MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Control System**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** x **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**MIE40003**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level		UG IV	**Semester of Delivery**		7
Administering Department		MIE	**College**	MUC	
Module Leader	Hassan Abbas		**e-mail**	hasan.abbas.extmie@muc.edu.iq	
Module Leader's Acad. Title		Lect. Dr.	**Module Leader's Qualification**		Ph.D.
Module Tutor			**e-mail**		
Peer Reviewer Name		Assist. Prof. Dr. Bassim Abdulbaki	**e-mail**	bassim.jumaa@muc.edu.iq	
Scientific Committee Approval Date		8/11/2023	**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Engineering mathematics MIE2104	**Semester**	UGII-S3
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims أهداف المادة الدراسية	The module aims to: 1. calculate system sensitivity and disturbance rejection and the effect of feedback on these 2. analyses and design for steady-state error requirements 3. analyses system stability and performance using analytical techniques 4. analyses system stability and performance using graphical frequency response techniques 5. design, simulate and evaluate compensator-based control schemes 6. design, simulate and evaluate PID-based control schemes 7. use appropriate software tools to present, analyses, design and simulate systems 8. effectively present and discuss the analysis and/or design of systems by written means 9. enable students to comprehend the characteristics of digital controller and apply appropriate design methods.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After completing this lecture, the student will be able to: 1. Define a control system and describe some applications. 2. Describe historical developments leading to modern day control theory 3. Describe the basic features and configurations of control systems 4. Describe control systems analysis and design objectives 5. Describe a control system's design process 6. Describe the benefit from studying control systems 7. Be able to apply the Laplace transform and Z transform in the development of transfer functions for a range of simple dynamic systems. 8. Be able to analyses transfer functions and present the properties of the systems they represent in terms of control objectives. 9. Be able to design static and dynamic control systems to achieve a set of desired control objectives. 10. Know how to use software tools, based upon the MATLAB environment to support control system analysis and design. 11. Be able to design and implement active control components such as PID 12. controllers to achieve desirable control objectives. 13. Understand how control engineering sits within robotics system design and implementation.
Indicative Contents المحتويات الإرشادية	The indicative contents of control system module include: 1. Introduction to linear control engineering. [15 hrs.] 2. Transfer function, block diagram representation and reduction, signal flow diagram, State space representation and analysis. [15 hrs.] 3. Mathematical background; laplace transform, complex variable, matrices. [10 hrs.] 4. Time domain analysis, steady – state transient analysis. Stability analysis; Routh, Nyquist. [9 hrs.] 5. Root locus technique. [10 hrs.] 6. Frequency domain analysis, gain margin, phase margin and bode plot. 7. Frequency domain synthesis, phase lead. [10 hrs.] 8. Compensation, phase – lag compensation lag – lead compensation - PID controllers design. [9 hrs.]

