Republic of Yemen

Ministry of Higher Education & Scientific Research

21 SEPTEMBER UNIVERSITY for MEDICALS & APPLIEED

SCIENCES

Faculty of Engineering and Computer

Department of Biomedical Engineering Technology

Course Specification of

Analog control System

Course No. 07.02.729

2022/2023

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed	Dr.

Ali Abdu			Al-shamahi	Abdulrahman Obaid

I. Course Identification and General Information:

1	Course Title:	Analog control System			
2	Course Code & Number:	07.02.729			
3	Credit Hours:	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
		3	2	--	1
4	Study Level/ Semester at which this Course is offered:	3 Level / 2 Semester			
5	Pre –Requisite (if any):	Engineering Physics, Electrical Circuits 1,, Electrical Circuits 2, General Biology, Electronics I			
6	Co –Requisite (if any):	Biomedical Signals Processing			
7	Program (s) in which the Course is Offered:	Biomedical Engineering Technology			
8	Language of Teaching the Course:	English			
9	Study System:	Regular (semester)			
10	Mode of Delivery:				
11	Location of Teaching the Course:	University Campus			
12	Prepared by:	Dr. Ammar Ali Ali Abdu			
13	Date of Approval:				

II. Course Description:

The Analog Control Systems course aims to give the student knowledge of the basic concepts and Theories of modeling, development, analysis, design and implement of analog control systems. This course includes mathematical modeling of control systems using transfer function and state variable models, block diagrams reduction and signal flow graphs, characteristics and performance of control systems, transient response analysis, stability analysis, Frequency response and Root-Locus method, logarithmic plots and Bode diagram method, and PID controllers. In addition, several design methods of control systems are introduced: series and compensation, state space design, controllability and observability, design of linear control systems, linear time varying state models and pole-placement design method. The practical part allows students to practice different control approaches studied in theoretical classes.

III. Course Intended Learning Outcomes (CILOs) : مخرجات تعلم المقرر))		Referenced PILOs مخرجات تعلم البرنامج))	
A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:			
a1	Explain the concepts and mathematical modeling of physical systems in transfer function model and state variable model.	A1	Explain the appropriate models, theories, mathematical foundations, and techniques related to biomedical engineering technology context.
a2	Describe how different analysis techniques are used to determine the specifications of control systems, and common design methods for design analog controllers.	A3	Clarify the biomedical devices maintenance principles and how these are important for solving biomedical devices and equipment's problems in health environment.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:			
b1	Apply common conventional and modern engineering methods to model, analyze, and organize the analog biomedical systems.	B1	Use the basic science, mathematical theories, engineering principles to analyze the problems of devices and/or processes relevant to biomedical engineering fields.
b2	Analysis, and evaluate the biomedical engineering systems	B2	Analyze the impacts of problems related to the Biomedical

	using the modern control engineering tools, then select the suitable analog controller for biomedical systems.		equipments and its solution principles in a creative manner by using a systematic and analytical thinking methods.
b3	Design the analog controllers, and others components of the medical devices by using the control system design methods.	B3	Assess the features of biomedical devices systems, engineering diagnostic skills, technological expertise, and analytical methods that related to identify and addressing of biomedical devices systems failures.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:			
c1	Use the modern engineering tools, and analytical techniques to evaluate performance characteristics of different types of plant and process, and applying the knowledge to design, and implement an analog control systems.	C1	Relate integrally knowledge of life science, biomedical engineering technology practice concepts, principles of engineering and techniques evaluation to solve problems relevant to biomedical engineering.
c2	Conduct appropriate experimentation related to analog control systems, and Locate different type of analog controllers used in real medical equipment.	C2	Evaluate an engineering technique, modern analytical tools and required computer programs to analyzing and solve the problems of medical devices.
D. Transferable Skills: Upon successful completion of the course, students will be able to:			
d1	Lead, and work productively as an individual and as a member of a team / multi-disciplinary team.	D1	Function effectively as an individual, team member, or leader in activities relevant to biomedical engineering, and collaborating to achieve a shared objective.

