Department of Electronics and Communication Engineering

SUBJECT NAME : TRANSMISSION LINES AND RF SYSTEMS
BRANCH : ECE
YEAR/SEM : III / VI

QUESTION BANK
UNIT I PART A (TWO MARKS)

1. Relate reflection factor and reflection loss with formula. (Nov 2019)
2. Draw the equivalent circuit of transmission line. (Nov 2019)
3. State the condition for a distortion less line. (May 2019)
4. Find the characteristic impedance of a line at 1600 Hz. if Zoc $= 750\angle -30\ \Omega$ and Zsc= $600\angle -20\ \Omega$. (May 2019)
5. State the line parameters of a transmission line. (Nov 2018)
6. What is distortionless line? Give the condition for a distortionless line. (Nov 2018)
7. What is meant by distortion less line? (May 2018) (Nov 2016) (Nov 2015)
8. Define reflection loss. (May 2017) (May 2016)
9. A transmission line has $Z0 = 745 \angle -120\ \Omega$ and is terminated in $ZR = 100\Omega$. Calculation the reflection factor. (May 2017)
10. Define smooth Line. (May 2017)
11. Find the characteristic impedance of a line at 1600 Hz if $Z_{OC} = 750\angle -300\ \Omega$ and $Z_{SC} = 600\angle -200\ \Omega$. (Nov 2016)
12. What is characteristic impedance? (May 2016)
13. Find the reflection coefficient of a 50 Ω transmission line when it is terminated by a load impedance of 60+j40 Ω. (Nov 2015)
14. What is the drawback of using ordinary telephone cables? (May 2015)
15. Define the term insertion loss. (May 2015)
16. Define wavelength of the line. (Nov 2014)
17. What is the significance of reflection coefficient (Nov 2014)
18. Define insertion loss. (May 2014)
19. Define characteristic impedance. (May2013)
20. Define SWR. (May2013)
21. At a frequency of 80 MHz, a lossless transmission line has a characteristic impedance of 300 Ω and a wavelength of 2.5 m. Find L and C(Dec 2012)
22. Draw the equivalent circuit of a unit length of a transmission line (May 2012)
23. What is meant by infinite line? (May 2012)
24. When does a finite line appear as an infinite line? (Nov 2011)
25. If a line is to have neither frequency nor delay distortion, how do your relate attenuation constant and velocity of propagation to frequency? (Nov 2011)
26. How can distortion be reduced in a transmission line? (Apr 2011)
27. A transmission line has $Z0=745\angle -12^{\circ}\Omega$ and is terminated is $Z_R=100\Omega$. Calculate the reflection factor and reflection loss. (Apr 2011)

28. Define Delay distortion. (Nov 2010)
29. Write the expressions for the phase constant and velocity of propagation for telephone cable. (Nov 2010)

UNIT I PART B (THIRTEEN MARKS)

1. Describe the types of waveform distortion and obtain the condition for distortion less line.(13) (Nov 2019)
2. Analyze the performance of transmission line loaded at uniform intervals and derive the Campbell's equation.(8) (Nov 2019)
3. Make use of input impedance expression to formulate the relation between ZO and ZSC, ZOC.(5) (Nov 2019)
4. (a) Derive the general transmission line equations for voltage and current at any point on a Line. (13) (May 2019)
5. (b) (i)Explain in detail about the reflection on a line not terminated by its characteristic impedance Z0. (7) (May 2019)
6. The Constant of a transmission line are R = 6 Ω /km, L 2.2 mH/km, C = 0.005μF/km and G = 0.25 x 10-3 mho/km, Calculate the characteristic impedance, attenuation constant and phase constant at 1000 Hz. (6)(May 2019)
7. Derive the equation of attenuation constant and phase constant of transmission lines in terms of line constants R, L, G and C. (13) (Nov 2018)
8. Explain the theory of open and short circuited lines and also derive all expressions for input impedance. (13) (Nov 2018)
9. Derive the general transmission line equations for voltage and current at any point on a line.(13) (May 2018)
10. 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, phase constant, velocity of propagation, wavelength, sending end current and receiving end current for given frequency f=1000 Hz, sending end voltage is 1 volt and transmission line length is 100 kilometers. (May 2018)
11. Discuss the general solution of a transmission line in detail. (10) (May 2017)
12. A generator of 1.0 volt, 1000 cycles, supplies power to a 100 mile open-wire line terminated in Z0 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 mho/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. (6) (May 2017)
13. Discuss in detail about lumped loading and derive the Campbell's equation. (8) (May 2017)
14. A 2 meter long transmission line with characteristic impedance of 60 + j40 Ω is operating at w = 106 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. (8) (May 2017)

15. (i) Explain in detail about the reflection on a line not terminated by its characteristic impedance Z0. (8) (Nov 2016)
    (ii) Derive the condition for minimum attenuation in a distortionless line. (8) (Nov 2016)
16. (i) Derive the transmission line equation and hence obtain expression for voltage and current on a transmission line (10) (May 2016)
    (ii) Prove that an infinite line equal to finite line terminated in its characteristic impedance. (6) (May 2016)
17. (i) Explain in detail about the wave-form distortion and also derive the condition for distortion less line (10) (Nov 2015)
    (ii) Derive the expressions for input impedance of open and short circuited lines. (6) (Nov 2015)
18. (i) 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 mho /m) and capacitance between conductors (C=5.56 nF/m). Find the characteristic impedance, attenuation constant, phase shift constant, velocity of propagation and wavelength. (10) (Nov 2015)
19. (ii) A 2 meter long transmission line with characteristic impedance of 60+j40Ω is operating at ω = 106 rad/sec has attenuation constant of 0 rad/m. If the line is terminated by a load of 20+j50 Ω, determine the input impedance of this line. (6) (Nov 2015)
20. (i)Derive the general solutions of a transmission line terminated with any load impedance Z_R.(8)(May2014)(NOV 2014)
    (ii)A transmission line has the following constants R= 10.4Ω, L=3.66mH, C=0.00835 μF and G=0.08 μ mhos. Calculate its characteristics impedance, attenuation and phase constant and phase velocity. (8) (May 2012) (May2014) (May2013).
21. (i) Obtain the general solution of transmission line (10)
    (ii) A telephone cable 64 km long has a resistance of 13 Ω/km and a capacitance of 0.008 μF/km. Calculate attenuation constant, velocity and wavelength of the line at 1000Hz. (6)
22. (i) Explain about different type of transmission line (8)
    (ii) Discuss the following: reflection loss and return loss. (8)
23. (i)A transmission line has the following per unit length parameters L-=0.1μH, R=50 ohms, C=300pF and G=0.01 mho. Calculate the propagation constant and characteristics impedance at 500MHz.(8) (Nov 2010)(May2014)
    (ii)Derive the conditions required for a distortion less line (8) (Nov 2010)(May2014)
24. (i)If $Z = R + j\,\omega\,L$ and $Y = G + j\,\omega\,C$, show that the line parameter values fix the velocity of propagation for an ideal line.(8)
    (ii)Deduce the expressions for characteristic impedance and propagation constant of a line of cascaded identical and symmetrical T sections of impedance. (8) (Nov 2011)
25. Derive the two useful forms of equations for voltage and current at any point on a transmission line. (Nov 2011)

26. Derive the equation of attenuation constant and phase constants of transmission lines in terms of line constants R, L, C and G and explain the significance of reflection coefficient and insertion loss. (Apr 2011)
27. (i)The characteristics impedance of a uniform transmission line is 2309.6 ohms at a frequency of 800MHz. At this frequency, the propagation constant is 0.054 (0.366+j0.99). Determine R and L (6)

    (ii)Explain the reflection on lines not terminated in characteristics impedance with phasor diagrams. Define reflection coefficient and reflection loss. (10) (Nov 2010)

UNIT I PART C (FIFTEEN MARKS)

1. A communication line has L = 3.67 mH/km, G = 0.08 x 10-6 mhos/km, C = 0.0083 μF/km and R = 10.4 ohms/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 volt and transmission line length is 100 kilometres. (16) (Nov 2016)
2. A generator of 1 V, 1000 Hz supplies power to a 100 km open wire line terminated in Z0 and having following parameters, R = 10.4 ohm per Km, L = 0.00367 Henry per Km, G = 0.8 X 10-6 mho per Km, C = 0.00835 μF per Km. Calculate Z0, α, β, λ, v. Also find the received power. (16). (May 2016)
3. Explain the condition for distortionless line. Characteristic impedance of a transmission line at 8 MHz is (40-2j) ohm and the propagation constant is (0.01+ j 0.18) per meter. Find the primary constants. (16) (Dec 2012)
4. Discuss following : (Dec 2012)

   (i) Reflection on a line not terminated in Z0. (8)(May 2013)

   (ii) Open and short circuited lines. (8)
5. A generator of 1V, 1 kHz supplies power to a 100 km open wire line terminated in 200Ω resistance. The line parameter are R=10Ω/km L=3.8 mH/km, G=$1x10^{-6}$ mho/km, C=0.0085 mF/km. Calculate the impedance, reflection coefficient, power and transmission efficiency. (Apr 2011)

UNIT II PART A (TWO MARKS)

1. List the standard assumptions to analyze transmission line at RF.(Nov 2019)
2. Define standing wave ratio.(Nov 2019)

3. Write the expression for standing wave ratio interms of reflection co-efficient. (May 2019)
4. What do the nodes and anti—nodes on a standing wave represent? (May 2019)
5. Define insertion loss. (NOV 2018)
6. Define propagation constant. (NOV 2018)
7. What are the assumptions to simplify the analysis of line performance at high frequencies? (May 2018) (May 2016)
8. Write the expression for the input impedance of open and short circuited, dissipationless line. (May 2018) (Nov 2016)
9. Define standing wave ratio. (May 2017)
10. A lossless line has a characteristic impedance of 400 Ω. Determine the standing wave ratio if the receiving end impedance is 800+j0.0 Ω. (May 2017)
11. Calculate Standing Wave Ratio and Reflection Coefficient on a line having the characteristic impedance Z0 = 300 Ω and terminating impedance in ZR = 300+j400Ω. (Nov 2016)
12. Write the expression for standing wave ratio in terms of reflection coefficient. (May 2016)
13. A lossless transmission line has a shunt capacitance of 100 pF/m and a series inductance of 4 μHm. Determine the characteristic impedance. (Nov 2015)
14. For the line of zero dissipation, what will be the values of attenuation constant and characteristic impedance? (Nov 2015)
15. How will you make standing wave measurements on coaxial line? (May 2015)
16. List the parameters of open wire line at high frequencies. (Nov 2014)
17. A line having characteristic impedance of 50 ohm is terminated in load impedance 75+j75 ohms. Determine the reflection coeff. (Nov 2014)
18. Give the expression for characteristic impedance and propagation constant of dissipation less line (May2014)
19. A 50 Ω coaxial cable feeds a 75 + j20 Ω dipole antenna. Find reflection coefficient and standing wave ratio. (Dec 2012)
20. Write the expression for VSWR in terms of (Dec 2012)
    (a) The reflection coefficient
    (b) VSWR in terms of Z_L and Z_0.
21. Write the relationship between SWR and reflection coefficient. (May 2012)
22. For the line of zero dissipation, what will be the values of attenuation constant and characteristic impedance? (Nov 2011)
23. Define standing wave ratio. (Nov 2011)
24. Express standing wave ratio in terms of a reflection coefficient.(Apr 2011)
25. A lossless line has a characteristics impedance of 400 ohms. Determine the standing wave ratio if the receiving end impedance is 800+j 0.0 ohms (Nov 2010)
26. Write the expressions for the input impedance of open and short circuited dissipationless line. (Nov 2010)

UNIT II <u>PART B</u> (THIRTEEN MARKS)

1. In a transmission line, load 50+j50 Ω is terminated at 300 MHz. calculate VSWR if characteristic impedance is 50Ω. Also find the position of the voltage minimum nearest to load.(8) (Nov 2019)
2. A lossless transmission line is terminated in a load reflecting a part of incident power with VSWR as 2. Find the percentage of power reflected?(5) (Nov 2019)
3. (i) Derive the line constants of a zero dissipation less line. (May 2019)
4. Briefly explain on 1. Standing wave 2. Reflection loss. (May 2019) (3+3) (May 2018) (4+4) (Nov 2016)
5. Derive an expression for power and find the input impedance of dissipation less line. When the load is short circuited, open circuited and for a matched line. (May 2019)
6. Explain the parameters of open-wire and co-axial line at radio frequency.(13) (Nov 2018)
7. A transmission line has Z0 = 1.0, ZL = 0.2 – j 0.2 ohms.(i)What is z at l = λ/4 =0.25λ? (ii) What is the VSWR on the line? (iii) How far from the load is at the first voltage minimum? Use smith chart.(5+4+4) (Nov 2018)
8. Derive the line constants of a zero dissipation less line. (6) (May 2018) (May 2016)
9. Describe an experimental setup for the determination of VSWR of an RF transmission. (7) (May 2018) (Nov 2016)
10. Discuss in detail about the variation of variation of input impedance along open and short circuit lines with relevant graphs. (7) (May 2018) (May 2016)
11. Derive the expression that permit easy measurements of power flow on a line of negligible losses. (10) (May 2017)
12. A radio frequency line with Z0 = 70 Ω is terminated by ZL = 115 – j80 Ω at λ = 2.5m. Find the VSWR and the maximum and minimum line impedances. (6) (May 2017)
13. 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'. (8) (Nov 2016)
14. 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. (8) (Nov 2016)
15. (i) Derive line constants of a zero dissipationless line (8) (ii) A line with zero dissipation has R = 0.006 ohm per m, C = 4.45 pF per m, L = 2.5 μH per m If the line is operated at 10MHz. find $_{R0}$, α, β, λ, v. (8) (May 2016)
16. (i) A lossless line 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 (6) (Nov 2015)
    (ii) Derive the expression that permit easy measurements of power flow on a line of negligible losses. (10) (Nov 2015)
17. Derive the expression for the input impedance of the dissipationless line and thus obtain the expression for the input impedance of the quarter wave line. Also discuss the applications of the quarter wave line. (10)

18. An ideal loss less quarter wave transmission line of characteristic impedance 60Ω is terminated in a load impedance Z_L. Give the value of the input impedance of the line when ZL=0, ∞ and 60Ω(6)
19. (i)Derive the expressions that permit easy measurements of power flow on a line of negligible losses. (10) (May2014)

    (ii) Derive the expressions for input impedance of open and short circuited lines (6) (Nov 2011) (May2014)
20. Discuss the various parameters of open-wire and co-axial lines at radio frequency. (Nov 2011) (NOV 2014)

UNIT II PART C (FIFTEEN MARKS)

1. A generator of 1V, 1KHz supplies power to a 100km open wire line terminated in Z0 and having following the line parameter are R= 10.4 Ω/km, L = 3.8mH/km, C = 0.0085μF/km and G = 0.8mho/km. Calculate Z0,α, β, λ, v. Also find the received power.(15) (May 2019)
2. Discuss in detail about the voltages and currents on the dissipation less line. (16) (May 2017)
3. Discuss the various parameters of open-wire and co-axial lines at radio frequency. (16) (Nov 2015)
4. (i) Discuss in detail about the variation of Input Impedance along open and short circuit lines with relevant graphs. (10) (ii)A loss less line has a Standing Wave ratio of 4. The R0 is 150 ohms and the maximum voltage measured in the line is 135 V. Find the power delivered to the load. (6) (May 2016)
5. A 50 Ω lossless transmission line is connected to a load composed of a 75Ω resistor in series with a capacitor of unknown capacitance. If at 10 MHz the voltage standing wave ratio on the line was measured as 3, determine the capacitance C. (Nov 2018)

