Course Specification of: Advanced Control Systems

Course Code (MTE532)

I. General Information About the Course:

1.	**Course Title:**	**Advanced Control systems**			
2.	**Course Code and Number:**	**MTE532**			
3.	**Credit Hours:**	**Credit Hours**			**Total**
		Lecture	Practical	Seminar/Tutorial	
		3			**3**
4.	**Study Level and Semester:**	**First Semester**			
5.	**Pre-requisites (if any):**				
6.	**Co-requisites (if any):**				
7.	**Program (s) in which the course is offered:**	MSc. In Mechatronics Engineering Program			
8.	**Language of teaching the course:**	English			
9.	**Study System:**	Courses & Thesis			
10.	**Prepared By:**	Dr. Mohammed Al-Olofi			
11.	**Reviewed by:**	Dr. ……			
12.	**Date of Approval:**				

II. Course Description:

This course covers design and applications of advanced modern control systems. This course will provide a solid theoretical background of design, simulation and implementation of digital controllers for electromechanical systems, analysis of discrete-time/digital systems: solution properties, poles/eigenvalues, eigenvectors, stability, structural decomposition, controllability/observability, stabilizability/detectability, control design of discrete-time/digital systems: pole assignment methods, optimal control method (LQR), LQG/Kalman filtering optional, model predictive control, non-linear control system, novel digital control design methods: fuzzy logic, neural network based controllers and evolutionary methods for designing control strategies, genetic algorithms, Adaptive control: Self-tuning model-based control of an experimental system in real-time. Students will be assumed to have a working knowledge of fundamentals of digital control systems, Matlab and Simulink.

III. Course Intended Learning Outcomes (CILOs):

Upon successful completion of **Advanced Control systems Course**, the graduates will be able to:

a1 - Show the concepts and the mathematical modeling of advance modern control systems and application in Mechatronics engineering.

a2 - Explain principles, components of advance modern control systems, and application of advance control systems in mechatronic systems.

b1 - Analysis and evaluate the mechatronic engineering systems using the advance modern control engineering tools.

b2- Design the modern controllers and the others components of the mechatronics products by using the advance modern control system design methods.

c1- Use the information technology tools to solve the advance modern control systems problems in the field of mechatronics.

c2- Apply the advance modern control system tools to measure and evaluate the mechatronics systems performance.

c3 - Implement the modern digital controllers by using the software and hardware realization methods.

d1- Work productively independently and communicate research that advances and extends knowledge and scholarship in related fields.

d2- Engage in independent lifelong learning.

IV. Alignment of Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs)

CILOs		PILOs
a. Knowledge and Understanding: Upon successful completion of **the Advanced Control systems Course**, the graduates will be able to:		**A. Knowledge and Understanding:** Upon successful completion of the **MSc. In Mechatronics Engineering Program**, the graduates will be able to:
a1.	Show the concepts and the mathematical modeling of advance modern control systems and application in Mechatronics engineering.	**A1.** Demonstrate in-depth understanding of applied mathematics in Mechatronics engineering, control system, computer engineering and science, and electronics to design more functional, adaptable and cost-effective products.
a2.	Explain principles, components of advance modern control systems, and application of advance control systems in mechatronic systems.	**A3.** Explain in-depth the principles of sustainable design and development of Mechatronics engineering.
b. Cognitive/ Intellectual Skills: Upon successful completion of the **Advanced Control systems Course,** the graduates will be able to:		**B. Cognitive/ Intellectual Skills:** Upon successful completion of the **MSc. In Mechatronics Engineering Program,** the graduates will be able to:

