**P.S.R ENGINEERING COLLEGE**
**(An Autonomous Institution & Affiliated to Anna University, Chennai**
**DEPARTMENT OF ECE**

**QUESTION BANK**

**231EC44-NETWORKS AND TRANSMISSION LINES**

**UNIT-I SYMMETRICAL AND ASYMMETRICAL TWO PORT NETWORKS**

| Q. No. | Part A (1 Mark) | Marks | COs | BTL |
|---|---|---|---|---|
| 1. | In a two-port network, the Z-parameters are defined as:<br>A)Voltage ratios B) Current ratios C) Voltage-to-current ratios D) Voltage-to-voltage ratios | 1 | CO1 | K1 |
| 2. | Which of the following conditions is necessary for a two-port network to be reciprocal?<br>A)The input impedance must be equal to the output impedance B) The transmission matrix must be symmetrical C) The network must have zero loss D) The input and output voltages must be in phase | 1 | CO1 | K1 |
| 3. | If a two-port network has an impedance matrix (Z-parameters), what does the parameter $Z_{11}$ represent?<br>A)Input impedance at port 1 when port 2 is open B) Output impedance at port 2 when port 1 is open C) Voltage gain D) Current gain | 1 | CO1 | K1 |
| 4. | The hybrid parameters H-parameters are most commonly used for:<br>A)Amplifiers and small signal analysis B) Transmission lines C) Cascaded two-port networks D) Impedance matching | 1 | CO1 | K1 |
| 5. | The admittance (Y) parameters are defined in terms of:<br>A) $V_1$ and $V_2$ in terms of $I_1$ and $I_2$ B) $I_1$ and $I_2$ in terms of $V_1$ and $V_2$ C) Power and energy D) Resistance and reactance | 1 | CO1 | K1 |
| 6. | The hybrid (h) parameters mix which two variables?<br>A) Voltage and current B) Power and energy C) Inductance and capacitance D) Resistance and reactance | 1 | CO1 | K1 |
| 7. | A lattice network consists of:<br>A) Series and shunt impedances in a square configuration B) Series impedances only C) Parallel impedances only D) Only T and π configurations | 1 | CO1 | K1 |
| 8. | The π-equivalent circuit of a two-port network consists of:<br>A) 2 series impedances and 1 shunt impedance B) 2 shunt impedances and 1 series impedance C) 3 shunt impedances D) 3 series impedances | 1 | CO1 | K1 |
| 9. | The image impedance of a two-port network is defined as:<br>A) The ratio of input voltage to input current B) The input impedance when both ports are terminated with their respective image impedances C) The reciprocal of admittance D) The sum of transmission parameters | 1 | CO1 | K1 |

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| 10. | For the short-circuit admittance parameters, what does $Y_{21}$ represent?<br>A) Forward transfer admittance B) Reverse transfer admittance C) Output admittance D) Input admittance | 1 | CO1 | K1 |
| 11. | A two-port network is characterized by: a) One input and one output port b) Two input ports c) Two output ports d) Multiple ports | 1 | CO1 | K1 |
| 12. | Which of the following parameters are used to describe a two-port network?<br>a) Impedance (Z) and Admittance (Y) b) Hybrid (h) and Transmission (ABCD) c) Inverse transmission and Inverse hybrid d) All of the above | 1 | CO1 | K1 |
| 13. | A two-port network is said to be reciprocal if:<br>a) Input and output impedances are equal b) $Z_{12}=Z_{21}$ or $h_{12}=h_{21}$<br>c) It consists only of resistors d) It has at least one dependent source | 1 | CO1 | K1 |
| 14. | A two-port network is said to be symmetrical if:<br>a) $Z_{11}=Z_{22}$, $Y_{11}=Y_{22}$, $h_{11}=h_{22}$ or A=D b) $Z_{12}=Z_{21}$ c) It contains active elements d) It has a negative determinant | 1 | CO1 | K1 |
| 15. | The impedance parameters relate:<br>a) Input and output voltages to input and output currents<br>b) Only input impedance to output voltage<br>c) Only output voltage to input current<br>d) None of the above | 1 | CO1 | K1 |
| 16. | The admittance matrix is obtained by expressing:<br>a) Voltages in terms of currents<br>b) Currents in terms of voltages<br>c) Power in terms of voltages and currents<br>d) None of the above | 1 | CO1 | K1 |
| 17. | The diagonal elements of the admittance matrix represent:<br>a) Driving point admittances<br>b) Transfer admittances<br>c) Open circuit voltages<br>d) Short circuit currents | 1 | CO1 | K1 |
| 18. | The ABCD parameters are also known as:<br>a) Transmission parameters<br>b) Transfer function parameters<br>c) Resistance parameters<br>d) Laplace parameters | 1 | CO1 | K1 |
| 19. | The condition for **a** lossless two-port network in terms of ABCD parameters is:<br>a) AD−BC=1 b) A=D=0 c) B=C=0 d) AD−BC=0 | 1 | CO1 | K1 |
| 20. | The purpose of lattice networks in transmission lines is:<br>a) To improve impedance matching<br>b) To increase signal distortion<br>c) To make the circuit unstable<br>d) None of the above | 1 | CO1 | K1 |
| | **PART B (2 Marks)** | | | |
| 1. | Define a two port network. | 2 | CO1 | K1 |