UNIT III PART A (TWO MARKS)

1. What does 2 sets of orthogonal circle represent in smith chart?(Nov 2019)
2. State the demerits of single stub matching.(Nov 2019)
3. Distinguish between single stub and double stub matching in a transmission line. (May 2019)
4. How is impedance matching achieved with stubs? (May 2019)
5. List the applications of smith chart. (Nov 2018)
6. What is the application of quarter wave line matching section? (Nov 2018)
7. What is an impedance matching in stub? (May 2018)
8. What are the uses of smith chart? (May 2018)
9. List the applications of a Quarter-wave line. (May 2017)

10. Why a short-circuited stub is ordinarily preferred to an open-circuited stub? (May 2017)
11. Distinguish between Single stub and Double stub matching in a transmission line. (Nov 2016) (Nov 2015)
12. Give the application of eight wave line. (Nov 2016)
13. Why a quarter wave line is considered as an impedance inverter? Justify. (May 2016)
14. What is a stub? Why it is used in between transmission lines? (May 2016)
15. List the applications of Quarter-wave line. (Nov 2015)
16. List the applications of the smith chart. (May 2015)
17. Mention the significance of $\lambda/4$ line(Dec 2012)
18. Write the disadvantages of single stub matching. (May 2012) (May2014)
19. Mention the application of quarter wave line. (Apr 2011)

UNIT III PART B (THIRTEEN MARKS)

1. Explain how quarter wave line is used for impedance matching with supporting expressions on Zin. Also illustrate the application in coupling to antenna.(13)(Nov 2019)
2. Enumerate the points on properties of smith chart.(5) (Nov 2019)
3. Design a short circuited stub to provide matching between load (50+j100) ohm and 50 ohm line at frequency of 30 MHz.(8) (Nov 2019)
4. Explain the operation of quarter wave transformer and mention its important applications. (May 2019)
5. Explain the technique of single stub matching and discuss of quarter wave transformer. (13) (Nov 2018)
6. Explain the procedure for obtaining the smith chart using R and X circles. (13)(Nov 2018)
7. With neat diagram, explain the single stub and double stub matching network. Also explain the design procedure.(15) (May 2018)
8. Prove that input impedance of a quarter wave line is $Z_{in} = R_o^2 / Z_R$. (6) (May 2018)
9. Design a quarter wave transformer to match a load a 200 Ω to a source resistance of 500 Ω. Operating frequency is 200 MHz (7) (May 2018)
10. Find the sending end impedance of a line with negligible losses when characteristic impedance is 55 Ω and the load impedance is (115 + j 75) Ω length of the line is 1.183 wavelength by using smith chart. (8) (May 2018)
11. Explain the significance of smith chart and its application in a transmission lines. (7) (May 2018)
12. A 300 Ω transmission line is connected to a load impedance of 450-j600 Ω at 10 MHz. Find the position and length of a short circuited stub required to match the line using Smith Chart. (16) (May 2017)
13. A load impedance of 90-j50 Ω is to be matched to a line of 50 Ω using single stub matching. Find the length and position of the stub. (10) (May 2017)
14. Design a quarter wave transformers to match a load of 200Ω to a source resistance of 500 Ω. The operating frequency is 200 MHz. (6) (May 2017)

15. Determine length and location of a single short circuited stub to produce an impedance match on a transmission line with characteristic impedance of 600 Ω and terminated in 1800 Ω. (8) (Nov 2016)
16. Explain the operation of quarter wave transformer and mention its important applications. (8) (Nov 2016)
17. Find the sending end impedance of a line with negligible losses when characteristic impedance is 55 Ω and the load impedance is 115+j75 Ω length of the line is 1.183 wavelength by using smith chart. (10) (Nov 2016)
18. Explain the significance of smith chart and its application in a transmission lines. (6) (Nov 2016)
19. (i) Prove that the input impedance of a quarter wave line is $Z_{in} = R_0^2 / Z_R$ (6). (May 2016)

    (ii) Design a quarter wave transformer to match a load of 200 ohms to a source resistance of 500 ohms. Operating frequency is 200 MHz. (10) (May 2016)
20. A load (50 – j 100) ohms is connected across a 50 ohms line. Design a short circuited stub to provide matching between the two at a signal frequency of 30 MHz using Smith chart. (16) (May 2016)
21. (i) What is Quarter-wave line? (4) (Nov 2015)

    (ii) A 75 Ω lossless transmission line is to be matched with a 100-j80 Ω load using single stub. Calculate the stub length and its distance from the load corresponding to the frequency of 30 MHz using Smith chart. (12). (Nov 2015)
22. (i) Discuss the principle of double stub matching with neat diagram (8) (Nov 2015

    (ii) A 300Ω transmission line is connected to a load impedance of (400-j600) Ω at 1 MHz. Find the position and length of a short circuited stub required to match the line using Smith chart. (8) (Nov 2015
23. Design a single stub match for a load of 150 + j225 ohms for a 75 ohms line a 500 MHz using smith chart. (6)
24. Discuss the following : (Dec 2012)

    (i) Impedance matching (8)

    (ii) Single and double stub matching. (8)
25. Write the concepts of single and double stub matching (10) (May 2012)
26. A 100Ω, 200 m long lossless transmission line operators at 10 MHz and is terminated into an impedance of 50 –j 200Ω. The transit time of the line is 1μs. Determine the length and location of short circuited stub line. (8) (May 2012)
27. Explain the technique of single stub matching and discuss operation of quarter wave transformer. (Apr 2011)
28. Explain the applications of smith chart. A 30m long lossless transmission line with Z_0=50Ω operating at 2 MHz is terminated with a load Z_L=60+j40 Ω. If U=0.6 C on the line, find the reflection coefficient γ, the standing wave ratio s and the input impedance. (Apr 2011)
29. (i)Draw and explain the operation of quarter waves line. (8)

(ii)It is required to match a 200 ohms load to a 300ohms 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? (4)

(iii)What are the drawbacks of single stub matching and open circuited stubs? (4) (Nov 2010)

30. (i)Draw and explain the principle of double stub matching. (8)(May2014) (Nov 2010)

(ii)A UHF lossless transmission line working at 1GHz is connected to an unmatched line producing a voltage reflection coefficient of 0.5 (0.866+j 0.5). Calculate the length and position of the stub to match the line. (8) (Nov 2010)

UNIT III PART C (FIFTEEN MARKS)

1. Design a single stub match for a load of 150+j 225 Ω for 75Ω line at 500 MHz using smith chart and outline the inference. (Nov 2019)
2. A 75 Ω lossless transmission line is to be matched with a (100—j80) D using single stub. Calculate the stub length and its distance from the load corresponding to the frequency of 30 MHz using Smith chart. (May 2019)
3. A single stub is to match a load 400 Ω line to a load of 200- j100 Ω. The Wave length is 3m. Determine the position and length of the short circuited stub. (May 2019)
4. Explain double stub matching on a transmission line and derive the expression and the length of the stub used for matching on a line. (16)
5. A 30 m long lossless transmission line with Z0 = 50 Ω operating at 2 MHz is terminated with a load ZL = 60 + 40j Ω. If U = 0.6C on the line, find
   (i) Reflection coefficient (5)
   (ii) Standing wave ratio (5)
   (iii) Input impedance (6) (Dec 2012)

UNIT IV PART A (TWO MARKS)

1. What is dominant mode?(Nov 2019)
2. Why TEM wave is impossible in waveguides? (Nov 2019)
3. Justify why TM01 and TM10 modes in a rectangular wave-guide do not exist. (May 2019)
4. How a cavity resonator is formed? What are its different types? (May 2019)
5. What are cavity resonators? (Nov 2018)
6. Identify when an evanescent mode occurs? (Nov 2018)
7. What is dominant mode? (May 2018)
8. What are the applications of cavity resonators? (May 2018) (Nov 2015) (Nov 2014)
9. Calculate the cut-off frequency of a rectangular waveguide whose inner dimensions are a = 2.5cm and b = 1.5 cm operating at TE10 mode. (May 2017)
10. Enumerate the parameters describing the performance of a cavity resonator. (May 2017)
11. Justify, why TM01 and TM10 modes in a rectangular waveguide do not exist. (Nov 2016)

12. An air-filled rectangular waveguide of inner dimensions 2.286 x 1.016 in centimetres operates in the dominant TE10 modes. Calculate the cut-off frequency and phase velocity of a wave in the guide at a frequency of 7 GHz. (Nov 2016)
13. Define dominant mode. What is the dominant mode of a rectangular wave guide? (May 2016)
14. How a cavity resonator is formed? (May 2016)
15. A rectangular waveguide of cross section 5 cm X 2 cm is used to propagate TM11 mode at 10 GHz. Determine the cut-off wave length. (Nov 2015)
16. Define the terms phase velocity and group velocity. (May 2015)
17. What are the characteristics of TEM wave? (May 2015)
18. A rectangular waveguide with a 5cm*2cm cross is used to propagate TM11 mode at 10Ghz. Determine the cut off wavelength. (Nov 2014)
19. Mention the applications of resonant cavities.
20. Why is TEM mode not supported by waveguide? (Nov 2014)
21. State the significance of dominant mode of propagation. (Nov 2014)
22. Give the equation for propagation constant and wavelength of TEM waves.(May2014)
23. A wave is propagated in the dominant mode in a parallel plane waveguide. The frequency and plane separation is 6GHz and 4cm. Calculate cutoff wavelength and wavelength in the waveguide. (May2014)
24. Characteristics of TEM wave.(May 2013)
25. What is degenerative mode in rectangular waveguide.(May 2013)
26. Compare TE and TM mode. (Dec 2012)
27. What is meant by dominant mode? What is the dominant mode for parallel plate guide? (May 2012)
28. Write the expression for the wave impedance and guide wavelength for TEM mode. (May 2012)
29. Write down the relationship between phase velocity and group velocity. (Nov 2011)
30. Write down the equations for characteristic impedance for TM and TE waves. (Nov 2011)
31. Define the cutoff frequency for the guided waves (Nov 2010)
32. For a frequency of 6 GHz and plane separation of 3cm, find the ground and phase velocities for the dominant mode.(Nov 2010)
33. Give the applications of cavity resonators.
34. A rectangular waveguide has the following dimensions l = 2.54 cm, b=1.27 cm and thickness = 0.127cm. Calculate the cut-off frequency for TE_{11} mode.
35. What are the dominant mode and degenerate modes in rectangular waveguide?
36. What is the dominant TE and TM mode in rectangular waveguide?
37. What is the need for guide termination?
38. How to design an air filled cubical cavity to have its dominant resonant frequency at 3 GHz?
39. What is the dominant mode of rectangular wave guide? Why?
40. Calculate the cutoff wavelength for the TM11 mode in a standard rectangular waveguide if a=4.5 cm
41. Compare transmission line and waveguide.

42. An air filled resonate cavity with dimensions a= 5 cm, b=4 cm and c= 10 cm is made of copper. Find the resonate frequency for lowest order mode.
43. A rectangular wave guide of cross section 5 cm x 2 cm is used to propagate TM11 mode at 10 GHz. Determine the cutoff wave length.

UNIT IV PART B (THIRTEEN MARKS)

1. Apply the boundary condition to wave equation and derive field strength for TE, TM waves between parallel plates. (Nov 2019)(13)
2. Obtain the field strength expression for TM waves in rectangular waveguide. (9)(Nov 2019)
3. Calculate the cutoff wavelength for rectangular waveguide TE11 mode with dimension ratio 2:1. (4)(Nov 2019)
4. Discuss in detail about the circular cavity resonator and summarize with necessary field configurations. (Nov 2019)
5. Derive an expression for the transmission of TE wave between parallel perfectly conducting planes for the field components. (13) (May 2019)
6. For a frequency of 10GHz and planes separation of 5cm in air, find the cut off frequency, cut off wavelength, phase velocity and group velocity of the wave. (13) (May 2019)
7. Write Bessel's differential equation and Bessel function and TM and TE waves in Circular wave guides. (13) (Nov 2018)
8. Derive the solution for TE and TM mode in rectangular wave guide (13) (Nov 2018)
9. Explain the wave behaviour in a guiding structures.(10) (May 2018)
10. Explain why TEM waves does not exist in wave guides. (5) (May 2018)
11. Derive an expression for the transmission of TM waves between parallel perfectly conducting planes for the field components. (13) (May 2018) (Nov 2016)
12. An air filled circular waveguide having an inner radius of 1 cm is excited in dominant mode at 10GHz. Find (a) the cut-off frequency of the dominant mode at 10GHz. (b) The guide wavelength and (c) Wave impedance. Also find the bandwidth for operation in the dominant mode only. (13) (May 2018)
13. Write a brief note on circular cavity resonator and its application.(8) (Nov 2016)
14. A TE11 wave is propagating through a circular waveguide. The diameter of the guide is 10 cm and the guide is air-filled. Given X11 = 1.842.
    (i)Find the cut-off frequency (3)
    (ii)Find the wavelength λg in the guide for a frequency of 3 GHz. (2)
    (iii)Determine the wave impedance in the guide. (3) (Nov 2016)
15. A rectangular air-filled copper waveguide with dimension 0.9 inch X 0.4 inch cross section and 12 inch length is operated at 9.2 GHz with a dominant mode. Find cut-off frequency, guide wave-length, phase velocity, characteristic impedance and the loss. (16) (Nov 2015)
16. (i) Using Bessel function derive the TE wave components in circular wave guides. (10)
    (ii) Calculate the resonant frequency of an air filled rectangular resonator of dimensions a = 2cm, b=4 cm and d=6cm operating in TE_{101} mode. (6) (Nov 2015)

17. Discuss the characteristics of TE and TM waves and also derive the cut off frequency and phase velocity from the propagation constant. (16)(MAY 2015)
18. (i)Derive field component of the wave propagation between parallel plates. (8) (MAY 2015)
    (ii)Derive the expression of wave impedance of TE, TM and TEM wave between a pair of perfectly conducting planes. (8) (MAY 2015)
19. (i)Explain about excitation modes in rectangular waveguide (10) (Nov 2014)
    (ii) Calculate resonant frequency of an air filled rectangular resonator of dimensions a = 3 cm, b = 2cm and d = 4cm operating in TE_{101} mode. (6) (Nov 2014)
20. Explain the propagation of electromagnetic waves in a cylindrical waveguide with suitable expressions. (16) (Nov 2014)
21. Discuss the principle of rectangular cavity resonator (May2014)
22. Discuss the transmission of TM waves between parallel planes and the characteristics of TE and TM waves. (May2014)
23. Discuss the characteristic of TM waves in circular wave guides (10)(May 2013)
24. Sketch the field lines of TE1 mode in parallel plate waveguides (May 2012)
25. Discuss the structure , advantage and disadvantage of resonant cavities (May 2012)
26. (i)Derive the equations that are the result of introduction of restrictions on time to Maxwell's equations (8)
    (ii)Derive the field equations for TE waves between parallel planes. (8) (Nov 2011)
27. Explain TEM and TM cases for attenuation with planes of finite conductivity. (Nov 2011)
28. Discuss in detail guided waves between parallel planes with neat diagram. (Apr 2011)
29. 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 dominant mode, guide wavelength, wave impedance and the bandwidth for operation in dominant mode only (8) (Nov 2010)

UNIT IV PART C (FIFTEEN MARKS)

