Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Semester: Odd Sem. 2019-20
Course Code: ECE 211
Course Name: TRANSMISSION LINES AND WAVEGUIDES
Program & Sem: B.Tech. (ECE) & V

Date: 30.09.2019
Time: 2.30PM to 3.30PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) Scientific and Non-programmable calculators are permitted.

Part A (Memory Recall Questions)

Answer both the Questions. Each Question carries four marks. (2Qx4M=8M)

1. Define Reflection coefficient and VSWR in transmission line?

(C.O.NO.1) [Knowledge]

2. What is Smith Chart? What are its applications?

(C.O.NO.1) [Knowledge]

Part B (Thought Provoking Questions)

Answer all the Questions. Each Question carries six marks (2Qx6M=12M)

3. The transmission line has a characteristic impedance 300 Ω and voltage standing wave ratio 10. What should be the value of load impedance you need connect to terminate the transmission line? (C.O.NO.1) [Comprehension]

4. The impedance of the source, when the transmission line is open circuited is (100+j5) Ω and (75-j2) Ω, when the transmission line is short circuited. Calculate the characteristic impedance of the transmission line? (C.O.NO.1) [Comprehension]

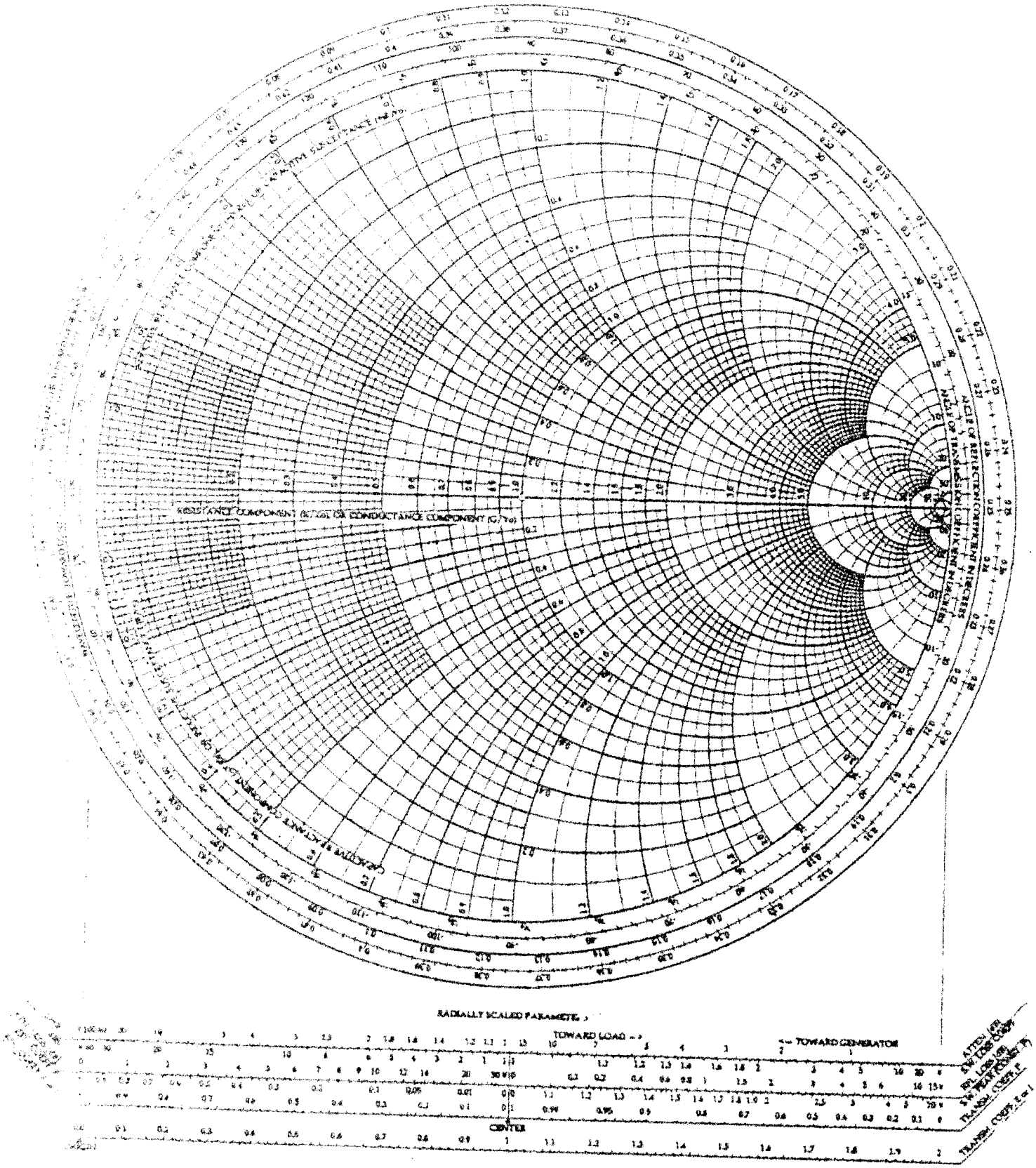
Part C (Problem Solving Questions)

