KADI SARVA VISHWAVIDYALAYA

B.E. Semester: VI
Electronics & Communication Engineering
Subject Name: Antenna And Wave Propagation
Subject Code : EC-602 **W.E.F 2014-2015**

A. **Course Objective:**

The educational objectives of this course are

- To present a problem oriented introductory knowledge of Antenna And Wave Propagation
- To address the underlying concepts and methods behind Antenna And Wave Propagation.

B. **Teaching / Examination Scheme**

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EC-602	**Antenna And Wave Propagation**	4	0	2	6	5	3	70	30	20	30	150

C. **Detailed Syllabus:**

1. **Basic antenna concepts**:
   Definition and functions of an antenna, comparison between an antenna & transmission line, radio communication link with transmitting antenna and a receiving antenna, radiation patterns of antennas-field and power patterns, all antenna types.
2. **Radiation of Electric dipole:**
   Potential functions and the electromagnetic field, Oscillating electric dipolederivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Application to antennas, Radiation from quaterwave monopole and half wave dipoles, Derivation for radiation resistance, application of reciprocity theorem to antennas, equality of directional patterns and effective lengths of transmitting and receiving antennas, directional properties of dipole antennas, antenna feeding methods.
3. **Antenna parameters and definitions:**
   beam area, beam width- Half-Power Beam width (HPBW)and First Null Beam width(FNBW) ,Polarisation,Radiation Intensity ,Beam Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, resolution, Antenna aperture-physical and effective apertures, effective height, transmission formula, antenna field zones, Transmission loss as a function of frequency.Antenna temperature and signal to noise ratio.
4. **Arrays of point sources :**
   Expression for electric fields from two, three and N element arrays- linear arrays: Broad-side array and End-Fire array- Method of pattern multiplication- Binomial array-Horizontal and Vertical Antennas above the ground plane, Effect of ground on ungrounded antenna, Schelkunoff theorems for linear arrays, Dolph-Tchebysheff distribution for linear arrays.

5. **Loop Antenna:**
   Small loop short magnetic dipole, comparison of far field of small loop and short dipole loop antennas, field pattern of circular loop antenna & radiation resistance of loop antenna, directivity of circular loop antennas with uniform current.
6. **Helical antenna:**
   Helical geometry, transmission radiation modes, practical design considerations, wide band characteristics of helical antenna.
7. **Arrays of dipoles & apertures**:
   3 element dipole Array with parasitic elements,Yagi-uda array-function and its design, Phased arrays, frequency scanning arrays, smart antennas, long wire antennas, location methods of feeding antennas, folded dipole antennas, matching arrangements.
8. **Reflector antennas**:
   Parabolic reflector, paraboloid reflector, aperture Pattern of large circular apertures with uniform illumination, off axis operation of paraboloid reflectors, Cassegrain feed system.
9. **Slot patch & Horn antennas**:
   Slot antenna, its pattern,Babinet's principle and complementary antennas, impedance of slot antennas, and horn antenna-function and types.
10. **Microstrip (patch) antennas :**
    Rectangular and circular types-function, features analysis ,design considerations and applications
11. **Lens antennas**:
    Nonmetallic Dielectric lens and artificial dielectric lens antennas, reflector lens antennas.
12. **Broadband & Freq. Independent antennas**:
    Broadband antenna, Frequency. Independent antenna, log periodic antennas.
13. **Antennas for special applications:**
    Antennas design consideration for satellite communication, antenna for terrestrial mobile communication systems, GPR, Embedded antennas, UWB, Plasma antenna.
14. **Antennas measurements**:
    Experimental set ups for Measurement of radiation patterns, gain, phase polarization, terminal impedance.
15. **Radio wave propagation** :
    Modes of propagation, Ground Wave Propgation,Structure of troposphere and ionosphere, Characteristic of Ionospheric layers, Sky wave propagation, definitions for Virtual height, MUF and Skip distance, OWF, Fading,ionospheric absorptions, Multi-hop propagation, Space wave propagation and Super refraction.

D. **Lesson Planning**

SR. No.	No. of Hours	% Weight-age in Exam	Topics
1	03	**5**	**Basic antenna concepts**: Definition and functions of an antenna, comparison between an antenna & transmission line, radio communication link with transmitting antenna and a receiving antenna, radiation patterns of antennas-field and power patterns, all antenna types.
2	06	**10**	**Radiation of Electric dipole:** Potential functions and the electromagnetic field, Oscillating electric dipolederivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Application to antennas, Radiation from quaterwave monopole and half wave