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1	Explain the concepts and mathematical modeling of physical systems in transfer function model and state variable model.	• Interactive lectures & • examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class • discussions, • Case studies, • Exercises and home • works, • Computer laboratory • based sessions, • Directed self- study, • Problem based learning, • Mini/major project.	• Written tests (mid and • final terms and • quizzes), • Short reports, • Practical lab • performance • assessment, • Coursework activities • assessment, • Home works and • assignments, • Presentations.
a2	Academy Development Center Dean of Engineering Quality Insurance Unite Prepared By & Quality Insurance 5 a2 Describe how different analysis techniques are used to determine the specifications of control systems, and common design methods for design analog controllers.		
(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1	Apply common conventional and modern engineering methods to model, analyze, and organize the analog biomedical systems.	• Interactive lectures & • examples, • Tutorials, • Videos demonstrations, • Presentation/seminar , • Interactive class	• Written tests (mid and • final terms and • quizzes), • Short reports, • Lab\Project report • Performance assessment,
b2	Analysis, and evaluate the biomedical engineering		

	systems using the modern control engineering tools, then select the suitable analog controller for biomedical systems.	• discussions, • Case studies, • Exercises and home • works, • Laboratory/Practical • experiments based • session, • Computer laboratory • based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Mini/major project.	• Coursework activities assessment, • Home works assignments, • Presentations.
b3	Design the analog Academy Development Center Dean of Engineering Quality Insurance Unite Prepared By & Quality Insurance 7 controllers, and others components of the medical devices by using the control system design methods		

(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1	Use the modern engineering tools, and analytical techniques to evaluate performance characteristics of different types of plant and process, and applying the knowledge to design, and implement an analog control systems.	• Interactive lectures & • examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class • discussions, • Case studies, • Exercises and home • works, • Computer laboratory • based sessions, • Directed self- study, • Problem based learning, • Mini/major project.	• Written tests (mid and • final terms and • quizzes), • Short reports, • Practical lab • performance • assessment, • Coursework activities • assessment, • Home works and • assignments, • Presentations.
c2	Conduct appropriate experimentation related to analog control systems, and Locate different type of analog controllers used in real medical equipment.		

(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to

Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1	Lead, and work productively as an individual and as a member of a team / multi-disciplinary team.	▪ Small group discussion	▪ Presentation

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**Introduction of control systems**	• Introduction of analog control systems, • types of analog control systems, • components of analog control systems, • steps to design analog control systems.	1	2	a1, a2
2	**Mathematical models of systems.**	• Mathematical models of electrical, mechanical, thermal, fluid, hydraulic systems, • differential equation, • linear approximation of control systems, • Laplace transform and theorems • transfer function models,	1	2	a1, a2
3	**Mathematical models of systems.**	• s-plane analysis of analog control systems, • block diagram reduction, • signal flow graph	1	2	a1, a2

4	**State-variable models**	• State-variable model, • analysis in State-variable, • transform from State variable model to transfer function model	1	2	a1,a2
5	**Feedback control system characteristics**	• Feedback control system characteristics, • error signal analysis, • sensitivity of feedback • control system to parameters variation, • disturbance and noise signal rejection, • cost of feedback control system, • design examples.	1	2	a2, b1, b2, b3
6	**Performance of the feedback control system**	• Performance of 2nd order feedback control system, • test input signals, • steady-state error of feedback control system, • performance index of feedback control systems, • design examples.	1	2	a2, b1, b2, b3
7	**The Stability of feedback control system**	• Stability analysis of feedback control system, • The Routh-Hurwitz Stability Criterion, • Relative stability, • Stability of State Variabl System • design examples.	1	2	a2, b1, b2, b3
8	**Mid-Term Theoretical Exam**	• previous topics	1	2	a1, a2, b1, b2,

