Shree Sathyam
College of Engineering and Technology
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.
NH-544, Salem - Coimbatore Highways, Kuppanur, Sankari Taluk, Salem - 637301, TamilNadu, India.
Email : principal@shreesathyam.edu.in Web : www.shreesathyam.edu.in Phone : 04283 - 244080

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

PROGRAMME	:	B.E. - ECE
ACADEMIC YEAR	:	2024-2025
SEMESTER	:	V (ODD)
REGULATION	:	2021
COURSE CODE	:	EC 3551
COURSE NAME	:	TRANMISSION LINES AND RF SYSTEMS
COURSE COMPONENT	:	CORE
NAME OF THE COURSE IN-CHARGE	:	Dr. P. KANNAN

UNIT I TRANSMISSION LINE THEORY

Syllabus: General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

Assessment Questions for UNIT I

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6-Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 &L4, HOTS – L5 &L6

Sl. No.	Questions	Marks	CO	BL	PI Code
	PART A				
1	What are the primary constants of a transmission line?	2	CO1	L1	1.4.1
2	What are the secondary constants of a transmission line?	2	CO1	L1	1.4.1
3	What are transmission lines?	2	CO1	L1	1.4.1
4	List the types of transmission lines.	2	CO1	L1	1.4.1
5	When will a transmission line deliver maximum power to a load?	2	CO1	L1	1.4.1
6	Name the types of line distortion.	2	CO1	L1	1.4.1
7	Write the condition for a distortionless line.	2	CO1	L1	1.4.1
8	Define wavelength and velocity of a wave.	2	CO1	L1	1.4.1
9	What is phase distortion or delay distortion?	2	CO1	L1	1.4.1
10	What is frequency distortion?	2	CO1	L1	1.4.1
11	How can distortion be reduced in a transmission line?	2	CO1	L1	1.4.1
12	Write an expression for characteristic impedance.	2	CO1	L1	1.4.1
13	What is called an infinite line?	2	CO1	L1	1.4.1
14	Define propagation constant.	2	CO1	L1	1.4.1
15	Mention the relation between characteristic impedance and primary constant of a transmission line.	2	CO1	L1	1.4.1
16	Draw the equivalent circuit of a transmission line.	2	CO1	L1	1.4.1
17	What does reflection take place on a transmission line?	2	CO1	L1	2.1.2
18	Define reflection coefficient.	2	CO1	L1	2.1.2

19	How are practical lines made appear as infinite lines?	2	CO1	L1	1.4.1
20	Define reflection factor.	2	CO1	L1	1.4.1
21	Define reflection loss.	2	CO1	L1	1.4.1
22	What is waveform distortion?	2	CO1	L1	1.4.1
23	The open circuit and short circuit impedances of a transmission line at 1500 Hz and 800 $\angle$-30^o Ω and 400 $\angle$-10^o Ω respectively. Calculate its propagation constant.	2	CO1	L1	1.4.1
24	Give the general equation for the input impedance of a dissipation line.	2	CO1	L1	1.4.1
25	Write the expressions for the characteristic impedance and propagation constant for the dissipationless line.	2	CO1	L1	1.4.1
26	How will you find out the propagation constant if the values of open and short circuited impedances are given?	2	CO1	L2	1.4.1
27	Give the relationship between the input impedance and characteristic impedance of an infinite line.	2	CO1	L2	1.4.1
28	Draw the waveform of voltage and current distribution along a short circuited line.	2	CO1	L2	1.4.1
29	Draw the waveform of voltage and current distribution along an open circuited line.	2	CO1	L2	1.4.1
30	What is the input impedance of an open circuit line?	2	CO1	L2	1.4.1
31	What is the input impedance of a short circuit line?	2	CO1	L2	1.4.1
32	A lossless line has a shunt capacitance of 69 pF and a series inductance of 0.387 μH. Calculate the characteristic impedance.	2	CO1	L2	1.4.1
33	Determine the reflection coefficient of a line when Z_R =200 Ω and Z_o= 692 $\angle$-12^{o}Ω.	2	CO1	L2	1.4.1
34	Calculate the load reflection of an open and short circuited line.	2	CO1	L2	1.4.1
35	Calculate the characteristic impedance of a transmission line if the following measurements have been made on the line Z_{oc} = 550 $\angle$-60^{o}Ω and Z_{sc} = 500 $\angle$ 30^{o}Ω.	2	CO1	L2	1.4.1
36	A 50 Ω line is terminated in load Z_R = 90 + j60 Ω. Determine the reflection coefficient.	2	CO1	L2	1.4.1
37	Find the attenuation and phase shift constant of a wave propagating along the line whose propagation constant is 1.048 x $10^{-4}\angle 88.8^o$.	2	CO1	L2	1.4.1
	PART B				
1	a) Discuss the general solution of a transmission line in detail. b) A generator of 1.0 Volts, 1000 cycles, supplies power to a 100 mile open wire line terminated in Z_o and having the following parameters: Series resistance R = 10.4 Ω/mile, Series inductance L = 0.00367 H/mile, Shunt conductance G = 0.8 x 10^{-6}℧/mile and capacitance between conductors C = 0.00835 x 10^{-6} F/mile. Find the Characteristic impedance, Propagation constant, Attenuation constant, Phase shift constant, Velocity of propagation and Wavelength.	7 6	CO1	L1	1.4.1
2	a) Discuss in detail about lumped loading and derive the Campbell's equation. b) A 2 meter long transmission line with characteristic impedance of 60 + j40 Ω is operating at ω = 10^6 rad/sec has attenuation constant of 0.921 Np/m and phase shift constant of 0 rad/m. If the line is terminated by a load of 20 + j50 Ω, determine the input impedance of this line.	7 6	CO1	L1	1.4.1
3	Explain the term SWR and derive its expression in terms of reflection coefficient for a lossless line.	13	CO1	L2	1.4.1

