

COURSE INFORMATION

School/ Faculty:	School of Mechanical Engineering / Faculty of Engineering	Page:	1 of 6
Course code:	SEMT 4223	Academic Session/Semester:	20182019/1
Course name:	Flight Dynamics and Control	Pre/co requisite (course name and code, if applicable):	Flight Mechanics (SEMT 3212), Control Engineering (SEMM 3233)
Credit hours:	3		

Course synopsis	This course is about the dynamics behaviour of rigid body aircraft and the application of control system theory to design simple stability augmentation systems to more complex automatic flight control systems. This includes the application of modern multivariable control system design using state-space methods. Topics include axes system and notation, equation of motion of rigid body including translation, aircraft longitudinal and lateral dynamic stability, flying and handling qualities, stability augmentation and automatic flight control system, aerodynamics stability derivatives and multivariable state-space methods. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems in aircraft dynamics and control, which also comprising The Fourth Industrial Revolution (<i>IR 4.0</i>) element.			
Course coordinator (if applicable)	Ir. Dr. Istas Fahrurrazi b Nusyirwan			
Course lecturer(s)	Name	Office	Contact no.	E-mail
	Ir. Dr-Ing Mohd Nazri bin Mohd Nasir	UTM Hangar	011-10845 041	mnazrimnasir@utm.my
	PM. Ir. Dr. Shuhaimi Mansor	V01	Ext. 58443	shuhaimi@utm.my

Mapping of the Course Learning Outcomes (CLO) to the Programme Learning Outcomes (PLO), Teaching & Learning (T&L) methods and Assessment methods:

No.	CLO	PLO (CODE)	*Taxonomies and **generic skills	T&L methods	***Assessment methods
CLO1	Outline and explain the use of axes system and notation and axes transformation in aircraft dynamics stability	PLO1 (KW)	C4	Lecture, active learning	T,Q, F
CLO2	Derive the linearized equation of motion using small perturbation theory of a rigid body aircraft	PLO1 (KW)	C3	Lecture, active learning	T,F, PR
CLO3	Analyse the stability and control derivatives and their effect on	PLO1 (KW)	C4	Lecture, active learning	T,Q, F

Prepared by:		Certified by:	
Name:	Ir. Dr-Ing Mohd Nazri bin Mohd Nasir	Name:	PM. Ir. Dr. Pakharuddin Md Samin
Signature:		Signature:	
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	aircraft stability modes and flying qualities				
CLO4	Apply the aircraft stability characteristics to develop flight control system design using classical and modern control theory	PLO5 (SCMT)	C3, C5	Lecture, active learning	T,Q, F
CLO5	Apply and analyse suitable flight control system design to adopt standard design requirements	PLO1 (KW), PLO5 (SCMT), PLO11 (SC)	C4, C5, P6 (SC1)	Project Based using IR 4.0	PR, Pr
Refer *Taxonomies of Learning and **UTM's Graduate Attributes, where applicable for measurement of outcomes achievement ***T – Test; Q – Quiz; ASG– Assignment; HW – Homework; PR – Project; Pr – Presentation; F – Final Exam etc.					

Details on Innovative T&L practices:

No.	Type	Implementation
1.	Problem based learning	Conducted through group projects in designing aircraft flight control and developing a simple simulator
2.	Active learning	Using the e-learning system

Weekly Schedule:

Week 1	Introduction To Subject And Its Application - Aircraft stability Aircraft flight control design
Week 2	Axes System And Notation - Body, wind and earth axes system. Euler angles, transformation axes (linear and angular, magnitude and sign convention)
Week 3	Aircraft Rigid Body Equation Of Motion - Force and moment equations. Gravitational and aerodynamics terms. Small perturbation equations,.
Week 4	Stability And Control Derivatives - Basic theory and semi-empirical methods using ESDU and DATCOM methods and wind tunnel testing.
Week 5	Characteristics Of Longitudinal And Lateral Mode -Characteristics equations, stability mode. Longitudinal short period and Phugoid mode. Lateral roll, spiral and Dutch roll mode.