b1.	Analysis and evaluate the mechatronic engineering systems using the advance modern control engineering tools.	**B1.** Apply appropriate principles, methodologies, techniques, tools and packages in the analysis, development and evaluation of mechatronics engineering systems.
b2.	Design the modern controllers and the others components of the mechatronics products by using the advance modern control system design methods.	**B3.** Design Mechatronics system, component, or process to meet desired needs within realistic constraints.
c. Professional and Practical Skills: Upon successful completion of the **Advanced Control systems Course,** the graduates will be able to:		**C. Professional and Practical Skills:** Upon successful completion of the **MSc. In Mechatronics Engineering Program,** the graduates will be able to:
c1.	Use the information technology tools to solve the advance modern control systems problems in the field of mechatronics.	**C1.** Conduct research to solve mechatronics engineering problems.
c2.	Apply the advance modern control system tools to measure and evaluate the mechatronics systems performance.	**C2.** Use advanced methodologies and skills to solve Mechatronics engineering problems.
c3.	Implement the modern digital controllers by using the software and hardware realization methods.	**C3.** Apply acquired knowledge of analysis and design for mechatronics engineering systems and implementation process.
c4.		
d. Transferable Skills: Upon successful completion of the **Advanced Control systems Course,** the graduates will be able to:		**D. Transferable Skills:** Upon successful completion of the **MSc. In Mechatronics Engineering Program,** the graduates will be able to:
d1.	Work productively independently and communicate research that advances and extends knowledge and scholarship in related fields.	**D3.** Conduct independently and communicate research that advances and extends knowledge and scholarship in related fields.
d2.	Engage in independent lifelong learning.	**D4.** Independent learning ability, self-direction and independence leading to the ability to continue to develop their knowledge understanding and skills through further professional development

V. Alignment of CILOs to Teaching and Assessment Strategies

a. Alignment of Knowledge and Understanding CILOs:

Knowledge and Understanding CILOs		Teaching Strategies	Assessment Strategies
a1.	Show the concepts and the mathematical modeling of advance modern control systems and application in Mechatronics engineering.	▪ Lectures, ▪ Seminars, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Group/Individual Projects and Studies, ▪ Field Work ▪ Active learning, ▪ Computer hands-on sessions.	▪ Oral & Writing Exams ▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments
a2.	Explain principles, components of advance modern control systems, and application of advance control systems in mechatronic systems.	▪ Lectures, ▪ Seminars, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Group/Individual Projects and Studies, ▪ Field Work ▪ Active learning, ▪ Computer hands-on sessions.	▪ Oral & Writing Exams ▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments

b. Alignment of Intellectual Skills CILOs:

Intellectual Skills CILOs		Teaching Strategies	Assessment Strategies
b1.	Analysis and evaluate the mechatronic engineering systems using the advance modern control engineering tools.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations,	▪ Oral & Writing Exams ▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments
b2.	Design the modern controllers and the others components of the mechatronics products by using the advance modern control system design methods.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving,	▪ Oral & Writing Exams ▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments

		▪ Brainstorming, ▪ Presentations,	

c. Alignment of Professional and Practical Skills CILOs:

Professional and Practical Skills CILOs		Teaching Strategies	Assessment Strategies
c1.	Use the information technology tools to solve the advance modern control systems problems in the field of mechatronics.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations,	▪ Seminar Report, ▪ Written Research Proposal, ▪ Thesis and Publication.
c2.	Apply the advance modern control system tools to measure and evaluate the mechatronics systems performance.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations,	▪ Seminar Report, ▪ Written Research Proposal, ▪ Thesis and Publication.
c3.	Implement the modern digital controllers by using the software and hardware realization methods.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations,	▪ Seminar Report, ▪ Written Research Proposal, ▪ Thesis and Publication.

d. Alignment of Transferable (General) Skills CILOs:

Transferable (General) Skills CILOs		Teaching Strategies	Assessment Strategies
d1.	Work productively independently and communicate research that advances and extends knowledge and scholarship in related fields.	▪ Dissertation Defenses and Presentation, ▪ Independent Study, ▪ Presentation, ▪ Brainstorming, ▪ Presenting Researches, ▪ Publish Research Papers.	▪ Written Research Proposal, Thesis and Publication, ▪ Written Exam, ▪ Assignments, ▪ Survey, ▪ Presentation, ▪ Written Report.

d2.	Engage in independent lifelong learning.	▪ Dissertation Defenses and Presentation, ▪ Independent Study, ▪ Presentation, ▪ Brainstorming, ▪ Presenting Researches, ▪ Publish Research Papers.	▪ Written Research Proposal, Thesis and Publication, ▪ Written Exam, ▪ Assignments, ▪ Survey, ▪ Presentation, ▪ Written Report.