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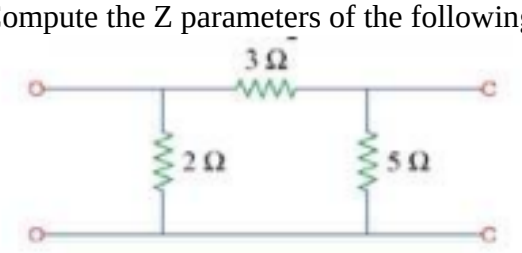
| 2. | What is the difference between symmetrical and asymmetrical two port networks? | 2 | CO1 | K1 |
| 3. | Show expressions for image impedances in terms of transmission parameters. | 2 | CO1 | K1 |
| 4. | Sketch the equivalent circuit of a two port network in terms of hybrid parameters | 2 | CO1 | K1 |
| 5. | Recall the expression of propagation constant of a two port network. | 2 | CO1 | K1 |
| 6. | What are called reverse transfer admittance and forward transfer admittance? | 2 | CO1 | K1 |
| 7. | Define the term reciprocal network. | 2 | CO1 | K1 |
| 8. | How are admittance parameters related to impedance parameters? | 2 | CO1 | K1 |
| 9. | Write the h-parameters equations for two port network. | 2 | CO1 | K1 |
| 10. | Draw the T equivalent circuit of a two port network. | 2 | CO1 | K1 |
| 11. | The admittance parameters matrix of a two port network is given as$Y_{11}$=1mho, $Y_{22}$ =2 mho, $Y_{21}$= $Y_{12}$= 1 mho. Determine the parameter $Z_{22}$ of the two port network. | 2 | CO1 | K2 |
| 12. | For a given, Z11=3Ω; Z12 =1 Ω V; Z21 = 2 Ω, and Z22 = 1 Ω, find the admittance matrix. | 2 | CO1 | K2 |
| 13. | What is image impedance, and how is it related to the Z-parameters of a two-port network? | 2 | CO1 | K2 |
| 14. | Convert transmission parameters to hybrid parameters | 2 | CO1 | K1 |
| 15. | What are the relationships between the H-parameters and Z/Y parameters? | 2 | CO1 | K1 |
| 16. | What condition must a two-port network satisfy for Z-parameters to be reciprocal? | 2 | CO1 | K1 |
| 17. | What do the diagonal elements of the Z-matrix represent? | 2 | CO1 | K1 |
| 18. | Define impedance parameters (Z-parameters) in a two-port network. | 2 | CO1 | K1 |
| 19. | What is the relationship between Z-parameters and h-parameters? | 2 | CO1 | K1 |
| 20. | How are ABCD parameters useful in cascading two-port networks? | 2 | CO1 | K1 |
| | **PART C (14Marks)** | | | |
| 1 a. | Construct the open circuit impedance and admittance parameters of a two port network and give the relation between them. | 7 | CO1 | K3 |
| b. | Compute the Z parameters of the following network.<br>  | 7 | CO1 | K3 |
| 2 a. | Express ABCD parameters in terms of h parameters. | 5 | CO1 | K3 |

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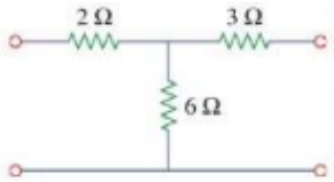
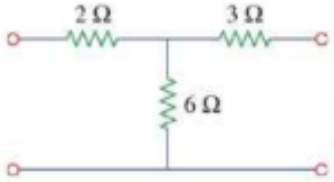
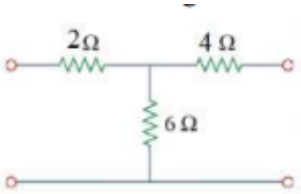
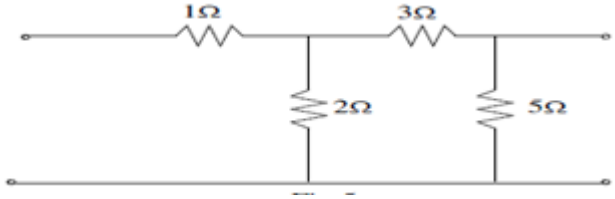
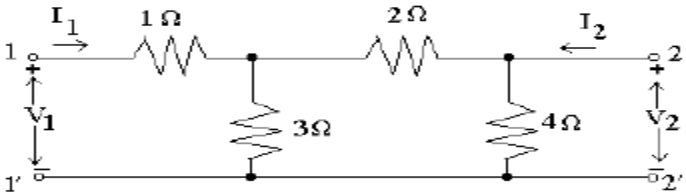
| b. | Compute Y-parameters for the following circuit.<br>  | 9 | CO1 | K3 |
| 3 a. | Express h parameters in terms of ABCD parameters. | 5 | CO1 | K3 |
| b. | Compute the ABCD parameters of the following circuit.<br>  | 5 | CO1 | K3 |
| 4. | Compute the Z and Y parameters for the following circuit.<br>  | 14 | CO1 | K3 |
| 5. | Compute the Z parameters and ABCD parameters of the network given below.<br>  | 14 | CO1 | K3 |
| 6 a. | Construct the open circuit impedance and admittance parameters of a two port network and give the relation between them | 7 | CO1 | K3 |
| b. | Calculate the transmission parameters of the network shown below.<br>  | 7 | CO1 | K3 |
| 7 a. | Derive the expressions for image parameters of a two port network and equation of propagation constant of a symmetrical reciprocal network. | 10 | CO1 | K3 |
| b | If the Z parameters are $Z_{11}$=10Ω, $Z_{22}$= 15 Ω, $Z_{12}$=$Z_{21}$=5Ω. Find the equivalent T-Network. | 4 | CO1 | K3 |
| 8 a. | Sketch T and π network and obtain impedances in terms of ABCD parameters. | 10 | CO1 | K3 |

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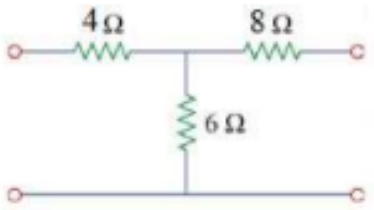
| b. | Express Y parameters in terms of Z parameters. | 4 | CO1 | K3 |
| 9 a. | Prove that $Z_{oc} * Z_{sc} = Z_1 Z_2 + \frac{Z_1^2}{4}$ of T filter network. | 7 | CO1 | K3 |
| b. | Construct the structure of lattice networks and obtain the Z-parameters for the | 7 | CO1 | K3 |
| 10 | Explain the concept of a two-port network and its characterization using different parameter sets | 14 | CO1 | K2 |
| 11 a | Compute the h parameters of the following circuit.<br>  | 9 | CO1 | K3 |
| b | Derive the relationship between Z and h parameters. | 5 | CO1 | K3 |