4	Derive an expression for the propagation constant and the velocity of propagation for an ordinary telephone cable.				
5	Show that a line will be distortionless if CR=LG.	13	CO1	L2	1.4.1
6	a) Explain in detail about the wave-form distortion and also derive the condition for distortion less line. b) Derive the expressions for input impedance of open and short circuited lines.	10 6			
7	Derive the condition to be satisfied for a distortionless line.	13	CO1	L2	1.4.1
8	Develop the differential equations governing the voltage and current at any point on a uniform transmission line. Solve these to obtain the voltage and current in terms of the load current and voltage.	13	CO1	L2	3.4.1
9	Explain the wave propagation in the zero dissipation line with waveforms of voltage and current for various loads.				
10	Derive an expression for the reflection co-efficient in terms of characteristic impedance Z_o and terminal impedance Z_R.	13	CO1	L3	1.4.1
11	Derive an expression for the input impedance of a transmission line. Assume the length of the lineas 'l', characteristic impedance Z_o terminated with Z_R.	13	CO1	L3	1.4.1
12	a) Explain in detail about the reflection on a line not terminated but its characteristic impedance Z_o. b) Derive the condition for minimum attenuation in a distortionless line.	7 6	CO1	L2	1.4.1 1.4.1
13	Derive the equations for α and β. Obtain the conditions for distortionless lines.	13	CO1	L1	1.4.1
14	Show that for any uniform transmission line the following relations are valid. $Z_o = \sqrt{Z_{oc}Z_{sc}}$ and $tanh\gamma l = \sqrt{\frac{Z_{sc}}{Z_{oc}}}$	13	CO1	L1	1.4.1
15	a) A parallel wire transmission line is having the following line parameters at 5 KHz. Series resistance (R=2.59 x 10^{-3} Ω/m), Series inductance (L=2 μH/m), Shunt conductance (G=0 ℧/m) and capacitance between conductors (C=5.56 nF/m). Find the characteristic impedance, attenuation constant, phase shift constant, velocity of propagation and wavelength. b) A 2meter long transmission line with characteristic impedance of 60+j40 Ω is operating at ω=10^6 rad/sec has attenuation constant of 0 rad/m. If the line in terminated by a load of 20+j50 Ω, determine the input impedance of this line.	7 6	CO1	L3 L3	2.1.2
16	a) Derive the transmission line equation and hence obtain expression for voltage and current on a transmission line. b) Prove that an infinite line equal to finite line terminated in its characteristic impedance.	7 6	CO1	L1 L1	1.4.1
17	A generator of 1 V, 1000 Hz supplies power to a 100 Km open wire line terminated in Z_o and having following parameters. R = 10.4 Ω/Km, G = 0.8 x 10^{-6}℧/Km, L = 0.00367 H/Km, C = 0.00835 μF/Km. Calculate Z_o, α, β, λ, ϑ. Also find the received power.	13	CO1	L3	2.1.2

18	A communication line has L = 3.67 mH/Km, G = 0.08 x 10^{-6}℧/Km, C = 0.0083 μF/Km and R = 10.4 Ω/Km. Determine the characteristic impedance, propagation constant, phase constant, velocity of propagation, sending end current and receiving end current for given frequency f = 1000 Hz, sending end voltage is 1 Volts and transmission line length is 100 Km.	13	CO1	L3	2.1.2
19	Derive the general transmission line equations for voltage and currents at any point on a line.	13	CO1	L1	1.4.1
20	Derive the input impedance Z_o from the transmission line equation and also find voltage reflection ratio at the load.	13	CO1	L1	1.4.1
	PART C				
1	A less loss transmission line with Z_o = 50 Ω and d = 1.5 m connects a voltage V_g source to a terminated load of Z_L = 50 + j50 Ω. If V_g = 60 V, operating frequency f = 100 MHz and Z_g = 50 Ω, find the distance of the first voltage maximum lM from the load and what is the power delivered to the load P_L? Assume the speed of the wave along the transmission line equal to speed of light.	15	CO1	L3	2.1.2
2	A 100 km long line is terminated in its characteristic impedance. A generator of internal impedance of 600 ohm and a voltage of 5 volts operating at frequency of 800 Hz is connected at the input end of the line. The characteristic impedance of the line is 550 ∠ -15^{0}and the propagation constant γ = 0.045 +j0.0825 per Km. Observe the parameter such as (a) Primary Constants (b)Sending end current and sending end voltage (c)Receiving end current and Receiving end Voltage (d) Sending end power and Receiving end power.	15	CO1	L3	2.1.2
3	Open circuited and short circuited measurements at a frequency of 5KHz on a line of length 200km yielded the following results: Z_{oc} = 570 ∠ -48^0 ohm , Z_{sc} = 720∠ 34^0 ohm. Evaluate Z_o , α, β and primary constants given that the approximate velocity of propagation to be 1.8 x 10^6 km/sec.	15	CO1	L3	2.1.2
4	a) An open wire line is 200 Km long is correctly terminated. The generator at the sending end has E_s = 10 V, f = 1 KHz and internal impedance of 500 Ohm. At that frequency Z_o=683-j138 and γ= 0.0074+j0.0356 per Km. Measure the sending and receiving end voltage, current and power. b) A cable has α = 0.01 Nepers /Km and β = 0.0018/Km and having length of 100 Km.Estimate the receiving end voltage when the line is terminated in its characteristic impedance and E_s = 5V.	8 7	CO1	L3 L3	2.1.2 2.1.2

