC Press.
2- Christopher A. Chung, 2003, Simulation Modeling Handbook: A Practical Approach, Florida, USA, CRC Press.
3- R. Johanessen, 1993, System Modeling and Identification, N.J., USA, Prentice Hall.
4- L. Ljung, 1999, System Identification: Theory for the User, 2 nd edition, N.J., USA, Prentice Hall.
5- Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Kevin R. Coombes, John E. Osborn, and Garrett J. Stuck, 2001, A Guide to MATLAB - for Beginners and Experienced Users, Cambridge, U.K. , Cambridge University Press.
6- Landau, Ioan Doré and Zito, Gianluca, 2006, Digital Control Systems: Design, Identification and Implementation, London, U.K. , Springer-Verlag.
7- Devendra K. Chaturvedi, 2002, Modeling and Simulation of Systems Using MATLAB and Simulink, N.Y., USA, CRC Press.

3- Electronic Materials and Web Sites *etc.*

Websites:

1- CHE 494/598, Introduction Course to System Identification (Spring 2018), Daniel E. Rivera, Arizona State University.
https://7starm.asu.edu/node/28
2- Kurssida: System Identification Course at Chalmers University of Technology (Sweden)
https://www.chalmers.se/sv/institutioner/e2/Sidor/default.aspx
3- Systems Control Demonstrations at Johns Hopkins University
http://www.jhu.edu/~signals/
4- KTH | EL1820 Modelling of Dynamical Systems Course at KTH, (Sweden)
https://www.kth.se/student/kurser/kurs/EL2820?l=en
5- MIT Open Course Ware, Modeling and Simulation of Dynamic Systems
https://ocw.mit.edu/courses/mechanical-engineering/2-141-modeling-and-simulation-of-dynamic-systems-fall-2006/

Journals:

1- International Journal of Modelling and Simulation, Taylor & Frances
https://www.tandfonline.com/toc/tjms20/current
2- International Journal of Engineering Systems Modelling and Simulation, Inderscience Enterprises
https://www.inderscience.com/jhome.php?jcode=ijesms
3- Discrete Event Dynamic Systems Theory and Applications, , Springer
https://link.springer.com/journal/10626

X.Course Policies:

1.	**Class Attendance:**

	The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and considered as an exam failure. If the student is absent due to illness, he/she should bring the approved statement from university Clinic.
2.	**Tardy:** For late in attending the class, the student will be initially notified. If he comes late in attending class again, he will consider as absent.
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in exam.
4.	**Assignments & Projects:** In general, one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment.
5.	**Cheating:** For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will disengage from the Faculty
6.	**Plagiarism:** Plagiarism is the attending of the student the exam of a course instead of other 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 Affair Council of the university.
7.	**Other Policies:** - The mobile phone is not allowed to be used during class lecture. It must be closed, otherwise the student will ask to leave the lecture room - The mobile phone is not allowed to be taken with in class during the examination. - Lecture notes and assignments may be 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. 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.

Head of the Department Assoc. Prof. Dr. Abdul-Malik Momin	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

Course Plan of System Modeling and Identification

I.Information about Faculty Member Responsible for the Course:								
Name of Faculty Member	Asst. Prof. Dr. Hatem Al-Dois.	Office Hours						
Location& Telephone No.	7746 77493.	SAT	SUN	MON	TUE	WED	THU	
E-mail	haldois@yahoo.com.							

II.Course Identification and General Information:						
.1	Course Title:	System Modeling and Identification.				
.2	Course Code & Number:	MT309.				
.3	Credit Hours:	C.H.				TOTAL Cr. Hrs.
		Th.	Seminar	Pr.	Tu.	
		2	--	2	--	3
.4	Study Level/ Semester at which this Course is Offered:	Fourth Year - Second Semester.				
.5	Pre –requisite (if any):	Computer Programming (1), Computer Programming (2), Analog Control System and Digital Control System.				
.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 Labs.				
11.	Location of Teaching the Course:	Mechatronics Engineering Department.				