**UNIT II LUMPED FILTERS**

| S.NO | Part A (1 Mark) | Marks | COs | BTL |
|---|---|---|---|---|
| 1. | In a low-pass filter, the cutoff frequency is defined as the frequency at which:<br>A) The gain drops by 3 dB B) The output voltage becomes zero C) The input impedance becomes infinite D) The phase shift is 180 degrees | 1 | CO2 | K1 |
| 2. | A high-pass filter allows signals with frequencies:<br>A) Below the cutoff frequency to pass B) Above the cutoff frequency to pass C) Within a specific frequency band to pass<br>D) With a specific phase shift to pass | 1 | CO2 | K1 |
| 3. | A Constant K Filter is defined by which of the following characteristics?<br>A) The reactance elements are fixed in value and are not affected by frequency B) The reactance elements are frequency-dependent C) The filter components are variable D) The filter has no reactive elements | 1 | CO2 | K1 |
| 4. | A M-derived filter can be obtained from a Constant-K filter by:<br><br>A)Replacing one of the reactive components with an additional series or parallel reactive element B) Replacing the inductors with capacitors C) Using a different resistor value D) Increasing the order of the filter without changing the component values | 1 | CO2 | K1 |

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| 5. | What is the primary use of the decibel (dB) in filter analysis?<br><br>A) To measure current B) To measure resistance C) To measure the ratio of power or voltage D) To measure the capacitance of a network | 1 | CO2 | K1 |
| 6. | What is the relationship between the Neper and Decibel in terms of attenuation?<br><br>A) 1 Neper = 10 dB B) 1 Neper = 20 dB C) 1 Neper = 0.5 dB D) 1 Neper = 8.686 dB | 1 | CO2 | K2 |
| 7. | The propagation constant of a transmission line is used to describe:<br><br>A) The ratio of the output voltage to input voltage B) The rate at which a signal is attenuated and delayed in the transmission medium C) The relationship between current and voltage in a passive circuit D) The capacitance per unit length of the transmission line | 1 | CO2 | K1 |
| 8. | In the context of filters, what does the term "Passband" refer to?<br><br>A) The range of frequencies that are blocked by the filter B) The frequency range where the filter provides maximum attenuation C) The frequency range where the filter allows signals to pass with minimal attenuation D) The cutoff frequency of the filter | 1 | CO2 | K1 |
| 9. | A Constant K filter is characterized by:<br><br>A) Having resistors and inductors only B) Having resistors and capacitors only C) Using inductors and capacitors to form low-pass, high-pass, and band-pass filters D) Using only resistors | 1 | CO2 | K1 |
| 10. | When designing a filter circuit, the cutoff frequency is determined by:<br><br>A) The impedance of the filter B) The power of the signal C) The values of inductance and capacitance used in the circuit D) The type of filter (low-pass, high-pass, etc.) | 1 | CO2 | K1 |
| 11. | Crystal filters are primarily used for:<br><br>A) Low-frequency noise reduction B) High-frequency communication systems due to their sharp frequency selectivity C) Power filtering in DC circuits D) Amplifying weak signals | 1 | CO2 | K1 |
| 12. | In a low-pass filter, the cutoff frequency is defined as the frequency where:<br><br>A) The signal is attenuated by 3 dB B) The signal is amplified by 3 dB C) The signal has no attenuation D) The output is equal to the input signal | 1 | CO2 | K1 |
| 13. | The propagation constant $\gamma$ of a transmission line is given by:<br>a) $\gamma=\alpha+j\beta$ b) $\gamma=j\beta$ c) $\gamma=\alpha-j\beta$ d) $\gamma=R+jX$ | 1 | CO2 | K1 |

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| 14. | In the propagation constant $\gamma=\alpha+j\beta$, the term $\alpha$ represents:<br>a) Attenuation constant b) Phase constant c) Propagation delay<br>d) Wavelength | 1 | CO2 | K1 |
| 15. | A band-pass filter passes frequencies:<br>a) Above a certain cutoff frequency<br>b) Below a certain cutoff frequency<br>c) Between two cutoff frequencies<br>d) In the entire frequency range | 1 | CO2 | K1 |
| 16. | The stop band of a filter is:<br>a) The frequency range where signals are strongly attenuated<br>b) The frequency range where signals pass without attenuation<br>c) The passband of a filter<br>d) The transition region between pass and stop bands | 1 | CO2 | K1 |
| 17. | A Constant-K high-pass filter contains:<br>a) Series inductors and shunt capacitors<br>b) Series capacitors and shunt inductors<br>c) Only resistors d) Only capacitors | 1 | CO2 | K1 |
| 18. | The characteristic impedance of an m-derived section is:<br>a) Higher than that of a constant-K filter<br>b) Lower than that of a constant-K filter<br>c) Same as a constant-K filter d) Zero | 1 | CO2 | K1 |
| 19. | A $\pi$-type attenuator consists of:<br>a) Two shunt resistors and one series resistor<br>b) Only capacitors c) Three inductors<br>d) Two series resistors and one shunt resistor | 1 | CO2 | K1 |
| 20. | The main function of an attenuator is to:<br>a) Reduce signal strength without distortion<br>b) Increase signal power<br>c) Remove harmonics<br>d) Amplify weak signals | 1 | CO2 | K1 |
| | PART B (2 Marks) | | | |
| 1. | What is the characteristic impedance of T and $\pi$ symmetrical network? | 2 | CO2 | K1 |
| 2. | If the short circuit impedance is 100 $\Omega$ and open circuit impedance is 400 $\Omega$, what is the characteristic impedance of symmetrical network? | 2 | CO2 | K2 |
| 3. | List the condition for stop band and pass band of a filter. | 2 | CO2 | K1 |
| 4. | Define cut-off frequency of a filter. | 2 | CO2 | K1 |
| 5. | Construct the structure of band elimination filter. | 2 | CO2 | K2 |
| 6. | What are the advantages of constants k prototype filter? | 2 | CO2 | K1 |
| 7. | Compare the units of neper and decibel. | 2 | CO2 | K2 |
| 8. | What are the salient features of crystal filter? | 2 | CO2 | K1 |
| 9. | What is a "T-section attenuator" and how does it work? | 2 | CO2 | K1 |