UNIT II HIGH FREQUENCY TRANSMISSION LINES

Syllabus: Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

Assessment Questions for UNIT II

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
	Part A				
1	Define Standing Wave Ratio.	2	CO2	L1	1.4.1
2	Determine the values of VSWR in the case of a) Z_R=0 and b) Z_R=Z_o.	2	CO2	L1	1.4.1
3	Write the equation of SWR in terms of reflection coefficient.	2	CO2	L1	1.4.1
4	Write the equation of reflection coefficient in terms of SWR.	2	CO2	L1	1.4.1
5	Give the minimum and maximum value of SWR and reflection coefficient.	2	CO2	L1	1.4.1
6	Why is the quarter wave line called as copper insulator?	2	CO2	L1	1.4.1
7	A lossless line has a characterisitic impedance of 400 Ohms. Determine the standing wave ratio if the receiving end impedance is 800 + j0.0 Ohms.	2	CO2	L3	1.4.1
8	Give the properties of an infinite line.	2	CO2	L2	1.4.1
9	A lossless transmission line has a shunt capacitance of 100 pF/m and a series inductance of 4 μH/m. Determine the characteristic impedance.	2	CO2	L3	1.4.1
10	For the line of zero dissipation, what will be the values of attenuation constant and characteristic impedance?	2	CO2	L3	1.4.1
11	What are the assumptions to simplify the analysis of line performance at high frequencies?	2	CO2	L3	1.4.1
12	Write the expression for standing wave ratio in terms of reflection coefficient.	2	CO2	L3	1.4.1
13	Write the expression for the input impedance of open and short circuited dissipationless line.	2	CO2	L3	1.4.1
14	Calculate standing wave ratio and reflection coefficient on a line having the characteristic impedance Z_o = 300 Ω and terminating impedance in Z_R = 300 + j400 Ω.	2	CO2	L3	1.4.1
15	Why is a quarter wave line called an impedance inverter?	2	CO2	L1	1.4.1
16	What is the nature and value of Z_o for the dissipationless line?	2	CO2	L1	1.4.1
17	What are nodes and antinodes on a line?	2	CO2	L2	1.4.1
18	Give the minimum and maximum values of SWR and reflection coefficient.	2	CO2	L2	1.4.1
19	A lossless transmission has a shunt capacitance of 100 pF/m and a series inductance of 4μH/m. Calculate the characteristic impedance.	2	CO2	L1	1.4.1
20	Analyze the line with dissipationless line and find the values of attenuation constant and characteristic impedance.	2	CO2	L1	1.4.1
21	Explain the concept of dissipation less line.	2	CO2	L2	1.4.1
22	Sketch standing waves on a line having open or short circuit termination.	2	CO2	L1	1.4.1
23	Write an expression for inductance of an open wire line and coaxial line.	2	CO2	L1	1.4.1
24	Find the terminating load for a certain R.F transmission line which has the characteristic impedance of the line 1200 Ω and the reflection co-efficient was observed to be 0.2.	2	CO2	L3	2.1.2
	Part B				
1	Derive the expressions for voltage and current at any point on the radio frequency dissipation less line. Obtain the expressions for the same for different receiving end conditions.	13	CO2	L1	1.4.1
2	a) Explain standing waves, nodes, standing wave ratio also make relation between the standing wave ratio S and the magnitude of the reflection coefficient. b) State the condition for the open wire line at high frequencies and derive the parameters.	7 6	CO2	L2 L1	1.4.1

3	a) Explain the parameters of open wire line and co axial at RF. Mention the standard assumptions made for radio frequency line. Label the Line constants for zero dissipation. b) Derive the voltage and current equation on dissipation less line.	7 6	CO2	L2 L1	1.4.1
4	a) Discuss the reflection coefficient of different transmission lines. b) The ratio of spacing'd' to the radius 'a' of an open wire dissipation less line is 25 and the space between the conductors has a dielectric of relative permittivity of 8. Calculate (i)Inductance (ii) Capacitance (iii) Characteristic impedance	6 7	CO2	L2 L3	1.4.1
5	a) Compare the features of open wire and co axial cable at high frequencies. b) Explain the variation of input impedance along open and short circuit lines with relevant graphs.	6 7	CO2	L2	1.4.1
6	a) Describe the various parameters of open wire and co axial lines at radio frequency. b) Summarize the concept of Standing wave ratio.	7 6	CO2	L2	1.4.1
7	Explain how the VSWR and wavelength of the line measured in detail.	13	CO2	L2	1.4.1
8	a) Derive the line constants of a zero dissipation less line. b) Sketch the voltages and currents on dissipation less line for the conditions given below. (i) Open circuit (ii) Short circuit (c) $R_R = R_o$	7 6	CO2	L1 L1	1.4.1
9	a) A low loss transmission line of 100 Ω characteristic impedance is connected to a load of 200 Ω. Calculate the voltage reflection coefficient and the standing wave ratio. b) Solve the standing wave ratio and reflection co – efficient on a line having Z_o=300 Ω and terminated in Z_R=300 + j400 Ω	6 7	CO2	L3 L3	2.1.2 2.1.2
10	a) Draw the standing wave pattern for (i) Open circuited load (ii) Short circuited load(iii) matched load b)Prove that the reflection coefficient [|Emax| - |Emin|] / [|Emax| +|Emin|].	7 6	CO2	L1 L1	1.4.1
11	Explain the expressions for the input impedance of the dissipation less line. Deduce the input impedance of open and short circuited dissipation less line.	13	CO2	L2	1.4.1
12	a) Examine the voltage and currents at any point on the dissipation less line along with incident and reflected voltage wave phasor diagrams which must satisfy the conditions such as open circuit, short circuit, $R_R = R_o$. b) Explain the concept of generation of standing waves with neat diagram.	7 6	CO2	L3 L2	1.4.1
13	a) Summarize the relation between standing wave ratio (S) and magnitude of relation co – efficient. b) Find the reflection coefficient and voltage standing wave ratio of a line having R_o = 100 ohm, Z_R = 100 – j100 Ω.	7 6	CO2	L3 L3	2.1.2 2.1.2
14	Explain the following parameters (a) Standing waves (b) Standing wave ratio (c) Relation between SWR and K (d) Nodes and Antinodes	 3 3 4 3	CO2	L2	1.4.1

15	Discuss the various parameters of open wire and co-axial lines at radio frequency.	13	CO2	L2	1.4.1
16	a) A lossless in air having a characteristic impedance of 300 Ω is terminated in unknown impedance. The first voltage minimum is located at 15 cm from the load. The standing wave ratio is 3.3. Calculate the wavelength and terminated impedance. b) Derive the expression that permit easy measurements of power flow on a line of negligible losses.	7 6	CO2	L3 L1	2.1.2 1.4.1
17	a) A line with zero dissipation has R = 0.006 Ω/m, C = 4.45 pF/m, L = 2.5 μH/m, if the line is operated at 10 MHz find Ro, α, β, λ and ϑ. b) A lossless line has a standing waving ratio of 4. The Ro is 150 Ω and the maximum voltage measured in the line is 135 V. Find the power delivered to the load.	7 6	CO2	L3 L3	2.1.2 2.1.2
18	a) Derive an expression for the input impedance of a dissipationless line and also find the input impedance is maximum and minimum at a distance 's'. b) Find the sending end line impedance for a HF line having characteristic impedance of 50 Ω. The line is of length (1.185λ) and is terminated in a load of (110+j80) Ω.	6 7	CO2	L1 L3	1.4.1 2.1.2
19	a) Describe an experimental set up for the determination of VSWR of an RF transmission. b) Briefly explain on: i) Standing waves ii) Reflection Loss	7 6	CO2	L2	1.4.1 1.4.1
20	a) Derive the expression that permit easy measurements of power flow on a line of negligible losses. b) A radio frequency line with Zo = 70 Ω is terminated by ZL = 115-j80 Ω at λ = 2.5 m. Find the VSWR and the maximum and minimum line impedances.	7 6	CO2	L1 L3	1.4.1 2.1.2
21	Calculate the average input power at a distance from the load 'l' and find the impedance when the load is short circuited, open circuited and for a matched line.	13	CO2	L3	2.1.2
22	a) A 30 m long lossless transmission line with Zo = 50 Ω operating at 2 MHz is terminated with a load ZL = 60 + j40. If u = 0.6c ('c' is velocity of light, 'u' is phase velocity) on the line. Find i) The reflection coefficient $'\gamma'$ ii) The standing wave ratio iii) The input impedance b) Draw the input impedance pattern for a lossless line when short circuited and open circuited.	7 6	CO2	L3 L1	2.1.2
	PART C				
1	a) A Dissipation less co-axial cable has an inner copper conductor of radius 3mm and an outer copper conductor of radius 15mm. It is filled with dielectric material of relative permittivity ε_r. When it is excited at one end by an a.c. source, the phase velocity of the wave was observed to be 1.5 X 10^8 m/s. The other end is terminated in a load resistance Z_R = R_R which produces standing wave ratio of 3.8. What would you recommend the values for following parameters? (i) Characteristic impedance Z_o = R_o (ii) Dielectric constant (iii) Load resistance ZR = RR	15	CO2	L3	1.4.1