Answer both the Questions. Each Question carries ten marks. **(2Qx10M=20M)**

5. A 100 KM lossless transmission line is terminated with an impedance of 200 Ω at a frequency of 1000 Hz. The transmission line constants are L=2mH and C=10μF. Determine (i) Propagation constant (ii) Phase constant (iii) Attenuation constant (iii) Phase velocity (iv) Characteristics impedance? (C.O.NO.1) [Comprehension]

6. A transmission line has an impedance of 500 Ω, length of (2/5) λ and is terminated by an impedance of 400 Ω. Determine (i) VSWR (ii) Input impedance (iii) Reflection co efficient using Smith Chart? (C.O.NO.1) [Comprehension]

The Smith Chart



SCHOOL OF ENGINEERING

Semester: V
Course Code: ECE 211
Course Name: Transmission Lines and Waveguides
Branch & Sem: ECE & V

Date: 30-09-2019
Time: 2.30-3.30 PM
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	Module1/ Transmission Line Theory	04 L2			04
2	2	Module2/ Transmission Line at Radio Frequencies	04 L2			04
3	1	Module1/ Transmission Line Theory		06 L2		06
4	1	Module1/ Transmission Line Theory		06 L2		06
5	1	Module1/ Transmission Line Theory			10 L2	10

6	2	Module2/ Transmission Line at Radio Frequencies							10	L4	10
	Total Marks	40		08		12			20		

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. DR. Sreenivasappa B V]

Reviewers' Comments

(1) 22/9/19 - Sunday
(2) Know Level Distrib
(3) Definitions are 11

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: V

Course Code: ECE 211

Course Name: Transmission Lines and Waveguides

Branch & Sem: ECE & V

Date: 30-09-2019

Time: 2.30-3.30

Max Marks: 40

Weightage: 20%

Part A

(2Q x 4M =8 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Reflection co-efficient (Γ) is the ratio of reflected voltage to the incident voltage. $\Gamma = \frac{V_2}{V_1}$	02	02 min
	Voltage standing wave ratio (VSWR) is the ratio of magnitude of maximum voltage to the magnitude of minimum voltage VSWR $= \frac{\lvert V_{max}\rvert}{\lvert V_{min}\rvert} = \frac{V_1+V_2}{V_1-V_2}$	02	02 min
2	Smith chart is a graphical tool to solve transmission line related problem very easily which would be tedious to solve using analytical method.	02	02 min
	Smith chart is used (i) To represent a complex impedance by a single point (ii) To determine VSWR (iii) To determine reflection coefficient (iv) To locate V_{max} and V_{min} (v) To find distance and length of the stub	Any Two applications Each 01 mark	02 min

