IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Principles of Classical and Modern Radar Systems		
New code	ELEC60031	New short title	Radar Systems

Brief description of module *(approx. 600 chars.)*

With the deployment of 5G/6G, a parallel revolution in radar technology is underway, with rapidly expanding applications well beyond traditional defence and security domains. Emerging use cases include collision-avoidance systems in autonomous vehicles, remotely piloted civilian drones, AgTech (agricultural technology), robotics and industrial automation, biomedical sensing, and remote sensing. These applications rely on radar for detection, parameter estimation, localisation, tracking, and classification of objects.
This course provides a comprehensive introduction to the fundamentals of classical long-range radar, alongside the latest developments in short-range

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit	
Credit value	5	10	N	HECOS codes
FHEQ level	level 6			

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	10	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	20	
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	75	*Incl. wider reading/ practice, follow-up work, completion of assessı*
Placement		*Incl. work-based learning and study that occurs overseas.*
Total hours	125	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Term 1	Other	

Ownership

Primary department	Electrical and Electronic Engineering
Additional teaching departments	

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Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	N
External institution	N/A
External department	N/A
External campus	N/A

Associated staff

Role	CID	Given name	Surname
Module Leader		Athanassios	Manikas

Learning and teaching

Module description

Learning outcomes	**Learning Outcomes** Upon successful completion of this module, students will be able to: • **Critically apply radar equations** to analyse, evaluate, and predict the performance of radar systems under varying operating conditions. • **Evaluate and compare radar architectures**, applying theoretical principles to classify systems and assess their performance, advantages, and limitations. • **Systematically analyse and design radar subsystems,** including transmitters and receivers, demonstrating an understanding of their role within complete radar systems. • **Design and justify radar waveforms and system architectures** for detection, estimation, localisation, tracking, and classification tasks, taking into account the effects of noise, clutter, and interference.

Module content	**A.** Classification of radar systems; fundamentals of radar system architectures; radar equations; radar waveforms and their applications; radar cross section (RCS) of targets. **B.** Continuous-wave (CW) and frequency-modulated (FM/FMCW) radar; moving target indication (MTI) and pulse radar; monostatic, bistatic, and multistatic radar architectures; Doppler effects and range/Doppler measurement; biologically inspired waveform design; cognitive radar; airborne radar systems. **C.** Detection, estimation, localisation, tracking, and classification of radar signals/targets/objects in the presence of noise, clutter, and interference. **D.** Advanced radar systems, including phased-array radar, synthetic aperture radar (SAR), SIMO and MIMO radar: principles, applications, advantages, and limitations. **E.** Civilian applications of radar; defence, security, and electronic warfare applications. **Delivery Structure** The above material is delivered through the following 10 topics (approximately 1 hour per topic): 1. Introductory Concepts 2. Radar Fundamentals 3. Target Reflectivity and Electromagnetic (EM) Wave Refresher 4. Radar Cross Section (RCS) and Clutter 5. Target Detectability, Estimation, and Classification 6. CW and FMCW Radar 7. Bistatic Radar 8. Phased-Array Radar 9. MIMO Radar 10. Modern Radar Systems (Passive Radar, OFDM Radar, Cognitive Radar, UWB Radar, Synthetic Aperture Radar)
Learning and Teaching Approach	Lectures which will be supported by a set of carefully designed notes and a large number of multiple choice tests covering the whole course syllabus
Assessment Strategy	Multiple choice online assessment and a radar design coursework. The coursework will be software based design (using Matlab, Labview, Python, Cython or visual C++) and the deliverables will include a number of script files and a pdf document with the results of the various tasks.
Feedback	This will follow standard Departmental good practice
Reading list	[1] Lecture Notes (Information): https://skynet.ee.ic.ac.uk/notes/Radar_0_Topics_Prelude.pdf [2] M. A. Richards, J. A. Scheer, and W. A. Holm, Principles of Modern Radar: Vol.I - Basic Principles. SciTech Publishing Inc., 2010. [3] W. L. Melvin and J. A. Scheer, Principles of Modern Radar: Vol.II - Advanced Techniques. SciTech Publishing Inc., 2013. [4] W. L. Melvin and J. A. Scheer, Principles of Modern Radar: Vol.III - Radar Applications. SciTech Publishing Inc., 2014.

Quality assurance

Date of first approval	
Date of last revision	October 2025
Date of this approval	July 2026
Module leader	Athanassios Manikas

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments	updated 11 Sept 2026

Template version

Assessment details

Grading method	Numeric	Pass mark	40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Multiple choise online assessment	60%	40%	N
Coursework	Radar Design	40%	40%	N
		100%		