<table>
<tr><td>1.</td><td colspan="5">Name of Course</td><td>Control Theory</td></tr>
<tr><td>2.</td><td colspan="5">Course Code</td><td>JCOT7313</td></tr>
<tr><td></td><td colspan="6">JCOT = the first alphabet identify the faculty within which the subject is offered., JCOT = the remaining three alphabet identify the course that offers the subject, 7313 = the first digit identify level of study; in this case undergraduate level, 7313= the second and third digits identify subject identity and 7313= the fourth digit identify credit value or credit hours</td></tr>
<tr><td>3.</td><td colspan="5">Name(s) of academic staff</td><td>To be Assigned</td></tr>
<tr><td>4.</td><td colspan="5">Rationale for the inclusion of the course/module in the programme</td><td>Knowledge of control theory is essential in electrical and electronics engineering. Moreover, acquiring knowledge control theory enable engineer to design feedback control systems.</td></tr>
<tr><td>5.</td><td colspan="5">Semester and Year offered</td><td>Year 3, Semester 2</td></tr>
<tr><td rowspan="3">6.</td><td colspan="2" rowspan="2">Total Student Learning Time (SLT)</td><td colspan="4">Face to Face</td><td rowspan="2">Total Guided and Independent Learning</td></tr>
<tr><td rowspan="2">L = Lecture T = Tutorial
P = Practical
IS= Independent Study</td><td>L</td><td>T</td><td>P</td><td>IS</td><td rowspan="2">Total Guided and Independent Learning = 120</td></tr>
<tr><td>42</td><td>7</td><td>6</td><td>65</td></tr>
<tr><td>7.</td><td colspan="5">Credit Value</td><td>3.0</td></tr>
<tr><td></td><td colspan="6">Lecture: 3 hours per week x 14 weeks
Tutorial: 1 hour per week x 7 weeks
Practical: 2 hours x 3weeks</td></tr>
<tr><td>8.</td><td colspan="5">Prerequisite (if any)</td><td>JSSY1043: Signal and System
JMAT1023: Engineering Mathematic II</td></tr>
<tr><td>9.</td><td colspan="6">Course Objectives
1. To introduce the control theory;
2. To equip the students with the knowledge feedback control system.

Course Learning Outcomes (CLO)
At the end of the semester students should be able to:

CLO1: To understand the basic application of feedback control system;
CLO2: To construct a mathematical model of a dynamic system that includes a control system;
CLO3: To Simplify mathematical models to linear, time-invariant systems through linearization and block diagram reduction.</td></tr>
<tr><td>10.</td><td colspan="6">Transferable Skills:
This course is expected the development of the following transferable skills:
▪ An ability to manage time and task
▪ An ability to learn both independently and co—operatively;
▪ An ability to take responsibility and carry out laboratory test;
▪ An ability to take initiative and lead other;
▪ An ability to use software where relevant to the subject.</td></tr>
<tr><td>11.</td><td colspan="6">Teaching-learning and assessment strategy

A variety of learning strategies are used throughout the course, including the following
• Classroom Lesson; Lecturer and power point presentation
• Tutorial session
• Student- lecturer Discussion</td></tr>
</table>

	• Collaborative and co-operative learn; • Independent study. **Assessment:** **Course works** **40%** Assignment 5% Tutorial 5% Quizzes 5% Laboratory works 10% Test 15% **Final Examination** **60%** **Total** **100%**
12.	**Synopsis:** This course is very important course in the field of electrical engineering. The objective of course is to introduce students to the techniques of analysis and design of feedback control systems based mainly on classical theory.
13.	**Mode of Delivery:** Lectures; Tutorials; Laboratory works

14.	**Assessment Methods and Types:** **Performance Criteria :**						
	CLO-PLO	**Assessment Tool**	**1**	**2**	**3**	**4**	**5**
	Marks		**0-39**	**40-49**	**50-59**	**60-74**	**75-100**
	Grade		**(F)**	**(D,D+)**	**(C-,C,C+)**	**(B-,B,B+)**	**(A-,A,A+)**
	CLO1: To understand the basic application of feedback control system;	**Assignment** **Tutorials** **Lab works** **Quizzes** **Test** **Examination**	**Fail To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Poor To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Satisfactory To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Good To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Excellent To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test
	CLO2: To Construct a mathematical model of a dynamic system that includes a control system;	**Assignment** **Tutorials** **Lab works** **Quizzes** **Test** **Examination**	**Fail To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Poor To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Satisfactory To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Good To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Excellent To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test
	CLO3: To Simplify mathematical models to linear, time-invariant systems through linearization and block diagram reduction;	**Assignment** **Tutorials** **Lab works** **Quizzes** **Test** **Examination**	**Fail To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Poor To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Satisfactory To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Good To**: - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test	**Excellent To:** - manage time and task - learn both independently and cooperatively - take responsibility and carry out laboratory test