	(iv) Reflection Coefficient K				
2	Generalize the expressions for voltage and current at any point on the radio frequency dissipation less line. Obtain the expressions for the same for different receiving end conditions.	15	CO2	L1	1.4.1
3	Find the length of dissipationless line to obtain an inductance of 15µH at 60 MHz frequency with open circuit termination? Given that characteristic impedance of the line is 400 Ohm.	15	CO2	3	2.1.2
4	a) How would you make up the expression for maximum and minimum impedances on the line for a lossless line as RoS and Ro/S respectively? b) What way would you design the coaxial line at high frequencies? Design a graph to show the variation of R_o for a coaxial line.	15	CO2	3 3	3.4.1

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

Syllabus: Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

Assessment Questions for UNIT III

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
	PART A				
1	What is the need for impedance matching?	2	CO3	L1	1.4.1
2	List the requirements of a better transmission line.	2	CO3	L1	1.4.1
3	Explain the effect of impedance mismatching.	2	CO3	L1	1.4.1
4	Write the expression for standing wave ratio in terms of reflection coefficient.	2	CO3	L1	1.4.1
5	What are nodes and anti-nodes in a transmission line?	2	CO3	L1	1.4.1
6	Why do standing waves exist on transmission lines?	2	CO3	L2	1.4.1
7	Give the minimum and maximum value of SWR and reflection coefficient.	2	CO3	L2	1.4.1
8	Calculate the standing wave ratio if the reflection co-efficient of a line is $0.3 \angle -66^o$.	2	CO3	L3	1.4.1
9	A lossless line has a characteristic impedance of 400Ω. Determine the standing wave ratio if the receiving end impedance is 800+j0Ω.	2	CO3	L2	1.4.1
10	List the application of a quarter wave line.	2	CO3	L2	1.4.1
11	Why quarter wave lines are termed as impedance inverter?	2	CO3	L3	2.1.2
12	Why Quarter wave line is called as copper insulator?	2	CO3	L2	1.4.1
13	A 75Ω lossless transmission line is to be matched to a resistive load impedance of Z_L =100Ω via a quarter wave section.	2	CO3	L1	1.4.1
14	State the characteristic impedance of the quarter wave transformer.	2	CO3	L3	2.1.2
15	Mention the advantages of Smith Chart.	2	CO3	L1	1.4.1
16	Explain the procedure to find the impedance from the given admittance using smith chart.	2	CO3	L3	2.1.2
17	Define the term Stub used in transmission line.	2	CO3	L3	2.1.2
18	Why short circuited stub is preferred to open circuited stub?	2	CO3	L1	1.4.1

19	Explain the method to determine the position and the length of a single stub connected across the transmission line.	2	CO3	L2	1.4.1
20	Compare single stub matching and double stub matching.	2	CO3	L2	1.4.1
21	It is required to match a 200 Ω load to a 300 Ω transmission line to reduce the SWR along the line to 1. What must be the characteristic impedance of the quarter wave transformer used for this purpose if it is directly connected to the load?	2	CO3	L3	2.1.2
22	Design a quarter wave transformer to match a load of 200 Ω to a source resistance 500 Ω. The operating frequency is 200 MHz.	2	CO3	L3	2.1.2
23	Name few applications of half-wave line.	2	CO3	L1	1.4.1
24	What are constant S circles?	2	CO3	L1	1.4.1
25	How Smith chart can be used as an admittance chart? Explain.	2	CO3	L2	1.4.1
26	What are the advantages of double stub matching over single stub matching?	2	CO3	L1	1.4.1
27	What is stub matching?	2	CO3	L1	1.4.1
28	Give the names of circles on Smith chart.	2	CO3	L1	1.4.1
29	Mention two applications of Smith chart.	2	CO3	L1	1.4.1
30	List the advantages of Smith chart.	2	CO3	L1	1.4.1
31	What are the limitations of single stub matching?	2	CO3	L1	1.4.1
32	What is the transformation utilized for formulating the Smith chart?	2	CO3	L1	1.4.1
33	Why short circuited stub is preferred to an open circuited stub?	2	CO3	L2	1.4.1
34	Distinguish between single and double stub matching.	2	CO3	L2	1.4.1
35	On what mathematical formulation are the curves, circles etc., of a Smith chart obtained?	2	CO3	L2	1.4.1
36	Why is single stub matching inaccurate on coaxial line?	2	CO3	L2	1.4.1
37	What is the importance of a quarter wave line? or Mention the uses of quarter line.	2	CO3	L1	1.4.1
38	What is the functional operation of quarter wave transformer?	2	CO3	L1	1.4.1
39	How tapped $\lambda/4$ line can be used as an impedance transformer?	2	CO3	L2	1.4.1
40	Write down the expression to determine the length of the stub.	2	CO3	L1	1.4.1
41	Write down the expression to determine the position of the stub.	2	CO3	L1	1.4.1
PART B					
1	Discuss how a Smith chart is constructed and explain its applications.	13	CO3	L1	1.4.1
2	Originating from the bilinear derive the analytical formulation of the Smith chart for a lossless transmission line.	13	CO3	L1	1.4.1
3	Derive from first principles how the Smith chart analytical equations can be obtained from bilinear transformation. Is the Smith chart an approximation?	13	CO3	L1	1.4.1
4	Enumerate the advantages of Smith chart, single stub and double stub matching on a line.	13	CO3	L2	1.4.1
5	Explain with diagrams, the method of deriving constant S circles and constant β_S circles used for impedance determination. Illustrate one application.	13	CO3	L2	1.4.1
6	Derive from first principle, the resistance and reactance circles converging through the centre of the Smith chart.	13	CO3	L2	1.4.1
7	Obtain from first principles, the Smith chart formulation using bilinear transformation. Explain how double stub matching is undertaken.	13	CO3	L2	1.4.1
8	Explain the following: a) Single stub matching b) Double stub matching	13	CO3	L2	1.4.1

