SATELLITE AND MICROWAVE ENGINEERING

VII Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB28	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

This course allows students to study and analyze microwave systems at high frequencies, typically in the MHz and GHz range where lumped elements (e.g., resistors, capacitors, inductors) are no longer appropriate. It introduces passive and active microwave devices that constitute wireless communication systems between the antenna and the signal processor. It deals withthe concepts of satellite communication and its principles to design of global satellite systems for communication.The main ap- plications are cellular communications, high-speed digital and analog circuits, wireless networks and radar.

II. OBJECTIVES:

The course should enable the students to:

I. Be Proficient in the concept of Satellite communication and understand placement of communication satellite in GEO.
II. Analyze the Satellite link budget and explain the satellite subsystems like telemetry, tracking and command system.
III. Perceive the concepts of waveguides and analyze the field components in different types of Waveguides.
IV. Categorize different types of microwave components based on their applications.
V. Imbibe knowledge to use microwave oscillators & amplifiers in microwave communication and Compare their characteristics.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** the concepts of transmission lines and waveguides to derive the field components of wave equations in TE, TM and TEM and understand their field patterns.	Remember
CO 2	**Apply** the concept of S-Matrix to measure output power in microwave components such as E-plane Tee, H-plane Tee, Magic –Tee and directional couplers.	Apply
CO3	**Determine** the performance characteristics of reflex klystron and two-cavity klystron for obtaining the mathematical expressions relatedto power gain and efficiency	Evaluate
CO 4	**Describe** the concept of microwave tubes for analyzing the microwave solid state devices	understand
CO 5	**Explain** the operating principle of GUNN diode using Ridley-Watkins- Hilum theory for obtaining the differential negative resistance.	understand
CO 6	**Categorize** and measure various microwave parameters using microwave test bench setup.	Analyze
CO 7	**Identify** different satellite systems like Low earth orbit (LEO), Medium earth orbit (MEO) and Geo synchronous earth orbit (GEO).	Apply

CO 8	**Examine** the various multiple access techniques used in communication satellites like FDMA, TDMA and CDMA	Analyze
CO 9	**Summarize** the concept of Sub-Systems of Satellites and Launches by using orbital mechanics	Understand
CO 10	**Illustrate** the design of Earth station and tracking of the satellites using orbit control system	Understand
CO 11	**Analyze** the design of satellite links for a specified C/N with and without frequency Re-use and link budget	Analyze

IV. SYLLABUS:

MODULE -I	**INTRODUCTION TO SATELLITE COMMUNICATION AND ORBITAL MECHANICS**	**Classes: 08**
Overview of present and future trends of satellite communications introduction to satellite systems; Orbital mechanics: Orbital elements; Locating the satellite with respect to the earth; Coverage angle; Slant range; Inclined orbits; Orbital perturbations; Eclipse of GEO satellite; Placement of a communication satellite in GEO satellite sub systems; Satellite link; Propagation effects.		
MODULE -II	**SATELLITE SUB-SYSTEMS &MODULATION AND MULTIPLE ACCESS SCHEMES**	**Classes: 09**
Multiple Access: Frequency division multiple access (FDMA), Time division multiple access (TDMA, demand assignment multiple access (DAMA). Code Division Multiple Access (CDMA) / Spread Spectrum Multiple Access (SSMA); Direct sequence CDMA (DS-CDMA) or DS spread spectrum transmission and reception, adjacent channel interference, inter modulation, handover, satellite diversity. Earth Station: Transmitters, receivers, antennas, tracking systems, terrestrial interface, power test methods, lower orbit considerations, VSAT (Very Small Aperture Terminal) Systems and Problems		
MODULE -III	**INTRODUCTION, WAVEGUIDE COMPONENTS AND APPLICATIONS**	**Classes: 09**
Introduction, Analysis of rectangular waveguide Wave impedance in rectangular waveguide: Wave impedance for a TM and TE wave in rectangular waveguide, Dominant mode and degenerate modes, mode characteristics of phase velocity, group velocity, wavelength and impedance relations; Cavity resonators; illustrative problems. Wave guide multiport junctions: Analysis; Ferrites: Faraday rotation principle, gyrator, isolator, circulator		
MODULE -IV	**MICROWAVE LINEAR BEAM AND CROSS FIELD TUBES (O TYPE AND M TYPE):**	**Classes: 10**
Microwave linear beam tubes (O type): Limitations of conventional tubes at microwave frequencies; Klystron; Multicavity Klystron amplifiers; Reflex Klystron; Helix Traveling Wave tube: Slow wave structures; Microwave cross field tubes (M type): Introduction, cross-field effects; Magnetrons		
MODULE -V	**MICROWAVE SOLID-STATE DEVICES & MICROWAVE MEASUREMENTS**	**Classes: 09**
Microwave solid-state devices: Microwave tunnel diode; Transferred electron devices: Gunn-effect diodes, Avalanche transit time devices: IMPATT diode, TRAPATT diode, BARITT diode, Pin diodes, varactor diodes, crystal detectors. Description of microwave bench: Different blocks and their features, precautions; Microwave power measurement: Bolometer; Measurement of attenuation; Frequency standing wave measurements: measurement of low and high VSWR; Cavity Q; Impedance measurements.		

V. Text Books:

1. Dennis roddy, "Satellite Communications", 4th Edition, 2004.
2. Pratt. Bostian, Allnutt, "Satellite Communications", Wiley India, 2nd Edition, 2006.
3. Gérard Maral, "Satellite Communication Systems", 1993.
4. Tri T. Ha, "Digital Satellite Communications", TMH, 2nd Edition, 1990.
5. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson, 3rd Edition, 2003.
6. Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, "Microwave Principles", CBS Publishers and Distributors, New Delhi, 1st Edition, 2004.
7. F.E. Terman, "Electronic and Radio Engineering", Tata McGraw-Hill Publications, 4th Edition,1955.

VI. Reference Books:

1. Rappaport T.S., "Wireless communications", Pearson Education, 2nd Edition, 2010.
2. Bruce Elbert, "Introduction to Satellite Communications", 1987.
3. M Richharia, "Satellite Communication Systems", R.E. Collin MacMillan, 2nd Edition, 2005.

VII. Web References:

1. http://nptel.ac.in/courses/106105082/33
2. http://onlinecourses.nptel.ac.in/noc16_ec10/preview
3. https://onlinecourses.nptel.ac.in/noc16_ec10/preview http://nptel.ac.in/courses/117101119/1
4. http://www-group.slac.stanford.edu/kly/Lecture_Series/slac_klystron_lecture_series.htm
5. https://books.google.co.in/books?id=ZU19Uemy83YC&printsec=frontcover&dq=microwave+ engineering & hl=en & redir_esc=y#v=onepage & q&f =false

VIII. E-Text Books:

1.https://ecedmans.files.wordpress.com/2014/10/microwave-devices-and-circuits-samuel-liao.pdf
2.http://www.faadooengineers.com/threads/11621-Microwave-engineering-ebook-pdf-Free-Download
3.http://www2.electron.frba.utn.edu.ar/~jcecconi/Bibliografia/Ocultos/Libros/Microwave_Engineering_David_M_Pozar_4ed_Wiley_2012.pdf.