TEL4213 RADIO FREQUENCY & MICROWAVE ENGINEERING

Hours per Semester				Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	30	00	60	100	60	40	4

Rationale

This course introduces the principles and RF & Microwave engineering and their application in radar and broadcast radio communication systems.

Course Objectives

By the end of the course the student should understand the

- Operation of components and devices used in RF & Microwave systems
- Principles of design and operation of devices for generation & processing of RF signals at different power levels.
- Applications of RF & microwave systems in communication, control & instrumentation.

Detailed Course Content:

Transmission lines and waveguides for RF: **[8 Hours]**

Evaluation of attenuation constant for the rectangular waveguide (perturbation analysis). Physical and electrical parameters of common coaxial lines and waveguides. Matching: physical realization of reactive elements; Sliding screw, triple screw and E-H tuners; Quarter-wave transformers. Energy coupling into and out of waveguides: probe, loop and aperture coupling.

Passive devices: **[6 Hours]**

Attenuators, couplers, terminators, phase shifters, slotted lines, hybrid junctions, tuners, switches, bends, twists, flanges and hybrid rings. Surface acoustic waves and SAW devices. Ferrite devices; Faraday rotation; Isolators and circulators. Microwave resonators; Frequency meters. Scattering parameters.

Generation and processing: **[8 Hours]**

Tube devices: Klystron; Magnetron; Traveling wave tube; Backward wave oscillator. Solid state devices: Bi-polar transistors; Field effect transistors; Tunnel diode; Transferred electron devices-Gunn diodes; Avalanche transit time devices-READ, IMPATT, TRAPATT, BARITT, PIN and SCHOTTKY diodes. Microwave integrated circuits and monolithic microwave integrated circuits. Parametric amplifiers; Masers; Lasers. **Active components**: Microwave filters, Microwave amplifiers, Oscillators and Mixers

Measurements: **[4 Hours]**

Frequency, wavelength, VSWR, reflection coefficient, attenuation and impedance; scattering parameters. Power measurements

Radio frequency power applications: **[8 Hours]**

Industrial, scientific and medical applications; Advantages of radio frequency heating. Interaction of radio frequency energy with materials: Mechanisms; Expression for energy conversion in a dielectric; Factors which affect dielectric heating. **Applicators**: Parallel plate, resonant and traveling wave. Biological effects ofnon-ionising radiation; Leakage standards and leakage control.

Radar systems: **[4 Hours]**

Radar equation and applications. Antenna types and scanning systems. Radar performance; pulse duration and pulse repetition frequency; Range and resolution; noise performance; Types of radar: Pulsed, MTI, CW,FM and mapping

Broadcast radio Communications: **[7 Hours]**

Learning Outcomes

On completion of this module, the learner will be able to:

- Demonstrate familiarity with the technical terms which are specific to microwave engineering, including the usages, styles and practices that are appropriate to this branch of electronics.
- Use software specific to microwave engineering to design matching networks, including conjugate matching and the use of quarter-wave transformers.
- Illustrate their solutions to matching problems on a Smith chart.
- Apply the S-parameters to characterize and to design microwave circuits.
- Demonstrate familiarity with the specialist instrumentation used in microwave engineering and calibrate and use such instrumentation to make basic measurements.

- Enumerate a variety of microwave antennas, their construction applications and the methodology used in making measurements on them.
- Recall the methods by which fixed terrestrial microwave radio systems are designed and use "noise calculations" to design radio systems.
- write an engineering report and comment critically on one of their laboratory exercises
- Make a presentation on an assigned aspect of microwave engineering (technology or the history of microwave engineering), working as part of a team and using appropriate media.

Method of Teaching /Delivery
The course will be taught by using lectures, tutorials and assignments.

Mode of Assessment
Assignments, tests and final examination. Their relative contributions to the final grade are :

Requirement	**Percentage contribution**
Course work (Assignments, tests)	40%
Final examination	60%
Total	
100%	

Recommended Books and References

1) Samuel Y Liao, "Microwave Devices & Circuits" , Prentice Hall of India, 2006.
2) Reinhold.Ludwig and Pavel Bretshko 'RF Circuit Design", Pearson Education, Inc., 2006
3) Robert. E.Collin-Foundation of Microwave Engg –Mc Graw Hill.
4) Annapurna Das and Sisir K Das, "Microwave Engineering", Tata Mc Graw Hill Inc., 2004.
5) M.M.Radmanesh , RF & Microwave Electronics Illustrated, Pearson Education, 2007.
6) Robert E.Colin, 2ed "Foundations for Microwave Engineering", McGraw Hill, 2001
7) D.M.Pozar, "Microwave Engineering.", John Wiley & sons, Inc., 2006.

Possible Lecturers:
Dr. J. Butime
Dr. D. Okello
Dr. Ing. L. L. Kaluuba
Mr. D. Nsubuga
Mubiru Mr. S.
Mwanje
Mr. A Wasswa Matovu
Mr. D. Sebbaale
Mr. I. Kitone