VI. Course Content

1. Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours	Course ILOs
1	**Introduction to advance modern control systems**	▪ Introduction of digital control systems, ▪ types of digital control systems, ▪ modern control systems.	1	3	a1, a2
2	**Pole placement and observer design (modern design methods)**	▪ Controllability, observability, ▪ Pole placement design method, ▪ observer design method, ▪ example problems and solutions.	1	3	a1, a2, b1, b2, c1,c2, c3
3	**Pole placement and observer design (modern design methods)**	▪ Servo design, s ▪ State feedback with integral control, ▪ dead feedback control with state feedback and dead observer, ▪ example problems and solutions.	1	3	a1, a2, b1, b2, c1,c2, c3
4	**Introduction to system identification and adaptive control system**	▪ System identification and adaptive control system, ▪ example problems and solutions	1	3	a1, a2, b1, c1
5	**Lyapunov stability analysis**	▪ Basic stability concepts, definitions, theorems, lyapunov function for linear and non-linear systems, ▪ model reference adaptive control systems, ▪ example problems and solutions.	1	3	a1, a2, b1, b2, c1, d2
6	**Optimal control systems**	▪ ▪ Parameters optimization and optimal control problems, ▪ quadratic performance index, control configurations, ▪ state regulator design through lyapunov equations,	1	3	a1, a2, b1, b2, c1, d2

7	**Optimal control systems**	▪ Quadratic optimal control, ▪ steady- state quadratic optimal control, ▪ quadratic optimal control of servo controller, ▪ example problems and solutions.	**1**	**3**	**a1, a2, b1, b2, c1, d2**
8	**Midterm Exam**	▪ all previous topics.	**1**	**3**	**All CILOs**
9	**Nonlinear control systems**	▪ Introduction to nonlinear control systems, ▪ class of nonlinear systems, ▪ filtered nonlinear systems,	**1**	**3**	**a1, a2, b1, b2, c1,c2, c3, d1, d2**
10	**Nonlinear control systems**	▪ Describing functions for nonlinear systems, ▪ stability analysis by the describing functions methods, ▪ nonlinear sampled data systems, ▪ example problems and solutions.	**1**	**3**	**a1, a2, b1, b2, c1,c2, c3, d1, d2**
11	**Neural Networks for control**	▪ Introduction, neuron model, ▪ networks architectures, ▪ learning in neural networks, ▪ training the neural networks, ▪ design example problems and solutions.	**1**	**3**	**a1, a2, b1, b2, c1,c2, c3, d1, d2**
12	**Neural Networks for control**	▪ Function approximation with neural networks, ▪ systems identification with neural networks, ▪ control with neural networks, ▪ design example problems and solutions.	**1**	**3**	**b1, b2, c1,c2, c3, d1, d2**
13	**Fuzzy control**	▪ Introduction, fuzzy quantification of knowledge, ▪ fuzzy inference, ▪ design example problems and solutions.	**1**	**3**	**a1, a2, b1, b2, c1,c2, c3, d1, d2**
14	**Fuzzy control**	▪ Designing of fuzzy control systems, ▪ design example problems and solutions.	**1**	**3**	**b1, b2, c1,c2, c3, d1, d2**
15	**Genetic algorithms**	▪ Introduction, genetic algorithms for control system, ▪ example problems and solutions..	**1**	**3**	**a1, a2, b1, b2, c1,c2, c3, d1, d2**

16	**Final Exam**	▪ all previous topics.	**1**	**3**	**All CILOs**
Number of Weeks /and Contact Hours Per Semester			**16**	**48**	