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| 10. | What is the relationship between the decibel (dB) and the Neper (Np)? | 2 | CO2 | K1 |
| 11. | List the advantages of m-derived filter over constant K filter. | 2 | CO2 | K1 |
| 12. | Derive the cutoff frequency of a constant K filter. | 2 | CO2 | K2 |
| 13. | Define Neper (Np) and its relation to decibel (dB). | 2 | CO2 | K1 |
| 14. | If the input power is 100 mW and the output power is 10 mW, calculate the power loss in dB. | 2 | CO2 | K2 |
| 15. | Write the equation for the propagation constant (γ) of a transmission line. | 2 | CO2 | K1 |
| 16. | How is the cutoff frequency of a low-pass Constant-K filter calculated? | 2 | CO2 | K1 |
| 17. | What is the difference between an m-derived high-pass filter and an m-derived low-pass filter? | 2 | CO2 | K1 |
| 18. | What is the purpose of the m factor in an m-derived filter? | 2 | CO2 | K1 |
| 19. | Why are attenuators used in communication systems? | 2 | CO2 | K1 |
| 20. | How does a T-type attenuator differ from a π-type attenuator? | 2 | CO2 | K1 |
| | PART C (14 Marks) | | | |
| 1 a. | Formulate the procedure to obtain m-derived low pass filter from constant k-high pass filter. | 5 | CO2 | K3 |
| b. | Design an m-derived LPF having cutoff frequency of 1 KHz, design impedance of 400 Ω and resonant frequency 1100 KHz . | 9 | CO2 | K3 |
| 2 a. | Formulate the procedure to obtain m-derived high pass filter from constant k-high pass filter. | 5 | CO2 | K3 |
| b. | Design m-derived T-section HPF with frequency cutoff at 10 KHz. Design impedance of 200 Ω; m=0.4. Determine frequency of infinite attenuation. | 9 | CO2 | K3 |
| 3 | Design a constant K-band elimination filter and also draw its different characteristics curves for $\alpha, \beta$ and reactance Vs frequency. | 14 | CO2 | K3 |
| 4 | Design a constant K-band pass filter and also draw its different characteristics curves for $\alpha, \beta$ and reactance Vs frequency. | 14 | CO2 | K3 |
| 5 | Design a constant K-low pass filter and also draw its different characteristics curves for $\alpha, \beta$ and reactance Vs frequency. | 14 | CO2 | K3 |
| 6 | Design a constant K-high pass filter and also draw its different characteristics curves for $\alpha, \beta$ and reactance Vs frequency. | 14 | CO2 | K3 |
| 7 | Design a m-derived low pass filter both T and $\pi$ sections and plot the characteristic curves for $\alpha, \beta$ and reactance Vs frequency. | 14 | CO2 | K3 |
| 8 | Design a m-derived low pass filter both T and $\pi$ sections and plot the characteristic curves for $\alpha, \beta$ and reactance Vs frequency. | 14 | CO2 | K3 |
| 9 | Design T and $\pi$ symmetrical attenuator circuits. | 14 | CO2 | K3 |

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| 10 a. | Design a low-pass filter (both $\pi$ and T-sections) having a cut-off frequency of 2 kHz to operate with a terminated load resistance of 500 ohms | 7 | CO2 | K3 |
| b | Design a high-pass filter (both $\pi$ and T-sections) having a cut-off frequency of 1 kHz with a load resistance of 600 ohms | 7 | CO2 | K3 |
| 11 a. | Design a m-derived low-pass filter having cut-off frequency of 1 kHz, design impedance of 400 ohms, and the resonant frequency of 1100 Hz. | 7 | CO2 | K3 |
| b. | Design an m-derived high-pass filter with a cut-off frequency of 10 kHz; design impedance of 5 ohms and m = 0.4 | 7 | CO2 | K3 |
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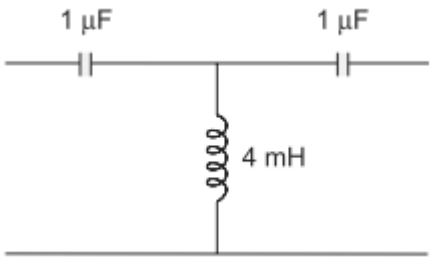
| 12 a | Design an m-derived T-section low-pass filter having cut-off frequency, fc = 7000 Hz, design impedance Ro = 600 ohms , and frequency of infinite attenuation | 7 | CO2 | K3 |
| b | Determine the cut-off frequency and design impedance for the T-section shown in Fig.   | 7 | CO2 | K3 |

| | UNIT III PASSIVE NETWORK SYNTHESIS | | | |
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| Q. No | Part A (1 Mark) | Marks | COs | BTL |
| 1. | The property of Hurwitz polynomials is that:<br><br>A) All roots of the polynomial must be on the right half of the complex plane. B) All coefficients of the polynomial are positive. C) All roots must lie in the left half of the complex plane. D) All coefficients of the polynomial are negative. | 1 | CO3 | K1 |
| 2. | The Foster form of an LC network represents a synthesis of the impedance function using:<br><br>A) Only capacitors. B) A series combination of inductors and resistors. C) Only inductors in a series form. D) A ladder network of reactive elements and resistors. | 1 | CO3 | K1 |
| 3. | The impedance function $\boldsymbol{Z(s) = \frac{s}{s^2+4s+5}}$ is a driving-point impedance. Is it a positive real function?<br><br>A) Yes, because the function has only positive real parts. B) No, because it does not have a positive real part for all s. C) Yes, because it is a rational function. D) No, because it has imaginary poles. | 1 | CO3 | K1 |
| 4. | In the Cauer form of synthesis, each stage of the ladder network consists of:<br><br>A) A parallel combination of a resistor and a capacitor. B) A series combination of an inductor and a resistor. C) A parallel combination of an inductor and a capacitor. D) A series combination of an inductor and a capacitor. | 1 | CO3 | K1 |
| 5. | What is the main characteristic of a positive real function?<br><br>A)It is always increasing B) It has no poles or zeros<br>C) The real part of the function is non-negative for all values of frequency D) It is a complex function with a non-negative imaginary part | 1 | CO3 | K1 |
| 6. | What is the significance of Brune's positive real function in network synthesis?<br><br>A) It is used for creating low-pass filters B) It provides a method for the synthesis of passive networks C) It gives the optimal configuration for active filters<br>D) It is used to find the cut-off frequencies of the network | 1 | CO3 | K1 |
| 7. | A function f(s) is even if:<br>a) f(s)=f(−s) b) f(s)=−f(−s) c) f(s)=0 for all s d) It contains only odd powers of s | 1 | CO3 | K1 |