					b3 -
9	**The Root Locus method**	• Root locus concept, • root locus procedures,	1	2	a2, b1, b2, b3, c1
10	**The Root Locus method**	• Parameters design by the root locus, • PID controllers, • design examples	1	2	a2, b1, b2, b3, c1
11	**Frequency Response methods**	• Frequency response plots, • bode diagram, • Frequency response measurements, • performance specifications in Frequency response, • design example	1	2	a2, b1, b2, b3, c1
12	**Design of feedback control systems**	• Approaches to System Design, • Cascade Compensation Networks, • Phase-Lead Design Using the Bode Diagram and • Root Locus,	1	2	a2, b1, b2, b3, c1, c2, d1
13	**Design of feedback control systems**	• System Design Using Integration Networks, • Phase-Lag Design Using the Bode Diagram and Root Locus, • Design on the Bode Diagram Using Analytical Methods, • Systems with a Pre-filter, Design for Dead beat Response, • design examples.	1	2	a2, b1, b2, b3, c1, c2, d1
14	**Design of state**	• Controllability and	1	2	a2, b1,

	variable feedback control systems	Observability, • Full-State Feedback Control Design, • Observer Design,			b2, b3, c1, c2, d1
15	Design of state variable feedback control systems	• Integrated Full-State Feedback and observer, • Reference Inputs, • Internal Model Design, • design examples	1	2	a2, b1, b2, b3, c1, c2, d1
16	Final Theoretical Exam	All topics	16	2	-
Number of Weeks /and Units Per Semester			16	32	

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction of analog control systems	1	2	a1, a2, b1, b2, b3, c1, c2, d1
2	Introduction of matlab software.	1	2	
3	Control Systems toolbox in matlab software.	1	2	
4	Control Systems toolbox in matlab software.	1	2	
5	Mathematical models of analog control system in matlab software.	1	2	
6	Mathematical models of analog control system in matlab software.	1	2	
7	Mid-Term Practical Exam (if any)	1	2	
8	Block diagram reduction in matlab software.	1	2	
9	Midterm Practical Exam	1	2	
10	Analysis of analog control systems response and performance .	1	2	
11	Root locus method in matlab program.	1	2	

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12	Bode plot method in matlab program.	1	2	
13	Analog controller design method in matlab program	1	2	
14	Analog controller design method in matlab program.	1	2	
15	Final Practical Exam	1	2	
Number of Weeks /and Units Per Semester		**15**	**30**	

V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Tutorials,
- Videos demonstrations,
- Presentation/seminar,
- Interactive class discussions,
- Case studies,
- Exercises and home works,
- Laboratory/Practical experiments based session,
- Computer laboratory-based sessions,
- Workshops practices,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms Exam and quizzes(.
- Class discussion.
- Presentation

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Problems, and advance problems, and computer problems of the Chapter 2	2	3	a1, a2
2	Problems, and advance problems, and computer problems of the Chapter 3	3	3	a1, a2
3	Problems, and advance problems, and computer problems of the Chapter 4, 5	5	3	a1, a2, b1, b2, b3
4	Problems, and advance problems, and computer problems of the Chapter 6, 7	6	3	a1, a2, b1, b2, b3
5	Problems, and advance problems, and computer problems of the Chapter 8	10	6	a1, a2, b1, b2, b3, c1, c2
6	Problems, and advance problems, and computer problems of the Chapter 10	13	6	a1, a2, b1, b2, b3, c1, c2
7	Problems, and advance problems, and computer problems of the Chapter 11	15	6	a1, a2, b1, b2, b3, c1, c2
Total			30	

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	Assignments	15	30	15%	a1,a2,b1,b2,c1,c2
2	Quiz 1	6	10	15%	a1, a2, b1, b2, b3, c1, c2
3	Midterm Exam	8	30	15%	a1, a2, b1, b2, b3