VII. Teaching Strategies:

- Lectures,
- Seminars,
- Self-Learning Problems/Studies,
- Case study,
- Group/Individual Projects and Studies,
- Field Work
- Active learning,
- Computer hands-on sessions.
- Project Supervision,
- Simulation Exercises,
- Independent Study,
- Analysis and Problem Solving,
- Brainstorming,
- Presentations,
- Dissertation Defenses and Presentation,
- Presenting Researches,
- Publish Research Papers

VIII. Assessment Methods of the Course:

- Oral & Writing Exams
- Reports,
- Survey,
- Written Exam,
- Assignments
- Seminar Report,
- Written Research Proposal,
- Thesis and Publication.
- Written Research Proposal, Thesis and Publication,

IX. Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due	CILOs (symbols)
1	**Homework**	**Individual**	**10**	**Weekly**	**a1, a2, b1, b2, c1, c2**

2	Project	Individual	20	9th week	a1, a2, b1, b2, c1, c2, c3
	Total Score		30	==	===

X. Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment	CILOs
1	Tasks and Assignments	9th week	30	30%	a1, a2, b1, b2, c1, c2, c3
2	Midterm Exam	8th week	20	20%	All CILOs
3	Final Exam (Theoretical)	16th week	50	50%	All CILOs
Total				100%	===

XI. Learning Resources :

1. Required Textbook(s) :

1. M Gopal, Digital Control Systems and state variable methods: conventional and neuro-fuzzy control systems, 2nd Edition, McGraw Hill,2006
2. Katsuhiko Ogata, Discrete-time control systems, 2nd Edition, Prentice Hall,2010

2. Essential References:

1. M. Sam Fadali, Digital control systems analysis and design, 1st Edition, Elsevier Inc,2009

3. Electronic Materials and Web Sites *etc.*

Websites:

1- National Instruments

https://learn.ni.com/teach/resources/1221/digital-control

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

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

Journals:

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

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

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

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

Other Web Sources:

MIT Open Course Ware , Analysis and Design of Digital Control Systems

https://ocw.mit.edu/courses/mechanical-engineering/2-171-analysis-and-design-of-digital-control-systems-fall-2006/

Purdue University | Purdue Online Learning, College of Engineering, Digital Control

https://engineering.purdue.edu/ProEd/courses/digital-control

http://www.sciencedirect.com/

http://dl.acm.org/dl.cfm

http://ieeexplore.ieee.org/Xplore/guesthome.jsp

http://www.emeraldinsight.com

http://www.scopus.com/home.url

http://link.springer.com/

i. الضوابط والسياسات المتبعة في المقرر Course Policies	
بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:	
1	**سياسة حضور الفعاليات التعليمية Class Attendance:** **- يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك.** **- يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.**
2	**الحضور المتأخر Tardy:** **- يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.**
3	**ضوابط الامتحان Exam Attendance/Punctuality:** **- لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان** **- إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.**
4	**التعيينات والمشاريع Assignments & Projects:** **- يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها.** **- إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.**
5	**الغش Cheating:** **- في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب.** **- في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.**
6	**الانتحال Plagiarism:** **– في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك**
7	**سياسات أخرى Other policies:** **- أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ**

Academic Year: ……....

Course Plan (Syllabus): Advanced Control Systems

I. Information about Faculty Member Responsible for the Course:

Name	Dr. Mohammed Al-Olofi	Office Hours					
Location &Telephone No.		SAT	SUN	MON	TUE	WED	THU
E-mail	al_olfe2001@yahoo.com						

II. General information about the course:

1.	Course Title	Advanced Control systems			
2.	Course Code and Number	MTE532			
3.	Credit Hours	Credit Hours			Total
		Lecture	Practical	Seminar/Tutorial	
		3			3
4.	Study Level and Semester	First Semester			
5.	Pre-requisites				
6.	Co –requisite				
7.	Program (s) in which the course is offered	MSc. In Mechatronics Engineering Program			
8.	Language of teaching the course	English			
9.	Location of teaching the course	Mechatronics Engineering Department			