1. A TE10 wave at 10 GHz propagates in a brass σ = 1.57 X 107 (S/m) rectangular wave guide with inner dimensions a = 1.5cm and b = 0.6 cm, which is filled with ϵr = 2.25, μr = 1, loss tangent = 4 X 10-4. Determine (i) the phase constant, (ii) the guide wavelength, (iii) the phase velocity, (iv) the wave impedance, (v) the attenuation constant due to loss in the dielectric, and (vi) the attenuation constant due to loss in the guide walls. (15). (Nov 2018)
2. Derive the field components of Transverse Electric wave in rectangular waveguide. (16) (May 2017)
3. When dominant mode is transmitted through a circular waveguide , the wavelength measured is to be 13.33 cm. The frequency of the microwave signal is 3.75 GHz. Calculate the cut-off frequency, inner radius of guide, phase velocity, group velocity, phase constant, wave impedance, bandwidth for operation in dominant mode only. (16) (May 2017)
4. Derive the field component of a Transverse Electric wave in Rectangular waveguides. (16). (May 2016)
5. For a frequency of 10 GHz and plane separation of 5cm in air, find the cut off frequency, cut off wavelength, phase velocity and group velocity of the wave. (16) (May 2016)

6. A rectangular air filled copper waveguide with dimensions 0.9 inch x0.4 inche cross section and 12 inch length is operated at 9.2 GHz with a dominant mode. Find the cutoff frequency, guide wave length, phase velocity, characteristic impedance and the loss. (Nov 2010)

UNIT V

PART A (2 MARKS)

1. List some of the active RF components.
2. Enumerate the bandgap energy for Si and Ge used for semiconductor diodes.
3. What is called as HBTs?
4. Define reverse active mode in bipolar junction transistor.
5. Classify RF field effect transistors based on physical construction.
6. Compare the enhancement type FET with Depletion type FET.
7. Outline the characteristics of modulation doped field effect transistor.
8. What is HEMTs?
9. Illustrate the generic RF amplifier design.
10. Mention various types of mixers.
11. Summarize the basic steps in the design process of RF amplifier circuits.
12. Distinguish between Oscillator and Mixer.
13. Examine the importance of voltage controlled oscillator in RF system.
14. Interpret the basic parameters of RF amplifier.
15. Generalize the concept of unconditional stability of an amplifier.
16. Analyze the techniques of efficiency boosting in RF power amplifier.
17. Evaluate the significance of negative resistance in oscillation of a circuit.
18. Devise the operation of single ended and differential ended LNA.
19. Deduce the transducer power gain of a RF power amplifier.
20. Draw typical output stability circle and input stability circle.
21. Define power gain of an amplifier in terms of S parameters and reflection coefficients.
22. What is Rollett factor?
23. ive the expression to verify the unconditionally stability of RF amplifier.
24. Write the expression for noise figure of a two port amplifier

PART B (THIRTEEN MARKS)

1. Elaborate the construction and the functionality of the bipolar junction transistor.
2. Discuss about the different operating modes of a bipolar junction transistor with appropriate diagram.
3. Compare the field effect transistor with the bipolar junction transistor
4. Explain the distinct features of high electron mobility transistors.
5. Analyze the steps involved to design a low noise amplifier
6. Interpret the various types of mixers with its principle of operation
7. Illustrate the design principles of RF amplifier and impedance matching.
8. A microwave amplifier is characterized by its S-parameters. Derive equations for power gain, available gain and transducer gain.
9. With reference to RF transistor amplifier, discuss the considerations for stability and gain.
10. Write the mathematical analysis of amplifier stability
11. Devise the various stabilization methods for an RF amplifier circuit.

PART C (FIFTEEN MARKS)

1. Draw a basic RF circuit block and explain about Low noise amplifiers, Mixers and Power Amplifiers.
2. A microwave amplifier is characterized by its S-parameters. Derive equations for power gain, available gain and transducer gain. (16)
3. A microwave transistor has the following S parameters at 10 GHz, with a50Ω reference impedance. S11=0.45 ∠ 150◦, S22=0.40 ∠-150◦, S12=0.01 ∠-10◦, S21=2.05 ∠ 10◦, the source impedance Zs=20Ω and load impedance is ZL=30Ω. Compute the power gain, available gain and transducer power gain. (16)
4. An RF amplifier has the following S parameters: S11=0.3∠-700, S21=3.5 ∠850, S12=0.2∠-100, S21=0.4∠-450. Further Vs=5V∠00, Zs=40Ω and ZL=73Ω. Assuming Zo=50Ω. Find GT, GTU, GA and G. Also find power delivered to the load PL, available power from source PA and incident power to amplifier Pinc.

Prepared by: **Approved by:**

QUESTION BANK

BRANCH: ECE **YEAR/SEM:** III/V

UNIT I TRANSMISSION LINES THEORY

PART – A

1. What is characteristic impedance **[D][Apr/May-2016]**
2. Define reflection loss. **[D][Apr/May-2016]**
3. What is meant by distortion less line? **[D][Nov/dec-2016]**
4. Find the characteristic impedance of a line at 1600HZ if z_{oc}=750<-30Ω and z_{sc}=600<-20Ω. **[ID][Apr/May-2016]**
5. A transmission line has z_o=745<-12Ω and is terminated in z_R=100Ω, calculate Reflection factor **[ID][Nov/Dec -2017]**
6. Define Smooth line. **[D][Nov/Dec -2017]**
7. What is meant by distortion less line? **[D][Apr/May-2018]**
8. Define reflection loss. **[D][Apr/May- 2016,2018]**
9. What is meant by infinite line? **[D][Nov/dec-2010]**
10. For a symmetrical network, define propagation constant and characteristic impedance? **[D][Apr/May-2011]**
11. Define propagation constant of a transmission line. . **[D][Apr/May-2013], Nov/dec-2012]**
12. What is the significance of the reflection co efficient? **[D][Nov/dec-2010]**
13. For a symmetrical network, define propagation constant and characteristic impedance? **[D][Nov/dec-2012]**
14. Write the relationship between Neper and decibel.[D]
15. What is meant by inductance loading of telephone cables?[D]
16. What is the relationship between characteristic impedance and propagation constant?[D]
17. Write the expressions for the phase constant and velocity of propagation for telephone cable.[D]
18. What is meant by finite and infinite line?[D]
19. How can you overcome delay distortion?]ID]
20. What are the different types of loading?[D]
21. What are the primary and secondary constants of transmission lines?[D]
22. Find the reflection coefficient of a 50 ohm transmission line when it is terminated by a load impedance of 60+40j ohm **[ID][Apr/May-2013].**
23. When does a finite line appear as a infinite line. **[ID]**
24. What is the significance of the reflection co efficient[D]
25. What is meant by inductance loading of telephone cables? **[ID]**
26. Define cutoff wave length?[D]
27. Give the general equation of the transmission line?[D]
28. Draw the equivalent electrical circuit of a unit length of a transmission line[D]
29. What are the primary and secondary constants of a transmission line?[D]
30. Define Reflection factor?[D]

PART – B

[First Half]

[General theory of transmission lines – General solution]

1. The constants of a transmission line are R= 6ohms/km, L=2.2m H/km, C=0.005×10^{-6} and G=0.25×10^{-6} mho/km. Determine the characteristics impedance and propagation constant at 1000 Hz.(7)[D]

2. A generator of 1v, 1000HZ supplies power to a 100km open wire line terminated in z_0 and having following parameters. R= 10.4hms/km, L=0.00367 H/km, C=0.8×10^{-6} and G=0.00835×10^{-6} mho/km. Determine the z_0, α, β, λ, v also find the received power. **(13)[D][Nov/dec-2016]**

3. Derive the general transmission line equation for the voltage and current at any point on a line. **(13)[D][May/Jun-2016], [Apr/May-2018]**

4. A transmission line has the following per unit length parameters: $L = 0.1\mu$ H, R =5 ohms, C = 300 pF and G = 0.01 mho. Calculate the propagation constant and characteristic impedance at 500 MHz. Derive expression for the attenuation and phase constant of transmission line in constant R, L, G and C. (6)[D] **(13)[D][Apr/May2018]**

5. A transmission line operating at 500 MHz has $Z_0=80\Omega$, α= 0.04 Np/m, β=1.5 rad/m. Find the line parameter series resistance (R Ω/m), series inductance (L H/m), shunt conductance (G mho/m) and capacitance between conductors (C F/m). **(13)[D]**
6. A communication line has. R= 10.4hms/km, L=0.00367 H/km, $C=0.8\times10^{-6}$ and $G=0.00835\times10^{-6}$ mho/km. Determine the characteristics impedance and propagation constant ,velocity of propagation ,sending end current given frequency=1000HZ,sending end voltage is 1v and transmission line length is 100Km. **[D][Apr/May-2017]**
7. Discuss the general solution of a transmission line in detail(10) **[D][Apr/May-2017]**
8. The constants of a transmission line are R= 6ohms/km, L=2.2m H/km, $C=0.005\times10^{-6}$ and $G=0.25\times10^{-6}$ mho/km. Determine the characteristics impedance and propagation constant at 1000 Hz. **(13)[D]**
9. Derive expression for the attenuation and phase constant of transmission line in constant R, L, G and C. **(13)[D]**

[Infinite line-wavelength, velocity of propagation]

10. Prove that an infinite line equal to finite line terminated in its characteristics impedance.(6) **[D][May/Jun-2016]**

[Second Half]

[Waveform Distortion, Distortion less line]

11. Derive the condition for minimum attenuation in a distortion less line. (8) **[D][Nov/dec-2016]**

12. A distortion less transmission line has attenuation constant $\alpha=1.15\times10^{-3}$ Np/m, and capacitance of 0.01 n F/m. the characteristic resistance L/C=50Ω find the resistance inductance and conductance per more of the line.(16)[D]

13. Derive the conditions required for a distortion less line.(10)[D]

14. Explain in detail about the wave form distortion and also condition for distortion less line. **(10) [D][Nov/dec-2016]**

[**Loading and different methods of loading**]

15. Discuss in detail about lumped loading and derive the Campbell's equation. (10)**[D][Apr/May-2017]**

16. A transmission line operating at 10^6 rad/s has α= 8 d B/m, β= 1 rad/m. and z_0= 60+ j40ohms, and is 2meter long. The line is connected to a source of 10 v, Zg=40ohms and terminated by a load of 20 + j50ohms. Determine the current at the middle of the line. (8)**[D][Apr/May-2017]**

[**Line not terminated in z_0, Reflection coefficient**]

17. Explain in detail about the reflection on a line not terminated by its characteristics impedance $\mathbf{z_0}$. (8)**[D][Apr/May-2017], [Nov/dec-2016]**

18. A low loss transmission line of 100 ohms characteristic impedance is connected to a load of 200ohm. Calculate the voltage reflection coefficient and the standing wave ratio.(16)[D]

[**Calculation of current voltage, power delivered and efficiency of transmission, input transfer impedance**]

19. Discuss the theory of open and short circuited lines with voltage and current distribution diagram and also get the input impedance expression.(16)[D]

20. A communication line has. R= 13.4hms/km, L=0.00467 H/km, C=0.9×10^{-6} and G=0.00735×10^{-6} mho/km. Determine the characteristics impedance and propagation constant ,velocity of propagation ,sending end current for given frequency=3000HZ,sending end voltage is 3v and transmission line length is 10Km. **[D][Apr/May-2013]**

UNIT II HIGH FREQUENCY TRANSMISSION LINES THEORY
PART-A

1. **A loss** less transmission line has a shunt capacitances 100 pf/m and series inductances 0f 4μH/m, find the characteristics impedances.[D] **[Nov/dec-2015]**

2. For the line of zero dissipation what will be the values of attenuation constant and characteristics impedances. .[ID] **[Nov/dec-2015]**

3. Write the expression for standing wave ratio in terms of reflection coefficient. **[D][May /june-2016]**

4. Why a quarter wave line is considered as a impedance inverter? justify.[ID] **[Nov/dec-2016]**

5. Write the expression for the input impedance of open and short circuited dissipation line.[D] **[Nov/dec-2016]**

6. Calculate the standing wave ratio and reflection coefficient on a line having the characteristics impedances Z_0=300Ω and terminating impedances Z_R=300+j400Ω. .[D] **[Nov/dec-2016]**

7. Define Standing wave ratio. **[D][Apr/May-2017]**

8. A low loss line has a characteristic impedance of 400ohms determine the SWR if the receiving end impedance is 650-j475Ω **[D][Apr/May-2017]**

9. State the relation between standing wave ratio and reflection coefficient.**[D] [Nov/dec-2017**]

10. At a frequency of 80 *MHz*, a lossless transmission line has a characteristic impedance of 300 _ and a wavelength of 2.5 m. Find L and C. **[Nov/dec-2017]**

11. What are assumptions to simply the analysis of line performances at high frequencies? **[D][Apr/May-2018]**

12. Write the expression for the input impedances and open and short circuited dissipation less line. **[D][Apr/May-2018]**

13. Find the reflection co efficient of the 50 ohm Transmission line when it is terminated by the load impedance of 60+j40 ohm.[D] **[Nov/dec-2010]**

14. When does a finite line appear as an infinite line? .[D] **[Nov/dec-2010]**

15. A 50 ohm coaxial cable feeds a 75 + j20 ohm. Dipole antenna. Find reflection coefficient and standing wave ratio. **[D] [Nov/dec-2012]**

16. A transmission line has Z0=745 12degree ohms and is terminated is Zs=100ohms calculate the reflection loss in Db. **[D] [Nov/dec-2012]**

17. At a frequency of 80 *MHz,* a lossless transmission line has a characteristic impedance of 300 _ and a wavelength of 2.5 m. Find L and C. **[May /june-2013]**

18. How can distortion be reduced in a transmission line? **[Nov/dec-2012]**

19. What are the properties of infinite length?[D]

20. Why is quarter wave line called as copper insulator?[ID]

21. Give the minimum and maximum value of SWR and reflection coefficient.[D]

22. If a line is to have neither frequency nor delay distortion how do your relate attenuation constant and velocity of propagation to frequency?[D][**Nov/dec-2010]**

23. A low loss line has a characteristic impedance of 400ohms determine the SWR if the receiving end impedance is 650-j475Ω **[D][Nov/dec-2010]**

24. Write the expressions for the phase constant and velocity of propagation for telephone cable? **[D][Nov/dec-2010]**

25. What is the application of the quarter wave matching section? [D]

26. Bring out the significance of a half wavelength line. [ID]

27. Give reasons for preferring a short- circuited stub when compared to an open circuited stub[.D]
28. Give the input impendence of eighth wave line terminated in a pure Resistance [D]
29. List parameters of the open wire line at High frequency. [D]

30. What are nodes and antinodes on a line? [D]

PART-B
(First Half)

[**Transmission line equation at radio frequencies-Line of zero dissipation-voltage and current on the dissipation less line**]

1. Derive the line constant of a dissipation less line(8) **[D][May/June2016]**
2. Discuss the various parameters of open-wire and co-axial lines at radio frequency. (16)**[D][Nov/Dec2015]**
3. Discuss in detail about the voltages and currents on the dissipation less line(16)**[D][Apr/May2017]**
4. Derive the expression that permit easy measurements of power flow on a line of negligible losses. (10))**[D][Nov/Dec2017]**
5. A line with zero dissipation has R=0.006 ohm per m, C=4.45pF per m, L=2.5µ10 per m , if the line is operated at 10MHz , find $R_0,\alpha,\beta,\lambda,v$.(8)**[D][May/June2016]**
6. Discuss in detail about the variation of input impedance along lines open and short circuit lines with relevant graph(10)**[D][May/Jun2016] May/Jun2018]**
7. A loss less line has a standing wave ratio of 4. The R_0 is 150 ohms and the maximum voltage measured in the line is 135v.Find the power delivered to the load.(6)**[D][May/June2016]**
8. A radio frequency line with z_0=70Ω is terminated by Z_L=115-j80Ωat λ=2.5m.Find the VSWR and the maximum and minimum line impedance(6)**[D][Apr/May2017]**