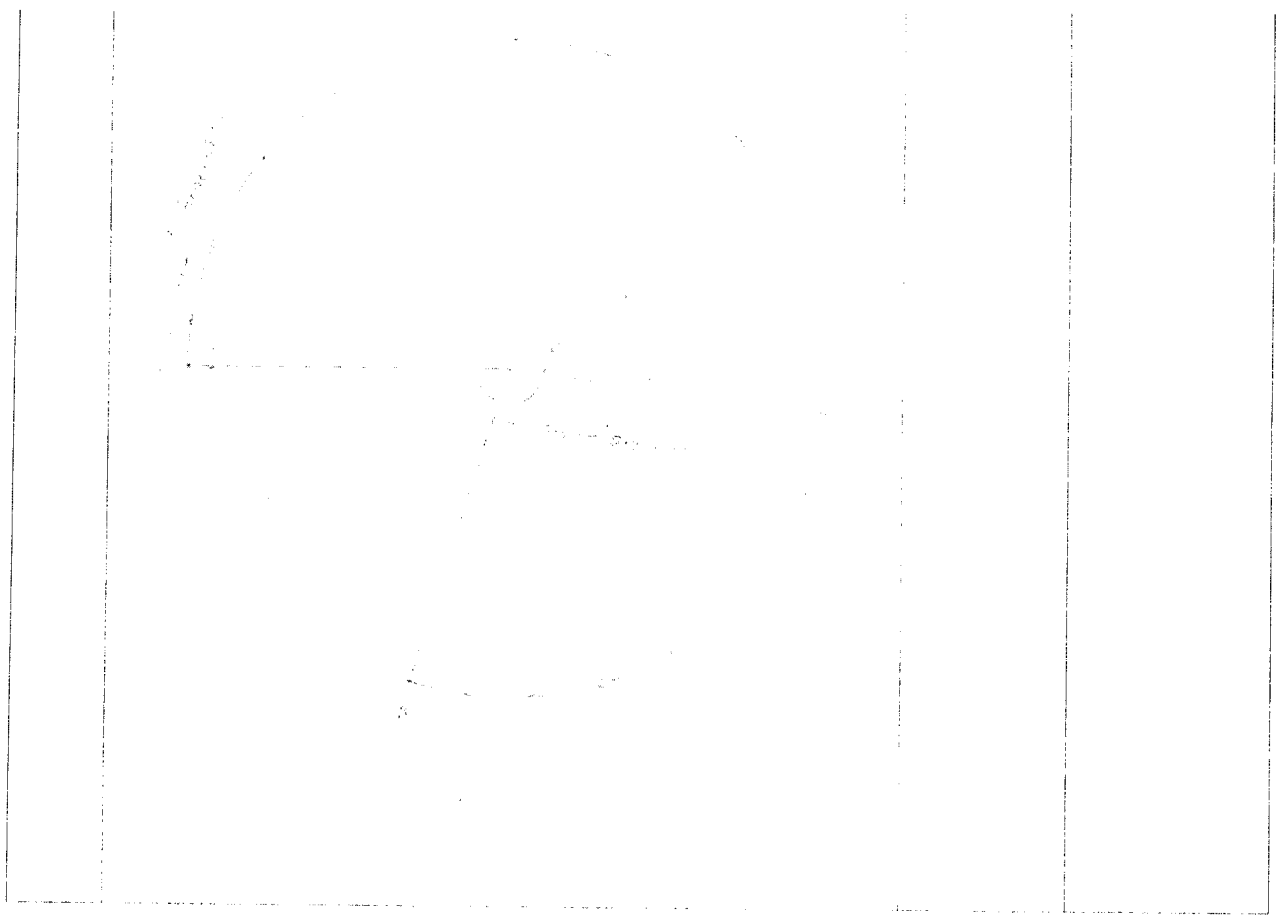
Part B

(2Q x 6M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3	Given data: $Z_O = 300\Omega$, VSWR=10		10 min
	We have VSWR $= \frac{1+\Gamma}{1-\Gamma}$ and $\Gamma = \frac{Z_L - Z_O}{Z_L + Z_O}$	01+01	
	$\Gamma = 0.8181$	01	
	$Z_L = \frac{1+\Gamma}{1-\Gamma} Z_O = VSWR\ X\ Z_O = 10\ X\ 300 = 3000\ \Omega$	01+01+01	
4	Given data: $Z_{OC} = (100 + j5)\Omega = 100.12 \angle 2.86^0$,	01	10 min
	$Z_{SC} = (75 - j2)\Omega = 75.02 \angle -1.52^0$	01	
	We have $Z_O = \sqrt{Z_{OC} \cdot Z_{SC}} =$		
	$\sqrt{100.12 \angle 2.86^0 \cdot 75.02 \angle -1.52^0} = 86.66 \angle \frac{2.86^0 - 1.52^0}{2}$	01	
	$Z_O = 86.66 \angle 0.67^0 = (86.65 + j1.01)\Omega$	01	
		01+01	

