**MULTIMEDIA UNIVERSITY OF KENYA**

**FACULTY OF ENGINEERING & TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL & COMMUNICATIONS ENGINEERING**

# COURSE OUTLINE

## Part I: General Information

**Name of Lecturer: Kilungu**
**Office Location:** (Communication lab)
**Office Hours: Thursday** (10.00hr-12.00hr*)*
**Mobile Number:** 0733317830/0708281960
**E-mail:** dmanthi2010@gmail.com
**Academic year**: *2020/2021*
**Programme Name: *Bsc* .Electrical and Communication Engineering**

**Semester**: *April – July. 2021*

## Part II: Course Information

**Course Name**: 2514 SATELLITE COMMUNICATION
**Prerequisite:** ECE 2412 **Data Communication**

### Purpose

The aim of the this course is to enable student to;

- Understand fundamental concepts of orbital mechanics and the use of satellites in communications, broadcasting, and global positioning

### Learning Outcomes

At the end of this course, the student should be able to;

- Explain how the satellite orbits in space.
- Explain the applications of satellite in communications, broadcasting and global positioning.
- Describe the concept of link budgets and analyze various parameters of Artificial Satellites.

Identify the types of equipment required for uplink and downlink

### Course Description

**Principles of satellite communication**. Applications. **Link design**. **Analog satellite communication:** Introduction, Baseband analogue signal, FDM techniques, Single channel per carrier (SCPC) systems, Companded single sideband (CSSB) systems, Analogue FM/FDM link: operations and applications. **Digital satellite communication:** Advantages, Elements, baseband

signals, modulation techniques, link design. **Multiple access techniques:** Introduction, TDMA, TDMA-Frame structure, TDMA-Burst structure, TDMA-Frame efficiency, TDMA-superframe, TDMA-Frame acquisition & Synchronization, TDMA compared to FDMA, TDMA Burst Time Plan, Multiple Beam TDMA satellite system, Beam Hopping-TDMA, CDMA & hybrid access techniques. **Satellite orbits:** Introduction, orbit, parameters, location with respect to earth, Look angles, Earth coverage & slant range, Eclipse effect, Satellite placement in geostationary orbit, station keeping, Satellite stabilization. **Special purpose communication satellites:** BDS, INMARSAT, INTELSAT, VSAT, MSAT, Sarsat & LEOs, Satellite communication with respect to Fiber Optic Communication, LANDSAT, Defense satellite. **Laser satellite communication:** Introduction, Link analysis, Optical satellite link transmitter, Optical satellite link receiver, Satellite Beam Acquisition, Tracking & Positioning, Deep Space Optical Communication Link.

***Course textbook***

1. Dennis Roddy, (2006), Satellite Communications, McGraw-Hill Professional, 4th edition. ISBN-13: 978-0071462983.
2. Gerard Maral, Michel Bousquet and Zhili Sun (2010), Satellite Communications Systems: Systems, Techniques and Technology, Wiley, 5th edition. ISBN-13: 978-0470714584.
3. Bruce R. Elbert (2008), Introduction to Satellite Communications, Artech House Publishers, 3rd edition. ISBN-13: 978-1596932104.

**Course journals**

1. IEEE Transactions on Communications, IEEE Communications Society, ISSN: 0090-6778.
2. International Journal of Sattellite Communications and Networking, Wiley, ISSN: 1542-0981.
3. Journal of Electromagnetics, Taylor & Francis, ISSN: 0272-6343.

**Reference *textbook***

1. Anil K. Maini and Varsha Agrawal (2010), Satellite Technology: Principles and Applications, Wiley, 2nd edition. ISBN-13: 978-0470660249.

2. Louis J. Ippolito (2008), Satellite Communications Systems Engineering, Wiley, 1st edition. ISBN-13: 978-0470725276.
3. Martin, P. Anderson and L. Bartamian (2007), Communication Satellites, AIAA, 5th edition. ISBN-13: 978-1884989193

**Reference journals**

1. International Journal of Satellite Communications Policy and Management, Inderscience Publishers, ISSN: 1742-7568.
2. The International Journal of Satellite Communications, John Wiley and Sons, ISSN (printed): 0737-2884.
3. Applied Computational Electromagnetics Society Journal, Genamics JournalSeek, ISSN: 1054-4887.