[Second half]

[Input impedance of dissipation less line]

9. A lossless line in air having a characteristic impedance of 300 n 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. (6) **[D][Nov/Dec2015]**

[Open and short circuited lines, Power and impedance measurement on line]

10. Derive the expression that permit easy measurements of power flow on a line of negligible losses. (10))**[D][Nov/Dec2015]**

11. Derive an expression for the input impedance of a dissipation less line and also find the input impedance is maximum and minimum at a distance 'S'(8)[**D][Nov/Dec2016]**
12. Draw the input impedance pattern for a lossless line when short circuited and open circuited.(6)[D**][Nov/Dec2016]**
13. Find the sending end line impedance for a HF line having characteristics impedance of 50Ω. The line is of length(1.185λ) and is terminated in a load of(110+j80)Ω(8)**[ID][Nov/Dec2016]**
14. Discuss in detail about voltages and currents on the dissipation less line(16)**[D][Aprl/May2017**]
15. 'Briefly explain on' :i) Standing Waves ii) Reflection loss(4+4))**[D][Aprl/May2017]**
16. A generator of 1v, 1kHz supplies power to a 100km open wire line terminated in 200 ohms resistance The line parameter are R= 10ohm/km, L=3.8 Mh/km G= 1×10 mho/km. c=0.0085 μF/km calculate the impedance, reflection coefficient power and transmission efficiency. (13) [D]**[Nov/Dec2017]**

[Standing waves, Nodes, Standing wave Ratio]

17. Briefly explain on; Standing waves (4)**[D][Nov/Dec2016]**
18. A loss less line has a Standing Wave ratio of 4~The Ro is 15.0ohms and the maximum voltage measured in the line is 135 V. Find the power delivered to the load(6)**[ID][May/june 2017]**

[Measurement of VSWR and Wavelength]

19. Describe an experimental set up for the determination of VSWR of an RF transmission(8)**[D][Nov/Dec2016]**
20. A radio frequency line with Zo = 70 D is terminated by ZL = 115 - j80 n at A =,2.5.m. Find the VSWR 'Rapid the maximum and minimum line impedances(6) **[D][Aprl/May2017]**

    [**Reflection losses**]
21. Briefly explain on' :i) Reflection loss(4) **[D][Apr/May2017**]

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

PART A

1. What is the relationship between standing wave ratio and reflection coefficient?[D][**Nov/Dec2017]**
2. What are the assumptions for the analysis of radio frequency line? [D][Nov/Dec2017]
3. Distinguish between Single Stub and Double Stub matching in a transmission line. [D][**Nov/Dec2016]**
4. Give the application of eight wave line. [D][**Nov/Dec2016**]
5. Express standing wave ratio in terms of a reflection coefficient.[D][**Apr/May2017**]
6. Mention the application of quarter wave line.[D][**Apr/May2017**]
7. What is the relationship between standing wave ratio and reflection coefficient?[D][**Nov/Dec2017**]
8. What are the assumptions for the analysis of radio frequency line ?[D][**Nov/Dec2017]**
9. Give the formula to calculate the length of the short circuited stub.[D]
10. What is the input impendence equation of a dissipation less line? [D]
11. Give the equation for the radius of a circle diagram.[D]
12. Write the expression for the input impedance of open and short circuited dissipation less line.[D][Nov/Dec2010]
13. A lossless line has a characteristic impedance of 400 ohms. Determine the standing wave ratio if the receiving end impedance is 800+j0.0 ohms [**ID**][**Nov/Dec2010**]
14. What are the applications of smith chart[**D**][**Nov/Dec2010**]
15. A loss less line has a shunt capacitance of 69 pF and a series inductance of 0.387pH .Calculate the characteristic impedance.[ID][**Apr/May2011]**
16. Write the value of SWR of the following loads (a) Open circuit (b) short circuit (c) matched load.[D][**Apr/May2011**]
17. Express SWR in terms of reflection coefficient.[D][**Nov/Dec 2012]**

18. What is impedance matching in stub?[D][**Apr/May2018**]
19. What are the uses of smith chart?[D][**Apr/May2018**]
20. Distinguish between Single Stub and Double Stub matching in a transmission line.[D][**Apr/May2016**]
21. Give the applications of eight wave lines[D][**Apr/May2016**]
22. What are the assumptions for the analysis of radio frequency line?[D][**Apr/May2017**]
23. What are the difficulties in single stub matching?[D]
24. How is the circle diagram useful to find the input impedance of open and short circuit lines[D]
25. Give the equation for the radius of a circle diagram.[D]
26. What is double stub matching?[D]
27. Give reason for an open line not frequently employed for impedance matching [ID]
28. Why double stub matching preferred over single stub matching?[ID]
29. What is the input impedance equation of a dissipation less line[D]
30. Mention the application of quarter wave line[D][**Apr/may2012]**

PART B

[FIRST SECTION]

[Impedance matching Quarter wave transformer]

1. Determine length and location of a single short circuited stub to produce' an impedance match on a transmission line with characteristic impedance of 600n and terminated in 1800 n. (8)[**D**][**Nov/Dec2016**]
2. Explain the 'operation of quarter wave transformer and mention it's .important applications. (8)[**D**][**Nov/Dec2016]**
3. Derive an expression for the input impedance of dissipation less lines. Deduce the input impedance of open and short circuited, dissipation less lines, (10)[D**][Apr/may2017**]
4. A lossless line in air having a characteristic impedance of 300 ohm is terminated in un known impedance. The first voltage minimum is located at 15em from the load. the standing wave ratio is 3.3, calculate the wavelength and terminated impedance.(6)[D][**Apr/May2017**]
5. Prove that input impedance of a quarter wave line $Z_n=R_o^2/Z_R$.(6)[D][**Apr/May2017**
6. Design a quarter wave transformer to match a load a 200Ω to a source resistance of 500Ω. Operating frequency is 200MHz.(7)[D][**Apr/May2018**]
7. Determine length and location of a single short circuited stub to produce an impedance match on a transmission line with characteristic impedance of 600Ω and terminated in 1800Ω(8)[ID][**Nov/Dec2016]**
8. Explain the operation of quarter wave transformer and mention its important applications(8)[D][**Nov/Dec2016**]
9. Antenna with impedance 40+j30 0 is to be matched to a 1000 loss less line with a shorted stub. Determine the required stub admittance, distance between the stub, stub length and standing wave ratio on each ratio of the system using smith chart. (16)[ID][**Nov/Dec2017**]

[SECOND PART]

[Impedance matching by stubs-single stub and double stub]

10. A lossless transmission line with characteristic impedance Zo= 300 n is connected to a load ZL = 120 - j600 . Calculate input impedance (Zin), standing wave ratio, r(Reflection coefficient) and input current. Given, length of the transmission line = 2 m

,phase velocity (vp) = 2.5x108m/s, operating frequency (f) = 100 MHz, source impedance (Zs) = 3000 and source voltage(Vr) = 60V.(16)[D]]Nov/Dec2017]

11. Discuss the principle of double- stub matching with neat diagrams and expressions. (8)[D][**Apr/May2017**]
12. Describe single stub matching technique, Derive the expression for length and location of stub.(10)[ID][**Nov/Dec2012**]
13. Discuss the following i) Impedance matching ii) Single and stub matching) Standing wave(16)[D][**Nov/Dec2013**]
14. Discuss the following i) Input impedance ii) Single and stub matching iii) Standing wave (5+5+6=16)[D][**May/Jun2013**]
15. Explain the technique of single stub matching and discuss operation of quarter wave transformer(16)[D][**Nov/Dec2012**]

[Smith chart- solution of problems using smith chart]

16. Finding the, sending end impedance of a line with negligible losses when Find characteristic impedance is 55 n and the load impedance is 115 +j75 n length of the line is 1.18,3wave length .by using smith chart. (10)[D][**Nov/Dec2017**]
17. Explain the significance of smith chart and its application of a transmission–lines. (6)[D][**Nov/Dec2017**]
18. A 300 ohm transmission line is connected to a load impedance of (450 -j600) n at 10 MHz. Find the position and length of a short circuited stub required to match the line using Smith chart.(8)[D][**Apr/May2017**]
19. Find the sending end impedance of a line with negligible losses when characteristic impedance is 55Ω and the load impedance is (115+j75)Ω length of the line is 1.183 wave length by using smith chart.(8)[ID][**Apr/May2018**] (10)[**Nov/Dec2016**]
20. Explain the application of smith chart .A 30m long lossless transmission line with Z_o=50Ω operating at 2MHz is terminated with a load Z_L=60+j40Ω if U=0.6C on the line , find the reflection coefficient , the standing wave ratio S and the input impedance(16)[ID][**Nov/Dec2012**]

UNIT IV PASSIVE FILTERS

PART A

1. What are the dominant modes for TE and TM waves in parallel plane wave guide?[D][**Nov/Dec2017**]
2. Write the expression for cutoff wavelength of the wave which is propagated in between two parallel planes.[D][**Nov/Dec2017**]
3. Why a composite filter is designed and what are the various sections of the composite filter?[D][**May/Jun2016**]
4. What are the major draw backs of a constant - k prototype filter?[D][May/Jun2016]
5. What are the dominant modes for TE and TM waves in parallel plane wave guide?[D][**Nov/Dec2017**]
6. Write the expression for cutoff wavelength of the wave which is propagated in between two parallel planes.[D][**Nov**/Dec2017]
7. A wave is propagated in the dominant mode in a parallel plane waveguide. The frequency is 6 GHz and the plane separation is 4 em, Calculate the cutoff wavelength and the wavelength in the waveguide.[D][**Apr/May2017**]
8. Give the equations for the propagation constant and a wavelength for TEM waves between parallel planes.[D][**Apr/May2017**]

9. A constant-K, T section high pass filter has a cut off frequency of 10 KH and the design impedance _is 600 Ohm. Determine the value of shunt inductance L and series Capacitance C. [D] [Nov/Dec2016]
10. Define propagation constant in a symmetrical network.[D][**Nov/Dec2016]**
11. What are the major drawbacks of constant-K prototype filter?[D][**May/Jun2018]**
12. Define propagation constant in a symmetrical network. [D][**May/Jun2018**]
13. State the significance of crystal filters in communication system [D][**Nov/Dec2012]**
14. What are the advantages of m-derived filters[D][**Nov/Dec2012,Apr/May2011**]
15. A waveguide can be called as high pass filter. Why?[ID][**Apr/May2011]**
16. A constant-K high pass filter has a cut off frequency of 10 KH and the design impedance is 600 Ohm. Determine the value of L. [D] [Nov/Dec2010] [May/Jun2013]
17. Why constant k filters are also known as proto type filters?[ID]
18. Define cut off frequency of a filter?[D]
19. What are the features of crystal filter?[D]
20. What is importance of terminating half section?[ID]
21. Give relationship between decibel and neper.[D]
22. What are the major disadvantages of proto type k-filters.[D]
23. What are the characteristics of ideal filters?[D]
24. Draw the equivalent circuit of a piezoelectric crystal.[D]
25. Define propagation constant.[D][Nov/Dec2012]
26. Define composite filters. [D]
27. What is the condition for occurrence cut of frequency of a filter.[D]
28. What is band elimination filter?[D]
29. Mention the condition for stop band and pass band of a filter.[D]
30. If the short circuit impedance is 100 Ohm, and open circuit impedance 400 Ohm, what is characteristic impedance of symmetrical network.[ID]

PART B

[First Half]

[Characteristic impedance of symmetrical network]

1. Design a symmetrical bridge T attenuator with an attenuation of 40 dB and impedance of600 ohm.**(10)[D][Nov/Dec2017]**
2. A π-section filter network consists of series arm inductance of 20 mH and two shunt capacitor of 0.16μF each. Calculate the cut off frequency, attenuation and phase shift at 10 KHz. What is the value of normal impedance in the pass band(6)**[D][Apr/may2018]**
3. Design T and π section low pass filter which has series inductance 80 MHz and shunt capacitance 0022μf. Find the cut off frequency and design impedance.(16)**[D][May/Jun2013]**

[Design of filters, constant K, LP, HP, BPF, BSF]

4. Sketch the reactance curve of a constant- K low pass filter. Determine attenuation constant and phase constant in pass band and stop band plot it.(16)**[D][Nov/Dec2017]**
5. Derive the design equations of a constant k low pass filter.(8)**[D][May/Jun2016]**
6. Design constant- K band stop filters (both T and 1r -sections) for the cutoff frequencies of 2 KHz and 6 KHz. The. design impedance is 500 ohm.(10)**[D][Apr/May2017]**
7. Derive the design equations of a constant K low pass filter?(7)**[D][Apr/May2018]**
8. Design a T section and π section constant K high pass filter having cut off frequency of 12KHz and nominal impedance R_0=500 ohm, Also find: i) Z_0, ii) Phase constant at 24 KHz, iii) Attenuation constant at 4 KHz(16)[D]
9. Draw a constant –K T section band elimination filter and explain the operations with necessary design equations.(8)[**D**][**Nov/Dec2010**]

10. Design a constant K-T section band pass filter with cut off frequency 1KHz, the design impedance is 600 ohms(8)**[D][Nov/Dec2010]**

[Second Half]

[m-derived section low pass and high pass filter]

11. Design a m-derived low pass filter (T and 1t section) having a design resistance of R_0 = 500 n and the cut off frequency (fc) of 1500 Hz and an infinite attenuation frequency (fc) of 2000 Hz. (16)**[D][Nov/Dec2017]**
12. What is m-Derived filter? Draw a m-Derived T-section and π-section low pass filter and explain the analysis of m-Derived low pass filter with, respect to attenuation, phase shift and characteristic impedance with frequency profile respectively. (16)**[ID][Nov/Dec2010]**
13. What is m-derived filter? Draw a m-derived T-section and π section low pass filter and explain the analysis of m-derived low pass filter with respect to attenuation, phase shift and characteristic impedance with frequency profile respectively(16).**[ID][Nov/Dec2016]**
14. Design m-derived T-type low pass filter connected to a load of 500Ω with cut off frequency 4 KHz and peak attenuation at 4.15 KHz. (13)**[D][Apr/May2018]**
15. Draw and explain the design and operation of m-derived T-section band pass filter with necessary equations and diagrams.(8)**[D][Apr/May2017]**
16. Design a m-derived LPF, with f_c= 5000 Hz, design impedance 600 ohm, f_∞ is 1.25(f_c).(16)[D]
17. Derive the relevant equations of m-derived low pass filter and design m-derived T type low pass filter to work the load of 500Ω with cut off frequency at 4 KHz and peak attenuation at 4.15nKHz(16)**[D][Nov/Dec2012]**

[Composite filters]

18. Explain the structure and application of crystal filter. Design a low pass filter with cut off at 2600 Hz to match 550Ω use one derived section with infinite attenuation of 2850 Hz(16)**[D][Nov/Dec2012]**
19. What is composite filter? Design a constant –K low pass filter (T-section and π-section) and having cut-off at which 2.5 KHz and design resistance Ro .is 700 n,. Also find the frequency at which this filter produces attenuation of 19.1 dB. Find its characteristic impedances and phase constant ~t pass band and stop or attenuation band.(2 + 14)[ID]**[May/Jun2016]**
20. Design a low pass composite filter. to meet the following specifications fc=2000 Hz, foo = 2050 Hz, Rk = 500 ohms. (16)[D]**May/Jun2016]**