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4	Midterm Theoretical Exam	9	20	10%	a1, a2, b1, b2, b3
5	Quiz 2	12	10	5%	a1, a2, b1, b2, b3, c1, c2
6	Final Practical Exam	15	30	15%	a1,a2,b1,b2,c1,c2
7	Final Theoretical Exam	16	70	35%	a1,a2,b1,b2,c1,c2,d1
Total			200	100%	

IX. Learning Resources:

1- Required Textbook(s) (maximum two)

1- Richard C. Dorf, Robert H. Bishop, 2013, Modern Control Systems, 12th Edition, Prentice Hall.

2- Katsuhiko Ogata, 2010, Modern Control Engineering, 5th Edition, Prentice Hall.

2- Essential References:

1- Norman S. Nise,2011, CONTROL SYSTEMS ENGINEERING, Sixth Edition, John Wiley & Sons, Inc.

2- FARIDGOLNARAGHI, BENJAMINC.KUO, 2010, Automatic Control Systems, ninth Edition, John Wiley & Sons, Inc.

3- Electronic Materials and Web Sites etc.:

Websites:

1- The National Program on Technology Enhanced Learning (NPTEL), Automatic Control

https://nptel.ac.in/courses/112/107/112107240/

Journals:

2- IEEE Transactions on control systems technology: Peer reviewed academic journal..

https://www.ieeexplore.ieee.org/xpl

3- International Journal of control, automation and systems: The leading peer reviewed academic journal

. https://www.springer.com/Journal

Other Web Sources:

4- Analog Devices, a Head of What's Possible,

https://www.analog.com/en/education/education-library/tutorials.html

X. Course Policies: (Based on the Uniform Students' By law (2007) تترك كما هي

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she 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 a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be

	required to retake the entire course again.
2	**Tardiness:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she 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:** In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating:** For cheating in exam, a student will be considered as fail. 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 proofed a plagiarism of a student, he/she 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 or according to the university roles.
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 might be given directly to students using soft or hard copy.

Second Part of Course Specification

Faculty of Medical Technology

Department of Biomedical Engineering Technology

Course Specification of

Analog control System

Course No. 07.02.729

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

Analog control System

Course No. 07.02.729

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member:	Dr. Ammar Ali Ali Abdu						
Location& Telephone No.:	Sanaa - 775207752						
E-mail:	dr.ammar.ali2018@gmail.com	SAT	SUN	MON	TUE	WED	THU
Office Hours							

2020/2021

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Ammar Ali Ali Abdu	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-Shamahi	Dr. Abdulrahman Obaid

I. Course Identification and General Information:

	Course Title:	Analog control System			
2	Course Code & Number:	Course No. 07.02.729			
3	Credit Hours:	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
		3	2	--	1
4	Study Level/ Semester at which this Course is offered:	3 Level / 2 Semester			
5	Pre –Requisite (if any):	Math 3, Computer principles and programming,			
6	Co –Requisite (if any):	N/A			
7	Program (s) in which the Course is Offered:	Bachelor in Biomedical Engineering Technology			
8	Language of Teaching the Course:	English			
9	Study System:	Regular (semester)			
10	Mode of Delivery:				
11	Location of Teaching the Course:	University Campus			
12	Prepared by:	Dr. Ammar Ali Ali			
13	Date of Approval:				

II. Course Description:

The Analog Control Systems course aims to give the student knowledge of the basic concepts and Theories of modeling, development, analysis, design and implement of analog control systems. This course includes mathematical modeling of control systems using transfer function and state variable models, block diagrams reduction and signal flow graphs, characteristics and performance of control systems, transient response analysis, stability analysis, Frequency response and Root-Locus method, logarithmic plots and Bode diagram method, and PID controllers. In addition, several design methods of control systems are introduced: series and compensation, state space design, controllability and observability, design of linear control systems, linear time varying state models and pole-placement design method. The practical part allows students to practice different control approaches studied in theoretical classes.