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| 8. | An odd function satisfies the property:<br>a) f(s)=f(−s) b) f(s)=−f(−s) c) f(s) is always 0 d) It contains only odd powers of s | 1 | CO3 | K1 |
| 9. | The driving point impedance function of a network is:<br>a) The ratio of voltage to current at any terminal pair b) The impedance looking into the input terminals with output terminals shorted c) The transfer function of the network d) The admittance function of a two-port network | 1 | CO3 | K1 |
| 10. | Foster's form of LC network synthesis is based on:<br>a) Partial fraction expansion of impedance function b) Continued fraction expansion of impedance function c) Direct evaluation of polynomial coefficients d) Direct numerical integration | 1 | CO3 | K1 |
| 11. | Cauer's form of LC synthesis is based on:<br>a) Partial fraction expansion b) Continued fraction expansion<br>c) Laplace transform properties d) Fourier series decomposition | 1 | CO3 | K1 |
| 12. | Foster's synthesis is suitable for:<br>a) Series networks only b) Parallel networks only c) Both series and parallel networks d) Non-passive networks only | 1 | CO3 | K1 |
| 13. | A function is said to be Positive Real (PR) if:<br>a) It has only real poles<br>b) Its real part is non-negative for all s with Re (s) $\geq 0$<br>c) It has no complex roots d) It is always stable | 1 | CO3 | K1 |
| 14. | A driving point function is realizable if:<br>a) It is a positive real function<br>b) It has at least one pole in the right half-plane<br>c) It has only imaginary roots<br>d) It satisfies Strum's theorem | 1 | CO3 | K1 |
| 15. | Brune's method is used to:<br>a) Convert a non-realizable function into a realizable one<br>b) Synthesize a given two-port network<br>c) Determine the frequency response of a filter<br>d) Solve for even and odd parts of a function | 1 | CO3 | K1 |
| 16. | For a polynomial to be Hurwitz, it must:<br>a) Have only even-order terms<br>b) Have all coefficients positive and non-zero<br>c) Have roots with positive real parts<br>d) Have all imaginary roots | 1 | CO3 | K1 |
| 17. | Strum's theorem is used to:<br>a) Count the number of real roots of a polynomial<br>b) Determine the transfer function of a circuit<br>c) Analyze the frequency response of a filter<br>d) Solve for complex poles | 1 | CO3 | K1 |
| 18. | Foster's Form I realization consists of:<br>a) Series LC networks in parallel b) Parallel LC networks in series<br>c) RL networks in series d) RC networks in parallel | 1 | CO3 | K1 |

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| 19. | Cauer's method is preferred over Foster's method when:<br>a) The function cannot be expanded into simple fractions<br>b) The function contains only imaginary poles<br>c) The function is purely resistive<br>d) The function has no complex conjugate pairs | 1 | CO3 | K1 |
| 20. | Cauer form of realization is mainly used for:<br>a) Passive network synthesis b) Active network synthesis<br>c) Signal processing d) Digital filter design | 1 | CO3 | K1 |
| | PART B (2 Marks) | | | |
| 1. | Sketch the synthesized RL network by using Cauer's method. | 2 | CO3 | K1 |
| 2. | Identify the polynomial for positive real function. | 2 | CO3 | K2 |
| 3. | Define Strum's theorem | 2 | CO3 | K1 |
| 4. | Test whether the given polynomial is Hurwitz<br>$P(S) = s^5 + 8s^4 + 24s^3 + 28s^2 + 23s + 6$ | 2 | CO3 | K1 |
| 5. | Test whether the given polynomial is Hurwitz<br>$P(S) = s^4 + s^2 + 1$ | 2 | CO3 | K2 |
| 6. | Test whether the given polynomial is positive real function $Z(s) = \frac{s+3}{s+1}$ | 2 | CO3 | K1 |
| 7. | Compare Foster form and Cauer form of a network. | 2 | CO3 | K2 |
| 8. | What are the salient features of crystal filter? | 2 | CO3 | K1 |
| 9. | What is a "T-section attenuator" and how does it work? | 2 | CO3 | K1 |
| 10. | Define a positive real function and mention any two properties. | 2 | CO3 | K1 |
| 11. | Give an example of a positive real function and justify why it is positive real. | 2 | CO3 | K1 |
| 12. | What is a driving point impedance function? Give an example. | 2 | CO3 | K1 |
| 13. | What is the purpose of Brune's synthesis method in network design? | 2 | CO3 | K1 |
| 14. | Define a Hurwitz polynomial and state its significance in system stability. | 2 | CO3 | K1 |
| 15. | Give an example of an even and an odd function. | 2 | CO3 | K1 |
| 16. | How do you determine whether a function is even or odd? | 2 | CO3 | K1 |
| 17. | State Strum's theorem and explain its application in root determination. | 2 | CO3 | K1 |
| 18. | Differentiate between Foster's I and Foster's II forms in network synthesis. | 2 | CO3 | K1 |
| 19. | How does Cauer's synthesis method differ from Foster's synthesis? | 2 | CO3 | K1 |
| 20. | What is the main criterion for a polynomial to be Hurwitz? | 2 | CO3 | K1 |
| | PART C (14 Marks) | | | |
| 1 a. | Interpret the properties of Brune's positive real function | 7 | CO3 | K2 |

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| b. | Outline the properties of Hurwitz polynomials | 7 | CO3 | K2 |
| 2 | Apply Foster's method to LC and RC networks with appropriate derivations | 14 | CO3 | K3 |
| 3. | Apply Cauer 's method to LC and RC networks with appropriate derivations | 14 | CO3 | K3 |
| 4 | Apply Foster's method and Cauer 's method to RL networks with appropriate derivations | 14 | CO3 | K3 |
| b | The driving point impedance of one port reactive LC network is givens as $Z(s) = \frac{5(s^2+4)(s^2+25)}{s(s^2+16)}$ | 14 | CO3 | K3 |
| Q. No. | Part A (1 Mark) Obtain the first Foster form of the networks. | Marks | COs | BTL |
| 5 | Compute the first and second Cauer realizations of driving point function of LC network given by $Z(s) = \frac{10s^4+12s^2+1}{2s^3+2s}$ | 14 | CO3 | K3 |
| 6 | Compute the first and second Foster realizations of driving point function of LC network given by $Z(s) = \frac{2(S+2)(S+5)}{(S+4)(S+6)}$ | 14 | CO3 | K3 |
| 7 | Compute the first and second Foster realizations of driving point function of RL network given by $z(s) = \frac{2(S+2)(S+5)}{(S+4)(S+6)}$ | 14 | CO3 | K3 |
| 8 | Compute the first and second Cauer realizations of driving point function of RL network given by $Z(S) = \frac{(S+3)(S+7)}{(S+2)(S+4)}$ | 14 | CO3 | K3 |
| 9 | Compute the first and second Foster realizations of driving point function of RC network given by $z(s) = \frac{(S+1)(S+3)}{S(S+2)}$ | 14 | CO3 | K3 |
| 10 | Compute the first and second Cauer realizations of driving point function of RC network given by $z(s) = \frac{(S+1)(S+3)}{S(S+2)}$ | 14 | CO3 | K3 |

