Course Information

UE22EC351B - Transmission Lines, Waveguides, and Antennas (4-0-2-4-5)

RR: Dr. RGK, Prof. PR, Prof. AK
EC: Dr. RK, Prof. SG **74 (Teaching) + 10 (A/H/P) + 42 (Lab) = 126 slots**

Unit No.	Unit Title	Lecture slots	A/H/P slots*	Lab slots*	DD in-charge	Status of DD
1	Transmission Lines & Impedance Matching	19	2	9	PR	Yet to be done
2	Waveguides, cavities, and radiation from point source:	18	3	12	AK	available
3	Wire antennas and radiation parameters	18	2	12	RK	available
4	Friis transmission formula and antenna arrays:	19	3	9	SG	available

*6 lab slots for Open-ended experiments, lab exams will be conducted in the last slots.

Class No.	Chapter Title / Reference Literature	Topics to be covered	% of Portions covered	
			Class-wise	Cumulative
UNIT1: Transmission Lines & Impedance Matching				
1	T1: 2.1 P:48-49	Lumped element circuit model of Tx. Line	1	1
2	T1: 2.1 P:49-50	Voltage and current waves on Tx. Line	1	2
3	T1: 2.1 P:50-51	Lossless line and terminated lossless line	2	4
4	T1: 2.1 P:56-59	Reflection coefficient and transmission coefficient	1	5
5	T1: 2.1 P:56-59	Return loss and insertion loss	1	6
6	T1: 2.1 P:56-59	Standing wave ratio and input impedance	2	8
7-9	**Lab 1**	**Familiarization of QUCS – Simple transmission line in the time domain**		
10	T1: 2.1 P:59-63	Short-circuited line	1	9
11	T1: 2.1 P:59-63	Open-circuited line	1	10
12	T1: 2.1 P:59-63	Half wavelength line	1	11
13	T1: 2.1 P:59-63	Quarter wave transformer	2	13

14	T1: 2.1 P:63-68	Smith Chart – introduction	1	14
15	T1: 2.1 P:63-68	Constant resistance circles	2	16
16-18	**Lab 2**	**Design an RF circuit with an ideal transmission line using QUCS**		
19	T1: 2.1 P:63-68	Constant reactance circles	1	17
20	T1: 2.1 P:63-68	Constant SWR circles	1	18
21	T1: 2.1 P:63-68	Examples using Smith Chart	2	20
22	R1: 11.6B P:527-528	Single stub matching using Smith Chart	2	22
23	T1: 2.1 P:57	Power flow in Tx. Lines	1	23
24	R1:10.11.3 P:478-479	S-parameters – introduction	1	24
25-27	**Lab 3**	**Designing a matching circuit for the mismatched circuit using QUCS**		
28	R1:10.11.3 P:478-479	S-parameters – examples	2	26
29-30	**A/H/P 1 & 2 - Write a MATLAB program to calculate the impedance of a circuit Z0 = $\sqrt{L/C}$**			
UNIT2: Waveguides, cavities, and radiation from point source				
31	T1: 3.1 P:96-99	Introduction: Waveguide propagation	1	27
32	T1: 3.1 P:96-99	Waveguide propagation	1	28
33	T1: 3.1 P:96-99	Waveguide propagation	1	29
34	T1: 3.1 P: 100-101	Solutions of wave equations in rectangular coordinates	1	30
35	T1: 3.1 P: 100-101	Solutions of wave equations in rectangular coordinates	2	32
36	**AHP 3 – Derive the general solution of the wave equation in a rectangular waveguide**			
37-39	**LAB -4 (Manual)**	**MATLAB implementation to obtain the E-H Field Pattern plot for rectangular waveguide for TEmn and TMmn mode**		
40	T1: 3.3 P: 110-114	TE mode in Rectangular Waveguides	1	33
41	T1: 3.3 P: 115-116	TM mode in Rectangular Waveguides-1	1	34
42	T1: 3.3 P: 115-116	TM mode in Rectangular Waveguides-2	1	35
43	T1: 3.3 P: 114-117	Poynting vector, Power Transmission, Power losses in rectangular waveguides	2	37
44	**AHP 4 – Design of simple waveguide in CST**			
45-47	**LAB -5 (Manual)**	**Analysis of Rectangular waveguide using CST simulator**		
48	T1: 3.3 P: 114-117	Power losses in rectangular waveguides	1	40

