COURSE OUTLINE

Department & Faculty: Electrical Engineering Faculty	Page : 1 of 5
Course Code: SKEE 3133 System Modeling and Analysis Total Contact Hours: 42 hours	Semester: 1 Academic Session: 2017/2018

Lecturer : PROF. DR. MOHD FUAAD RAHMAT

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Synopsis : This course introduces the students to the fundamental ideas and definitions of control systems, open loop and close loop control systems, transfer functions and transient and steady state responses. Students will be taught how to obtain mathematical models of actual physical systems such as electrical, mechanical and electromechanical systems in the transfer function form. Methods of system representation such as block diagram representation and signal flow graphs will be discussed. The students will also be exposed to techniques of analysing control systems performance and stability in time and frequency domains. Finally, an introduction to the design and analysis of control systems using MATLAB will also be given.

LEARNING OUTCOMES

By the end of the course, students should be able to:

No.	Course Learning Outcome	Programme Outcome	Taxonomies & Soft-Skills	Assessment Methods
CO1	Apply the knowledge of basic control theory to describe the structure of control system design and control system representation.	PO1	C2	T1, T2, F
CO2	Apply the knowledge of mathematics, science and electrical engineering to derive the mathematical models and transfer functions of electrical, mechanical, and electromechanical systems.	PO1	C3, P4, A2	T1, F
CO3	Employ the transfer function of the control system to illustrate its performance and stability in time and frequency domains.	PO1	C3, P4, A2, CTPS1-3	T2, F
CO4	Use MATLAB software in analyzing control system performance and stability.	PO4	C3, P4, A2, TS1-3	HW
(T – Test ; PR – Project ; Q – Quiz; HW – Homework ; Pr – Presentation; F – Final Exam)				

Prepared by:	Certified by: (Course Panel Head)
Name: Dr. Fatimah Sham Ismail Signature: Date: 10 September 2017	Name: Assoc. Prof. Ir Dr. Norhaliza Abd Wahab Signature: Date: 10 September 2017

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STUDENT LEARNING TIME (SLT)

Teaching and Learning Activities	**Student Learning Time (hours)**
1. Face-to-Face Learning	
a. Lecturer-Centered Learning i. Lecture	39
b. Student-Centered Learning (SCL) i. Laboratory/Tutorial ii. Student-centered learning activities – Active Learning, Project Based Learning	3
2. Self-Directed Learning	
a. Non-face-to-face learning or student-centered learning (SCL) such as manual, assignment, module, e-Learning, etc.	32
b. Revision	28
c. Assessment Preparations	13.5
3. Formal Assessment	
a. Continuous Assessment (Test)	2
b. Final Exam	2.5
Total (SLT)	**120**

TEACHING METHODOLOGY

- Lecture, tutorial and class discussion.
- Individual Assignment, Written Test and Final Examination.
- Active Learning Approach – Group Assignment.

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WEEKLY SCHEDULE:

Week 1 : **Chapter 1: Introduction to Control Systems (3 hours)**
- History of Control Systems
- Control System Basics
- Control System Configuration
- Examples of Control Systems
- Control System Design
- Simulation Software in Control - MATLAB

Week 2 ~ 4 : **Chapter 2: Mathematical Modelling in Transfer Function Form (8 hours)**
- Introduction to Laplace Transform & Transfer Function
- Modelling of Electrical Systems
- Modelling of Mechanical Systems – Translational, Rotational & Rotational with Gears
- Modelling of Electromechanical Systems

TEST 1 (Week 7: 23 October 2017, Monday)

Week 4 ~ 5 : **Chapter 3: System Representation (4 hours)**
- Important definitions of block diagrams and signal flow graphs.
- Techniques of simplifying block diagrams.
- Signal flow graphs.
- Changing block diagrams to signal flow graphs and vice versa.
- Mason's Rule

Week 6 ~ 9 : **Chapter 4(a): Response Analysis in Time Domain (9 hours)**
- Introduction – System Categories, Poles & Zeros, System Response, Standard input test signal
- First-order System – Transient & Steady-sate response
- Second-order System – Transient & Steady-State Response, Response Specification
- System Response with Additional Poles
- Steady-State Error – Definition, Test Input Signal, SS Error