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Week 6	Aircraft Transfer Function. Mode excitation. State-space Matrix. Stability Augmentation System
Week 7	Aircraft Flying And Handling Qualities - Evaluation of flying qualities using standard MILSPEC-F-8785C and FAR. Pilot Rating and Cooper-Harper scale. Longitudinal and lateral flying and handling qualities.
Week 8	Mid-Semester Break
Week 9	Stability Augmentation And Automatic Control - Feedback control system design for longitudinal motion. Feedback control system design for lateral motion.
Week 10	Classical Control Theory - Time response and frequency response analysis. Application of classical control to autopilot design
Week 11	Classical Autopilot Design - S-plane and Root Locus method. Yaw damper and yaw attitude and roll control
Week 12	Modern Control Theory - General equation of motion. Matrix algebra. Observable and controllable analysis. Solution to longitudinal and lateral motions.
Week 13	Modern Autopilot Design - Control system design using multivariable state-space methods. Application of multivariable to autopilot design
Week 14	Flight Control System Design - Pitch rate and Pitch Attitude Control. PI and PID control system design and lead/lag compensation. Effect of actuator and sensors. Cruise control, height and Mach hold and landing.
Week 15	MATLAB Simulation And Flight Control System Design. Introduction to engineering flight simulator. Auto stabilization using multivariable control system.

Transferable skills (generic skills learned in course of study which can be useful and utilised in other settings):

Modern Tools Usage

Lifelong learning

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Student learning time (SLT) details:

Distribution of student Learning Time (SLT) Course content outline	Teaching and Learning Activities						TOTAL SLT
	Guided Learning (Face to Face)				Guided Learning Non-Face to Face	Independent Learning Non-Face to face	
CLO	L	T	P	O			
CLO 1	12h				5h	10h	27h
CLO 2	8h		4h		5h	10h	27h
CLO 3	12h				5h	10h	27h
CLO 4	2h				5h	10h	17h
CLO 5	2h				4h	10h	16h
Total SLT	36h		4h		24h	50h	114h

Continuous Assessment		PLO	Percentage	Total SLT
1	Test 1	PLO1 (KW)	15	1hr
2	Test 2	PLO1 (KW)	15	1hr
3	Assignments	PLO2 (THPA)	15	30m
4	Projects	PLO1 (KW)	5	20m
5	Projects	PLO11 (SC)	5	10m
Final Assessment			Percentage	Total SLT
1	Final Examination	PLO1 (KW), PLO2 (THPA)	40	3h
Grand Total			100	120h

L: Lecture, T: Tutorial, P: Practical, O: Others

Special requirement to deliver the course (e.g: software, nursery, computer lab, simulation room):

Matlab, Flight simulator, Flight gear, Joystick

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Learning resources:

Text book (if applicable)

1. Nelson, R.C., Flight Stability and Automatic Control, McGraw-Hill Book Company, 1989.
2. McLean, D., Automatic Flight Control System, Prentice Hall International, 1990.
3. Etkin B., Dynamic of Flight – Stability and Control, Prentice Hall International, 1990.
4. Blakelock, J.H., Automatic Control of Aircraft and Missiles, Second edition, 1991.
5. Cook M V., Flight Dynamics Principles, 1st Edition, Butterworth, 1997

Online resources

<http://elearning.utm.my>

Academic honesty and plagiarism: *(Below is just a sample)*

Assignments are individual tasks and NOT group activities (UNLESS EXPLICITLY INDICATED AS GROUP ACTIVITIES) Copying of work (texts, simulation results etc.) from other students/groups or from other sources is not allowed. Brief quotations are allowed and then only if indicated as such. Existing texts should be reformulated with your own words used to explain what you have read. It is not acceptable to retype existing texts and just acknowledge the source as a reference. Be warned: students who submit copied work will obtain a mark of **zero** for the assignment and disciplinary steps may be taken by the Faculty. It is also unacceptable to do somebody else's work, to lend your work to them or to make your work available to them to copy.

Other additional information (Course policy, any specific instruction etc.):

Attendance must not be less than 80%

Disclaimer:

All teaching and learning materials associated with this course are for personal use only. The materials are intended for educational purposes only. Reproduction of the materials in any form for any purposes other than what it is intended for is prohibited.

While every effort has been made to ensure the accuracy of the information supplied herein, Universiti Teknologi Malaysia cannot be held responsible for any errors or omissions.

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