			dipoles, Derivation for radiation resistance, application of reciprocity theorem to antennas, equality of directional patterns and effective lengths of transmitting and receiving antennas, directional properties of dipole antennas,antenna feeding methods.
3	06	**10**	**Antenna parameters and definitions:** beam area, beam width- Half-Power Beam width (HPBW)and First Null Beam width(FNBW) ,Polarisation,Radiation Intensity ,Beam Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, resolution, Antenna aperture-physical and effective apertures, effective height, transmission formula, antenna field zones, Transmission loss as a function of frequency.Antenna temperature and signal to noise ratio.
4	07	**10**	**Arrays of point sources :** Expression for electric fields from two, three and N element arrays-linear arrays: Broad-side array and End-Fire array- Method of pattern multiplication- Binomial array-Horizontal and Vertical Antennas above the ground plane, Effect of ground on ungrounded antenna, Schelkunoff theorems for linear arrays, Dolph-Tchebysheff distribution for linear arrays.
5	03	**05**	**Loop Antenna:** Small loop short magnetic dipole, comparison of far field of small loop and short dipole loop antennas, field pattern of circular loop antenna & radiation resistance of loop antenna, directivity of circular loop antennas with uniform current.
6	03	**05**	**Helical antenna:** Helical geometry, transmission radiation modes, practical design considerations, wide band characteristics of helical antenna
7	05	**10**	**Arrays of dipoles & apertures**: 3 element dipole Array with parasitic elements,Yagi-uda array-function and its design, Phased arrays, frequency scanning arrays, smart antennas, long wire antennas, location methods of feeding antennas, folded dipole antennas, matching arrangements.
8	04	**05**	**Reflector antennas**: Parabolic reflector, paraboloid reflector, aperture Pattern of large circular apertures with uniform illumination, off axis operation of paraboloid reflectors, Cassegrain feed system.
9	03	**05**	**Slot patch & Horn antennas**: Slot antenna, its pattern,Babinet's principle and complementary antennas, impedance of slot antennas, and horn antenna-function and types.
10	05	**10**	**Microstrip (patch) antennas :** Rectangular and circular types-function, features analysis ,design considerations and applications
11	02	**05**	**Lens antennas**: Nonmetallic Dielectric lens and artificial dielectric lens antennas, reflector lens antennas.
12	02	**05**	**Broadband & Freq. Independent antennas**: Broadband antenna, Frequency. Independent antenna, log periodic antennas.

13	03	**05**	**Antennas for special applications:** Antennas design consideration for satellite communication, antenna for terrestrial mobile communication systems, GPR, Embedded antennas, UWB, Plasma antenna.
14	02	**05**	**Antennas measurements**: Experimental set ups for Measurement of radiation patterns, gain, phase polarization, terminal impedance.
15	06	**05**	**Radio wave propagation** : Modes of propagation, Ground Wave Propgation,Structure of troposphere and ionosphere, Characteristic of Ionospheric layers, Sky wave propagation, definitions for Virtual height, MUF and Skip distance, OWF, Fading,ionospheric absorptions, Multi-hop propagation, Space wave propagation and Super refraction.
TOTAL	60	**100**	

E. Instructional Method & Pedagogy (ANNEXURE-I)

F: Suggested list of Experiments

1. To study the variation of field strength of radiated with distance from transmitting antenna
2. To plot the radiation pattern of an Omni directional antenna.(Polar plot on log/linear scales & Cartesian plot on log/linear scales)
3. To plot radiation pattern of directional antenna.(Polar plot of Azimuth & Elevation planes on log/linear scales and Cartesian plot on log scales)
4. To study the phenomenon of linear and circular polarization of antennas.
5. To demonstrate that the transmitting and receiving radiation patterns of an antenna are equal and hence confirm the reciprocity theorem of antennas.
6. To study and plot the radiation pattern of the dipole/Folded dipole antennas.
7. To study and plot the radiation pattern of the monopole/whip/collinear antenna.
8. To study and plot the radiation pattern of the end fire array (L/2) antenna & L/4 phased array (W8JK antenna).
9. To study and plot the radiation pattern of broad side array antenna.
10. To study and plot the radiation pattern of the loop antenna.
11. To study and plot the radiation pattern of biconical antenna.
12. To study and plot the radiation pattern of crossed dipole antenna.
13. To study and plot the radiation pattern of vee antenna.
14. To study and plot the radiation pattern of log-periodic antenna and LPDA-PCB.
15. To study and plot the radiation pattern of slot antenna.
16. To study and plot the radiation pattern of sleeve antenna.
17. Design of Yagi-Uda antenna, folded dipole,loop antenna,helical antenna,microstrip antenna.
18. To study different types of antenna characteristic using simulation exercise.

G: Students Learning Outcomes

On successful completion of the course

- The student can identify different areas of antenna & wave propagation . Can find the applications of all the areas in day to day life. Can identify the operations, working,

construction, material etc. Aspects of antenna & wave propagation, types of antennas, parameters of antennas etc. can work with the antenna simulation software HFSS.

H. Recommended Study Materials

Text Book:

1. Antennas for all applications 3 edition. by J.D.Krauss, TMH.
2. Electromagnetic wave & radiating systems by Jordan & Balmain, PHI Publication.
3. Antenna & Wave Propagation by K.D. Prasad, Satyaprakash Publications.

References Books:

1. Antenna Theory: Analysis and design –C. Balanis ,Wiley India.
2. Antenna and wave propagation By G.S.N. Raju,Pearson Education