II. Course Description:

This course covers design and applications of advanced modern control systems. This course will provide a solid theoretical background of design, simulation and implementation of digital controllers for electromechanical systems, analysis of discrete-time/digital systems: solution properties, poles/eigenvalues, eigenvectors, stability, structural decomposition, controllability/observability, stabilizability/detectability, control design of discrete-time/digital systems: pole assignment methods, optimal control method (LQR), LQG/Kalman filtering optional, model predictive control, non-linear control system, novel digital control design methods: fuzzy logic, neural network based controllers and evolutionary methods for designing control strategies, genetic algorithms, Adaptive control: Self-tuning model-based control of an experimental system in real-time. Students will be assumed to have a working knowledge of fundamentals of digital control systems, Matlab and Simulink.

IV. Course Intended Learning Outcomes (CILOs):

Upon successful completion of **Advanced Control systems Course**, the graduates will be able to:

a1 - Show the concepts and the mathematical modeling of advance modern control systems and application in Mechatronics engineering.

a2 - Explain principles, components of advance modern control systems, and application of advance control systems in mechatronic systems.

b1 - Analysis and evaluate the mechatronic engineering systems using the advance modern control engineering tools.

b2- Design the modern controllers and the others components of the mechatronics products by using the advance modern control system design methods.

c1- Use the information technology tools to solve the advance modern control systems problems in the field of mechatronics.

c2- Apply the advance modern control system tools to measure and evaluate the mechatronics systems performance.

c3 - Implement the modern digital controllers by using the software and hardware realization methods.

d1- Work productively independently and communicate research that advances and extends knowledge and scholarship in related fields.

d2- Engage in independent lifelong learning.

V. Course Content:

1. Theoretical Aspect:

Order	Units	Sub Topics	Week Due	Contact Hours
1	**Introduction to advance modern control systems**	▪ Introduction of digital control systems, ▪ types of digital control systems, ▪ modern control systems.	**1**	**3**
2	**Pole placement and observer design (modern design methods)**	▪ Controllability, observability, ▪ Pole placement design method, ▪ observer design method, ▪ example problems and solutions.	**1**	**3**
3	**Pole placement and observer design (modern design methods)**	▪ Servo design, s ▪ State feedback with integral control, ▪ dead feedback control with state feedback and dead observer, ▪ example problems and solutions.	**1**	**3**
4	**Introduction to system identification and adaptive control**	▪ System identification and adaptive control system, ▪ example problems and solutions	**1**	**3**

	system			
5	**Lyapunov stability analysis**	▪ Basic stability concepts, definitions, theorems, lyapunov function for linear and non-linear systems, ▪ model reference adaptive control systems, ▪ example problems and solutions.	**1**	**3**
6	**Optimal control systems**	▪ Parameters optimization and optimal control problems, ▪ quadratic performance index, control configurations, ▪ state regulator design through lyapunov equations,	**1**	**3**
7	**Optimal control systems**	▪ Quadratic optimal control, ▪ steady- state quadratic optimal control, ▪ quadratic optimal control of servo controller, ▪ example problems and solutions.	**1**	**3**
8	**Midterm Exam**	▪ all previous topics.	**1**	**3**
9	**Nonlinear control systems**	▪ Introduction to nonlinear control systems, ▪ class of nonlinear systems, ▪ filtered nonlinear systems,	**1**	**3**
10	**Nonlinear control systems**	▪ Describing functions for nonlinear systems, ▪ stability analysis by the describing functions methods, ▪ nonlinear sampled data systems, ▪ example problems and solutions.	**1**	**3**
11	**Neural Networks for control**	▪ Introduction, neuron model, ▪ networks architectures, ▪ learning in neural networks, ▪ training the neural networks, ▪ design example problems and solutions.	**1**	**3**
12	**Neural Networks for control**	▪ Function approximation with neural networks, ▪ systems identification with neural networks, ▪ control with neural networks, ▪ design example problems and solutions.	**1**	**3**