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching strategies employed in a Control system engineering module can vary depending on the specific course or institution. However, here are some common strategies that may be used: 1. 1. Lectures: Theoretical ideas and the basics of control system knowledge are frequently presented in lectures. Using visual aids like slides, diagrams, and demonstrations, lecturers may go through important theories, concepts, and methods. 2. 2. Practical Sessions: Practical sessions strengthen theoretical ideas while also provide practical experience. Implementing and analyzing signal processing methods can be done by students using software tools like MATLAB, Python, or specialist software. Students can apply their knowledge and work in groups or individually during practical sessions to address difficulties in real-world processing. 3. 3. Laboratory Experiments: In a controlled setting, laboratory experiments give students the chance to apply CONTROL SYSTEM ENGINEERING ideas. To design and implement, they might use hardware like signal generators, oscilloscopes, and CONTROL SYSTEM ENGINEERING boards. 4. 4. Problem-Solving activities: In class and as homework assignments, problem-solving activities let students use their understanding and analytical abilities to tackle CONTROL SYSTEM ENGINEERING issues. These exercises could entail creating mathematical models, interpreting signals, generating mathematical expressions, or putting algorithms into practice. To assist students in developing their problem-solving skills, instructors may offer comments and direction. 5. Case Studies and Applications: CONTROL SYSTEM ENGINEERING case studies and real-world applications assist students in comprehending the relevance and application of the ideas they are taught. This method improves students' ability to use CONTROL SYSTEM ENGINEERING principles in a variety of contexts. 6. Group talks and Peer Learning: Group talks and cooperative exercises encourage peer-to-peer engagement and active learning. Together, students may solve issues, discuss ideas, and exchange ideas. This strategy promotes critical thinking, understanding through many views, and teamwork abilities. Online Resources, In addition to traditional teaching methods, instructors may utilize online resources, multimedia content, and interactive tools to supplement learning. These resources can include video tutorials, simulations, online quizzes, and discussion forums. They provide flexibility, enable self-paced learning, and facilitate deeper exploration of CONTROL SYSTEM ENGINEERING concepts. 7. Assessments: Students' comprehension and application of CONTROL SYSTEM ENGINEERING principles are assessed by assessments such as quizzes, examinations, projects, and presentations. Theoretical inquiries, problem-solving exercises, and practical demonstrations could all be a part of these evaluations. They aid in measuring learning outcomes and give students feedback on their development.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	79	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	46	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #1, 2, 8 and 9
	Assignments	2	10% (10)	7, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	8	15% (10)	Continuous	All
	Report	1	5% (10)	14	LO # 1-14
Summative assessment	**Midterm Exam**	2 hours	10% (10)	7	LO # 1-7
	Final Exam	3 hours	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	• Introduction to CONTROL SYSTEM ENGINEERING: Overview, applications, and advantages of control system. • Test signal : Introduction to continuous-time, unit-step, ramp and system representations.
Week 2	• Mathematical background; modelling , application of mathematical modelling.
Week 3	• Laplace transformation and inverse Laplace transform, partial fraction
Week 4	• Block diagram representation for 1st and 2nd type
Week 5	• Block diagram representation reduction, rules of minimizing block diagram.
Week 6	• signal flow diagram.
Week 7	• Mid-term exam

Week 8	• Time domain analysis, for 1st , 2nd and higher order system
Week 9	• Stability analysis; Routh, Nyquist • Root locus technique
Week 10	• Root locus technique design
Week 11	• Frequency domain analysis, Gain margin, phase margin and bode plot.
Week 12	• Frequency domain synthesis, phase lead
Week 13	• Compensation, phase – lag compensation lag – lead compensation.
Week 14	• PID controllers design.
Week 15	• Preparatory week before the final Exam

Delivery Plan (Weekly Workshop Syllabus) المنهاج الاسبوعي للورشة	
	Material Covered
Week 1	Lab Safety & Lab Equipment Use Tutorial.
Week 2	Introduction to Computer Simulation
Week 3	Transfer Function Simplification and Solution
Week 4	State Space Method
Week 5	Zeros, Poles and Stability
Week 6	Time Response characteristics for 1st ,2nd order system
Week 7	Root-Locus drawing
Week 8	Root-Locus design controller
Week 9	Frequency response characteristics
Week 10	Bode and Nyquist diagram
Week 11	Check the stability by PM and GM
Week 12	PID Controller
Week 13	QNET DC Motor Position Control
Week 14	Lead-Lag Compensation
Week 15	Presentation & Demonstration of Final Project

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks (%)**	**Definition**
Success Group	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors

(50 - 100)	**D -** Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Learning and Teaching Resources مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Modern Control Engineering, Ogata Katsuhiko, 5th Edition, Prentice-Hall, 2010.	Yes
Recommended Texts	Nise, N. S., 'Control Systems Engineering', 5th Edition, John Wiley, International Student Version. 2008. ISBN 978-0-470-16997-1	No
Websites	The Collage E-Library	