UNIT V WAVE GUIDES AND CAVITY RESONATORS

PART A

1. Define - Phase Velocity and Group Velocity.[D]**[Nov/Dec2017]**
2. What are the characteristics of TEM waves? .[D]**[Nov/Dec2017]**
3. Define dominant mode. What is the dominant mode of a rectangular wave guide? .[D]**[Nov/Dec2016]**
4. How a cavity resonator is formed? .[ID]**[Nov/Dec2016]**
5. A rectangular waveguide with a 5 cm x 2 ern cross is used to propagate TMr. mode at 10 GHz. Determine the cut off wave length.[D]**[Apr/May2017]**
6. Mention the cavity of resonators. [D]**[Apr/May2017]**
7. Justify, why TM_{01} and TM_{10} modes in.a rectangular waveguide do not exit.**[ID][Nov/Dec2016]**
8. An air-filled rectangular waveguide of inner dimensions 2.286 x 1.016 in centimeters operates in the dominant TE_{10} modes. Calculate the cut-off frequency and phase velocity of a wave in the guide at a frequency of 7 GHz.[ID]**[Nov/Dec2016]**
9. What is dominant mode?[D]**[Apr/May2016]**
10. Calculate the cut-off frequency of a rectangular waveguide whose inner dimensions are a = 2.5 em and b = 1.5 em operating at TE_{10} mode.[ID]**[Apr/May2015]**

11. Why is circular or rectangular form used as wave guides. [ID]
12. What is relationship between loaded , unloaded , and external Q of a cavity resonator?[D][**Apr/May2011**]
13. Why is the Bessel function of the second kind (Neumann's function) not applicable for the field analysis inside the circular wave guide?[ID]
14. What are degenerate modes?[**D**][**Apr/May2011**]
15. What is resonant frequency of microwave resonator?[D]
16. Distinguish between wave guides and cavity resonator. [D]
17. An air filed resonant cavity with dimension a=5cm, b=4cm, c=10 cm is made of copper find the resonant frequency for lowest order mode. [ID]
18. A rectangular waveguide of cross section 5cm×2cm is used to propagate TM11 mode at 10 GHz determine the cut off frequency. [ID]
19. What is the need for guide termination? [D]
20. Write the expression for the wave impedance and guide wavelength for TEM mode? [D]
21. What is the dominant mode of a rectangular waveguide? Why? [ID]
22. Calculate the cutoff wavelength for the TM11 mode in a standard rectangular waveguide if a = 4.5 cm.[ID]
23. Why TEM waves is impossible in a rectangular Wave guides .[**ID**][**Ape/May2011**]
24. What is the dominant TE and TM mode in rectangular waveguide? [D]
25. How to design an air filled cubical cavity to have its dominant resonant frequency at 3 GHz?[D]
26. What is Bessel function? Write Bessel's functions of first kind of order zero?[D][**Nov/Dec2010**]
27. Define quality factor of resonator [D][**Nov/Dec2010**]
28. Why transmission line are not usually used as a microwave resonator.[ID][**Nov/Dec2010**]
29. How the resonator is constructed at low frequency. [ID]
30. Enumerate the parameters describing the performance of a cavity resonator.[**ID**][**May/Jun2015**]

PART- B

[First Half]

[General Wave Behaviours along uniform Guiding structures, Transverse Electromagnetic Waves, Transverse Magnetic Waves, [TM and TE Waves between parallel planes]

1. Derive an expression for the transmission of TE waves between parallel perfectly conducting planes for field components. (16)[**D**][**Nov/Dec2016**]
2. Derive the solution of field equation using cylindrical co-ordinates.(8)[D]
3. Write a brief note on the manner of wave travel and their velocities between parallel planes.(8)[**D**][**Nov/Dec2010**]
4. For a frequency of 10 GHz and plane separation of 5cm min: air, find the cut off frequency, cut off wavelength, phase velocity and group velocity of the wave.(16)[**D**][**May/Jun2016**]

[TM and TE Waves in Rectangular Wave guides]

5. Discuss the propagation of TM waves in a circular waveguide with relevant expression for the field components.(8)[D]
6. Discuss briefly the attenuation of TE and TM wave between parallel planes(8)[**D**][**Apr/May2015**]
7. Give a brief note on the transmission of TEM waves between parallel planes(8)[**D**][**Apr/May2015**]

8. Calculate the cutoff wavelength, guide wavelength and characteristic wave impedance of a circular wave guide with an internal diameter of 4 cm for a 10 GHz signal propagated in it in the TE_{11} mode.(16)[D]
9. A rectangular wave guide with dimension a=2.5cm, b=1cm is to operate below 15 GHz How many TE and TM modes can the wave guide transmit if the guide is filed with a medium characterized by σ=0, €=4 €0, βr=1? Calculate the cutoff frequency of the modes.(16)[**ID**][**Nov/Dec2012**][**May/Jun2017**]
10. Explain in detail: i) Excitation of wave guides. ii) Resonant cavities.(8+8)[**D**][**Nov/Dec2012**]][**May/Jun2017**]
11. Derive the field equations of Transverse Electric waves travelling in Z direction rectangular wave guide(16)[**D**][**Nov/Dec2017**]
12. Derive the field component of a Transverse Electric wave in Rectangular wave guides.(16)[**D**][**May/Jun2016**] (16)

[Second Half]

13. Discuss the propagation of TM waves in a rectangular waveguide with relevant expressions and diagrams for the field components.(16)[D]
14. A rectangular waveguide measuring a = 4.5 cm and b = 3 cm internally has a 9 GHz signal propagated in it. Calculate the guide wavelength, phase and group velocities and characteristic impedance for the dominant mode(16)[**D**][**Nov//Dec2012**]

[Bessel's differential equation and Bessel function]

15. Derive the expression for TM wave components in wave guides using Bessel function.(16)[D]
16. Derive the TM wave components in circular wave guide using Bessel function?(16)[D]

[TM and TE Waves in circular Wave guides]

17. Derive the expression for the field components of TE and TM waves in a circular wave guides(16)[**D**][**Nov/Dec2013**]
18. A TE_{11} wave is propagating through a circular waveguide. The diameter of the guide is 10 em and the guide is air-filled. Given Xu = 1.842 Find the cut-off frequency. Find the wavelength λg In the guide for a frequency of 3 GHz Determine the wave impedance in the guide.(16)[D][**Nov/Dec2017**]

[Rectangular and circular cavity resonators]

19. Derive expressions for the field components existing in a rectangular cavity.(16)[D][Apr/May2015]
20. Derive the equation for Q-factor of rectangular cavity resonator for TE_{101} mode.(8)[D]
21. Write a brief note on circular cavity resonator and its application.(8)[D][**Nov/Dec2016**]
22. A circular air filed copper cavity is excited in the TM_{010} mode at 9.375 GHz. The cavity has ratio length radius = 1.5. Find the Q-factor. (16)[D]
23. Derive the resonant frequency of a rectangular resonator.**(16)[D][Nov/Dec2017]**
24. Calculate the resonant frequency of an air field rectangular resonator of dimensions a=3cm, b=2cm, d=4cm operating in TE_{101} mode.(16)[**ID**]**Nov/Dec2013**]

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

UNIT – 1 **Transmission Line Theory**

Part – A

1) Define Characteristic Impedance.
2) Find the characteristic impedance of a line at 1600 Hz if Zoc =750∠-30°Ω and Zoc=600∠-20°Ω
3) State the condition for a distortion less line?
4) Give the Campbell's formula for a uniformly loaded line?
5) Define Propagation Constant.
6) Give the relation between Reflection factor & Reflection loss?
7) Define Reflection loss & insertion loss.

Part – B

1) Derive the transmission line equation and hence obtain expressions for voltage and current on a transmission line.
2) Derive the equation of attenuation constant and phase constant of transmission line in terms of line constants R,L,C and G
3) Prove that an infinite line equal to finite line terminated its characteristic impedance
4) Explain in detail about the wave form distortion and also derive the condition for distortion less line
5) i) Explain in detail the reflection on a line not terminated by its characteristic Impedance Z_0.

   ii) The constants of a transmission line are R=6Ω/km, L=2.2mH/km,C=0.005μF/km & G=0.25x10-3/km. Calculate the Z_0, attenuation constant & phase constant at 1000Hz.
6) A Generator of 1 V, 1000 Hz supplies power to a 100 km open wire line terminated in Z0 and having the following parameters: R = 10.4 Ohm/km, G = 0.8 x 10-6 mho/km, L= 0.00367 henry/m and C = 0.00835 μF/km. Find the characteristic impedance(Z0), propagation constant(γ), attenuation constant (α),phase shift constant(β), velocity of propagation(v) and wavelength(λ). Also find the sending end current, receiving end current and received power.

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UNIT - 2 High Frequency Transmission Lines

Part – A

1) Give the minimum and maximum values of SWR and Reflection Coefficient.
2) Write the expression for standing wave ratio in terms of reflection co efficient
3) Write the equations of Voltage and Current on the dissipation less line.
4) For the line of zero dissipation, what will be the value of attenuation constant and Characteristic Impedance?
5) Write the Expression for input impedance of open and short circuited dissipation less line.
6) List the Parameters of the open wire line at high frequencies.
7) What is mean by Reflection Loss?
8) What are the assumptions to simplify the analysis of line performance at high frequencies?

Part – B

1) Derive the Transmission line equations at radio frequencies (open wire & Co axial line parameters)
2) Discuss in detail about the voltage and current on the dissipation less line
3) Derive the expression for power and find the input impedance of dissipation less line, when the load is short circuited, open circuited and for a matched line.
4) A lossless line in air having a characteristic impedance of 300Ω is terminated in unknown impedance; the first voltage minimum is located at 15cm from the load. The standing wave ratio is 3.3. Calculate the wavelength and Terminated Impedance.
5) A 50Ω loss line transmission line is connected to a load composed of 75Ω resistor in series with a capacitor of unknown capacitance. If at 10 MHz, the voltage standing wave ratio on the line was measured as '4'. Determine the capacitance 'C'?
6) A 30m long lossless transmission line with Z_0 = 50W operating at 2MHz is terminated with a load Z_L = 60+j40. If u = 0.6C on the line.

   Note: (where 'C' is Velocity of light and 'u' is Phase velocity)

   Find i) Reflection Co-efficient (G)

   ii) Standing wave Ratio (S)

   iii) The Input Impedance (Z_{in})

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UNIT – 3 Impedance Matching in High Frequency Lines

Part – A

1) What is Impedance Matching and state the need for impedance matching.
2) What is Stub Matching? Name the impedance matching devices.
3) Explain the significance of smith chart.
4) List the applications of a quarter wave line.
5) What is impedance matching in stub?
6) Write down the Expression to determine the position of Stub?
7) Write down the Expression to determine the length of Stub?

Part – B

1) Explain the significance of smith chart and its applications in a transmission lines.
2) A single stub is to match a load 400Ω line to a load of 200-j100Ω. The wave length is 3m. Determine the position and length of the short circuited stub.
3) A 300Ω transmission line is connected to a load impedance of (450-j600)Ω at 10MHz. Find the position and length of short circuited stub required to match the line using smith chart.
4) Explain the technique of impedance matching by stubs and discuss the operation of quarter wave transformer
5) Explain the procedure for obtaining the smith chart using R and X circles.
6) Determine the following

    i) Standing wave Ratio (SWR)

    ii) Load Impedance (Z_L)

    iii) Distance between load and the first voltage minimum along the transmission line for a line with a characteristic impedance of 300Ω and terminated in a load of 175+j207Ω. An electrical signal of 200 MHz is transmitted along the line in free space.

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UNIT – 4 **Waveguides and cavity Resonators**

Part – A

1) What are rectangular wave guides
2) Write the expression for cutoff wavelength of the wave which is propagated in between two parallel planes.
3) What are the dominant mode and degenerate modes in rectangular wave guides
4) Justify, why TM_{01} and TM_{10} modes in a rectangular wave guide do not exist.
5) Give the expression for wave impedance and power transmission in TE & TM waves in a rectangular wave guide
6) Calculate the cut-off frequency of a rectangular wave guide whose inner dimension are a= 2.5cm & b=1.5cm operating at TM_{10} mode
7) State the relation between the attenuation factor for TE waves and TM waves for parallel plate waveguide.

Part – B

1) Briefly explain about general wave behavior along uniform guiding structures, TE, TM & TEM waves.
2) A rectangular air filled copper waveguide with dimension 0.9 inch X 0.4 inch cross section and 12 inch length is operated at 9.2Ghz with a dominant mode. Find cut off frequency, guide wavelength, Phase velocity, characteristic impedance and the loss
3) Derive an expression for the transmission of TM waves between parallel perfectly conducting planes for the field components
4) An air filled circular waveguide having an inner radius of 1 cm is excited in dominant mode at 10Ghz. Find a) cut off frequency of the dominant mode at 10 Ghz b) Guide wave length c) wave impedance. Also find the bandwidth for operation in the dominant mode.
5) Write Bessel's differential equation & derive the TE Wave components in circular wave guides.
6) A TE_{10} wave at 10 GHz propagates in a brass $\sigma_c = 1.57 \times 10^7$ S/m rectangular wave guide with inner dimensions a= 1.5 cm & b= 0.6 cm, which is filled with $\varepsilon_r = 2.25$, $\mu_r = 1$, loss tangent = 4×10^{-4}. Determine i) Phase constant ii) Guide wavelength iii) Phase velocity iv) Wave impedance v) attenuation due to loss in the dielectric vi) attenuation due to loss in the guide walls

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UNIT – 5 RF System Design Concepts

Part – A

1) What is MESFET? List the different types of FETs used in RF Circuits.
2) What is mean by Unilateral transducer gain G_{TU} & Transducer gain G_T
3) What is the main purpose of LNA & what are the problems arise due to non-linear characteristics of LNA?
4) Define Conduction angle and give its significance in power amplifiers.
5) Define unconditional stability.
6) Give the expression for noise of a two port amplifier.
7) What are multipliers based mixers and mention their types.
8) What are three operating points in MESFET?
9) What are the factors for selecting a matching network?
10) What are the advantages of RF/microwave transistors?

Part – B

1) Briefly explain about design process of RF/Microwave Circuits
2) Give the analysis of frequency response of MESFET, What are its limiting values?
3) Discuss about the basic architecture of RF System and importance of RF Circuit design.
4) Briefly explain about High Electron Mobility Transistor (HEMT) & explain the functionality of HEMT.
5) A Ga As MESFET has the following parameters: $N_D = 10^{16}$ cm^{-3}, d=0.75 μm, W= 10μm, L= 2μm, ε_r = 12.0, V_d = 0.8v and μ_n = 8500 cm^2 /vs. Determine a) The Pinch off voltage b) Threshold voltage c) The Maximum Saturation Current I_{DSS}.
6) List and give constructional figures of the different types of FETs based on the way the gate is connected to the conducting channel.
7) What is the importance of RF Circuit design and design consideration steps for RF Systems.
8) i) Write short notes on sub-harmonic mixer and its characteristics

   ii) Explain the behavior of LNA topologies with its design constraints.
9) Derive the equation for power gain, available power gain and transducer power gain.
10) Give the analysis of unconditional stability in RF Amplifier.