## UNIT 4 TRANSMISSION LINE THEORY

| | | | | |
|---|---|---|---|---|
| 1. | In a lossless transmission line, the primary cause of signal distortion is:<br><br>A) The capacitance and inductance of the line. B) The resistance of the conductors.<br>C) The dielectric losses. D) Reflections from impedance mismatches. | 1 | CO4 | K1 |
| 2. | In a lossless transmission line, the primary cause of signal distortion is:<br><br>A) The capacitance and inductance of the line. B) The resistance of the conductors.<br>C) The dielectric losses. D) Reflections from impedance mismatches. | 1 | CO4 | K1 |
| 3. | For an open-circuited transmission line, the reflection coefficient is:<br><br>A) 0. B) 1. C) -1. D) Undefined. | 1 | CO4 | K1 |
| 4. | The general solutions for the voltage and current on a transmission line are derived from:<br><br>A) Maxwell's equations. B) Kirchhoff's current law and voltage law. C) The wave equation.<br>D) Ohm’s law for transmission lines. | 1 | CO4 | K1 |
| 5. | If a transmission line is not terminated in its characteristic impedance $Z_o$, the result is:<br><br>A) Complete power transmission without any reflection. B) Reflection of some portion of the signal back toward the source. C) Zero reflection of the signal. D) Maximum power transfer to the load. | 1 | CO4 | K1 |
| 6. | A transmission line consists of cascaded:<br>a) L sections b) π sections c) T sections d) RC sections | 1 | CO4 | K1 |
| 7. | The physical significance of the transmission line equation is to describe:<br>a) The resistance of the line<br>b) The voltage and current distribution along the line<br>c) The efficiency of the line<br>d) The power loss in the line | 1 | CO4 | K1 |

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| 8. | An infinite transmission line behaves as a:<br>a) Finite line with termination<br>b) Line with infinite impedance<br>c) Line with zero impedance<br>d) Line with constant characteristic impedance | 1 | CO4 | K1 |
| 9. | The velocity of propagation v is given by:<br>a) $v = \frac{1}{\sqrt{LC}}$<br>b) $v = \sqrt{LC}$<br>c) $v = \frac{1}{LC}$<br>d) $v = LC$ | 1 | CO4 | K1 |
| 10. | A transmission line is distortionless if:<br>a) R=0 b) L=G c) R/L=G/C d) L=C | 1 | CO4 | K1 |
| 11. | The primary parameters of a telephone cable are adjusted to make it:<br>a) Distortionless b) Lossless c) High gain d) Completely reflective | 1 | CO4 | K1 |
| 12. | If a transmission line is short-circuited, the reflection coefficient is:<br><br>a) 1 b) -1 c) 0 d) Infinity | 1 | CO4 | K1 |
| 13. | If a transmission line is open-circuited, the reflection coefficient is:<br><br>a) 1 b) -1 c) 0 d) Infinity | 1 | CO4 | K1 |
| 14. | The insertion loss of a transmission line is measured in:<br>a) Hertz<br>b) Neper<br>c) Decibel<br>d) Both b and c | 1 | CO4 | K1 |
| 15. | Insertion loss is defined as:<br>a) Power absorbed by the line<br>b) Ratio of power with and without network<br>c) Energy stored in the line<br>d) Efficiency of the line | 1 | CO4 | K1 |
| 16. | A transmission line is modeled as an infinite number of:<br>a) Resistors in series<br>b) L and C sections in series and shunt<br>c) Inductors in series only<br>d) Capacitors in shunt only | 1 | CO4 | K1 |
| 17. | The wavelength λ of a signal on a transmission line is related to its velocity v and frequency f by:<br><br>a) λ=vf b) λ=v/f c) λ=v+f d) λ=1/(vf) | 1 | CO4 | K1 |

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| 18. | The reflection coefficient Γ is zero when:<br>a) The line is short-circuited<br>b) The load impedance matches the characteristic impedance<br>c) The line is open-circuited<br>d) The transmission line is infinite | 1 | CO4 | K1 |
| 19. | A transmission line is said to be terminated in its characteristic impedance when:<br>a) The voltage along the line is constant<br>b) There are reflections from the load<br>c) No reflections occur<br>d) The line is open-circuited | 1 | CO4 | K1 |
| 20. | The attenuation constant α of a transmission line is given by:<br><br>a) α=Re( γ) b) α=Im( γ) c) α= γ d) α=wγ | 1 | CO4 | K1 |
| | PART B (2 Marks) | | | |
| 1. | Show the equivalent circuit of a transmission line. | 2 | CO4 | K1 |
| 2. | Define Characteristic Impedance. | 2 | CO4 | K1 |
| 3. | Why the line parameters are called distributed elements? | 2 | CO4 | K1 |
| 4. | What is the necessary condition for a distortion less line? | 2 | CO4 | K1 |
| 5. | Define Propagation Constant. | 2 | CO4 | K1 |
| 6. | Find the attenuation and phase shift constant of a wave propagating along the line whose propagation constant is $1.048 \times 10^{-8}\ (angle) < 88.8^0$. | 2 | CO4 | K2 |
| 7. | What is meant by the wavelength of a line? | 2 | CO4 | K2 |
| 8. | What are the different types of line distortions? | 2 | CO4 | K1 |
| 9. | How is distortion avoided in a telephone line? | 2 | CO4 | K1 |
| 10. | When does reflection occur in a line? | 2 | CO4 | K1 |
| 11. | Define reflection coefficient | 2 | CO4 | K1 |
| 12. | Define the term insertion loss | 2 | CO4 | K1 |
| 13. | Define attenuation constant and phase constant and their units. | 2 | CO4 | K1 |
| 14. | If a transmission line has an attenuation constant α=0.1 Np/m and a phase shift constant β=5rad/m, find the propagation constant. | 2 | CO4 | K2 |
| 15. | How do you calculate the attenuation constant and phase constant from the propagation constant in polar form? | 2 | CO4 | K2 |
| 16. | What is the expression for the propagation constant γ in terms of transmission line parameters? | 2 | CO4 | K1 |
| 17. | A signal has a frequency of 100 MHz and propagates through a transmission line with a phase shift constant β=10 rad/m. Find the wavelength. | 2 | CO4 | K2 |
| 18. | Calculate the phase constant for a lossless transmission line. | 2 | CO4 | K2 |