Part C (2Q x 10M =20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	Given : $Z_L = 200\Omega, L = 2mH, C = 10\mu F, f = 1000\ Hz$		12 min
	(i) $\gamma = \alpha + j\beta = 0 + j0.8885 = j0.8885$	02	
	(ii) $\beta = \omega\sqrt{LC} = 0.8885\ rad/KM$	02	
	(iii) $\alpha = 0$ for lossless transmission line	02	
	(iv) $V_P = \frac{1}{\sqrt{LC}} = 7071.06\ m/sec$	02	
	(v) $Z_O = \sqrt{\frac{L}{C}} = 14.14\Omega$	02	
6	Given : $Z_O = 500\Omega$, $Z_L = 400\Omega, L = \left(\frac{2}{5}\right)\lambda = 0.4\lambda$		20 min
	Step1: Normalize the load impedance		
	$z_L = \frac{Z_L}{Z_O} = \frac{400}{500} = 0.8 + j0 = r + jx$, $r = 0.8$ and $x = 0$	02	
	Locate a point on the Smith chart with $r = 0.8$ and $x = 0$, let it be A		
	Step2: With O as center OA as radius draw a circle (constant S-circle) which cuts horizontal axis at $r = 1.29$ towards right hand side of Smith chart. At this point (E) the value of VSWR=1.29	02	
	Step3: Extend OA till it cuts wavelength circle at point B. From point B move in clockwise direction (towards generator) to find $L = 0.4\lambda$ at point B'. Join OB' which cuts constant S-circle at point A' at this point $r = 0.85$ and $x = -0.2$ this is the required input impedance $z_S = 0.85 - j0.2$	04	
	To find actual input impedance $Z_S = z_S \cdot Z_O = (425 - j100)\Omega$		
	Step4: To find Reflection co-efficient Γ, draw an arc on the radially scaled parameters below the Smith chart with OA as radius. At point D $\lvert\Gamma\rvert = 0.12$ and to find $\angle\Gamma$, extend OA upto point C on the reflection co-efficient angle circle. At point C, $\angle\Gamma = \pm 180^0$	02	



Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019-20 | **Date**: 26 December 2019

Course Code: ECE 211 | **Time**: 9:30 AM to 12:30 PM

Course Name: TRANSMISSION LINES AND WAVEGUIDES | **Max Marks**: 80

Program & Sem: B.Tech (ECE) & V | **Weightage**: 40%

Instructions:

(i) Scientific Calculators are allowed (ii) No exchange of Calculators (iii) The Smith Chart has to be removed from the Question paper and should be tied to the answer sheet.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. (10Qx2M=20M)

1. (a). Define a Transmission line. Draw the Equivalent diagram and List the types of transmission line. (C.O.No.1) [Knowledge]

   (b). Differentiate Reflection coefficient and Reflection factor. Write the equations for both. (C.O.No.1) [Knowledge]

   (c). Outline the Relationship between Transmission line parameters in a Lossless Transmission line. (C.O.No.1) [Knowledge]

   (d). List the types of stub matching and Define. (C.O.No.2) [Knowledge]

   (e). State Quality factor with Equations. Determine the same if R_{max} = 100Ω and R_{min} = 10Ω (C.O.No.2) [Knowledge]

   (f). Identify TE waves and TM waves and the Components Present. (C.O.No.3) [Knowledge]

   (g). Recognize the difference between the cut off frequency for guided waves in TE, TM modes and TEM mode. Illustrate your answer with equations (C.O.No.3) [Knowledge]

   (h). Describe Waveguides with neat diagrams. Reproduce how the waves will travel inside the waveguide. (C.O.No.4) [Knowledge]

   (i). Select a Waveguide which can be used at high frequencies. State the reason for selecting it. (C.O.No.4) [Knowledge]

   (j). Relate a cavity resonator with a shorted plate waveguide on both sides. (C.O.No.4) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Question. Each Question carries 6 marks. (5Qx6M=30M)

