

Western University
Faculty of Engineering
Department of Electrical and Computer Engineering
ECE 4431A: Applied RF Engineering for Modern Applications
COURSE OUTLINE Fall 2026-2027

DESCRIPTION This course explores the principles and advanced applications of Radio Frequency (RF) engineering across diverse fields, including automotive systems, biomedical devices, space exploration, and consumer electronics. The course bridges foundational RF theory with practical engineering implementation, utilizing an interactive, case-based approach. Students execute a continuous 12-week engineering design workflow—moving from high-level system specifications to CAD modeling, electromagnetic simulation, hardware measurement, and physical platform integration—culminating in an individual design project and a formal technical report.

ACADEMIC CALENDAR DESCRIPTION

https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_015097_1&Keywords=4431&SelectedCalendar=Live&ArchiveID=

CEAB ACADEMIC UNITS

Engineering Science 50%, Engineering Design 50%

ENROLLMENT RESTRICTIONS Prerequisites: ECE 3337A (Electronic Circuits), ECE 3370B (Communication Electronics I), ECE 3336B (Electromagnetic Theory).

INSTRUCTOR CONTACT INFORMATION Course Instructor: Office: Office Hours:

COURSE FORMAT Face-to-face.

TOPICS

The course operates on a dual-track timeline: instructor-led case studies run sequentially across the term, while students concurrently execute a 12-week individual design project.

Topic #	Description	Learning Activities	Tentative Timeline	CEAB Graduate Attributes Indicators
1	Case Study 1: Automotive Systems	High-level vehicle specifications, system link budget analysis, Friis transmission equation, Noise Figure (NF), Linearity (IP3,	Weeks 1–4	KB4

Topic #	Description	Learning Activities	Tentative Timeline	CEAB Graduate Attributes Indicators
		P1dB), cascaded gain, dynamic range, phase noise, PCB design interference and coexistence, antenna/circuit simulation, and platform integration (e.g., Navigation/Radar).		
2	Case Study 2: Biomedical Devices	Body-centric system analysis, Smith Chart impedance matching, planar transmission lines, microstrip coupled-line filter synthesis, miniaturized circuit simulation, power splitters, device integration, and testing (e.g., Wearable Telemetry).	Weeks 5–8	KB4
3	Case Study 3: Consumer & Space Tech	Product specifications, active circuit design (LNA stability/noise circles, PA efficiency classes A/AB/F), integrated patch antenna simulation, packaging, Signal/Power Integrity (SI/PI), board shielding for EMC, and over-the-air (OTA) measurements.	Weeks 9–12	KB4
4	Project Phase 1: Project Scope	Literature review, presenting a core research paper to the class, defining system requirements, and formally proposing an individual project topic.	Weeks 1–3	D1
5	Project Phase 2: Simulation & Prototyping	Developing active/passive circuit models in CAD (Keysight ADS, Ansys HFSS/CST), performing EM simulations, component synthesis, microstrip layout, and initial bench validation.	Weeks 4–8	D2, D3, ET2

Topic #	Description	Learning Activities	Tentative Timeline	CEAB Graduate Attributes Indicators
6	Project Phase 3: Integration & Final Assessment	Finalizing CAD models, hardware benchtop characterization (VNA measurement), physical integration, oral defense, and submitting the final engineering design report.	Weeks 9–12	D4, ET2

SPECIFIC LEARNING OUTCOMES & CEAB GRADUATE ATTRIBUTES

Degree Level Expectation / CEAB Attribute	Weight	Assessment Tools	Learning Outcomes
Application of Knowledge (KB, PA)	40%	Homework / Practical Assignments, Project	Ability to apply RF theory to analyze system specifications, calculate cascaded link budgets (NF/IP3), and solve PCB-level interference and coexistence challenges.
Engineering Design & Tools (Design, ET, Investigation)	30%	Project Modeling, Lab Demos	Ability to design active/passive RF circuits using industry CAD tools (ADS, HFSS), perform 3D EM extraction, and conduct VNA hardware measurements.
Communication Skills (CS, ITW)	30%	Project Presentation, IEEE Final Report	Ability to communicate technical design workflows, trade-offs, and physical measurement results clearly through oral defenses and formal IEEE-style reports.