13	**Fuzzy control**	▪ Introduction, fuzzy quantification of knowledge, ▪ fuzzy inference, ▪ design example problems and solutions.	**1**	**3**
14	**Fuzzy control**	▪ Designing of fuzzy control systems, ▪ design example problems and solutions.	**1**	**3**
15	**Genetic algorithms**	▪ Introduction, genetic algorithms for control system, ▪ example problems and solutions..	**1**	**3**
16	**Final Exam**	▪ all previous topics.	**1**	**3**
Number of Weeks /and Contact Hours Per Semester				**48**

VI. Teaching Strategies:

- Lectures,
- Seminars,
- Self-Learning Problems/Studies,
- Case study,
- Group/Individual Projects and Studies,
- Field Work
- Active learning,
- Computer hands-on sessions.
- Project Supervision,
- Simulation Exercises,
- Independent Study,
- Analysis and Problem Solving,
- Brainstorming,
- Presentations,
- Dissertation Defenses and Presentation,
- Presenting Researches,
- Publish Research Papers

VII.Assessment Methods of the Course:

- Oral & Writing Exams
- Reports,
- Survey,
- Written Exam,

VII. Assessment Methods of the Course:

- Assignments
- Seminar Report,
- Written Research Proposal,
- Thesis and Publication.
- Written Research Proposal, Thesis and Publication,

VIII. Tasks and Assignments:

No	Assignments	Individual /Groups	Mark	Week Due
1	Homework	Individual	10	Weekly
2	Project	Individual	20	9th week
	Total Score		30	

IX. Learning Assessment:

No	Assessment Method	Week Due	Mark	Proportion of Final Assessment %
1	Tasks and Assignments	9th week	30	30%
2	Midterm Exam	8th week	20	20%
3	Final Exam (Theoretical)	16th week	50	50%
	المجموعTotal		100	100 %

X. Learning Resources:

1. Required Textbook(s) :

1. M Gopal, Digital Control Systems and state variable methods: conventional and neuro-fuzzy control systems, 2nd Edition, McGraw Hill,2006
2. Katsuhiko Ogata, Discrete-time control systems, 2nd Edition, Prentice Hall,2010

2. Essential References:

1. M. Sam Fadali, Digital control systems analysis and design, 1st Edition, Elsevier Inc,2009

3. Electronic Materials and Web Sites etc.

Websites:

2- National Instruments

https://learn.ni.com/teach/resources/1221/digital-control

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

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

Journals:

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

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

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

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

Other Web Sources:

MIT Open Course Ware , Analysis and Design of Digital Control Systems

https://ocw.mit.edu/courses/mechanical-engineering/2-171-analysis-and-design-of-digital-control-systems-fall-2006/

Purdue University | Purdue Online Learning, College of Engineering, Digital Control

https://engineering.purdue.edu/ProEd/courses/digital-control

1. http://www.sciencedirect.com/
2. http://dl.acm.org/dl.cfm
3. http://ieeexplore.ieee.org/Xplore/guesthome.jsp
4. http://www.emeraldinsight.com
5. http://www.scopus.com/home.url
6. http://link.springer.com/

ii. الضوابط والسياسات المتبعة في المقرر Course Policies	
بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:	
سياسة حضور الفعاليات التعليمية Class Attendance: - يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك. - يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.	1
الحضور المتأخر Tardy: - يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.	2
ضوابط الامتحان Exam Attendance/Punctuality: - لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان - إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.	3
التعيينات والمشاريع Assignments & Projects: - يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها. - إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.	4
الغش Cheating: - في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب. - في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.	5
الانتحال Plagiarism: – في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك	6
سياسات أخرى Other policies: - أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ	7