III.Course Description:

This course provides students with an overview of modeling and simulation methods of dynamic systems. The contents of the course are distributed into three main areas: principles for physical

modeling, simulation, and system identification. Therefore, approaches for building mathematical models based on physical principles and measured data are provided. In addition, numerical and computer-based solution techniques are examined for various engineering problems. Software tools, such as MATLAB/Simulink and/or LABVIEW, are employed to simulate and analyze systems performance. Case studies in industrial applications are exploited to illustrate the studied methods.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Describe methods to obtain mathematical models of technical systems from different domains based on fundamental physical relations and measured output data.	A1
a2.	Depict knowledge of how differential-algebraic equations (DAEs) arise in modeling of various physical systems.	A8
b1.	Construct different types of models for mechatronics applications.	B1
b2.	Analyze the statistical properties of basic estimation techniques, and explain the practical significance of these results.	B2
c1.	Employ systematic and object-oriented based modeling and simulation tools to the design and analysis problems of mechatronics systems.	C2
d1.	Assess results of different modeling and simulation tools successfully.	D1
d2.	Review problem solving skills to basic real world situations through appropriate modeling and simulation techniques.	D2
d3.	Evaluate simulation and modeling tools to assist in finding graphical, numerical, statistical and analytic solutions to practical problems.	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.	• Physical Modeling. • Systems and Models. • What is a Model? • Types of Mathematical Models. • What is a System? • Models and Simulation. • How to Build Models? • How to Verify Models?	1	2
2.	Examples of Models from Different Areas.	• An Ecological System. • A Flow System. • An Economic System.	2	2
3.	Models for Systems and Signals.	• Block Diagram Models. • Differential Equations. • D-Operator Notation. • The transfer function. • Conversions from Model to Model. • Examples.	3	2
4.	Review on Basic Relationships in Physics.	• Basic Electrical Relations. • Basic Mechanical Relations (Translational & Rotational). • Modeling of Fluid Elements. • Modeling of Thermal Elements.	4	2
5.	Modeling of Electrical and Mechanical Systems.	• Modeling Electrical Networks. • Modeling of Linear & Rotational Mechanical Systems. • Mechanical System Transfer Functions TF. • TF for Systems with Gears. • TF for Electromechanical System. • Electric Circuit Analogs.	5	2
6.	Principles of Physical Modeling.	• Phases to Construct Physical Models. • Example: Modeling the Head Box of a Paper Machine. • Multi-domain Example: Loudspeaker Dynamics. • Model Simplification.	6	2

7.	State Space Modeling.	• General State-Space Representation (SSR). • Applying the SSR. • Techniques for Selecting State Variables. • SSR for Mechanical Systems. • Conversion between a Transfer Function and State Space Model.	7	2
8.	Mid-Term Exam.	• The First 7 Chapters.	8	2
9.	Bond Graph.	• Bond Graph Elements. • Examples of Simple Bond Graphs. • Simplifications. • Systems with Mixed Physical Variables. • Causality. • Ill-Posed Modeling. • State Equations from Bond Graphs. • Controlled Elements.	9	2
10.	Simulation.	• Block Diagrams. • Numeric Methods. • Classification of Simulation Languages. • Desirable Software Features. • General-Purpose Simulation Packages. • Object Oriented Modeling.	10	2
11.	Model Identifications.	• Basic Definitions. • Stationary Solutions. • Stability. • Static Relationships. • Disturbances in Dynamic Models. • Description of Signals in Time Domain and Frequency Domain. • Links between Continuous Time and Discrete Time Models. • Linear Systems. • Linearization.	11	2

12.	Identification Methods for Modeling Purposes: Non-Parametric Identification.	• System Identification. • Types of model. • Mathematical modeling and system identification. • Non-Parametric Identification Methods.	12	2
13.	Parametric Estimation in Dynamic Models.	• How System Identification is applied? • Tailor-made Models. • Linear, Ready-made Models. • Fitting Parameterized Models to Data. • Model Properties.	13	2
14.	System Identification as a Tool for Model Building.	• Program Packages for Identification. • Design of Identification Experiments. • Post treatment of Data. • Choice of Model Structure. • Model Validation. • Conclusions: Possibilities and Limitations of Identification.	14	2
15.	Simulation of Manufacturing Systems.	• Objectives of Simulation in Manufacturing. • Simulation Software for Manufacturing Applications. • Modeling System Randomness. • Case Studies: UAV Quadrotor. • Case Studies: Hard Discs.	15	2
16.	Final Exam.	All the Chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Practical Aspect: (Modeling & Simulation Lab.)