ASSESSMENTS

Assessment Type	Scope / Material Covered	Tentative Due Date	Weight	CEAB GAs Assessed
Project Phase 1: Scope & Link Budget	System specifications, cascaded link budget analysis, and formal proposal.	Week 3	10%	D1
Project Phase 2: CAD Circuit Simulation	Schematic synthesis and active/passive circuit simulation (Keysight ADS).	Week 6	20%	D2, ET2
Project Phase 3: EM Extraction & Prototyping	3D EM simulation and layout bench validation.	Week 9	20%	D3, ET2
Project Final Presentation	Comprehensive oral defense of design workflow and trade-offs.	Week 11	15%	D4
Project Final Report	Engineering Design Manuscript detailing full implementation.	Week 12	35%	D4, KB4

Note on Assessment Scope & Cross-Listing: The project is an individual assessment. While cross-listed graduate students (ECE 9709) are held to research novelty and journal publication standards, undergraduate students (ECE 4431A) are evaluated primarily on the successful execution, simulation, and hardware validation of the engineering design workflow.

PROJECT SUBMISSION & LATE POLICY

- **Format:** The final project report must be submitted in IEEE manuscript format.
- **Deadlines:** All assignments and project reports are due by 23:55 on the due date.
- **Late Policy:** This course employs flexible deadlines for the assignments and the project report. Students are permitted to submit their assignment up to 48 hours past the deadline without academic penalty. Submissions after that window will not be accepted.

COLLABORATION & INDIVIDUAL WORK POLICIES Activities in which collaboration is permitted: None by default. Collaboration on any assignment or project phase is permitted only with explicit prior written approval from the instructor on a case-by-case basis. Activities in which students must work alone: Unless explicit prior approval is granted, students are expected to work entirely alone on all homework assignments, CAD circuit modeling, EM simulations, oral presentations, and the final report.

REQUIRED TEXTBOOKS, SOFTWARE, HARDWARE & MATERIAL COSTS

- **Required Material:** No textbook purchase is required. Curated IEEE research papers and lecture materials are available through university credentials on OWL Brightspace.
- **Recommended Reference Books:**
 - Primary: D. M. Pozar, Microwave Engineering, 4th Edition, Wiley. Print copies available at the Western Bookstore (~\$170 CAD). Free electronic access and e-book borrowing are available through Western Libraries.
 - Supplemental: C. A. Balanis, Antenna Theory; B. Razavi, RF Microelectronics; H. W. Ott, EMC Engineering. All available digitally via Western Libraries.
- **Simulation Software:** ADS, Keysight Genesys/EMPro. Available at no cost via Western ECE computer labs and university network remote access / free student desktop licenses.
- **Hardware & Measurement Component:** Hands-on laboratory and project bench testing utilize Vector Network Analyzers (VNAs, e.g., Keysight E5063A/E5061B), Spectrum Analyzers, RF signal generators, microstrip substrates, and test fixtures provided in lab sessions.
- **Material Cost Statement:** All required CAD software, laboratory measurement instruments, hardware test components, and digital textbook references are provided at zero cost (\$0 CAD) to enrolled students.

GENERAL POLICIES OF THE FACULTY OF ENGINEERING

The Faculty of Engineering has published a set of policies that govern the organization of the course, Faculty and University in [Policies and Procedures for Undergraduate Students](#). The policy covers:

- Absence/Late Accommodation Policy
- Religious Accommodation
- Academic Integrity
- Academic Offences
- Faculty of Engineering AI Policy
- Accessibility
- Inclusivity, Diversity, and Respect
- Health and Well-being
- Gender-Based and Sexual Violence