9	What are the features of a quarter wave transformer? Discuss its properties.	13	CO3	L2	1.4.1
10	A single stub tuner is to match a lossless line of 400 Ω to a load of 800 – j300 Ω. The frequency is 3 GHz. Find the distance from the load and determine the length of the stub.	13	CO3	L3	2.1.2
11	A line of Zo = 300 Ω is connected to a load of 73 Ω, for frequency of 40 MHz. Find the length and location of the nearest load of a single stub to produce an impedance match.	13	CO3	L3	2.1.2
12	A 300 Ω line feeding an antenna has a standing wave ratio of 4 and the distance from the load of the first voltage minima is 6 cm. If the frequency is 150 MHz, design a single stub matching the system to eliminate the standing wave from the maximum possible length of the line.	13	CO3	L3	2.1.2
13	A lossless line $\frac{3}{8}\lambda$ long has a normalized input impedance of 1.2 + j0.95. Find the normalized load impedance and standing wave ratio.	13	CO3	L3	2.1.2
14	An antenna, as load on a transmission line, produces a standing wave ratio of 3 with a voltage minimum 0.12λ from the antenna terminals. Find the antenna impedance and the reflection coefficient at the antenna, if characteristic impedance is 300 Ω for the line.	13	CO3	L3	2.1.2
15	A lossless line terminated in a resistance is found to have a standing wave ratio of 4. The characteristic impedance is 100 Ω. A short circuited stub that matches the line to the load is placed less than λ/8 from the load. a) What is the value of the load resistance? b) What is the stub length in wave lengths?	13	CO3	L3	2.1.2
16	Determine the sending end impedance of a lossless line whose data is given below: Z_o = 70 Ω, Z_R = 20 + j100 Ω, length of the line = 4.2 λ.	13	CO3	L3	2.1.2
17	A load impedance of 40 – j80 Ω is connected to a 100 Ω line. Calculate the reflection coefficient at the load, input impedance of the line of length 0.7λ connected to the above load impedance. Determine the length of the stub required to connect the susceptance utilizing the Smith chart.	13	CO3	L3	2.1.2
18	A SWR on a lossless line is found to be 5 and the successive voltage minimum are 40 cm apart. The first voltage minimum is observed to be 15 cm from the load. The length of the line is 160 cm and the characteristic impedance is 300 Ω. Using Smith chart determine a) Load impedance b) Sending end impedance	13	CO3	L3	2.1.2
19	Using Smith chart, find the length, termination and location nearest to the load of a single stub to produce impedance matching for a line of characteristic impedance of 500 Ω connected to a load of 63 Ω if the frequency is 50 MHz.	13	CO3	L3	2.1.2
PART C					
1	a) Determine length and location of a single short circuited stub to produce an impedance match on a transmission line with characteristic impedance of 600 ohm and terminated in 1800 ohm. b) A 300 Ω transmission line is connected to a load impedance of (450-j600) Ω at 10MHz.Evaluate the position and length of a short circuited stub required to match the line using smith chart.	8 7	CO3	L3	2.1.2
2	For a normalized load impedance of 0.8+j1.2Ω design a double stub tuner with the distance between them as 3λ/8. Considering the stubs are short circuited determine the length of the stubs and the position of the	15	CO3	L3	2.1.2

	first stub from the load. Verify the answer using Smith Chart.				
3	a) A line having characteristic impedance of 50 Ω is terminated in load impedance [75+j75] Ω. Determine the reflection coefficient and voltage standard wave ratio. b) Mention the significance of smith chart and its application in transmission lines.	8 7	CO3	L3	1.4.1
4	a) Develop the expression for the input impedance of the dissipation less line and thus obtain the expression for the input impedance of the quarter wave line. Also discuss the application of the quarter wave line. b) Design a single stub match for a load of 150+j225 Ω for a 75 Ω line a 500 MHz using smith chart.	8 7	CO3	L3	1.4.1 2.1.2

UNIT IV WAVEGUIDES

Syllabus: General Wave behavior along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular waveguides, TM and TE waves in rectangular waveguides, Bessel Functions, TM and TE waves in Circular waveguides.

Assessment Questions for UNIT IV

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
	PART A				
1	What are guided waves? Give examples.	2	CO4	L1	1.4.1
2	What is TE wave or H wave?	2	CO4	L1	1.4.1
3	What is TM wave or E wave?	2	CO4	L1	1.4.1
4	What is dominant mode? Give examples.	2	CO4	L1	1.4.1
5	Give the dominant mode for TE and TM of rectangular wave guide.	2	CO4	L1	1.4.1
6	What is cut-off frequency?	2	CO4	L1	1.4.1
7	Write down the expression for cut-off frequency when the wave is propagated in between two parallel plates.	2	CO4	L1	1.4.1
8	Write down the expression for cut-off wavelength of the wave which is propagated in between two parallel plates.	2	CO4	L1	1.4.1
9	Give the expression for the guide wavelength when the wave is transmitted in between two parallel plates.	2	CO4	L1	1.4.1
10	Write down the relation between guide wavelength and cut-off wavelength.	2	CO4	L1	1.4.1
11	Give the expression for velocity of propagation of wave in between two parallel plates.	2	CO4	L1	1.4.1
12	What is TEM wave or Principal wave?	2	CO4	L1	1.4.1
13	Mention the characteristic of TEM waves.	2	CO4	L1	1.4.1
14	Give the relation between phase velocity and group velocity.	2	CO4	L1	1.4.1
15	Define attenuation factor.	2	CO4	L1	1.4.1
16	Give the relation between the attenuation factor for TE waves and attenuation factor for TM waves.	2	CO4	L1	1.4.1