2. In an Active Learning session conducted on TLWG subject, The Professor Sir took the students to the open green space lounge and showed them the long cables going from one cell phone tower to other cell phone tower. Also, they were told that a generator of 1V, with an angular frequency of 2000π radians/second, supplies power to that 100KM long cable with the parameters R = 10.4 Ω / KM, L = 0.00367 H / KM, G = 0.8 μ℧ / KM, C = 0.00835 μF / KM.
   (a). Recognize the cables. [0.5M]
   (b). Identify all the Parameters you can find from the given data. [1.5M]
   (c). Calculate any two Parameters. [4M]
   (C.O.No.1) [Application]

3. In a Transmission Line buried under the Earth, Everything was perfect initially. The water supply board workers, while digging for water connection, accidently made a cut in the line.
   (a) Explain the problem caused because of the cut. [2M]
   (b) Derive the mathematical equation for the ratio of maximum voltage to minimum voltage that is existing along the line. [4M] (C.O.No.1) [Application]

4. The Presidency School took their PUC students to Presidency University for a Technical visit. As they came to ECE department, they were taken to Advanced Communication Lab. The Third year Engineering students are explaining about the guided waves, different modes of propagation and waveguides. A PUC student asked if Electric field is in Y direction and Magnetic fields are present in X and Z directions, where Z is the propagating direction, Name that mode and wave. Another curious mathematical student asked the Equations for Electric and magnetic field components in that mode.
   (a) Name that mode and wave. [1M]
   (b) Estimate the Electric and magnetic field components in that mode by deriving, starting from the governing equations with diagram. [5M]
   (C.O.No.3) [Comprehension]

5. It is decided unanimously that every year December 26 will be celebrated as Transmission Lines and Wave Guides Day. All the 6996 total SOE students agreed to bring at least one transmission line each on that day. They decided to decorate at least one transmission line in all their classrooms in entire university.

   (a) Suggest one transmission line so that all 6996 SOE students can bring and recognize at least one transmission line in your class room so that you will decorate it on that day. [1M]

On the same day, all 6996 SOE students gathered in a big Auditorium for the celebrations. To mark this auspicious event, they conducted one magic show. In the magic show, the magician performed Tricks. The magician made an open call that any student can come forward to perform any magic from TLWG. Suddenly, a curious third year ECE student came forward and told the audience that he is going to perform one Trick. He showed three components to the Audience, A black box with variable knob attached to it, a long hollow metallic rectangular tube and a Green LED. He connected the black box on one side of the tube and the Green LED on the other side of the tube properly with some electronic connections and he covered all the connections and everything with his black magic towel. As he varied the variable knob from low to high position, up to some position of the knob, the Green LED was not glowing (OFF). At a particular position of the knob and after, the LED started glowing (ON). He performed this magic and stunned the Audience and also the original magician. The magician took the long metallic tube, saw this side and that side and not able to find anything in it. He got astonished and awarded the student with gifts and choclates.

(b) Discover what has been done, by drawing a simple block diagram from the given inputs. [1M]
(c) Name the black box with variable knob on it and the work done by varying the variable knob. [0.5M]
(d) Recognize the long metallic tube, describe the application it is used and derive a mathematical equation for the point at which the LED started glowing from OFF to ON mode. [3.5M] (C.O.No.4) [Comprehension]

6. Relate the wavelength and Velocities of the Electromagnetic wave inside the waveguide with the one in free space. Indicate whether they are same. If not,
(a) Describe at least three different components inside the waveguide. Support your classification with mathematical equations and distinguish between them clearly. [3M]
(b) Mention any three properties of Waveguides. [3M]
(C.O.No.4)[Comprehension]

Part C [Problem Solving Questions]

Answer all the Question. Each Question carries 10 marks. (3Qx10M=30M)

7. A load impedance of Z_L = (200 + J300) Ω is connected to a coaxial line with characteristic impedance 400 Ω. The Angular frequency of operation is 1600π radians /sec.
(a) Indicate is there any problem in the Line. If yes, Report the problem. [1M]
(b) Identify all the parameters you can find with the given data. [1M]

