INTRODUCTION TO RADAR & SATELLITE ENGINEERING

ECE 514E – RADAR & SATELLITE ENGINEERING

Monday, 07 September 2026

ECE 514E SYLLABUS

Pre-requisites:

ECE 328 - Principles of Communication Systems,

ECE 416 - Digital Communication Systems

Course Purpose:

To enable students be familiarize with modern radar and navigation systems and principles of design radio-navigation and location systems, as well as radar systems

WHY IS THIS COURSE IMPORTANT? /1-1

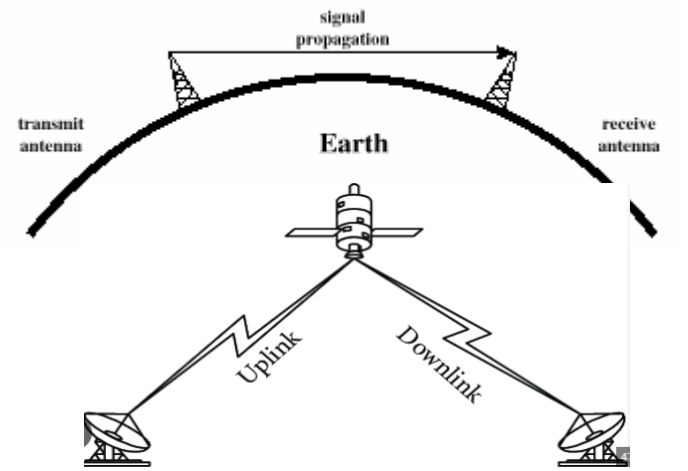
1. Knowledge of **Radar** is essential for engineers who whish to understand wireless ranging, i.e precise determination of distance between two objects and remote sensing.
2. **Principles of radar** are essential for detection of objects in other media such as water (undersea measurements).

WHY IS THIS COURSE IMPORTANT? /1-2

3. **Principles of radar** are essential for one to understand
   a) Avionics (navigation, communication, etc.)
   b) Remote sensing
   c) Medical applications such as ultrasound and NMR

WHY IS THIS COURSE IMPORTANT? /2-1

1. **Satellite systems** allow us to communicate at microwave frequencies over the radio horizon.

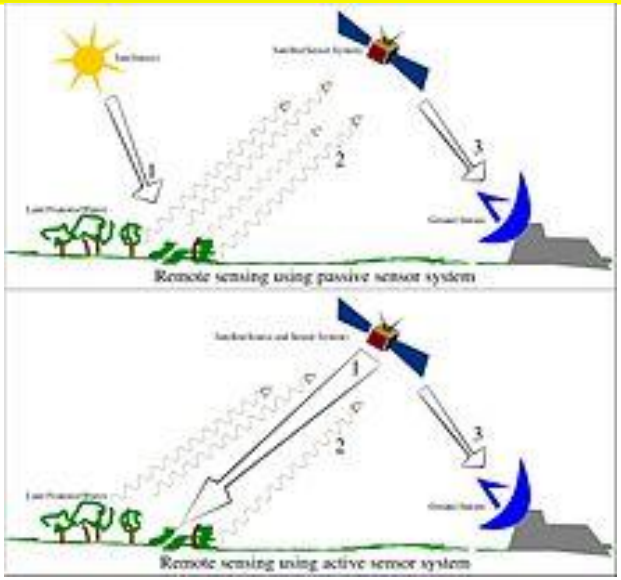


2. **Weather Satellite systems** allow us to monitor and predict weather conditions.



WHY IS THIS COURSE IMPORTANT? /2-2

1. **Satellite systems** support remote sensing applications for surface mounted and underground objects/conditions.



2. **Satellites** are used as recovery systems when fibre communication system fail or are under maintenance.

ECE 521E SYLLABUS (1)

Purspose of Course:

To enable students be familiarize with modern radar and navigation systems and principles of design radio-navigation and location systems, as well as radar systems.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. explain principles of operation of radar systems;

ii. apply theoretical and practical knowledge about principles, methods and applications of modern radar systems;

iii. measure and identify the parameters which determine the performance of radar systems;

iv. explain the function of satellite subsystems;

v. apply orbital mechanics formula and tools to spacecraft mission design;

vi. select appropriate launch systems and understand their effect on satellite and payload design and performance;

vii. design and analyse satellite links;

viii.evaluate satellite subsystem performance

ECE 514E SYLLABUS (3)

Course Content (1)

1. **Basic Principles of Radar:** Antenna parameters, Radar equation. Performance parameters, target cross-section,
2. **MTI and Doppler radar:** Doppler Effect, CW radar, FMCW radar, Delay line cancellers, Pulse Doppler Radar.
3. **Scanning, Duplexers and Radar receivers:** Sequential lobbing, Conical Scanning, Monopulse Tracking RADAR, Tracking with surveillance RADAR, Acquisition, Radar receiver, Radar Displays; Duplexers

ECE 514E SYLLABUS (5)

Course Content (2)

4. **Introduction to satellite communication:** international regulation & frequency coordination, satellite frequency allocation & band spectrum, active & passive satellites.
5. **Orbits and Launching Methods:** Kepler's laws, orbital elements, apogee and perigee heights, orbital perturbations, effects of non-spherical earth, atmospheric drag, the geostationary orbit, antenna look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launches and launch vehicles.
6. **Satellite Subsystems:** power supply, altitude control, station keeping, thermal control, transponders, antenna subsystem.

ECE 514E SYLLABUS (6)

Course Content (2)

7. **Earth stations:** transmit/receive earth stations.
8. **Space Segment:** Introduction, equivalent isotropic radiated power, transmission losses, link power budget equation, system noise, carrier-to noise ratio.
9. **Interference:** interference between satellite circuits, combined (C/I) due to interference on uplink and downlink, antenna gain function, pass band interference.

ECE 514E SYLLABUS (7)

Recommended book:

1. Skolnik M. I, *Introduction to Radar Systems*, McGraw-Hill.

2. Gerard Maral, Michel Bousquet, *Satellite Communications Systems: Systems, Techniques and Technology*, ISBN: 0-471-49654-5.

3. M. Richharia,, *Satellite Communication Systems*, 2nd Edition, McGrawHill Telecommunication Series, ISBN: 0-07-134208-7.

4. Kadish J.E. and East T.W.R., *Satellite Communication Fundamentals*, Artech House Books, ISBN: ISBN-10: 1580531369