17	Find the frequency of minimum attenuation for TM mode.	2	CO4	L3	1.4.1
18	Distinguish TE and TM waves.	2	CO4	L2	1.4.1
19	Define wave impedance.	2	CO4	L1	1.4.1
20	What is a wave guide?	2	CO4	L1	1.4.1
21	Why are rectangular waveguides preferred over circular waveguides?	2	CO4	L4	1.4.1
22	Mention the applications of waveguides.	2	CO4	L1	1.4.1
23	Why waveguide is designed in circular or rectangular form?	2	CO4	L4	1.4.1
24	For an air filled copper X-band waveguide with dimensions a = 2.286 cms and b = 1.016 cms, determine the cut-off frequencies for TE_{11} and TM_{11} modes.	2	CO4	L3	1.4.1
25	Define wave impedance.	2	CO4	L1	1.4.1
26	What is evanescent mode?	2	CO4	L1	1.4.1
27	Which are the non-zero field components for the TE_{10} mode in a rectangular waveguide?	2	CO4	L2	1.4.1
28	Which are the non-zero field components for the TM_{11} mode in a rectangular waveguide?	2	CO4	L2	1.4.1
29	Draw a neat sketch showing the variation of wave impedance with frequency for TE and TM waves in a waveguide.	2	CO4	L1	1.4.1
30	Find the cut-off wavelength and cut-off frequency of the TE_{10} mode in a rectangular waveguide?	2	CO4	L3	1.4.1
31	Find the cut-off wavelength and cut-off frequency of the TM_{11} mode in a rectangular waveguide?	2	CO4	L3	1.4.1
32	What is the wave impedance of the TEM waves in a waveguide?	2	CO4	L1	1.4.1
33	Write the expression for wave impedance of the TE mode.	2	CO4	L1	1.4.1
34	Write the expression for wave impedance of the TM mode.	2	CO4	L1	1.4.1
35	Write the expression for phase velocity in a waveguide.	2	CO4	L1	1.4.1
36	Define characteristic impedance in a waveguide.	2	CO4	L1	1.4.1
37	Explain why TM_{01} and TM_{10} modes in a rectangular waveguide do not exist.	2	CO4	L2	1.4.1
38	A rectangular waveguide has the following dimensions l=2.54 cm, b=1.27 cm, waveguide thickness = 0.127 m. Calculate the cut-off frequency for TE_{11} mode.	2	CO4	L3	1.4.1
39	What are dominant mode and degenerate modes in rectangular waveguide?	2	CO4	L1	1.4.1
40	Why the TE_{10} wave is called as dominant wave in rectangular waveguide?	2	CO4	L4	1.4.1
41	A rectangular waveguide with dimensions a=8.5 cm and b=4.3 cm is fed by 5 GHz carrier. Will a TE_{11} mode be propagated?	2	CO4	L4	1.4.1
42	Calculate the cut-off wavelength of a rectangular waveguide whose inner dimensions are a=2.3cm and b=1.03cm operating at TE_{10} mode.	2	CO4	L3	1.4.1
43	For a frequency of 6 GHz and plane separation of 3 cm, find the group velocity and phase velocity for the dominant mode.	2	CO4	L3	1.4.1

44	Calculate the cut-off wavelength for the TM_{11} mode in a standard rectangular waveguide if a=4.5 cm.	2	CO4	L3	1.4.1
45	Mention the applications of a circular waveguide.	2	CO4	L1	1.4.1
46	Which mode in circular waveguides has attenuation effect decreasing with increase in frequency?	2	CO4	L2	1.4.1
47	Mention the dominant modes in rectangular and circular waveguides.	2	CO4	L1	1.4.1
48	Write the expression for cut-off frequency in a circular waveguide.	2	CO4	L1	1.4.1
49	Calculate the cut-off frequency of a copper tube with 3 cm diameter, filled with air, in the TE_{11} mode.	2	CO4	L3	1.4.1
50	Determine the cut-off frequency of a circular waveguide with a diameter of 2.36 cms operating in the dominant mode.	2	CO4	L3	1.4.1
51	Why is TM_{01} mode preferred to the TE_{01} mode in a circular waveguide?	2	CO4	L4	1.4.1
52	A circular waveguide operated at 11 GHz has the internal diameter of 4.5 cm. For a TE01 mode propagation, calculate λ and λ_c $[(ha)_{01} = 2.405]$.	2	CO4	L3	1.4.1
53	Write Bessel's function of first kind of order zero.	2	CO4	L1	1.4.1
54	Why is the Bessel's function of second kind (Neumann's function) not applicable for the field analysis inside circular waveguide?	2	CO4	L4	1.4.1
55	What is Bessel function?	2	CO4	L1	1.4.1
PART B					
1	A parallel plane wave guide consists of two sheets of good conductor separated by 10 cm. Find the propagation constant at frequencies of 100 MHz and 10 GHz, when the wave guide is operated in TE_{10} mode. Does the propagation take place in each case.	8	CO4	L4	1.4.1
2	A pair of perfectly conducting planes are separated by 8 cm in air. For frequency of 5000 MHz with the TM1 mode excited, Analyze the cut-off frequency, wave impedance, attenuation constant for f=0.95fc, phase shift constant, phase velocity, group velocity and wavelength measured along the guiding walls.	8	CO4	L4	1.4.1 1.4.1
3	For a frequency of 6000 MHz and plane separation of 7 cm, examine the cut-off frequency, angle of incidence on the planes, phase velocity, group velocity. Is it possible to propagate TE_3 mode?	8	CO4	L4	1.4.1
4	Consider a parallel plate wave guide with plate separation 20 cm with the TE10 mode excited at 1 GHz. Analyze the propagation constant, the cut-off frequency and guide wavelength assuming $\varepsilon_r = 4$ for medium of propagation in the guide.	8	CO4	L4	1.4.1
5	A waveguide is formed by two parallel copper sheets $\sigma = 5.8 \times 10^7$ s/m separated by a 5 cm thick lossy dielectric $\varepsilon_r = 2.25$, $\mu_r = 1$, $\sigma = 10^{-10}$ s/m. For an operating frequency of 10 GHz, categorizeβ, α_d, α_c, v_p, v_g and λ_g for TE_1 mode, TM_2 mode and TEM mode.	8	CO4	L4	1.4.1
6	For an air filled copper X-band wave guide with dimensions a = 2.286 cm, b = 1.016 cm, analyze the cut-off frequency of the first four propagating modes. What is attenuation for 1 metre	8	CO4	L4	1.4.1 1.4.1