Week 8 : **Semester Break**

Week 10 ~ 12 : **Chapter 4(b): Stability Analysis in Time Domain (9 hours)**
- Introduction
- Relative stability (stability based on poles location)
- Method to test stability: using Routh Hurwitz Criterion
- Stability analysis
- MATLAB Session (3 hours)

TEST 2 (Week 13: 4 Dec 2017, Monday)

Week 13 ~ 15 : **Chapter 5: Response and Stability Analysis in Frequency Domain (9 hours)**
- Introduction to Frequency Response
- Plotting in Frequency Domain
- Bode Plot Analysis
- Relation between closed-and Open-loop
- Stability Analysis, gain adjustment
- Steady state error

COURSE OUTLINE

Week 16-18 : Revision Week and Final Examination

MAIN TEXTBOOK:

1. Teaching Module SKEE3133: System Modeling and Analysis, UTM, 2017
2. Norman S. Nise, Control Systems Engineering (6th Edition), John Wiley and Sons. 2011

REFERENCES :

1. Katsuhiko Ogata, Modern Control Engineering (5th Edition). Pearson Education International, Inc., 2010.
2. Richard C. Dorf and Robert H. Bishop, Modern Control Systems (12th Edition), Pearson Educational International, 2011.
3. Rao V. Dukkipati, Analysis and Design of Control systems Using MATLAB, Published by New Age International (P) Ltd., Publishers, 2006
4. Benjamin C. Kuo, Automatic Control Systems (7th Edition), Prentice-Hall International, Inc., 1995.
5. Katsuhiko Ogata, MATLAB For Control Engineers, Pearson Education International, Inc., 2008.

ASSESSMENT:

Item	Mark (%)	No of test/quiz/assignment	Duration
Assignments	20	Up to the lecturer, as long as follow the CO/PO mapping, 10% for Matlab (P04)	
Test 1 (Chap. 1 & 2)	15	1 (Week 7, **23 Oct. 2017**, Monday; 9.00 -10.00 pm, Bilik Peperiksaan P16, BKT3,4)	1 hour
Test 2 (Chap. 3 & 4a)	15	1 (Week 13, **4 Dec. 2017**, Monday; 9.00 -10.00 pm, Bilik Peperiksaan P16, BKT3,4)	1 hour
Final Exam	50	1	2.5 hours

CO and PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	T, F											
CO2	T, F, HW											
CO3	T, F, PR/HW											
CO4				HW								

(T – Test ; PR – Project ; Q – Quiz; HW – Homework ; Pr – Presentation; F – Final Exam)

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Program Outcomes (PO)

Students of an engineering program are expected to have the following outcomes:-

PO1. Ability to acquire and apply the knowledge of mathematics, science and electrical engineering to the solution of complex engineering problems.

PO2. Ability to conduct experiments and researches, perform analysis and interpret data for complex engineering problems.

PO3. Ability to identify, formulate, investigate and synthesis of information to solve complex electrical engineering problems.

PO4. Ability to use appropriate techniques, skills and modern engineering tools, modern instrumentation, software and hardware necessary for complex engineering practice with an understanding of their limitations.

PO5. Ability to design solution for complex system, component or process within a defined specification that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO6. Ability to articulate ideas, communicate effectively, in writing and verbally, on complex engineering activities with the engineering community and with society at large.

PO7. Ability to function effectively as an individual, and as a member or leader in diverse teams.

PO8. Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO9. Ability to analyze the impact of global and contemporary issues, the role of engineers on society, including health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering.

PO10. Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PO11. Ability to execute responsibility professionally and ethically.

PO12. Ability to demonstrate knowledge and understanding of engineering and management principles to manage projects in multidisciplinary environments.

***PO1, PO2, PO3, PO4 and PO5 are related to technical knowledge and competencies.**
***PO6, PO7, PO8, PO9, P10, P11 and P12 are related to generic skills**.