III. Course Intended Learning Outcomes (CILOs) :(مخرجات تعلم المقرر)

A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:	
a1	Explain the concepts and mathematical modeling of physical systems in transfer function model and state variable model.
a2	Describe how different analysis techniques are used to determine the specifications of control systems, and common design methods for design analog controllers.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:	
b1	Apply common conventional and modern engineering methods to model, analyze, and organize the analog biomedical systems.
b2	Analysis, and evaluate the biomedical engineering systems using the modern control engineering tools, then select the suitable analog controller for biomedical systems
b3	Design the analog controllers, and others components of the medical devices by using the control system design methods.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:	
c1	Use the modern engineering tools, and analytical techniques to evaluate performance characteristics of different types of plant and process, and applying the knowledge to design, and implement an analog control systems.

c2	Conduct appropriate experimentation related to analog control systems, and Locate different type of analog controllers used in real medical equipment.
D. Transferable Skills: Upon successful completion of the course, students will be able to:	
d1	Lead, and work productively as an individual and as a member of a team / multi-disciplinary team

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Introduction of control systems**	– Introduction of analog control systems, – types of analog control systems, – components of analog control systems, – steps to design analog control systems.	1	2
2	**Mathematical models of systems.**	– Mathematical models of electrical, mechanical, thermal, fluid, hydraulic systems, – differential equation, – linear approximation of control systems, – Laplace transform and theorems – transfer function models,	1	2
3	**Mathematical models of systems.**	– s-plane analysis of analog control systems, – block diagram reduction, – signal flow graph	1	2
4	**State-variable models**	– State-variable model, – analysis in State-variable,	1	2

		– transform from State-variable model to transfer function model		
5	**Feedback control system characteristics**	– Feedback control system characteristics, – error signal analysis, – sensitivity of feedback control system to parameters variation, – disturbance and noise signal rejection, – cost of feedback control system, – design examples.	1	2
6	**Performance of the feedback control system**	– Performance of 2nd order feedback control system, – test input signals, – steady-state error of feedback control system, – performance index of feedback control systems, – design examples.	1	2
7	**The Stability of feedback control system**	– Stability analysis of feedback control system, – The Routh-Hurwitz Stability Criterion, – Relative stability, – Stability of State Variable Systems, – design examples.	1	2
8	**Mid-Term Theoretical Exam**	– All previous topics	1	2
9	**The Root Locus method**	– Root locus concept, – root locus procedures,	1	2
10	**The Root Locus method**	– Parameters design by the root locus, – PID controllers,	1	2

		– design examples		
11	**Frequency Response methods**	– Frequency response plots, – bode diagram, – Frequency response measurements, – performance specifications in Frequency response, – design example	1	2
12	**Design of feedback control systems filters**	– Approaches to System Design, – Cascade Compensation Networks, – Phase-Lead Design Using the Bode Diagram and Root Locus,	1	2
13	**Design of feedback control systems**	– System Design Using Integration Networks, – Phase-Lag Design Using the Bode Diagram and Root Locus, – Design on the Bode Diagram Using Analytical Methods, – Systems with a Pre-filter, Design for Dead beat Response, – design examples.	1	2
14	**Design of state variable feedback control systems**	– Controllability and Observability, – Full-State Feedback Control Design, – Observer Design,	1	2
15	**Design of state variable feedback control systems**	– Integrated Full-State Feedback and observer, – Reference Inputs, – Internal Model Design, – design examples	1	2
16	**Final Theoretical Exam**	All topics	1	2
Number of Weeks /and Units Per Semester			**16**	**32**