	length of the guide when operating at the frequency of 10 GHz?				
7	A rectangular wave guide has cross section dimensions a = 7 cm and b = 4 cm. Categorize all the modes which will propagate through the wave guide at a frequency of 6 GHz.	8	CO4	L4	1.4.1 1.4.1
8	A 10 GHz signal is to be propagated in the dominant mode in a rectangular wave guide. If its group velocity is to be 90% of the free space velocity of light, what must be the breadth of the wave guide and the wave impedance?	8	CO4	L4	1.4.1 1.4.1
9	An air filled hollow rectangular conducting waveguide has cross section dimensions of 8 x 10 cm. How many TE modes will this waveguide transmit at frequencies below 4 GHz? How these modes designated and what are their cut-off frequencies?	8	CO4	L4	1.4.1 1.4.1
10	What are the dimensions of a waveguide with the following specifications: a) At a frequency of 9959.5 MHz, the guide wavelength for TE10 mode is 87.5% of the cut-off wavelength. b) TE_{30} and TE_{12} mode have the same cut-off frequency.	8	CO4	L4	2.1.2 1.4.1
11	A X-band air filled rectangular waveguide has inner dimensions of a = 2.3 cm and b = 1 cm. Categorize the cut-off frequencies in the following modes: TE_{10}, TE_{20}, TM_{11}, TM_{12}. Also check which of the modes will propagate along the waveguide when the signal frequency in 10 GHz.	8	CO4	L4	3.4.1
12	A TE_{10} wave 10 GHz propagates with velocity of 2 x 10^8 m/sec in a brass σ_c = 1.57 x 10^7 s/m rectangular waveguide with inner dimensions a = 1.5 cm and b = 0.6 cm, which is filled with polyethylene ε_r = 2.25, μ_r = 1. Calculate the phase shift constant, guide wavelength, phase velocity, wave impedance which, which signal among the two separate signals with frequency 5 GHz and 15 GHz will be supported by the rectangular waveguide for propagation through it?	8	CO4	L3 L3	2.1.2 2.1.2
13	Calculate and compare the values of β, v_p, v_g, λ_g and wave impedance for TE_{10} mode for a 2.5 cm x 1.5 cm rectangular waveguide operating at 7.5 GHz (a) if the waveguide is hollow (b) if the waveguide is filled with a dielectric medium characterized by ε_r =2, μ_r = 1 and σ = 0.	8	CO4	L4	1.4.1
14	A rectangular air filled waveguide with dimension 0.9" x 0.4" cross section and 12" length is operated at 902 GHz with dominant mode. Analyze cut-off frequency, guide wavelength, phase velocity, wave impedance and conductor loss in dB.	8	CO4	L4	1.4.1
15	An air filled circular waveguide having an inner radius of 1 cm is excited in dominant mode at 10 GHz. Find cut-off frequency of the dominant mode at 10 GHz, the guide wavelength, wave impedance. Also find the bandwidth for operation bandwidth for operation in the dominant mode only.	8	CO4	L3	1.4.1
16	Given a circular waveguide used for a signal at a frequency of 11 GHz propagated in the TE_{11} mode and the internal diameter is 4.5 cm. Calculate cut-off wavelength, guide wavelength, group velocity, phase velocity and characteristic impedance.	8	CO4	L3	2.1.2
17	A circular waveguide has a cut-off frequency of 9 GHz in the dominant mode: a) Find the inner diameter of the guide if it is air filled b) Determine the inner diameter of the guide if the guide is filled with dielectric. The relative dielectric constant is ε_r =4.	8	CO4	L3	2.1.2
18	An air filled circular waveguide of 2 cm inside radius is operated	8	CO4	L4	2.1.3

	in the TE_{01} mode. a) Compute the cut-off frequency b) If the guide is to be filled with a dielectric material of εr = 2.25, to what value must its radius be changed in order to maintain the cut-off frequency at its original value?				
PART C					
1	Design a rectangular waveguide with the following specifications a) At a 7.5 GHz, the guide wavelength for TE_{10} mode is 90% of the cut-off wave length b) TE_{30} and TE_{12} have the same cut-off frequency	15	CO4	L3	1.4.1
2	A TE10 wave 10 GHz propagate with velocity of $2x10^8$ m/sec in a brass σ_c=1.57 x 107 s/m rectangular waveguide with inner dimensions a = 1.5 cm and b = 0.6 cm, which is filled with polyethylene ε_r=2.25, μ_r=1. Calculate the phase constant, guide wavelength, phase velocity, wave impedance which signal among the two separate signals with frequency 5 GHz and 15 GHz will be supported by the rectangular waveguide for propagation through it?	15	CO4	L3	1.4.1
3	A X-band air filled rectangular waveguide has inner dimensions of a = 2.3 cm and b = 1 cm. Calculate the cut-off frequencies in the following modes: TE10, TE20, TM11, TM12. Also check which of the modes will propagate along the waveguide when the signal frequency in 10 GHz.	15	CO4	L4	1.4.1

UNIT V RF SYSTEM DESIGN CONCEPTS

Syllabus: Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.

Assessment Questions for UNIT V

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
PART A					
1	What is the band gap energy for germanium, silicon, and gallium arsenide?	2	CO5	L1	1.4.1
2	What is diffusion current?	2	CO5	L1	1.4.1
3	What is diffusion barrier potential or built-in potential?	2	CO5	L1	1.4.1
4	What is junction capacitance?	2	CO5	L1	1.4.1
5	What is diffusion capacitance?	2	CO5	L1	1.4.1
6	What is Schottky contact?	2	CO5	L1	1.4.1
7	Mention the advantages of Schottky contact.	2	CO5	L1	1.4.1
8	Define forward current gain in BJT.	2	CO5	L1	1.4.1
9	Define reverse current gain in BJT.	2	CO5	L1	1.4.1
10	What are the salient features of RF FETs?	2	CO5	L1	1.4.1
11	How RF FETs are classified?	2	CO5	L2	1.4.1
12	What is pinch-off voltage?	2	CO5	L1	1.4.1
13	What is a high electron mobility transistor (HEMT)?	2	CO5	L1	1.4.1
14	Mention the advantages of HEMT.	2	CO5	L1	1.4.1
15	What is Mixer?	2	CO5	L1	1.4.1
16	What is a low noise amplifier?	2	CO5	L1	1.4.1