49	T1: P: 161-162	Numericals	1	41
50	T1: 6.3: P:284	Microwave Cavities	1	42
51	T1: 6.3: P:284-287	Rectangular cavity resonator	1	43
52	T2: 3.1-3.3 P: 133-138	Magnetic vector potential - introduction	1	44
53	T2: 3.1-3.3 P: 133-138	Magnetic vector potential, Retarded potentials	1	45
54-56	**LAB -6 (Manual)**	**Familiarization with CST software:** **a) Analysis of monopole antenna using CST software.** **b) Analysis of dipole antenna using CST software.**		
57	**AHP 5- Numericals**			
58	T2: 3.1-3.3 P: 133-138	Relation between vector and scalar potential, Lorentz condition	1	46
59	T2: 3.5 P: 139-142	Inhomogeneous wave equation	1	49
60	T2: 3.5 P: 139-142	Solution for wave equation due to point source	1	50
61-63	**LAB -7 (Manual)**	**MATLAB implementation to obtain the field pattern and power pattern of a Dipole antenna.**		
		ISA-1 WEEK FOR UNITS 1 AND 2		
UNIT3: Wire antennas and radiation parameters				
64	T2:4.1-4.2 P:151	Infinitesimal current element or Hertzian dipole	2	52
65-67	**LAB -8 (Manual)**	**MATLAB implementation to obtain the field pattern and power pattern of a Dipole antenna**		
68	T2: 4.3-4.4.3 P: 162-170	Short dipole	2	54
69	T2:4.5-4.5.2 P: 170-172	Half-wavelength dipole	2	56
70	T2: 4.2.1-4.2.2 P: 151-156	Current distribution and radiated fields	2	58
71	T2:4.5-4.5.2 P: 170-172	Power density and power radiated	2	60
72	T2:4.5-4.5.2 P: 170-172	Power density and power radiated		
73	T2: 4.2.1-4.2.2 P: 151-156	Radiation resistance	2	62
74-75		Numericals		
76	T2:4.5-4.5.2 P: 170-172	Finite length dipole: current distribution	2	64

77-79	**LAB -9 (Manual)**	**MATLAB implementation to obtain the radiation pattern of a typical antenna system and find the half-power beam width and first null beam width.**		
80	**A/H/P 6: Numerical on directivity HPBW, FNBW**			
81	**A/H/P 7: Derive field equations of hertz, dipole antenna, and monopole antenna**			
82	-----do------	Radiated fields and power density	2	66
83	T2: 2.1-2.4,2.8 P: 27-42	Antenna parameters: radiation intensity	2	68
84	T2: 2.1-2.4,2.8 P: 27-42	Radiation pattern, directivity and gain	2	70
85	T2: 2.1-2.4,2.8 P: 27-42	Effective aperture and half-power beam width	2	72
86-88		Numericals		
89-91	**LAB -10 (Manual)**	**MATLAB implementation to obtain radiation pattern of an typical antenna systems and compare the Exact and approximate values of maximum directivity using Kraus and Tai &Pereira for U (Θ) with N varying from 1 to 2.**		
92	T2:2.5,2.6,2.8.2.9,2.13 P: 42-58,64-69,80-81	Input impedance and polarization	2	74
93-95	**LAB -11 (Manual)**	**Explore the concept of co-polarization and cross-polarization of a sectoral antenna.**		
UNIT 4: Friis transmission formula and antenna arrays:				
96	T2:2.16-2.17 P: 92-95	Friis transmission formula	1	75
97	T2:2.16-2.17 P: 92-95	Problems on Friss transmission formula	2	77
98		Field regions: near field region, intermediate field region, and far field region	2	79
99	T2:5.1 P: 195-199	Antenna arrays: Linear array	1	80
100	T2:5.2 P: 199-212	Two-element array: broadside array	2	82
101-103	**LAB -12 (Manual)**	**Measurement of Gain by substitution method**		
104	T2:5.1 P: 195-197	Pattern multiplication and array factor	1	83
105		Examples of pattern multiplication	1	84
106	T2:5.2 P: 199-212	Two-element array: broadside array	2	86

107 108	T2:5.2 P: 199-212	Two-element array: end-fire array	2	88
109	T2:5.2 P: 199-212	Examples on two-element arrays	1	89
110	T2:5.3 P:212-218	Array factor of a uniform linear array of N elements	2	91
111-113	**LAB -13 (Manual)**	**To study and plot the radiation pattern of an End fire array & Broad-side array using MATLAB &MATLAB implementation to obtain the radiation pattern of a planar Array**		
114	**A/H/P 8: Numerical problems for ARRAYS**			
115	**A/H/P 9: Project on arrays**			
116	T2:5.3 P:212-218	Main lobe and grating lobes	2	93
117	T2:5.4.1 P:228-232	Antenna array with uniform spacing and non-uniform amplitude (binomial array)	2	95
118	T2:5.4.1 P:228-232	Array factor of binomial array	2	97
119	T2:5.4.1 P:228-232	Comparison of uniform linear array and binomial array	1	98
120		Special antennas (Qualitative description)	2	100
121-123	**LAB -14**	**Project work**		
124	**A/H/P 10: Numerical problems on antenna arrays**			
125-126	**Conduction of Lab**			
ISA-2 WEEK FOR UNITS 3 AND 4				

References:

Book Type	Title & Author	Publisher	Edition
Textbook 1	Microwave Engineering by David M. Pozar	John Wiley & Sons	2nd Edition, 2004
Textbook 2	Antennas and Propagation by A.R.Harish and M.Sachidananda	Oxford University Press	1st Edition, 2007
Reference book 1	Principles of Electromagnetics by M. N. O. Sadiku and S. V. Kulkarni	Oxford University Press	6^{th} Edition, 2015

Assessment plan:

Event	Portion	Marks		Mode
A/H/P	At least one per unit	10 (A/H/P 1-10) + 10 (Project work – LAB 14)		**Simulation, Report Coding**
ISA 1	Units 1 and 2	40	Scaled to 30	**Hybrid mode**
ISA 2	Units 3 and 4	40		**Hybrid mode**
Total ISA		**50**		
ESA – Theory	Units 1, 2, 3, 4	100	Scaled to 50	**Hybrid mode**
ESA – Lab	Lab assessment	20		**Lab conduction + Observation**
Total ESA		**50**		
Total ISA + ESA		**100**		