EC 8651 – TRANSMISSION LINES AND RF SYSTEMS

FREQUENTLY ASKED QUESTIONS

UNIT 1 - TRANSMISSION LINE PARAMETERS

1. Derive voltage and current equation of a transmission line. Derive its general solution. Also discuss the physical significance of line equations.
2. Derive the expression of input impedance of a line. Also derive input impedance expression for open and short circuited line.
3. Define reflection coefficient and transfer impedance. Derive its expression..
4. Explain the different types of distortions of a line. Derive the condition for distortion less line.
5. What is loading? What are the different types of loading? Prove that by means of loading distortionless line can be achieved.
6. Explain reflection loss in a transmission line.

UNIT 2 - HIGH FREQUENCY TRANSMISSION LINES

1. Define standing wave ratio (SWR). Also derive its expression.
2. What are the constants of a lossless line? Write the voltage and current equation of a lossless line.
3. With neat diagrams explain the measurement of VSWR and wavelength.
4. Derive the expression of input impedance of a dissipationless line. Also derive the input impedance expression for open and short circuited line

UNIT 3 – IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

1. Obtain the expression for the input impedance of the quarter wave line. Also discuss the applications of the quarter wave line.
2. Obtain the expression for the length and location of a short circuited stub for impedance matching on a transmission line.
3. Explain double stub matching on a transmission line.

UNIT 4 - WAVEGUIDES

1. Derive the field components of TM waves of a parallel plate waveguide.
2. Derive the field components of TE waves of a parallel plate waveguide.
3. Derive the field components of TM waves of a Rectangular waveguide.
4. Derive the field components of TE waves of a Rectangular waveguide.
5. Derive the field components of TM waves of a Circular waveguide.
6. Derive the field components of TE waves of a Circular waveguide.

UNIT 5 - RF SYSTEM DESIGN CONCEPTS

1. With neat diagrams explain the structure, operation and types of BJT and FET.
2. Explain high electron mobility transistor in detail
3. Explain stability considerations in amplifier design
4. Explain the operation of voltage controlled oscillator in detail
5. Write short notes on the basics of low noise and power amplifier.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

QUESTION BANK

SUBJECT : EC8651 TRANSMISSION LINES AND RF SYSTEMS
SEM / YEAR: VI/ III Year B.E.

UNIT I - TRANSMISSION LINE THEORY

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 Z_0 - 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.

PART A (2 marks)

Q.No.	Questions	BT Level	Competence
1.	Define transmission line.	BTL 1	Remembering
2.	List the conditions for distortion less line.	BTL 1	Remembering
3.	State phase distortion and frequency distortion.	BTL 1	Remembering
4.	What are primary constants and secondary constants of a transmission line?	BTL 1	Remembering
5.	How to avoid the distortion that occurs in the line?	BTL 1	Remembering
6.	Choose the properties of infinite line.	BTL 1	Remembering
7.	Write the expressions for the phase constant and velocity of propagation.	BTL 2	Understanding
8.	Discuss the effect of inductance loading of telephone cable.	BTL 2	Understanding
9.	Deduce the relationship between characteristic impedance and propagation constant.	BTL 2	Understanding
10.	Conclude the general equation for the input impedance and transfer impedance of a transmission line.	BTL 2	Understanding
11.	Build the voltage and current equations at any point on a uniform transmission line.	BTL 3	Applying
12.	Illustrate how practical lines made appear as infinite lines.	BTL 3	Applying
13.	Sketch the equivalent circuit of a unit length of transmission line.	BTL 3	Applying
14.	Analyze the expression for reflection coefficient and reflection loss.	BTL 4	Analyzing
15.	The open circuit and short circuit impedance of a transmission line at 1500 Hz are 800 $\angle$-30 Ω and 400 $\angle$-10 Ω respectively, Examine its propagation constant.	BTL 4	Analyzing
16.	Assess the expression for reflection factor.	BTL 4	Analyzing
17.	Prove that 1 neper=8.686dB.	BTL 5	Evaluating

18.	Estimate the reflection coefficient of a 50ohm transmission line when it is terminated by a load impedance of 60+j40Ω.	BTL 5	Evaluating
19.	Formulate the equation to find the relation between characteristic impedance and primary constants of a transmission line.	BTL 6	Creating
20.	Design Campbell's formula for a uniformly loaded line.	BTL 6	Creating

PART –B (13 marks)

1.		Obtain the general transmission line equation for the voltage and current at any point on a transmission line.	(13)	BTL 1	Remembering
2.	(i)	Outline the expression for the attenuation and phase constants after obtaining an expression for the characteristic impedance.	(7)	BTL 1	Remembering
	(ii)	How to solve the Campbell's equation for the loading cables?	(6)		
3.	(i)	Discuss in detail about inductance loading of telephone cables and recall the attenuation constant, phase constant and velocity of signal transmission for the uniformly loaded cable.	(7)	BTL 1	Remembering
	(ii)	Describe about the reflection on a line not terminated in its characteristic impedance.	(6)		
4.	(i)	What is a loading? Specify the types of loading of lines.	(7)	BTL 1	Remembering
	(ii)	Write a short note on reflection factor and reflection loss and give expressions.	(6)		
5.	(i)	Explain in detail about the waveform distortion and also derive the condition for distortion less line.	(7)	BTL 2	Understanding
	(ii)	Predict the expression for open and short circuited impedance.	(6)		
6.	(i)	Identify the conditions (α, β) required for a distortion less line.	(7)	BTL 2	Understanding
	(ii)	A distortion less transmission line has attenuation constant α=1.15×10-2 Np/m, and capacitance of 0.01 nF/m. the characteristic resistance L/C=50Ω. Identify the resistance, inductance and conductance per more of the line.	(6)		
7.	(i)	A telephone line has parameters of R = 6.5 Ω/km, L= 0.4 mH/km, C=0.05μF/km and G=0.5 μmho/km. Extend the calculation for finding the input impedance of the line at a frequency of 500 Hz given that the line is very long.	(7)	BTL 2	Understanding
	(ii)	A lossless transmission line with Z_0 = 75ohm and electrical length l= 0.3 λ is terminated with a complex load impedance of Z_R = 40+j20ohm. Estimate reflection	(6)		

		coefficient and VSWR of the line.			
8.	(i)	The characteristic impedance of a certain transmission line is 682.5-j195.7 ohm. The frequency of operation is 1 KHz. At this frequency, the attenuation constant in the line was observed to be 0.01 neper/km and phase constant 0.035 radians /km. Prepare the line constants R, L, G and C per km of the line.	(8)	BTL 3	Applying
	(ii)	Draw and explain the reflection loss due to mismatch between source and load impedances.	(5)		
9.	(i)	An open wire line having R=10.15 ohm/km, L = 3.93 mH/km, G=0.29 μmho/km and C=0.00797 μF/km is 100 km long and terminated in Z_0. Solve Z_0, α, β and γ.	(7)	BTL 3	Applying
	(ii)	Illustrate the Zo and in terms of primary constants.	(6)		
10.	(i)	Connect the value of attenuation constant 'α' as **R/2** $\sqrt{C}/L$ + **G/2**$\sqrt{L}/C$, when the series resistance R and shunt resistance G of the transmission line are small but not negligible.	(7)	BTL 4	Analyzing
	(ii)	Demonstrate the concept of attenuation and phase constant of an infinite line.	(6)		
11.	(i)	Analyze the expressions for short circuited and open circuited impedance.	(6)	BTL 4	Analyzing
	(ii)	Point out the propagation constant of continuously loaded cable.	(7)		
12.	(i)	A 2 meter long transmission line with characteristic impedance of 60+j40 is operating at $=10^6$ rad/sec has attenuation constant of 0.921 Np/m and phase shift constant of 0 rad/miff the line is terminated by a load of 20+j50,find the input impedance of this line.	(7)	BTL 4	Analyzing
	(ii)	Simplify the expression for input impedance and transfer impedance of transmission lines.	(6)		
13.	(i)	Summarize how an infinite line equal to finite line terminated in its characteristic impedance.	(6)	BTL 5	Evaluating
	(ii)	The characteristics impedance of a 805m-long transmission line is 94 angle -23.2°Ω, the attenuation constant is 74.5×10^{-6} Np/m. and the phase shift constant is 174×10^{-6} rad/m at 5KHz. Assess the line parameters R,L,G and C per meter and the phase	(7)		

		velocity on the line.			
14.		The constants of a transmission line are R= 6Ω/km, L=2.2mH/km, C=0.005×10^{-6}F/km and G=0.25×10^{-6} mho/km. calculate at the frequency of 800 HZ, Design (a) The terminating impedance for which no reflection will be setup in the line, (b) The attenuation in dB suffered by the signal after travelling a distance of 50Km when the line is properly terminated and the phase velocity with which the signal would travel.	(6) (7)	BTL 6	Creating
PART C (15 marks)					
1.	(i)	Adapt the condition for minimum attenuation in a distortion less line	(7)	BTL 6	Creating
	(ii)	Develop and derive the relation between primary constants and secondary constants.	(8)		
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)	BTL 6	Creating
3.		Open circuited and short circuited measurements at a frequency of 5KHz on a line of length 200km yielded the following results: Zoc = 570 ∠ -48^0 ohm , Zsc = 720∠ 34^0 ohm EvaluateZo , α, β and primary constants given that the approximate velocity of propagation to be 1.8 *10^6 km/sec.	(15)	BTL 5	Evaluating
4.	(i)	An open wire line is 200 km long is correctly terminated. The generator at the sending end has Es = 10 V, f = 1 KHz and internal impedance of 500 ohm. At that frequency Zo=683-j138 and γ= 0.0074+j0.0356 per km. Measure the sending and receiving end voltage, current and power.	(10)	BTL 5	Evaluating
	(ii)	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 Es = 5V.	(5)		
UNIT II - HIGH FREQUENCY TRANSMISSION LINES					
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.			
PART A (2 marks)			
Q.No.	**Questions**	**BT Level**	**Competence**
1.	Define Skin effect.	BTL 1	Remembering
2.	Label the assumptions made for the analysis of performance of the line at radio frequency.	BTL 1	Remembering
3.	Compare the values of SWR for $Z_R = 0$ and $Z_R = Z_0$.	BTL 1	Remembering
4.	Recognize the dissipationless line with the proper condition.	BTL 1	Remembering
5.	What are nodes and antinodes on a line?	BTL 1	Remembering
6.	Find the nature and value of Z0 for the dissipation less line.	BTL 1	Remembering
7.	Give the relation between standing wave ratio and magnitude of reflection co efficient.	BTL 2	Understanding
8.	Express reflection coefficient in terms of SWR.	BTL 2	Understanding
9.	Predict the expression for input impedance of RF line.	BTL 2	Understanding
10.	Indicate the minimum values and maximum values of SWR and reflection coefficient.	BTL 2	Understanding
11.	Relate the nature of input impedance of open circuited and short circuited and matched load condition for dissipation less line.	BTL 3	Applying
12.	Solve 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.	BTL 3	Applying
13.	Sketch standing waves on a line having open or short circuit termination.	BTL 3	Applying
14.	Deduce an expression for inductance of an open wire line and coaxial line.	BTL 4	Analyzing
15.	Analyze the line with dissipationless line and find the values of attenuation constant and characteristic impedance.	BTL 4	Analyzing
16.	Explain the concept of dissipation less line.	BTL 4	Analyzing
17.	How would you justify that the point of voltage minimum is measured rather than the voltage maximum?	BTL 5	Evaluating
18.	A lossless transmission has a shunt capacitance of 100 pF/m and a series inductance of 4μH/m. Evaluate the characteristic impedance.	BTL 5	Evaluating
19.	Can you predict the range of values of standing wave ratio?	BTL 6	Creating
20.	Adapt the condition for open and short circuited line.	BTL 6	Creating
PART B (13 marks)			

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)	BTL 1	Remembering
2.	(i)	Brief notes on Standing waves, nodes, standing wave ratio also make relation between the standing wave ratio S and the magnitude of the reflection coefficient.	(7)	BTL 1	Remembering
	(ii)	State the condition for the open wire line at high frequencies and derive the parameters.	(6)		
3.	(i)	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.	(7)	BTL 1	Remembering
	(ii)	Enumerate the voltage and current equation on dissipation less line.	(6)		
4.	(i)	Discuss the reflection coefficient of different transmission lines.	(6)	BTL 1	Remembering
	(ii)	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. Recognize (a)Inductance (b) Capacitance (c) Characteristic impedance	(7)		
5.	(i)	Compare the features of open wire and co axial cable at high frequencies.	(7)	BTL 2	Understanding
	(ii)	Outline the variation of input impedance along open and short circuit lines with relevant graphs.	(6)		
6.	(i)	Describe the various parameters of open wire and co axial lines at radio frequency.	(7)	BTL 2	Understanding
	(ii)	Summarize the concept of Standing wave ratio.	(6)		
7.		Explain how the VSWR and wavelength of the line measured in detail.	(13)	BTL 2	Understanding
8.	(i)	Derive the line constants of a zero dissipation less line.	(7)	BTL 3	Applying
	(ii)	Sketch the voltages and currents on dissipation less line for the conditions given below. (a) Open circuit (b) Short circuit (c) $R_r = R_0$	(6)		
9.	(i)	A low loss transmission line of 100Ω characteristic impedance is connected to a load of 200Ω.Apply the formula to calculate the voltage reflection coefficient and the standing wave ratio.	(7)	BTL 3	Applying

	(ii)	Solve the standing wave ratio and reflection co – efficient on a line having Z_0 =300ohm and terminated in Z_R=300+j400	(6)		
10.	(i)	Draw the standing wave pattern for (a) Open circuited load (b) Short circuited load (c) matched load	(7)	BTL 4	Analyzing
	(ii)	Predict that the reflection coefficient [|Emax| - |Emin|] / [|Emax| +|Emin|].	(6)		
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)	BTL 4	Analyzing
12.	(i)	Examine the voltage and currents at any point on the dissipation less line along with incident and reflected voltage wave phasor diagrams which should satisfy the conditions such as open circuit, short circuit, R_R=R_0.	(7)	BTL 4	Analyzing
	(ii)	Analyze the standing waves with neat diagram.	(6)		
13.	(i)	Summarize the relation between standing wave ratio (S) and magnitude of relation co – efficient.	(7)	BTL 5	Evaluating
	(ii)	Find the reflection coefficient and voltage standing wave ratio of a line having Ro = 100 ohm, Zr = 100 – j100 ohm.	(6)		
14.		Formulate the following parameters (a) Standing waves (b) Standing wave ratio (c) Relation between SWR and K (d) Nodes and Antinodes	(13)	BTL 6	Creating
PART C (15 marks)					
1.		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 1.5×10^{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? (a) Characteristic impedance Zo = Ro		BTL 5	Evaluating

		(b) Dielectric constant (c) Load resistance $Z_R = R_R$ (d) Reflection Coefficient K	(4) (4) (3) (4)		
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)	BTL 5	Evaluating
3.		How could you adapt 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)	BTL 6	Creating
4.	(i)	How would you make up the expression for maximum and minimum impedances on the line for a lossless line as R_oS and R_o/S respectively?	(8)	BTL 6	Creating
	(ii)	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.	(7)		

UNIT III - IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

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.