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| 19. | List the primary constants of transmission line with their units. | 2 | CO4 | K1 |
| 20. | A transmission line operates at 50 MHz. Find the wavelength. Also find its wavelength for a velocity factor of 0.8 | 2 | CO4 | K2 |
| PART C (14 Marks) | | | | |
| 1 | Derive the transmission line equation and explain its general solution for voltage and current at any points. | 14 | CO4 | K3 |
| 2 a | Determine the propagation constant and the velocity of propagation for an ordinary telephone cable. | 7 | CO4 | K3 |
| b | An open wire telephone line has R=10 Ω/Km, L=0.004 H/Km, C=0.008 × $10^{-6}$ F/Km, and G= 0.4 × $10^{-6}$ Ω/Km. Determine its | 7 | CO4 | K3 |
| 3 a | Explain Campbell's formula for the loading cables. | 7 | CO4 | K2 |
| b | Demonstrate if the following relations for uniform transmission line are valid $Z_0 = \sqrt{Z_{oc} \times Z_{sc}}$ , $\tan h\,\gamma l = \sqrt{\frac{Z_{sc}}{Z_{oc}}}$ | 7 | CO4 | K2 |
| 4 a | Explain in detail about the reflection on a line not terminated in its characteristics impedance. | 7 | CO4 | K2 |
| b | Summarize the concept of reflection factor and reflection loss. | 7 | CO4 | K2 |
| 5 | Derive the expression for the input impedance of a transmission line and hence obtain the input impedance for a lossless line. | 14 | CO4 | K3 |
| 6 a | Derive input impedance of infinite line and explain its significance. | 7 | CO4 | K3 |
| b | Derive expressions for wavelength and velocity of wave propagation in a transmission line. | 7 | CO3 | K3 |

## UNIT 5 LINE AT RADIO FREQUENCIES

| Q. No. | Part A (1 Mark) | Marks | COs | BTL |
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| 1. | Which of the following transmission lines is least affected by external interference?<br>a) Open-wire line b) Coaxial cable c) Twin-lead cable d) Ladder line | 1 | CO5 | K1 |
| 2. | Standing wave ratio (SWR) is defined as the ratio of:<br>a) Maximum voltage to minimum voltage along the transmission line b) Minimum voltage to maximum voltage along the transmission line c) Load impedance to characteristic impedance<br>d) Forward power to reflected power | 1 | CO5 | K1 |
| 3. | What is the range of the Voltage Standing Wave Ratio (VSWR)?<br>a) 0 to 1 b) 1 to ∞ c) -1 to +1 d) 0 to ∞ | 1 | CO5 | K1 |
| 4. | The relation between VSWR and reflection coefficient Γ is<br>a)VSWR=$\frac{1+\Gamma}{1-\Gamma}$ b) VSWR=$\frac{1-\Gamma}{1+\Gamma}$ c)VSWR= Γ d)VSWR=1-$\Gamma^2$ | 1 | CO5 | K1 |
| 5. | A quarter-wave transformer is used for:<br>a) Power amplification b) Impedance matching<br>c) Signal modulation d) Frequency doubling | 1 | CO5 | K1 |
| 6. | Single stub matching is preferred over double stub matching because:<br>a) It requires two tuning elements<br>b) It is more complex<br>c) It is simpler and requires only one tuning element<br>d) It is less efficient | 1 | CO5 | K1 |
| 7. | Which of the following is a primary application of the Smith Chart?<br>a) Frequency multiplication<br>b) Impedance matching<br>c) Digital signal processing<br>d) Antenna radiation pattern analysis | 1 | CO5 | K1 |
| 8. | If a transmission line is not terminated in its characteristic impedance $Z_o$, the result is:<br><br>A) Complete power transmission without any reflection. B) Reflection of some portion of the signal back toward the source. C) Zero reflection of the signal. D) Maximum power transfer to | 1 | CO5 | K1 |

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| 9. | Standing Wave Ratio (SWR) is:<br><br>A) The ratio of the total reflected power to the transmitted power. B) The ratio of the maximum to the minimum voltages along a transmission line. C) The ratio of the transmitted power to the total power in the system. D) The ratio of the reflected power to the incident power. | 1 | CO5 | K1 |
| 10. | A single stub matching network involves:<br><br>A) The use of a quarter-wave transformer and a matching network. B) A single stub placed at a specific position along the transmission line. C) A two-port network with inductive and capacitive elements. D) A combination of resistors and capacitors. | 1 | CO5 | K1 |
| 11. | In a waveguide, the TM (Transverse Magnetic) mode implies:<br><br>A) The magnetic field has no components in the direction of propagation. B) The electric field has no components in the direction of propagation. C) The magnetic field has components in the direction of propagation. D) The electric field has both longitudinal and transverse components. | 1 | CO6 | K1 |
| 12. | Which of the following is NOT a parameter represented on a Smith Chart?<br>a) Reflection coefficient b) Impedance c) Admittance<br>d) Bandwidth | 1 | CO5 | K1 |
| 13. | In a rectangular waveguide, the lowest cut-off frequency corresponds to which mode?<br>a) $TE_{10}$ b) $TM_{11}$ c) $TE_{01}$ d) TEM | 1 | CO6 | K1 |
| 14. | Which of the following statements is true for waveguides?<br>a) TEM waves can propagate in waveguides.<br>b) TE and TM waves can propagate in waveguides.<br>c) Only TEM waves propagate in rectangular waveguides.<br>d) Only TM waves propagate in circular waveguides. | 1 | CO6 | K1 |
| 15. | In a waveguide, phase velocity is:<br>a) Always equal to the speed of light<br>b) Always less than the speed of light<br>c) Greater than the speed of light<br>d) Equal to the speed of the wave in free space | 1 | CO6 | K1 |
| 16. | If the reflection coefficient $\Gamma$ of a transmission line is zero, then the SWR is:<br>a) 0 b) 1 c) Infinity d) -1 | 1 | CO5 | K1 |