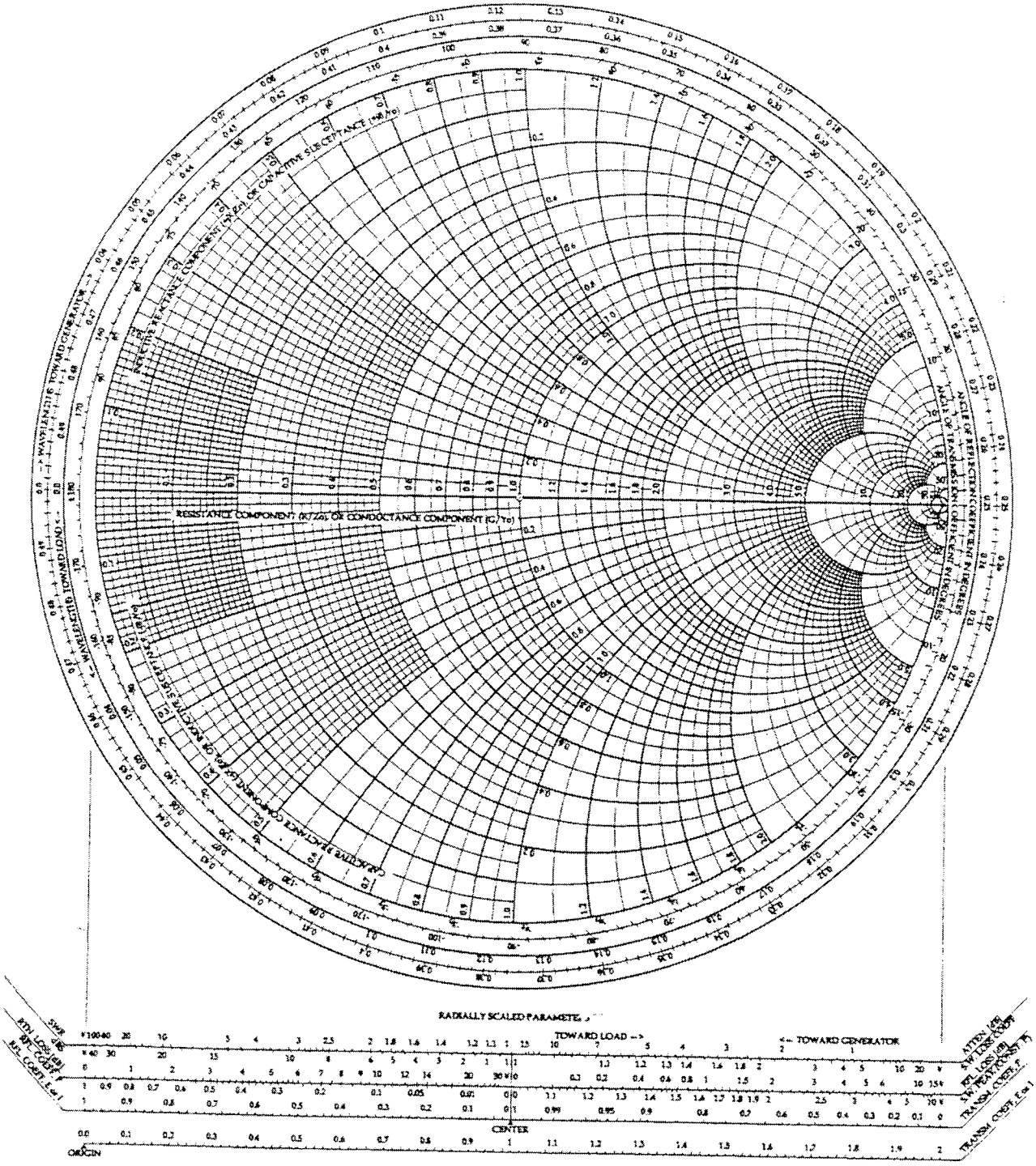
(c) Express the different solutions available to solve this problem. [1M]
(d) Recognize whether you need any Graphical aid to solve this problem. If yes, Name the graphical aid you need. [1M]
(e) Show an easy solution using the graphical aid. [6M](C.O.No.2) [Application]

8. In the Research and Innovations lab of Presidency University, A pair of perfectly conducting planes are separated by 7 cm in air was placed. A student excited magnetic waves in the fundamental mode or also called dominant mode with the angular frequency of 12000π radians/sec.