PART A (2 marks)

Q.No.	Questions	BT Level	Competence
1.	What is the need for impedance matching?	BTL 1	Remembering
2.	List the requirements of a better transmission line	BTL 1	Remembering
3.	Interpret the effect of impedance mismatching.	BTL 2	Understanding
4.	Express standing wave ratio in terms of reflection coefficient.	BTL 2	Understanding
5.	Discuss about nodes and anti nodes in a transmission line.	BTL 4	Analyzing
6.	Why do standing waves exist on transmission lines?	BTL 1	Remembering
7.	Give the minimum and maximum value of SWR and reflection coefficient.	BTL 1	Remembering

8.		Calculate the standing wave ratio if the reflection co-efficient of a line is $0.3 \angle -66°$.		BTL 3	Applying
9.		A lossless line has a characteristic impedance of 400Ω. Determine the standing wave ratio if the receiving end impedance is 800+j0Ω		BTL 5	Evaluating
10.		List the application of a quarter wave line.		BTL 1	Remembering
11.		Justify the statement - quarter wave lines are termed as impedance inverter.		BTL 5	Evaluating
12.		Analyze why Quarter wave line is called as copper insulator.		BTL 4	Analyzing
13.		A 75Ω lossless transmission line is to be matched to a resistive load impedance of Z_L =100Ω via a quarter wave section.		BTL 6	Creating
14.		Determine the characteristic impedance of the quarter wave transformer.		BTL 2	Understanding
15.		Mention the advantages of Smith Chart.		BTL 2	Understanding
16.		Illustrate the procedure to find the impedance from the given admittance using smith chart.		BTL 3	Applying
17.		Define the term Stub used in transmission line.		BTL 1	Remembering
18.		Examine why short circuited stub is preferred to open circuited stub.		BTL 3	Applying
19.		Generalize the method to determine the positon and the length of a single stub connected across the transmission line.		BTL 6	Creating
20.		Compare single stub matching and double stub matching.		BTL 3	Applying
PART –B (13 Marks)					
1.	(i)	Examine the operation and application of quarter wave transformer.	(7)	BTL 2	Understanding
	(ii)	Consider a line with a load of Z_R/R_O =2.6+j, which is 28° long. Find the input impedance.	(6)		
2.	(i)	Deduce the expression for input impedance of a quarter wave transformer and mention its applications.	(8)	BTL 6	Creating
	(ii)	Design a Quarter wave transformer to match a load of 200Ω to a source resistance of 500Ω which operates at the frequency of 200 MHz.	(5)		
3.		Analyze the transmission line circle diagram by deriving the expression for constant S and constant βs circle.	(13)	BTL 4	Analyzing
4.		A lossless line with Z_O =70Ω is terminated with Z_R =115-80jΩ. Wavelength of transmission is 2.5 λ. Using smith chart evaluate the VSWR, reflection coefficient, input impedance and input admittance	(13)	BTL 5	Evaluating
5.		Describe the impedance matching technique using single stub and obtain the expression for the stub location and stub length.	(13)	BTL 1	Remembering
6.		Consider a line of R_O = 55 ohms terminated with 115+j75 ohms. If the total length of the line is 1.183λ, find the reflection coefficient, VSWR, input impedance and admittance	(13)	BTL 1	Remembering
7.		What is the procedure for double stub matching on a transmission line, explain with an example.	(13)	BTL 1	Remembering

8.		A UHF lossless transmission line working at 1 GHz is connected to an unmatched line producing a voltage reflection coefficient of 0.5(0.866+j 0.5). Calculate the length and position of the stub to match the line using corresponding equations verify the values using Smith Chart.	(13)	BTL 2	Understanding
9.		A transmission line is terminated in Z_L. Measurements indicate that the standing wave minima are 102 cm apart and that the last minimum is 35 cm from the load end of the line. The value of standing wave ratio is 2.4 and R_0 = 250Ω. Determine frequency, wavelength, Real and reactive components of the terminating impedance. Also Verify the results obtained from equations using the smith chart.	(13)	BTL 2	Understanding
10.		VSWR of a lossless line is found to be 5 and successive voltage minima are 40cm apart. The first voltage minima is observed to be 15cm from the load. The length of the line is 160cm and Z_o is 300 Ω. Apply the values in smith chart to find the load impedance and input impedance.	(13)	BTL 3	Applying
11.		A RF transmission line with Z_o=300∠0° Ω is terminated in an impedance of 100∠45°Ω. This load is to be matched to the transmission line by using a short circuited stub. With the help of smith chart, Determine the length and location of the stub.	(13)	BTL 4	Analyzing
12.		A 50 Ω transmission line feeds an inductive load 35+j35Ω. Analyze and design a double stub tuner to match this load to the line using smith chart. Spacing between the two stubs is λ/4.	(13)	BTL 1	Remembering
13.		Derive the expression of radius and center for constant R and X circles in Smith Chart.	(13)	BTL 4	Analyzing
14.		Examine the transmission line to provide an impedance matching using a stub. Obtain the length and location of the stub to provide an impedance match on a line of 600 ohms terminated with 200 ohms. Assuming that the stub is short circuited at one end.	(13)	BTL 3	Applying
PART – C (15 Marks)					
1.	(i)	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.	(8)	BTL 5	Evaluating
	(ii)	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	(7)		

		smith chart.			
2.		For a normalized load impedance of 0.8+j1.2 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 first stub from the load. Verify the answer using Smith Chart.	(15)	BTL 6	Creating
3.	(i)	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.	(8)	BTL 5	Evaluating
	(ii)	Mention the significance of smith chart and its application in transmission lines.	(7)		
4.	(i)	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.	(10)	BTL 6	Creating
	(ii)	Design a single stub match for a load of 150+j225 Ω for a 75 Ω line a 500 MHz using smith chart.	(5)		

UNIT IV - WAVE GUIDES

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.

PART A (2 marks)

Q.No.	Questions	BT Level	Competence
1.	What are guided Waves? Give examples for guiding structures.	BTL 1	Remembering
2.	Interpret the characteristics of E wave and H wave.	BTL 2	Understanding
3.	Write about Principal wave.	BTL 1	Remembering
4.	Express the dominant mode in the wave propagating in the waveguide.	BTL 2	Understanding
5.	Deduce the expression for cut off frequency when the wave is propagated in between two parallel plates.	BTL 4	Analyzing
6.	Examine the Characteristics of TEM waves.	BTL 3	Applying
7.	Justify, why TM_{01} and TM_{10} modes in a rectangular waveguide do not exists.	BTL 5	Evaluating
8.	Define cutoff frequency of a waveguide.	BTL 1	Remembering
9.	Illustrate the features of TE and TM mode.	BTL 2	Understanding
10.	Mention about the dominant mode of a rectangular waveguide.	BTL 1	Remembering
11.	Discuss about the dominant mode and degenerate modes in rectangular	BTL 5	Evaluating

	waveguide.		
12.	Explore the relation between group velocity, phase velocity and free space velocity.	BTL 3	Applying
13.	Why rectangular waveguides preferred over circular waveguides?	BTL 1	Remembering
14.	Exhibit the nature of the evanescent mode.	BTL 3	Applying
15.	Analyze why TM_{01} and TM_{10} modes in a rectangular waveguide do not exist	BTL 4	Analyzing
16.	How would you categorize the modes as degenerate modes in a rectangular waveguide?	BTL 4	Analyzing
17.	Consider an air filled rectangular waveguide with a cross – section of 5 cm × 3 cm. For this waveguide, deduce the cut off frequency (in MHz) of TE_{21} mode.	BTL 6	Creating
18.	List the dominant mode in circular waveguide.	BTL 1	Remembering
19.	Write Bessel's functions of first kind of order zero?	BTL 2	Understanding
20.	Formulate the size of the circular waveguide required to propagate TE_{11} mode if λc=8cm and p'_{11}=1.841.	BTL 6	Creating

PART - B (13 marks)

1.		Obtain the expression for the field components of an electromagnetic wave propagating between a pair of perfectly conducting planes?	(13)	BTL 1	Remembering
2.		Derive the expression for the field strength for TE waves between parallel plates propagating in Z direction?	(13)	BTL 6	Creating
3.	(i)	Explain about transverse electromagnetic waves between a pair of perfectly conducting planes?	(7)	BTL 1	Remembering
	(ii)	Determine the expression of wave impedance of TE, TM and TEM wave between a pair of Perfectly conducting planes.	(6)		
4.		Illustrate the transmission of TM waves between two parallel perfectly conducting planes with necessary equations and diagram.	(13)	BTL 2	Understanding
5.		A pair of perfectly conducting plates is separated by 10cm in air and carries a signal frequency of 6GHz in TE1 mode. Find Cut-off frequency, Angle of incidence on planes, Phase velocity, group velocity, Phase constant, Cut-off wavelength, characteristic wave impedance, and wavelength along guiding walls. Is it possible to propagate TE_3 mode.	(13)	BTL 3	Applying
6.	(i)	Interpret the propagation of TE waves in a rectangular waveguide with necessary expressions for the field components.	(6)	BTL 2	Understanding
	(ii)	Summarize the characteristics of TE and TM waves and also derive the cutoff frequency and phase velocity from	(7)		

		propagation constant.			
7.		Analyze the field configuration, cut off frequency and velocity of propagation for TM waves in rectangular wave guides.	(13)	BTL 4	Analyzing
8.		A rectangular air filled copper waveguide with dimension 0.9inch x 0.4inch cross section and 12inch length is propagated at 9.2GHz with a dominant mode. Find the cutoff frequency, Guide wavelength, Phase velocity, characteristic impedance and the loss.	(13)	BTL 5	Evaluating
9.		An air filled rectangular waveguide of 5cm x 2 cm cross section is operating in the TE_{10} mode at a frequency of 4GHz. Determine (a)the group velocity (b)the guide wavelength (c) the attenuation to be expected at a frequency which is 0.95 times the cut off frequency (assuming the guide walls is made of perfect conductors).	(3) (4) (6)	BTL 2	Understanding
10.		Using Bessel differential equation Obtain the TM field components in circular waveguides.	(13)		
11.		A TE_{11} wave is propagating through a circular waveguide. The diameter of the guide is 10cm and the guide is air-filled. Given p'_{11}=1.842 (a)Find the cut off frequency (b)Find the wavelength λg in the guide for a frequency of 3GHz. (c)Determine the wave impedance in the guide.	(4) (4) (5)	BTL 4	Analyzing
12.		Analyze the expressions for the transmissions of TE waves in a circular waveguide conducting planes for the field components.	(13)	BTL 4	Analyzing
13.		An air filled circular waveguide has a radius of 2 cm. Examine the cut off frequency and the phase constant for the dominant mode (p11' = 1.841 and p11 = 2.405.)	(13)	BTL 3	Applying
14.		Obtain the field distribution of transverse and longitudinal components of the electric and magnetic fields in circular waveguide with necessary equations.	(13)	BTL 1	Remembering
		PART C (15 marks)			
1.	(i)	A hollow rectangular waveguide is to be used to transmit signals at a carrier frequency of 6GHz. Choose its dimensions so that the cut off frequency of the dominant TE mode is lower than the carier by 25 % and that of the next mode is atleast 25 % higher than the carrier.	(8)	BTL 6	Creating
	(ii)	Evaluate the ratio of the area of a circular waveguide to that of a rectangular one if both are to have the same cut off frequency for dominant mode.	(7)		

2.	(i)	The interior of a 20/3 *cm* × 20/4 *cm* rectangular waveguide is completely filled with a dielectric of $\varepsilon_r = 4$. Waves of free space wave – length shorter than which can be propagated in the TE_{11} mode.	(8)	BTL 5	Evaluating
	(ii)	A rectangular waveguide having TE_{10} mode as dominant mode is having a cut off frequency of 18 GHz for the TE_{30} mode. Evaluate the inner broad – wall dimension of the rectangular waveguide.	(7)		
3.		Determine the cut off frequencies of the first two propagating modes of a circular waveguide with a=0.5cm and ε_r = 2.25 the guide is 50cm in length operating at f=13GHz. Determine the cut off wavelength and propagation constant.	(15)	BTL 5	Evaluating
4.		A TE wave propagating in a dielectric filled waveguide of unknown permittivity has dimensions a=5 cm and b = 3cm.If the x – components of the electric field is given by $E_x=36\cos(40\pi x)\sin(100\pi y)\sin(2.4\pi\times1010t-52.9\pi z)$ (V/m). Devise (a) ε_r of the material in the guide, (b) the cutoff frequency, (c) the expression for H_y.	 (5) (4) (6)	BTL 6	Creating

UNIT V - RF SYSTEM DESIGN CONCEPTS

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.

PART A (2 marks)

Q.No.	Questions	BT Level	Competence
1.	List some of the active RF components.	BTL 1	Remembering
2.	Enumerate the band gap energy for Si and Ge used for semiconductor diodes.	BTL 4	Analyzing
3.	Draw the cross section of multifinger Bipolar Junction Transistor	BTL 1	Remembering
4.	What is called as HBTs ?	BTL 1	Remembering
5.	Define reverse active mode in bipolar junction transistor.	BTL 1	Remembering
6.	Classify RF field effect transistors based on physical construction.	BTL 2	Understanding
7.	Compare the enhancement type FET with Depletion type FET.	BTL 3	Applying
8.	Outline the characteristics of modulation doped field effect transistor	BTL 1	Remembering
9.	Illustrate the generic RF amplifier design.	BTL 2	Understanding
10.	Mention the various types of mixers.	BTL 1	Remembering
11.	Summarize the basic steps in the design process of RF amplifier circuits.	BTL 5	Evaluating
12.	Distinguish between oscillator and Mixer	BTL 4	Analyzing
13.	Examine the importance of voltage controlled oscillator in RF system.	BTL 2	Understanding
14.	Interpret the basic parameters of RF amplifier.	BTL 2	Understanding