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	Introduction of analog control systems.	1	2
2	Introduction of matlab software.	1	2
3	Control Systems toolbox in matlab software.	1	2
4	Control Systems toolbox in matlab software.	1	2
5	Mathematical models of analog control system in matlab software	1	2
6	Mathematical models of analog control system in matlab software	1	2
7	Mid-Term Practical Exam (if any)	1	2
8	Block diagram reduction in matlab software.	1	2
9	Midterm Practical Exam	1	2
10	Analysis of analog control systems response and performance	1	2
11	Root locus method in matlab program.	1	2
12	Bode plot method in matlab program.	1	2
13	Analog controller design method in matlab program	1	2
14	Analog controller design method in matlab program.	1	2
16	Final Practical Exam	1	2
Number of Weeks /and Units Per Semester		**15**	**30**

V. Teaching Strategies of the Course:

- Lectures
- Discussion
- Assignment
- Self-learning

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- Lab experiments
- Training at computer labs(Simulation)
- Small group discussion

VI. Assessment Methods of the Course:

- Written tests (mid and final terms Exam and quizzes(.
- Class discussion.
- Presentation

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Problems, and advance problems, and computer problems of the Chapter 2	2	3	a1, a2
2	Problems, and advance problems, and computer problems of the Chapter 3	3	3	a1, a2
3	Problems, and advance problems, and computer problems of the Chapter 4, 5	5	3	a1, a2, b1, b2, b3
4	Problems, and advance problems, and computer problems of the Chapter 6, 7	6	3	a1, a2, b1, b2, b3
5	Problems, and advance problems, and computer problems of the Chapter 8	10	6	a1, a2, b1, b2, b3, c1, c2
6	Problems, and advance problems, and computer problems of the Chapter 10	13	6	a1, a2, b1, b2, b3, c1, c2
7	Problems, and advance problems, and computer problems of the Chapter 11	15	6	a1, a2, b1, b2, b3, c1, c2
Total			30	

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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	Assignments	15	30	15%	a1,a2,b1,b2,c1,c2
2	Quiz 1	6	10	15%	a1, a2, b1, b2, b3, c1, c2
3	Midterm Exam	8	30	15%	a1, a2, b1, b2, b3
4	Midterm Theoretical Exam	9	20	10%	a1, a2, b1, b2, b3
5	Quiz 2	12	10	5%	a1, a2, b1, b2, b3, c1, c2
6	Final Practical Exam	15	30	15%	a1,a2,b1,b2,c1,c2
7	Final Theoretical Exam	16	70	35%	a1,a2,b1,b2,c1,c2,d1
Total			200	100%	

IX. Learning Resources:

1- Required Textbook(s) (maximum two)

1- Richard C. Dorf, Robert H. Bishop, 2013, Modern Control Systems, 12th Edition, Prentice Hall.

2- Katsuhiko Ogata, 2010, Modern Control Engineering, 5th Edition, Prentice Hall.

2- Essential References:

1- Norman S. Nise,2011, CONTROL SYSTEMS ENGINEERING, Sixth Edition, John Wiley & Sons, Inc.

2- FARIDGOLNARAGHI, BENJAMINC.KUO, 2010, Automatic Control Systems, ninth Edition, John Wiley & Sons, Inc.

3- Electronic Materials and Web Sites etc.:

Websites:

1- The National Program on Technology Enhanced Learning (NPTEL), Automatic Control

https://nptel.ac.in/courses/112/107/112107240/

Journals:

2- IEEE Transactions on control systems technology: Peer reviewed academic journal..

https://www.ieeexplore.ieee.org/xpl

3- International Journal of control, automation and systems: The leading peer reviewed academic journal

. https://www.springer.com/Journal

Other Web Sources:

4- Analog Devices, a Head of What's Possible,

https://www.analog.com/en/education/education-library/tutorials.html

X. Course Policies: (Based on the Uniform Students' By law (2007) تترك كما هي

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she 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 a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardiness:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she 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:** In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the

	assignment.
5	**Cheating:** For cheating in exam, a student will be considered as fail. 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 proofed a plagiarism of a student, he/she 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 or according to the university roles.
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 might be given directly to students using soft or hard copy.