**Teaching Methodology**

- The course will be conducted through lectures, tutorials, group discussion and presentation for 6 hours per week for the first six weeks of the semester. From the seveth to fourteenth week, 3 hours will be allocated to laboratory sessions on rotational basis and the other three hours per will be for lectures and tutorials.
- The lectures and tutorials will be conducted in **SM RM1** and laboratory exercises will be conducted in **Communication Lab**.

## Part III: Topic Outline/Schedule

**Week 01: Overview of satellite communication**

- Introduction to Frequency allocations for satellite services
- Kepler's first law – Kepler's second law – Kepler's third law
- Definitions of terms for earth parameters

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**Week 02 and Week 03: Analog satellite communication**

- Introduction to Baseband analogue signal
- FDM techniques
- Single channel per carrier (SCPC) systems
- Companded single sideband (CSSB) systems,
- Assignment-1

**Week 04:** Analogue FM/FDM link

- Operations and applications

**Week 05: Digital satellite communication:**

- Advantages
- Elements
- Baseband signals
- Modulation techniques link design.
- CAT-1 (5-6 PM)
- venue SM RM 1

**Week 06**: **Multiple access techniques**

- Introduction to TDMA
- TDMA-Frame structure
- TDMA-Burst structure
- TDMA-Frame efficiency
- TDMA-super frame
- TDMA-Frame acquisition & Synchronization
- TDMA compared to FDMA
- TDMA Burst Time Plan
- Multiple Beam TDMA satellite system
- Beam Hopping-TDMA
- CDMA & hybrid access techniques

**Week 07 and Week 08: Satellite orbits:**

- Introduction to orbit
- Orbital parameters
- location with respect to earth
- Look angles
- Earth coverage & slant range
- Eclipse effect
- Satellite placement in geostationary orbit
- Station keeping and Satellite stabilization
- **CAT-2** (17-18 PM)venue SM RM 1
- **Labs**

**Week 09 and Week 10: Special purpose communication satellites:**

- Overview of satellite application -BDS, INMARSAT, INTELSAT, VSAT, MSAT
- Sarsat & LEOs
- Satellite communication with respect to Fiber Optic Communication
- LANDSAT
- Defense satellite
- Assignment -2
- Labs

**Week 11: Laser satellite communication**

- Introduction to laser satellite communication .
- Link analysis

**Week 12: Overview of Optical Satellite communication**

- Optical satellite link transmitter
- Optical satellite link receiver
- Satellite Beam Acquisition
- Tracking & Positioning
- Deep Space Optical Communication Link
- **Labs**
- **CAT-3 venue SM RM 1**

**Week 13: & 14 Revision**

**Week 15& 16 End of Semester Exam**

## Part IV: Mode of course assessment

The course unit is practical, the distribution of marks for various components is as indicated in the table below:-

***For Practical Unit***

| Description | Points |
|---|---|
| Continuous Assessment Test | 10% |
| Assignments | 5% |
| Laboratory /Workshop | 15% |
| Final Examination | 70% |
| Total Points Possible | 100% |

***For other units***

| Description | Points |
|---|---|
| Continuous Assessment Test | 20% |
| Assignments | 10% |
| Final Examination | 70% |
| Total Points Possible | 100% |

## Part V: Course Policies

**Class Attendance**

- Students are expected to attend all class sessions as indicated on the semester teaching timetable. A class attendance register will be used to tract the student's attendance. Note that if you don 't attend 2/3 of the lectures, you will not be allowed to sit for end of semester examination

**Late Work Policy**

- Be sure to pay close attention to deadlines—there will be no makeup assignments or CATs, or late work accepted without a serious and compelling reason and lecturer/Chairman of Department approval.

**Complete Assignments**

- Assignments must be submitted by the given deadline or special permission must be requested from Lecturer before the due date. Extensions will not be given beyond the next assignment except under extreme circumstances.

**Important Note:** Any form of academic dishonesty, including cheating and plagiarism, will be reported to the University Student Disciplinary Committee.

**Lecturer signature**:…….. **Date**:…….

**C.o.D Signature**: ……. **Date**:……..