Order	Tasks/ Experiments	Learning Outcomes	Weeks	Contact Hours
1.	Introduction: MATLAB, Simulink, Modelica, LabView, and SimElectronics.	c1, d2	1,2,3	6
2.	Computer Exercise:	c1, d2, d3	4,5,6	6

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	Develop a physical model of an industrial servo and illustrate the differences between block diagram-oriented modeling and object-oriented modeling tools.			
3.	Computer Exercise: Develop a physical model of an industrial robot. This laboratory exercise is a continuation of the first one, in which we extend the servo model to a more complete model of an industrial robot.	c1, d1, d2, d3	7,8,9	6
4.	Computer Exercise: A system identification project (System Identification), A project in system identification in which data are collected from a simple real process. System identification techniques are used to construct a model.	b2, c1, d1, d2, d3	10,11,12	6
5.	Final Practical Exam.	b1, b2, c1, d1, d2	13,14	4
Number of Weeks /and Units Per Semester			**14**	**28**

VI.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- Independent Applications of Engineering Analysis.
- Group Learning and Problem-Based Learning.
- Design Work and Projects.
- Case Studies.
- Computer and Web-Based Learning.
- The use of Communication and Information Technology.
- Seminars.

VII.Assignments:

No	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	Physical Modeling Assignment.	a1, a2, b1, c1	5th	3.75
2.	Identification Assignment.	a1, a2, b1, b2, c1	11th	3.75

Total	7.5

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned CILOs
1.	Assignments.	5th & 11th	7.5	5%	a1, a2, b1, b2, c1
2.	Quizzes.	4th & 10th	7.5	5%	a1, a2, b1, b2
3.	Mid-Term Exam.	8th week	15	10%	a1, a2, b1
4.	Lab. Reports & Experiments Including System Identification Project.	Weekly	15	10%	b1, b2, c1, d1, d2, d3
5.	Final Exam (Practical).	13th week	15	10%	b1, b2, c1, d1, d2, d3
6.	Final Exam (Theoretical).	16th week	90	60%	a1, a2, b1, b2
	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).

1- L. Ljung and T. Glad, 1994, Modeling of Dynamic Systems, N.J., USA, Prentice Hall.
2- Georg Pelz, 2003, Mechatronic Systems: Modelling and Simulation with HDLs, N.Y., USA, Wiley.

2- Essential References.

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3- R. Johanessen, 1993, System Modeling and Identification, N.J., USA, Prentice Hall.
4- L. Ljung, 1999, System Identification: Theory for the User, 2 nd edition, N.J., USA, Prentice Hall.

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5- Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Kevin R. Coombes, John E. Osborn, and Garrett J. Stuck, 2001, A Guide to MATLAB - for Beginners and Experienced Users, Cambridge, U.K. , Cambridge University Press.
6- Landau, Ioan Doré and Zito, Gianluca, 2006, Digital Control Systems: Design, Identification and Implementation, London, U.K. , Springer-Verlag.
7- Devendra K. Chaturvedi, 2002, Modeling and Simulation of Systems Using MATLAB and Simulink, N.Y., USA, CRC Press.

3- Electronic Materials and Web Sites *etc.*

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https://7starm.asu.edu/node/28
2- Kurssida: System Identification Course at Chalmers University of Technology (Sweden)
https://www.chalmers.se/sv/institutioner/e2/Sidor/default.aspx
3- Systems Control Demonstrations at Johns Hopkins University
http://www.jhu.edu/~signals/
4- KTH | EL1820 Modelling of Dynamical Systems Course at KTH, (Sweden)
https://www.kth.se/student/kurser/kurs/EL2820?l=en
5- MIT Open Course Ware, Modeling and Simulation of Dynamic Systems
https://ocw.mit.edu/courses/mechanical-engineering/2-141-modeling-and-simulation-of-dynamic-systems-fall-2006/

Journals:

1. International Journal of Modelling and Simulation, Taylor & Frances
   a. https://www.tandfonline.com/toc/tjms20/current
2. International Journal of Engineering Systems Modelling and Simulation, Inderscience Enterprises
   a. https://www.inderscience.com/jhome.php?jcode=ijesms
3. Discrete Event Dynamic Systems Theory and Applications, , Springer
   a. https://link.springer.com/journal/10626

X.Course Policies:

Unless otherwise stated, the normal course administration policies and rules of the Faculty of ----- apply. For the policy, see: ------------------------------------

1.	**Class Attendance:** The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and considered as an exam failure. If the student is absent due to illness, he/she should bring the approved statement from university Clinic.
2.	**Tardy:** For late in attending the class, the student will be initially notified. If he comes late in attending class again, he will consider as absent.

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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

3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in exam.
4.	**Assignments & Projects:** In general, one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment.
5.	**Cheating**: For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will disengage from the Faculty
6.	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other 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 Affair Council of the university.
7.	**Other Policies:** - The mobile phone is not allowed to be used during class lecture. It must be closed, otherwise the student will ask to leave the lecture room - The mobile phone is not allowed to be taken with in class during the examination. - Lecture notes and assignments may be given directly to students using soft or hard copy.

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