Subject Description Form

Subject Code	AAE4304
Subject Title	Advanced Positioning and Navigation Systems
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To provide students with advanced knowledge of positioning and navigation systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. possess all required mathematical concepts and skills related to the area of positioning and navigation; 2. apply the learnt concepts and skills to maintain and perform diagnosis on existing positioning and navigation systems; 3. extend their knowledge to analyze and develop new electronic modules and components in positioning and navigation for desired needs.
Subject Synopsis/ Indicative Syllabus	**Introduction and Radio Theory**: EM radiation (radio waves); dipole aerial; polarization; radio frequency spectrum; frequency, amplitude, pulse and phase modulation; SSB in HF communications; pulse modulation; classification of emissions; refraction, reflection, diffraction and attenuation; dipole, parabolic, phase array and slotted antennae; VHF; VHF/UHF; signal propagation; atmospheric/ionospheric ducting; Doppler effect; **NDB and ADF**: ground DF; VDF let-down procedure; NDB frequencies; NDBs locators and beacons; ground installations; BFO; NON A1A and NON A2A; ADF; cardioid polar diagram; RBI/RMI; errors of NDB/ADF; ICAO required fixing accuracy of NDBs; QDM and QDR interception **VOR and VOR Tracking**: VOR frequencies; principle of operation; aircraft navigation reception equipment; aircraft installation; VOR indicator/OBI; ICAO required accuracy of VOR; error of VOR; self-monitoring function; radial cross cuts; **Landing Aids**: DME, interrogation response, required accuracy, transmission classification P0N, beacon saturation. ILS Localiser, Glide-path, ILS displays on the OBI, HSI and EFIS PFD, limits of ILS CATI, II and III, MLS, principle of operation, ICAO required accuracy **Radar**: Radar theory, operating frequencies, pulse radar, radar mile, factors controlling bearing and range resolution, ground based radars, Airborne

Weather Radar (AWR), CWR (radio altimeter), Mention Doppler Radar (MTR)

Transponders: SSR transponders, operation principle, digital data in pulse transmission, Mode A and C, ADS-B

Area Navigation Systems (RNAV), FMS & EFIS: ICAO Annex 11; B-RNAV and P-RNAV; operation of basic RNAV; limitations of B-RNAV; RNP; FMC/FMS operation; internal database content and structure; FMS set-up procedure; EFIS system; recognise and interpret glass cockpit displays; failure warnings; SEI

Global Navigation Satellite Systems -FANS & RNAV Approaches: ICAO required accuracy for GPS; GPS in ADS-B

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for positioning and navigation.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	**Intended subject learning outcomes**		
	1	**2**	**3**
1. Lecture	√	√	
2. Tutorial	√	√	
3. Homework assignment	√	√	
4. Case study report	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		1	2	3
1. Assignments	20 %	√	√	
2. Test	20 %	√	√	
3. Case study	20 %	√	√	√
4. Examination	40 %	√	√	√
Total	100 %			

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: Overall Assessment: 0.40 End of Subject Examination + 0.60 Continuous Assessment The continuous assessment consists of three components: homework assignments, test, and case study. They are aimed at evaluating the progress of students study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt. The examination is used to assess the knowledge acquired by the students for understanding and analyzing the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Self-Study	22 Hrs.
	▪ Case Study	44 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. *Oxford ATPL Manual 11 - Radio Navigation – EASA,* Oxford Publishing, Latest Edition 2. Davide Dardari et al, *Satellite and terrestrial radio positioning techniques: a signal processing perspective,* Oxford Academic Press, 2012. 3. Pratap Misra, *Global positioning system : signals, measurements, and performance,* Ganga-Jamuna Press, 2006 4. Pat Langley-Price et al, *Ocean yachtmaster : Adlard Coles' coursebook for ocean navigation student,* Adlard Coles Nautical, 2007. 5. Mohinder S. Grewal, *Global navigation satellite systems, inertial navigation, and integration*, John Wiley & Sons, 2013 6. Aboelmagd Noureldin, *Fundamentals of inertial navigation, satellite-based positioning and their integration,* Springer, 2013	