15.		Generalize the concept of unconditional stability of an amplifier.		BTL 6	Creating
16.		Analyze the techniques of efficiency boosting in RF power amplifier		BTL 4	Analyzing
17.		Evaluate the significance of negative resistance in oscillation of a circuit		BTL 5	Valuating
18.		Devise the operation of single ended and differential ended LNA.		BTL 5	Creating
19.		Deduce the transducer power gain of a RF power amplifier.		BTL 3	Applying
20.		Demonstrate typical output stability circle and input stability circle		BTL 3	Applying
PART –B (13 Marks)					
1.		Outline the process to compute the junction capacitance and the space charge region length of a *pn* junction semiconductor device.	(13)	BTL 1	Remembering
2.	(i)	For a Si pn junction the doping concentration are given as $N_A = 10^{18}$ cm^{-3} and $N_D = 10^{15}$ cm^{-3} with an intrinsic concentration of $n_i = 1.5 \times 10^{10} cm^{-3}$. Find the barrier voltages for T = 300° K.	(7)	BTL 5	Evaluating
	(ii)	Considering the electron concentration and hole concentration in a semiconductor as ***n*** and ***p*** respectively infer that $\boldsymbol{np} = \mathbf{n_i}^2$ where ni is the intrinsic concentration.	(6)		
3.		Elaborate the construction and the functionality of the bipolar junction transistor.	(13)	BTL 3	Applying
4.		Discuss about the different operating modes of a bipolar junction transistor with appropriate diagram.	(13)	BTL 3	Applying
5.		Derive the drain saturation voltage and maximum saturation current for a field effect transistor.	(13)	BTL 6	Creating
6.	(i)	Compare the field effect transistor with the bipolar junction transistor	(6)	BTL 4	Analyzing
	(ii)	Explain the distinct features of high electron mobility transistors.	(7)		
7.	(i)	Analyze the steps involved to design a low noise amplifier	(6)	BTL 4	Analyzing
	(ii)	Distinguish power match and noise match in a Low Noise Amplifier.	(7)		
8.	(i)	Interpret the various types of mixers with its principle of operation	(6)	BTL 2	Understanding
	(ii)	Examine the following parameters of Conversion gain, Linearity and isolation of a mixer.	(7)		
9.		Illustrate the design principles of RF amplifier and impedance matching.	(13)	BTL 2	Understanding
10.	(i)	Write about the method used to design an integer N frequency synthesizer.	(7)	BTL 1	Remembering
	(ii)	Determine the transfer function of a voltage controlled oscillator.	(6)		
11.		Obtain the expression for unilateral power gain with necessary signal flow diagram.	(13)	BTL 1	Remembering
12.		Describe the various power gain for a two port RF network	(13)	BTL 1	Remembering

		considering the stability of the amplifier involved.			
13.		Discuss about input and output stability circles in the complex Γ_L and Γ_S planes, also derive the condition for unconditional stability.	(13)	BTL 2	Understanding
14.		A MESFET operated at 5.7GHz ha the following S parameters: $S_{11}=0.5\angle-60°$, $S_{12}=0.02\angle0°$, $S_{21}=6.5\angle115°$ and $S_{22}=0.6\angle-35°$. Determine if the circuit is unconditionally stable and Find the maximum power gain under optimal choice of reflection coefficients, assuming unilateral design ($S_{12}=0$).	(13)	BTL 4	Analyzing
PART – C (15 Marks)					
1.		An abrupt pn junction made of Si has the acceptor and donor concentration of $N_A= 10^{18}$ cm^{-3} and $N_D = 5 \times 10^{15}cm^{-3}$, respectively .Assuming that the device operates at the room temperature , Formulate (a) the barrier voltage (b) the space charge width in the p- and n- type semiconductors (c) the peak electric field across the junction (d) the junction capacitance for a cross sectional area of $10^{-4}cm^2$ and a relative dielectric constant of $\varepsilon_r = 11.7$	(15)	BTL 6	
2.		An RF amplifier has the following S parameters: $S_{11}=0.3\angle-70°$, $S_{21}=3.5\angle85°$, $S_{12}=0.2\angle-10°$, $S_{22}=0.4\angle-45°$. Further $Vs=5V\angle0°$, $Zs=40\Omega$ and $Z_L=73\Omega$. Assuming $Zo=50\Omega$. Find GT, GTU, GA and G. Also find Power delivered to the load PL, available power from source PA and incident power to amplifier Pinc.	(15)	BTL 5	Evaluating
3.		Consider a Si bipolar junction transistor whose emitter, base , collector are uniformly doped with the following concentrations $N^E_D = 10^{21}$ cm^{-3} , $N^B_A = 2\times10^{19}cm^{-3}$, $N^C_D = 10^{19}$ cm-3. Assume that the base emitter voltage is 0.75 and the collector –emitter potential is set to 2 V. The cross sectional area of both junctions is 10-4 cm2 and the emitter, base and collector thickness are $d_E = 0.8\mu m$, $d_B = 1.2\mu m$ and $d_C = 2\mu m$ respectively. Assuming that the device is operated at room temperature : (a) Find the space charge region extents for both junctions. (b) Compute the base, emitter and collector currents (c) Calculate the forward and reverse current gains	(5) (5) (5)	BTL 5	Evaluating
4.	(i)	Generelize the homodyne and heterodyne architecture of RF system	(8)	BTL 6	Creating
	(ii)	Devise the various stabilization methods for a RF amplifier circuit.	(7)		

Question Bank	
	5th Semester – B.E. / B.Tech.
	Electronics and Communication Engineering
	EC3551 - Transmission Lines and RF Systems
	Part-A
1.	What is Characteristic impedance?
2.	Find the attenuation and phase shift constant of a wave propagating along the line whose propagation constant is $(1.048\times 10^{-4})\angle 88.8^\circ$.
3	The transmission line has the inductance of 20mH and the capacitance of 0.05pF.Find the wavelength and velocity of the line at 5MHz
4	At a frequency of 80MHz, a lossless transmission line has a characteristic impedance of 300Ω and a wavelength of 2.5m.Find L & C.
5	What is a distortion less line? What is the condition for a distortion less line?
6	A transmission line has a characteristic impedance of 400 Ω and is terminated by a load impedance of (650-j475) Ω. Determine the reflection coefficient
7	If a line is to have neither frequency nor phase distortion, how do you relate attenuation constant and velocity of propagation to frequency?
8	Find the characteristic impedance of a transmission line, if $Z_{OC} = 550 \angle -60^\circ\ \Omega$, $Z_{SC}=500 \angle 30^\circ\ \Omega$
9	State the assumptions made for the analysis of the performance of the line at high frequencies.
10	A lossless line has a shunt capacitance of 69 pF and a series inductance of 0.387μH. Calculate the characteristic impedance.
11	A lossless line has a characteristic impedance of (20-45j)Ω .Determine the standing wave ratio if the receiving end impedance is (10+5j) Ω.
12	Give the minimum and maximum value of SWR and reflection coefficient.
13	Find the maximum and minimum input impedances of a line with characteristic impedance of 100 ohms and Standing wave ratio S is 3.
14	A lossless line has a standing wave ratio of 3.The R_0 is 100 ohms and the minimum voltage measured on the line is 125V.Find the power being delivered to the load.
15	A lossless line has a standing wave ratio of 2.The R_0 is 40 ohms and the maximum voltage measured

	on the line is 75V.Find the power being delivered to the load.
16	A lossless line has a characteristic impedance of 400 ohms. Determine standing wave ratio if the receiving end impedance is 800 +j 0.0 ohms.
17	Distinguish between single stub matching and double stub matching.
18	Mention the applications of a quarter wave line.
19	Why a quarter wave line is considered as impedance inverter? Justify.
20	What are the applications of smith chart?
21	Design a quarter wave transformer to match a load of 200 Ω to a source resistance of 500Ω. The operating frequency is 200 MHz.
22	List the procedural steps to find the admittance from the given impedance using smith chart.
23	Write the procedure to find the impedance from the given load admittance using smith chart.
24	Why short circuited stub is preferred to open circuited stub?
25	What is a stub? Why it is used in between the transmission lines?
26	Define critical or cutoff frequency. What is the cut off frequency of TEM wave?
27	List the characteristics of TEM waves.
28	Define TEM waves.
29	Define the terms phase velocity and group velocity.
30	A rectangular waveguide of cross section 5cm x 2cm is used to propagate TM_{11} mode at 10 GHz. Determine the cut-off wave length.
31	A rectangular waveguide has the following dimensions l = 2.54 cm, b = 1.27 cm. Calculate the cut-off frequency for TE_{11} mode.
32	A rectangular waveguide with dimensions a = 8.5 cm and b = 4.3 cm is fed by 5GHz carrier. Will a TE_{11} mode be propagated?
33	A rectangular air filled copper waveguide with dimension of a=3.4cm and b=1.2cm has a 9.2 GHz signal propagated in it. Determine the guide wavelength for TE_{10} mode.
34	Give the applications of cavity resonator?
35	What is the need for impedance matching networks?

36	What is loaded Quality factor?
37	Define nodal quality factor.
38	Draw the typical output stability circle and input stability circle.
39	Define power gain of an amplifier in terms of S parameters and reflection coefficients.
40	What is Rollett factor?
41	What is the use of Microstrip Line Matching network?
42	Give the expression to verify the unconditionally stability of RF amplifier.
43	Write the expression for noise figure of a two port amplifier.
	<u>Part – B</u>
11.	(i) Derive the general solution of a transmission line. (10) (ii)The characteristic impedance of a uniform transmission line is 2309.6 ohms at a frequency of 800 MHz At this frequency the propagation constant is 0.054(0.0366+j0.99). Determine R ,L. (3)
11.	Derive the expression for voltage and current at any point along a line which is terminated in Z_0 (13)
11.	Obtain the expressions for current and voltage at any point along a parallel wire transmission line. (13)
11.	Derive the expression for the current and voltage at any point along of a transmission line. (13)
11.	(i) Derive the expression for input and transfer impedance of the transmission line. (8) (ii) A transmission line has $Z_0=745\angle -12°\Omega$ and is terminated in $Z_R=100\Omega$. Calculate reflection factor and reflection loss (5)
11.	(i) Explain in detail about waveform distortion and also derive the condition for distortion less Transmission line. (7) (ii) A telephone cable of 64km long has a resistance of 13Ω/km and a capacitance of 0.08μF/km. Calculate the attenuation constant, velocity and wavelength of the line at 1000Hz (6)
11.	What is the need for loading? Derive the propagation constant of a continuously loaded line and also derive Campbell's equation. (13)
11.	Discuss the following

	(i) Reflection on a line not terminated in Z_o. (7) (ii) Open and short circuited lines. (6)
12.	(i) Derive the expression for voltage and current on the dissipation less line. (10) (ii) Dissipation less line has the characteristic impedance of 50 Ω with terminated load of (60+j40) Ω.Find the reflection coefficient and standing wave ratio. (3)
12.	(i)Derive the line constants of Zero dissipationless line (7) (ii)A radio frequency line with Z_0=70 ohms is terminated by Z_L=115-j80Ω at λ=2.5 m. Find the VSWR and the maximum and minimum line impedances. (6)
12.	Derive the expressions for voltage and current at any point on the dissipationless line. Obtain the same for different receiving end conditions. (13)
12.	(i)A line with zero dissipation has R=0.006ohms/m, L=2.5 μH/m, C=4.45pF/m. If the line is operated at 10 MHz find (i)Ro (ii)attenuation constant (iii)phase Constant (iv) Velocity of propagation and (v) wavelength. (8) (ii) Discuss the various parameters of a open wire line at high frequencies. (8)
12.	(i)Discuss in detail about the variation of input impedance along the open and short circuited lines with relevant graphs. (9) (ii) Derive the expressions that permit easy measurements of power flow on the dissipationless line. (4)
12.	(i) Derive the input impedance of open circuited and short-circuited line and sketch the variations of the normalized value of reactance with distance s. (9) (ii)Explain Reflection losses on an unmatched line. (4)
12.	(i) Explain the different methods of measuring the VSWR on transmission lines. (8) (ii) Explain the method of power and impedance measurement on the dissipationless line (6)
12.	Derive an expression for the input impedance of the dissipationless line. Deduce the input impedance of open and short circuited dissipationless lines. (13)
13.	(i) Discuss operation of quarter wave transformer along with its applications. (4) (ii) Design a single stub matching system to match a load of 50-j100 ohms for a 75 ohms line operating at 500 MHz using relevant formula. (9)
13.	(i) Draw and explain the principle of double stub matching with neat diagram and expressions.(9) (ii) Discuss operation of quarter wave transformer along with its applications.(4)
13.	(i) Draw and explain the operation of Quarter wave line (6) (ii) Design a quarter wave transformer to match a load of 200 Ω to a source resistance of 500Ω, operating at a frequency of 200MHz. (7)
13.	(i)Explain the technique of single stub matching . (10) (ii)A UHF lossless transmission line working at 1 GHz is connected to an unmatched line producing a voltage reflection coefficient of 0.5(0.866+j 0.5). Calculate the length and position of the stub to match the line. (3)
13.	A single stub is to match a 200 ohms line to a load of 100- j 50 ohms. The wavelength is 6m. Determine the position and length of the short circuited stub mathematically and also using smith

	chart.(13)
13.	A 50 Ω lossless transmission line is terminated in a load impedance of Z_L= (25+j50) Ω. Use the smith chart top find voltage reflection coefficient, VSWR, input impedance of the line, given that the line is 3.3 λ long and input admittance of the line. (13)
13.	A 75 Ω lossless line feeder line is to be matched to an antenna with Z_L= (100-j80) Ω at 100MHz using single stub. Calculate the stub length and the distance of the stub from load using SMITH chart at 30 MHz. (13)
13.	(i)A 100+j50Ω is connected to a 75Ω transmission line lossless line. Find the VSWR, reflection Coefficient, load admittance and input impedance at the generator if the line is 25m long operating at 600 MHz using smith chart.(13)
14.	(i) Derive the equations for the characteristic impedance of symmetrical T and π networks. (8) (ii)A line is composed of T section of pure resistances. Calculate the characteristic impedance and propagation constant if each series arm is 100 ohms and shunt arm is 2000 ohms. (5)
14.	Derive the field expressions for TE wave propagation in rectangular waveguides. (13)
14.	Derive the field expressions for TM wave propagation in rectangular waveguides. (13)
14.	Derive an expression for transmission of TE waves between perfectly parallel conducting planes for the field components. (13)
14.	(i) What are the restrictions applied to the Maxwell's equation in solving the electric and magnetic field components of a wave propagating in the rectangular waveguide? (7) (ii) A rectangular waveguide measuring a=4.5cm and b=3cm internally has a 9GHz signal propagated in it. Calculate the guide wavelength, phase and group velocities and characteristic impedance for dominant mode. (6)
14.	(i) Derive the field equations for the TE waves in Circular waveguides. (13)
14.	Describe the principle and operation of rectangular cavity resonators with suitable expressions. (13)
14.	(i) Explain the propagation of electromagnetic waves in a cylindrical waveguide with suitable expressions (13)
14	(i) Explain the excitation of modes in rectangular waveguides (6) (ii) Find the resonant frequencies of first five lowest order modes of an air-filled rectangular cavity of dimensions 5 cm x 4 cm x 2.5cm. (7)
15.	Discuss various aspects of amplifier-power relations for RF transistor amplifier design. (16)
15.	A microwave amplifier is characterized by its S-parameters. Derive equations for power gain, available gain and transducer gain. (16)
15.	(i)Write the mathematical analysis of amplifier stability.(8) (ii) Design a microwave amplifier for maximum transducer power gain.(8)

15.	A microwave transistor has the following S parameters at 10 GHz, with a50Ω reference impedance. $S_{11}=0.45\angle 150°$, $S_{22}=0.40\angle -150°$, $S_{12}=0.01\angle -10°$, $S_{21}=2.05\angle 10°$, the source impedance $Z_s=20\Omega$ and load impedance is $Z_L=30\Omega$. Compute the power gain, available gain and transducer power gain. (16)
15.	Explain about High frequency BJT and FET
15.	Explain about Low noise amplifiers
15.	Explain (i) Mixers (ii) Power Amplifiers
	Part – C
16.	An air filled coaxial line of copper is to have a capacitance of 22 pF per meter. The inner conductor has a diameter of 0.1 cm. (i) Calculate the inductance of the line (ii) Find the inner radius of the outer conductor (iii) What is the characteristic impedance of the line? (iv) Find the phase constant and wavelength at a frequency of 25 MHz neglecting dissipation (15)
16.	For a frequency of 10GHz and plane of separation of 5cm in air find the cutoff frequency, cutoff wavelength, phase velocity and group velocity of the wave. (15)
16.	A generator of 1 volt, 1000 cycles, supplies power to a 100 mile open wire line terminated in 200 ohms resistance. The line parameters are R=10.4 ohms/ mile, L=0.00367henry/mile, $G=0.8\times10^{-6}$mho/mile, C=0.00835 uf/mile. Calculate Characteristic Impedance, Propagation constant, Reflection coefficient, Input Impedance, Wave length, Velocity of propagation. (15)
16.	A ratio of the spacing 'd' to the radius 'a' of an open wire dissipationless line is 25 and space between the conductor has a dielectric of relative permittivity of 8. Determine (i) the inductance (ii) the capacitance (iii) characteristic impedance (iv) Velocity of propagation when the line is excited by a source. (15)
16.	A 100Ω lossless transmission line is terminated in load impedance of 50+j100 Ω. Use the Smith chart to find SWR, K, input impedance of the line given that the line is 3.45λ long and input admittance of the line. (15)