(a) Identify all the parameters you can find from the given data. [2M]
(b) Compute at least eight parameters. [8M]
(C.O.No.3) [Application]

9. In the TLWG class, the Professor Sir brought Rectangular and circular waveguides and explained about the rectangular wave guide excited in the Dominant mode, with electric waves being passed through it.
(a) Derive an equation for the electric wave vector in the propagating direction [6M]
(b) Express whether the waveguide has any boundary conditions. If yes, determine them. [2M]
(c) Apply the boundary conditions and find the solution to the equations. [2M]
(C.O.No.4) [Application]

The Smith Chart



SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: Odd Semester: 2019-20
Course Code: ECE 211
Course Name: TRANSMISSION LINES AND WAVEGUIDES

Date: 26 Dec 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	1	2			2
2	1	1	2			2
3	1	1	2			2
4	2	2	2			2
5	2	2	2			2
6	3	3	2			2
7	3	3	2			2
8	4	4	2			2
9	4	4	2			2
10	4	4	2			2
11	1	1			6	6
12	1	1			6	6
13	3	3		6		6

14	4	4		6		6
15	4	4		6		6
16	2	2			10	10
17	3	3			10	10
18	4	4			10	10
	Total Marks		20	18	42	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature: (DR. M. LEVY)

Reviewer Commend: ① Consider change in Q Numbering ② Timing - Pl check ③ Thought Provg

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

Semester: Odd Semester: 2019-20
Course Code: ECE 211
Course Name: TRANSMISSION LINES AND WAVEGUIDES

Date: 26 Dec 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Q No	Solution	Scheme of Marking in Marks	Max. Time required for each Question in Minutes
1	Mechanism of Guiding Electrical Energy from one place to another Types-Parallel, Coaxial, Waveguide	1 1	4
2	Ratio of Reflected voltage or current to incident voltage or current $V_r/V_i = V_2/V_1$	2	4
3	Ratio of Maimum voltage to minimum voltage V_{max}/ V_{min}	2	4
4	For Impedance matching, a small length of the transmission line is connected near the load.	2	4
5	Quality factor used in reactance impedance matching equation $Q = \sqrt{\frac{Rlarger}{Rsmaller} - 1}$	2	4
6	Magnetic waves is present in the direction of Propagation Components present are E_y, H_x, H_z	2	4
7	Maximum frequency that can be propagated through the waveguide. $F_c = mV/2a$	2	4
8	A waveguide consists of a hollow metallic tube of either rectangular or circular cross-section used to guide electromagnetic wave.	2	4
9	Circular waveguide has the property that as the frequency increases the attenuation of wave inside the wave guide decreases. This makes it suitable for high frequaency propagation.	2	4
10	A cavity resonator has only one frequency of resonance for a given mode $f_o = C / \lambda_o$	2	4
11	Correct Equations Y = 0.0364 Angle =77.43°; 0.0079+j0.0355 Z_O = 694.39 Angle = 11.71°; (680 – j 140.9)Ω	2 2 2	15
12	VSWR = (1+ Γ) / (1- Γ) Proper derivation	6	15

13	For TE mode, in the direction of propagation, only Magnetic component is present. Hence it is called Magnetic waves. E_y, H_x, H_z for TE mode For TM mode, in the direction of propagation, only Electric component is present. Hence it is called Electric waves. H_y, E_x, E_z for TM mode	 3 x 1 =3 3 x 1 =3	15
14	Proper derivation F_c Equation	4 2	15
15	Guide wavelength Phase velocity Group velocity	2 2 2	15
16	Smith chart Problem Normalized load impedance = 0.5 + j0.75 Admittance = 0.625 – j 0.925 d = 0.306 λ = 11.475 cm Value of susceptance = j1.3 l = 3.9 cm	 2 2 2 2 2	20
17	f_c= 2.143 GHz $\theta = 69.08^0$ $V_p = 3.21 \times 10^8$ m/sec $V_g = 2.8 \times 10^8$m/ sec β =117.38 rads/m Z_{oTE} =403.61Ω λ_c = 14 cm λ_{gw} = 5.35 cm	2 2 1 1 1 1 1 1	20
18	Proper derivation Apply Boundary Conditions E_z= C Sin (mπ/a) Sin (nπ/b)	6 4	20
		Total = 80 marks	175 Minutes. 5 Minutes for Reading The Question Paper