Covenant University
2014|15 Academic Session Course Compact

College: **Engineering**
School: **Applied Engineering**
Department: **Electrical and Information Engineering**
Programme: **Information and Communication Engineering**

Course Code: **ICE 510**
Course Title: **Satellite Communications**
Course Units: **Three (3)**
Semester: **Alpha**
Course Lecturer: ***Prof. AAA. Atayero***

A. Brief Overview of Course

It is the aim of this course to provide broad coverage of Satellites Communications systems with just enough depth to serve as a foundation for more advanced studies in the field. The tool of mathematics is used to explain the physics of the technologies and schemes adopted for the transmission of content as well as mitigating the natural losses incurred from the conduit.

B. Course Objectives

At the end of this course, the attentive and studious student will have a good understanding of the following:

- Derivation of orbital equations for satellites in space
- Understanding of the Kepler's laws of planetary motion vis-à-vis their application to satellite orbits and location of satellite in orbit
- Various space segment-based satellite subsystems including: Attitude and Orbit Control System (AOCS), Telemetry, Tracking, and Command (TTC) system, Power Subsystem, Communication Subsystem, Antenna Subsystem
- System noise temperature, G/T ratio, Downlink design, Uplink design, Design for specified C/N, Design examples
- Analogue and Digital modulation techniques employed in satellite communications including: FM transmission by satellite, SCPC FM links, Digital transmission, Digital Modulation/Demodulation, Digital transmission of analogue signals
- Various multiple access schemes relevant to satellite communications: Frequency Division MA, Time Division MA, Code Division MA, Spread Spectrum Transmission and Reception.
- Very Small Aperture Terminal (VSAT) systems. Their network architectures, Access control protocols, Basic techniques, and VSAT Earth Station engineering.

C. Methods of Lecture Delivery / Teaching Aids:

- **Lecture Delivery**
  - Multimedia projection of PowerPoint slides of lecture materials
  - Interactive classroom sessions.
  - Question-and-answer sessions during and after lectures.
- **Teaching Aids**
  - Course administration on the *Moodle™* e-Learning platform:
    - http://moodle2.covenantuniversity.edu.ng
  - Visit to the Earth Station of the Network Operation Center of WMA HQ.

D. Course Outline:

Module 1: An Overview of Satellite Communications

Week 1: Course description, course objectives, grading system, brief history of Satcom, overview of Satcom: benefits, types of satellites, types of satellite services.

Module 2: Orbital Mechanics

Weeks 2 & 3: Deriving orbital equations, Kepler's laws of planetary motion, satellite orbits, locating satellite in orbit, orbital elements…

Module 3: Satellite Subsystems

Weeks 4 & 5: Attitude and Orbit Control System (AOCS), Telemetry, Tracking, and Command (TTC) system, Power Subsystem, Communication Subsystem, Antenna Subsystem.

Module 4: Satellite Link Design

Week 6 & 7: System noise temperature, G/T ratio, Downlink design, Uplink design, Design for specified C/N, Design examples.

Module 5: Modulation and Multiplexing Techniques

Week 8 & 9: Analogue FM transmission by satellite, SCPC FM links, Digital transmission, Digital Modulation/Demodulation, Digital transmission of analogue signals.

Module 6: Multiple Access Schemes

Week 10 & 11: Frequency Division MA, Time Division MA, Code Division MA, Spread Spectrum Transmission and Reception.

Module 7: VSAT Systems

Week 12: Overview, Network architectures, Access control protocols, Basic techniques, VSAT ES engineering.

E. Tutorials

One-hour tutorial class every fortnight.

F. Structure of Programme / Method of Grading:

- **Continuous Assessment [30marks]**
  - Short class tests (Test Your Knowledge –TYKs)
  - Impromptu / Mid-Semester tests
  - Other assignments/quiz
- **End of Semester Examination [70marks]**

G. Ground Rules & Regulations:

- All class assignments must be submitted on schedule.
- Lateness to classes is NOT allowed.
- Active participation in all class discussions is encouraged.
- No group discussions allowed during instruction.
- Group discussion encouraged for case studies.

H. Topics for Term Papers / Assignments / Student Activities:

Reading assignment is given at the end of each lecture from the reference text in preparation for subsequent lecture. TYKs are employed to test students understanding of course material.

I. Alignment with Covenant University Vision / Goals

The course is packaged and delivered with the core values of the University in mind. The specifics of the course serve as a rich platform for empowering the students to become seasoned technocrats in the field of telecommunications.

J. Contemporary Issues / Industry Relevance:

The relevance and import of satellite communications to the telecommunications industry is glaring. Modern telecommunications is inconceivable without employing the tools and services of satellite communications. This is of particular relevance to developing economies (like Nigeria) where there is a usual lack of extensive fiber-optic communication links. Satellite communications affords such economies the advantage of leapfrogging the technology gap between them and developed economies.

K. Recommended Text:

1. Timothy Pratt *et al.*, *Satellite Communications*, Copyright©2003, ISBN:9814-12-684-5
2. Dennis Roddy, *Satellite Communications,* Copyright©2001, ISBN:0-07-120240-4
3. Agarwal D.C., *Satellite Communications,* 2nd Ed., Khanna Publishers, Delhi.
4. Joseph A. Pecar *et al., The New McGraw-Hill TELECOM Factbook,* 2nd Ed., Copyright©2000, ISBN: 0-07-135163-9
5. Atayero A.A. and Sheluhin O.I. (2013), Integrated Models for Information Communication Systems and Networks: Design and Development, IGI-Global Publishers, USA, ISBN: 978-1-466-62208-1, 30th Jun. 2013, Available: http://qr.net/im4icsn
6. Patricia Morreale, Kornel Terplan, *The CRC Handbook of MODERN TELECOMMUNICATIONS,* Copyright©2001, ISBN: 0-8493-3337-7
7. Atayero A.A., Luka M.K., Alatishe A.A.. "Satellite link design: A tutorial." International Journal of Electrical & Computer Sciences 11, no. 4 (2011): 1-6.
8. MIT OCW, available at: http://ocw.covenantuniversity.edu.ng