# EE4108: ANTENNAS FOR WIRELESS COMMUNICATIONS AND SENSING CONNECTIVITY

**Effective Term**
Semester A 2022/23

## Part I Course Overview

**Course Title**
Antennas for Wireless Communications and Sensing Connectivity

**Subject Code**
EE - Electrical Engineering
**Course Number**
4108

**Academic Unit**
Electrical Engineering (EE)

**College/School**
College of Engineering (EG)

**Course Duration**
One Semester

**Credit Units**
3

**Level**
B1, B2, B3, B4 - Bachelor's Degree

**Medium of Instruction**
English

**Medium of Assessment**
English

**Prerequisites**
EE2104 Introduction to Electromagnetics

**Precursors**
Nil

**Equivalent Courses**
Nil

**Exclusive Courses**
Nil

# Part II Course Details

**Abstract**

This course aims to provide students with essential techniques for the analysis and design of popular antennas for modern wireless communications. Emphasis is placed on the understanding of principles of operation. Basic measurement techniques will be learned.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | Describe and analyze some simple radiating systems | | x | x | |
| 2 | Analyze basic antenna arrays | | x | x | |
| 3 | Describe the general characteristics of high gain antennas | | x | x | |
| 4 | Describe the general characteristics of broadband antennas | | x | x | |
| 5 | Design dipole antennas, slot antennas and microstrip patch antennas | | x | x | |
| 6 | Design small antennas | | x | x | |

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

**Teaching and Learning Activities (TLAs)**

| | TLAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|---|---|---|---|
| 1 | Lecture | Background, basic theory, analysis, measurement techniques.<br>Exercises on basic analysis and practical designs.<br>Simulation on dipole antenna characteristics, design of microstrip antennas. | 1, 2, 3, 4, 5, 6 | 3 hrs/wk |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Tests (min.: 2) | 1, 2, 3, 4 | 36 | |
| 2 | #Assignments (min.: 3) | 1, 2, 3, 4 | 9 | |
| 3 | Lab Exercises/Reports | 4, 5, 6 | 15 | |

**Continuous Assessment (%)**

60

**Examination (%)**

40

**Examination Duration (Hours)**

2

**Additional Information for ATs**

Remark:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained.

# may include homework, tutorial exercise, project/mini-project, presentation

**Assessment Rubrics (AR)**

**Assessment Task**

Examination

**Criterion**

Achievements in CILOs

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

---

**Assessment Task**

Coursework

**Criterion**

Achievements in CILOs

**Excellent (A+, A, A-)**
High

**Good (B+, B, B-)**
Significant

**Fair (C+, C, C-)**
Moderate

**Marginal (D)**
Basic

**Failure (F)**
Not even reaching marginal levels

---

# Part III Other Information

**Keyword Syllabus**

Antenna Fundamentals
Overview, basic EM theory, transmission line theory, inhomogeneous wave equation, Hertzian dipole, transmitting antenna parameters, receiving antenna, antenna polarization, antenna measurement

Wire antennas
Electrically-small dipole, half-wave dipole, monopole, balun, folded dipole, loop antennas, inverted-F antenna

Antenna arrays
Array factors, pattern multiplication, uniform array, mutual coupling, scan blindness, multidimensional array, feed network, switched-beam array

High gain antennas
Yagi-Uda antenna, corner reflector antenna.

Broadband antennas
Travelling-wave antenna, helical antenna, frequency-independent antennas

Aperture antennas
Fields as sources of radiation, Huygen’ s Principle, horn antenna, slot antenna, reflector antennas

Microstrip antennas
Basic characteristics, transmission line model, cavity model, feed techniques, bandwidth enhancement techniques, size reduction techniques, PIFA.

**Reading List**

**Compulsory Readings**

| | Title |
|---|---|
| 1 | K F Lee: Principles of Antenna Theory, (John Wiley & Sons, New York, 1984) |
| 2 | W L Stutzman and G A Thiele: Antenna Theory and Design, (John Wiley & Sons, New York, 2nd Edition, 1998) |

**Additional Readings**

| | Title |
|---|---|
| 1 | R E Collin: Antennas and Radiowave Propagation, (McGraw-Hill, New York, 1985) |
| 2 | C A Balanis: Antenna Theory – Analysis and Design, (John Wiley & Sons, New York, 3rd Edition, 2005) |
| 3 | K F Lee and W Chen: Advances in Microstrip and Printed Antennas, (John Wiley & Sons, New York, 1997) |
| 4 | D K Cheng: Field and Wave Electromagnetics, (Addison-Wesley, Reading, 2nd Edition 1989) |