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| 17. | On a Smith Chart, the center point represents:<br>a) Open circuit b) Short circuit c) Matched load<br>d) Infinite impedance | 1 | CO5 | K1 |
| 18. | Which of the following is an advantage of using a quarter-wave transformer for impedance matching?<br>a) Works for all frequencies<br>b) Requires multiple components<br>c) Works only at a specific frequency<br>d) Has a complex circuit design | 1 | CO5 | K1 |
| 19. | A stub matching technique is used to:<br>a) Increase power loss<br>b) Reduce impedance<br>c) Reduce reflections<br>d) Increase the reflection coefficient | 1 | CO5 | K1 |
| 20. | The movement in a Smith Chart along a constant VSWR circle corresponds to:<br>a) A change in the impedance value along the line<br>b) A change in characteristic impedance<br>c) A change in the length of the transmission line<br>d) No change in impedance | 1 | CO5 | K1 |
| | PART B (2 Marks) | | | |
| 1. | Define Standing Wave Ratio(SWR). | 2 | CO5 | K1 |
| 2. | Define reflection coefficient. | 2 | CO5 | K1 |
| 3. | What is meant by waveform distortion? | 2 | CO5 | K1 |
| 4. | Show the general equation for the input impedance of dissipation less line. | 2 | CO5 | K1 |
| 5. | Recall the expression for the characteristic impedance and propagation constant for the dissipation less line. | 2 | CO5 | K1 |
| 6. | Determine the values of VSWR in the case of (a) $Z_R = 0$ and (b) $Z_R = Z_{0.}$ | 2 | CO5 | K2 |
| 7. | Distinguish the relationship between the input impedance and characteristic impedance of an infinite line. | 2 | CO5 | K2 |
| 8. | Sketch the waveform of voltage and current distribution along a short circuited line. | 2 | CO5 | K1 |
| 9. | Sketch the waveform of voltage and current distribution along an open circuited line. | 2 | CO5 | K1 |
| 10. | Derive the equation of SWR in terms of reflection coefficient. | 2 | CO5 | K2 |
| 11. | Find the equation of reflection coefficient in terms of SWR. | 2 | CO5 | K1 |
| 12. | Determine the reflection coefficient of a line when $Z_R = 200\ \Omega$ and $Z_0 = 692 \angle -12°\ \Omega$. | 2 | CO5 | K2 |
| 13. | Why standing wave do exist in transmission lines? | 2 | CO5 | K1 |

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| 14. | Find the reflection coefficient of a 60 Ω transmission line when it is terminated by a load impedance of 50+j50 Ω. | 2 | CO5 | K2 |
| 15. | How do you determine the normalized impedance using the Smith Chart? | 2 | CO5 | K1 |
| 16. | A lossless transmission line has Z0=50Ω and is terminated with a load of ZL=100Ω. Calculate the reflection coefficient. | 2 | CO5 | K2 |
| 17. | What is the effect of quarter-wave transformer in impedance matching? | 2 | CO5 | K1 |
| 18. | Write the mathematical equation for the cutoff frequency of TE and TM modes in a rectangular waveguide. | 2 | CO6 | K1 |
| 19. | Compare the phase velocity of TE and TM waves in a waveguide with the speed of light. | 2 | CO6 | K2 |
| 20. | If a wave propagates in a rectangular waveguide with an operating frequency of 12 GHz and a cutoff frequency of 6 GHz, find the guide wavelength $\lambda_g$ | 2 | CO6 | K2 |
| PART C (14 Marks) | | | | |
| 1 a | Demonstrate the concept of smith chart and applications in impedance matching | 7 | CO5 | K2 |
| b | Derive the equations for impedance matching using quarter wave transformer and illustrate its applications in transmission lines. | 7 | CO5 | K2 |
| 2 | A lossless transmission line with Zo=75 ohms and of electrical length l =0.3m terminated with impedance of $Z_R$=40+j20 ohms. . Determine the reflection co-efficient at load, SWR of line, input impedance of the line. | 14 | CO5 | K3 |
| 3 a | Determine the length & impedance of quarter length transformer that will match a 150 Ω load to 15 Ω at a frequency of 12GHz. | 7 | CO5 | K3 |
| b | A transmission line operating at 500MHz has $Z_0$ =80 ohms, α =0.04Np/m, β =1.5rad/m. Find the parameters R, L, C & G. | 7 | CO5 | K3 |
| 4 | 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 30MHz using smith chart. | 14 | CO5 | K3 |
| 5 | A transmission line has a characteristic impedance of 300 Ω and terminated in a load $Z_L$=150+j150 Ω. Find the following using smith chart a) VSWR b) Reflection coefficient c) The input impedance at a distance of 0.1λ d) The Input admittance at a distance of 0.1λ | 14 | CO5 | K3 |

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| 6 a | Derive expressions for Standing Wave Ratio (SWR) in terms of reflection coefficient for a lossless line. | 7 | CO5 | K3 |
| b | Develop expressions for single stub matching for the transmission lines. | 7 | CO5 | K3 |
| 7 a | Interpret expression for the input impedance of a transmission line. Assume the length of the line as *'l'*, characteristic impedance $Z_0$ and terminated with $Z_{R.}$ | 7 | CO5 | K3 |
| b | Infer about impossibility of TEM waves in waveguides. | 7 | CO6 | K3 |
| 8 a | A rectangular waveguide of cross section 5cm x 2cm is used to propagate $TM_{11}$ mode at 10GHz. Determine the cutoff wavelength. | 7 | CO6 | K3 |
| b | A rectangular waveguide has the following dimensions l=2.54cm, b=1.27cm. Calculate the cutoff frequency for $TE_{11}$ mode | 7 | CO6 | K3 |
| 9 | A rectangular waveguide measuring a=4.5cm, b=3cm has internally 9GHz signal propagated in it. Calculate the guide wavelength, phase and group velocity and characteristic impedance for $TM_{11}$ mode. | 14 | CO6 | K3 |
| 10 | Explain the characteristics of TE and TM waves in rectangular waveguides with expressions for various parameters such as cutoff frequency, cutoff wavelength and phase velocity | 14 | CO6 | K2 |