15. **Mapping of the Programme Objectives to the Programme Learning Outcomes**

Programme Learning Outcomes (PO) / Programme Objectives (PO)	**PLO1:** Ability to acquire and apply knowledge of science and engineering fundamentals.	**PLO2:** Acquired in-depth technical competence in electrical engineering discipline.	**PLO3:** Ability to undertake problem identification, formulation and solution;	**PLO4:** Ability to utilise systems approach to design and evaluate operational performance.	**PLO5:** Understanding of the principles of design for sustainable development;	**PLO6:** Understanding of professional and ethical responsibilities and commitment to them.	**PLO7:** Ability to communicate effectively, not only with engineers but also with the community at large.	**PLO8:** Ability to function effectively as an individual and in a group with the capacity to be a leader or manager;	**PLO9:** Understanding of the social, cultural, global and environmental responsibilities of a professional engineer	**PLO10:** Recognising the need to undertake lifelong learning, and possessing/acquiring the capacity to do so	**PLO11:** Ability become entrepreneur
PO1: To produce graduates with excellent knowledge and competency in Electrical and Electronic Engineering;	✓							✓		✓	
PO2: To produce graduates with professional, generic attributes to meet the present and future global demands.											
PO3: To produce graduates with Islamic humanistic values and reinvention skills to meet the requirement of a dynamic environment. These skills include Civil Intelligence, Moral Intelligence, Self-Reliance and Communication Skills**.**											

16. **Mapping of the course Learning Outcome to the Programme Outcome**

Programme Learning Outcomes (PLO) / Course Learning Outcome (CLO)	**PLO1:** Ability to acquire and apply knowledge of science and engineering fundamentals.	**PLO2:** Acquired in-depth technical competence in electrical engineering discipline.	**PLO3:** Ability to undertake problem identification, formulation and solution;	**PLO4:** Ability to utilise systems approach to design and evaluate operational performance.	**PLO5:** Understanding of the principles of design for sustainable development;	**PLO6:** Understanding of professional and ethical responsibilities and commitment to them.	**PLO7:** Ability to communicate effectively, not only with engineers but also with the community at large.	**PLO8:** Ability to function effectively as an individual and in a group with the capacity to be a leader or manager;	**PLO9:** Understanding of the social, cultural, global and environmental responsibilities of a professional engineer	**PLO10:** Recognising the need to undertake lifelong learning, and possessing/acquiring the capacity to do so	**PLO11:** Ability become entrepreneur
CLO1: To understand the basic application of feedback control system;	✓							✓		✓	
CLO2: To Construct a mathematical model of a dynamic system that includes a control system;	✓							✓		✓	
CLO3: To Simplify mathematical models to linear, time-invariant systems through linearization and block diagram reduction;	✓							✓		✓	

17. **Content outline of the course/module and the SLT per topic**

Details		SLT (Hour)				
		L	**T**	**P**	**IS**	**Total**
Topic 1	**Introduction and basic mathematics.** • An introduction to control systems, • Types and effects of feedback. • Complex variables, difference and differential equations and Laplace transform**.**	3	-	-	8	**11**
Topic 2	**Transfer Function, Block Diagrams and Signal-Flow Graphs.** • Impulse response, • transfer functions, • block diagram, signal-flow graph and gain formula	3	1	-	10	**14**
Topic 3	**Mathematical Modelling for Physical Systems.** • Electrical networks, • Mechanical systems, • Sensors and encoders, • Non-linear systems. **Linear System Stability.** • Bounded-input bounded-output, • Zero-input stability, • Routh-Hurwitz • Stability criterion.	9	2	-	15	**26**
Topic 4	**Time Response Analysis.** • Time response, • Test signals, • Time-domain specifications, • Steady-state error, • Transient response of second-order systems, • Effects of zero-pole placements, • Higher-order system approximation. **Root Locus Techniques**. • Root locus characteristics, building root locus and root contour	9	1	-	10	**20**
Topic 5	**Frequency Response Analysis** • Bode diagram, • Polar plot, • Nichols plot. • Nyquist stability criterion • Non-mathematical description of Nyquist criterion, • Interpretation of stability. • Relative stability • Gain and phase margins. • Closed-loop frequency response analysis • M and N contours, Nichols chart.	9	1	-	10	**20**

	Topic 6	**Time-domain and Frequency-domain Controller Design.** • Phase-lead controller, • Phase-lag controller, • Lead-lag controller, • Zero-pole cancellation, • Lad and feed forward compensation) **Compensation Techniques** • Compensation techniques lag, • Lead and lag-lead compensation, • PD, • PI and PID controllers • Cascade compensation based on root locus method. Introduction to feedback compensation	9	2	-	12	**23**
	Practical	1. PID controller design. 2. Frequency response analysis	-	-	6	-	**6**
	Total SLT (Hour)		**42**	**7**	**6**	**65**	**120**
18.	**Main references supporting the course** 1. Control Systems Engineering, 6th edition, 2008 (ISBN: 0471445770), Norman S. Nise, Wiley						
	Additional references supporting the course 1. Modern Control Engineering, 4th edition, 2008 (ISBN: 0130609072), K. Ogata, Prentice Hall 2. Modern Control Systems, 10th edition, 2005 (ISBN: 0-13-127765-0), R.C. Dorf & R.H. Bishop, Prentice Hall. 3. Automatic Control Systems, 8th edition, 2007(ISBN: 0471134767), B. C. Kuo, John Wiley & Sons						
19.	**Other additional information** All materials will be available to the students in the library.						