17	List the characteristics of power amplifier.	2	CO5	L1	1.4.1
18	Define transducer power gain.	2	CO5	L1	1.4.1
19	Define available power gain.	2	CO5	L1	1.4.1
20	Define power gain.	2	CO5	L1	1.4.1
21	What are stability circles?	2	CO5	L1	1.4.1
22	Compare stability circles.	2	CO5	L2	1.4.1
23	Define stability of an amplifier.	2	CO5	L1	1.4.1
24	Distinguish between conditional and unconditional stabilities of an amplifier.	2	CO5	L2	1.4.1
25	Write the demerits of S-parameters for checking amplifiers stability.	2	CO5	L1	1.4.1
25	List the methods available to verify amplifiers stability. Write the types of analytical stability methods.	2	CO5	L1	1.4.1
26	Write the three-parameter test expressions.	2	CO5	L1	1.4.1
27	Write the two-parameter test expressions.	2	CO5	L1	1.4.1
28	Write advantages and disadvantages the two and three parameter tests.	2	CO5	L1	1.4.1
29	What is single parameter test and its merits?	2	CO5	L1	1.4.1
30	Write the limitations of analytical method.	2	CO5	L1	1.4.1
31	Write the expressions to verify the stability factor of an amplifier.	2	CO5	L1	1.4.1
32	Draw the output stability circles stable and unstable regions.	2	CO5	L1	1.4.1
33	Draw the input stability circles stable and unstable regions.	2	CO5	L1	1.4.1
34	Write the disadvantages of stability circles.	2	CO5	L1	1.4.1
35	How do you calculate the intrinsic carrier concentration in GaAs at room temperature T=300^{o}K, Nc = 4.7 x 10^{17} /cm3, Nv = 7 x 10_{18}/cm3 and the bandgap energy is 1.42 eV?	2	CO5	L3	1.4.1
36	Define the condition for stability in circuit design.	2	CO5	L1	1.4.1
37	Mention the requirements and applications of low noise amplifiers.	2	CO5	L1	1.4.1
38	Consider a p-type Si semiconductor whose doping concentration at room temperature is N_A=5x10^{16}/cm^3 and intrinsic concentration is n_i=1.5x10^{10}/cm^3. Find the minority and majority carrier concentration and conductivity of the semiconductor of μ_n=1350 cm^2/v.s and μ_p=480 cm^2/v.s.	2	CO5	L3	1.4.1
39	In a p-type semiconductor, a linear hole concentration changing from 5x10^{17}/cm^3 to 10^{18}/cm^3 over a distance of 100 μm. Find the current density if the diffusion coefficient is given at T=300^{o}K is D_p=12.4 cm^3/s.	2	CO5	L3	1.4.1
40	A p-type semiconductor of N_A=10^{18}/cm^3 joined with an n-type semiconductor of N_D=5x10^{15}/cm^3. Find the barrier potential at room temperature if n_i=1.45x10^{10}/cm^3.	2	CO5	L3	1.4.1
41	A silicon pn junction has a conductivity of 10 s/cm and 4 s/cm for p and n layers respectively. Calculate the built-in voltage of the junction at room temperature if mobilities μ_p=480 cm^2/v.s and μ_n=1350 cm^2/v.s.	2	CO5	L3	1.4.1
	PART B				
1	Explain the quantitative theory of *pn* junction with necessary diagrams.	13	CO5	L2	1.4.1
2	Derive an expression for diffusion barrier voltage of *pn* junction.	13	CO5	L1	1.4.1
3	Derive an expression for diffusion capacitance of *pn* junction.	13	CO5	L1	1.4.1
4	Explain the quantitative theory of *pn* junction under forward bias and reverse bias with aid of space charge distribution, electric field distribution and voltage distribution diagrams.	13	CO5	L2	1.4.1
5	With aid of energy band diagram, explain the Schottky contact.	13	CO5	L2	1.4.1
6	Describe the construction of high frequency BJT and explain its operation with the help of its characteristics.	13	CO5	L2	1.4.1

7	Derive the expressions for forward current gain and reverse current gain of RF BJT.	13	CO5	L1	1.4.1
8	Explain the operation of BJT in (a) forward active mode, (b) reverse active mode, (c) saturation mode.	13	CO5	L2	1.4.1
9	Describe the construction of MESFET and explain its operation with characteristics.	5 8	CO5	L2	1.4.1
10	Derive the expression for drain current and saturation current of MESFET.	13	CO5	L1	1.4.1
11	Explain the construction and operation of high electron mobility transistor with energy band diagram and necessary equations.	13	CO5	L2	1.4.1
12	Draw the circuit diagram of low noise amplifier and explain its operations.	13	CO5	L2	1.4.1
13	Explain the concept of RF mixer and explain its operation with circuit diagram	13	CO5	L2	1.4.1
14	Explain the concept of RF VCO and explain its operation with circuit diagram.	13	CO5	L2	1.4.1
15	Discuss the various aspects of amplifier-power relations for RF transistor amplifier design.	13	CO5	L4	1.4.1
16	Discuss gain consideration of RF amplifier.	13	CO5	L4	1.4.1
17	Derive equations for power gain of RF amplifier.	13	CO5	L1	1.4.1
18	Explain stability considerations for RF amplifier.	13	CO5	L2	1.4.1
19	Explain the power amplifiers used at RF frequencies.	13	CO5	L2	1.4.1
20	Explain the working of FET at RF frequencies.	13	CO5	L2	1.4.1
PART C					
1	Determine the stability of a GaAs FET that has the following S-parameters at 2 GHz in a 50 Ω system both graphically and mathematically: $S_{11} = 0.89 \angle -60^o$, $S_{21} = 3.1 \angle 123^o$, $S_{12} = 0.02 \angle 62^o$, $S_{22} = 0.78 \angle -27^o$	15	CO5	L3	1.4.1
2	A BJT has the following S-parameters: $S_{11} = 0.65 \angle -95^o$, $S_{21} = 5.0 \angle 115^o$, $S_{12} = 0.035 \angle 40^o$, $S_{22} = 0.8 \angle -35^o$ Is this transistor unconditionally stable? If not, analyze the reason.	15	CO5	L4	1.4.1
3	The scattering parameters for a transistor is given below. Determine stability and in a potentially unstable, draw the input and output stability circles: $S = \begin{bmatrix} 0.67\angle 67^\circ & 0.075\angle 6.2^\circ \\ 1.74\angle 36.4^\circ & 0.6\angle -92.6^\circ \end{bmatrix}$	15	CO5	L3	1.4.1
4	The S-parameters of several two-port networks are given by: $S = \begin{bmatrix} 0.7\angle 0^\circ & 0.7\angle 180^\circ \\ 0.7\angle 0^\circ & 0.7\angle 0^\circ \end{bmatrix}$ Determine K and $\lvert\Delta\rvert$. Draw the input and output stability circles for each case as well.	15	CO5	L3	1.4.1

Prepared by
Course in-Charge

Verified by
HoD

Approved by
PRINCIPAL