Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 71744

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Seventh Semester

Electronics and Communication Engineering

EC 6701 — RF AND MICROWAVE ENGINEERING

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the frequency range for following IEEE microwave bands?
   (a) L band
   (b) S band
   (c) C band
   (d) X band
2. Give the relation between S and ABCD parameters.
3. Define transducer power gain.
4. What are waveguide bends? What are the two types of bends?
5. List the applications of magic - Tee.
6. Write the S matrix for 4 port circulator.
7. Write the classification of microwave tubes and explain the difference between them.
8. What are slow wave structures? Give examples.
9. Compare TWT anti Klystron.
10. Define guide wavelength.

PART B — (5 × 16 = 80 marks)

11. (a) Derive the overall network parameters for cascade connection of two port network. Discuss about short circuit, open circuit, h and ABCD low Frequency parameters.

Or

(b) (i) State and prove the properties of S-matrix.

(ii) Explain the symmetry property in a reciprocal network.

12. (a) Explain in detail about microstrip line matching network with neat diagram.

Or

(b) Discuss about the design of T-section and Pi section matching network.

13. (a) With neat diagram discuss the characteristics of series Tee and shunt Tee and derive the S matrix.

Or

(b) Discuss the principle of operation of any two non reciprocal devices and derive the S parameters.

14. (a) With neat diagram explain the operation of two cavity klystron amplifier and derive the equations for velocity modulation process.

Or

(b) (i) Give the comparison between Gunn, IMPATT, TRAPATT and Baritt.

(ii) Explain the operation of travelling wave tube and write its characteristics.

15. (a) Discuss the impedance, wavelength and frequency measurement using slotted line method.

Or

(b) Write short notes on power sensors used for microwave power measurement.

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Reg. No. :

Question Paper Code : 40971

25/04/2018 AN

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Seventh Semester
Electronics and Communication Engineering
EC 6701 – RF AND MICROWAVE ENGINEERING
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Smith Chart should be provided

Answer ALL questions

PART – A (10×2=20 Marks)

1. State the applications of RF circuit.
2. What are the reasons that low frequency parameters cannot be measured in microwaves ?
3. Define matching network.
4. What is the need of Rollett factor, K ? Write its expressions.
5. State Faraday's rotation law.
6. State the two parameters that describe a directional coupler ? Define them.
7. What is velocity modulation ?
8. What is the purpose of slow wave structures in TWT ? Name them.
9. What is the significance of VSWR measurement ?
10. List any two methods of measuring microwave power.

PART – B (5×16=80 Marks)

11. a) Derive the properties of scattering matrix. (16)

(OR)

b) i) How microwave junction can be described by scattering matrix ? Derive the scattering matrix relation between the input and output of n × n junction. (10)

ii) Describe the losses in microwave devices. (6)

12. a) Derive the expressions for various types of power gain of RF amplifier. **(16)**

(OR)

b) i) Explain microstrip line matching networks. **(10)**

ii) Explain in detail noise figure in an amplifier. **(6)**

13. a) Derive the S matrix for a directional coupler and also verifying the properties of it. **(16)**

(OR)

b) i) Derive the S matrix H plane TEE. **(8)**

ii) Explain the mode of oscillation of gunn diode. **(8)**

14. a) i) Draw a neat sketch showing the constructional features of a cavity magnetron and explain why magnetron is called as crossed field device. **(8)**

ii) Derive an expression for cut off magnetic field for a cylindrical magnetron. **(8)**

(OR)

b) A reflex klystron is operated at 8 GHz with dc beam voltage of 600 V for 1.75 mode, repeller space length of 1 mm, and dc beam current of 9 mA. The beam coupling coefficient is assumed to be 1. Calculate the repeller voltage, electronic efficiency and output power. **(16)**

$V_o = 600$ V, L = 1 mm, $I_0 = 9$ mA

$\beta_0 = 1$, f = 8 GHz, n = 2 or 1 ¾ mode

15. a) i) Draw the block diagram for the slotted line method of VSWR measurement and explain. **(8)**

ii) Explain a method for high power measurement. **(8)**

(OR)

b) i) Draw the experimental set-up for the measurement of impedance of a discontinuity and explain. **(8)**

ii) Draw the experimental set-up for S-parameter measurement of Magic Tee and explain. **(8)**

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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 80352

12/11/16 FN

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Seventh Semester

Electronics and Communication Engineering

EC 6701 — RF AND MICROWAVE ENGINEERING

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List the radio frequency bands available in microwave and radio frequency ranges.
2. Define S-parameters.
3. Define Noise figure.
4. Calculate VSWR of an amplifier, if the amplifier has reflection coefficient 0.2533.
5. Compare PIN and PN diode.
6. What is isolator? And why isolators are called uniline?
7. What is magnetron?
8. What is Tetrodes and Pentodes?
9. What is network analyzer?
10. Classify microwave powers with its range.

PART B — (5 × 16 = 80 marks)

11. (a) (i) What is transmission (T) matrix? Obtain and explain the relationship with [S] and vice versa. (8)

(ii) Compute the intrinsic wave impedance, phase velocity and wavelengths of an electromagnetic wave in free space and a printed circuit board (PCB) material whose dielectric constant is 4.6 for the frequency f = 30 MHz and 3 GHz. (8)

Or

(b) (i) Explain and analyze any reciprocal lossless network with derivation. (10)

(ii) Discuss on the application of RF and microwave area. (6)

12. (a) Derive the equation for power gain, available power gain and transducer power gain. (16)

Or

(b) Investigate the stability regions of a transistor whose S-parameters are recorded as follows :

$S_{12} = 0.2\angle -10^\circ$; $S_{11} = 0.7\angle -70^\circ$; $S_{21} = 5.5\angle 85^\circ$ and $S_{22} = 0.7\angle -45^\circ$ at 750 MHz. (16)

13. (a) Discuss briefly about working principle, operation, characteristics and application of varactor diode. (16)

Or

(b) What is circulator? With neat diagram, explain the working principle, construction, operation of four-port circulator using magic-tee. Verify the circulator theory with necessary S-parameter equations.

14. (a) Explain the working principle and operation of multi-cavity Klystron amplifier and derive the expressions for its output power. (16)

Or

(b) A travelling wave tube (TWT) operates under the following parameters :

Beam Voltage $V_0 = 3$ kV

Beam Current $I_0 = 30$ mA

Characteristic impedance of helix $= Z_0 = 10\ \Omega$

Circuit length $= N = 50$ m

Frequency $f = 10$ GHz

Determine :

(i) Gain parameters C.

(ii) Output power gain A_p in decibels.

(iii) All four propagation constants. (16)

15. (a) Explain the impedance measurement technique using slotted line and reflectometer. (8 + 8)

Or

(b) Explain the measurement of high VSWR with the help of block diagram. (16)

06/11/17 FN

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 50453

B.E./B.Tech./B.Arch. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Seventh Semester
Electronics and Communication Engineering
EC 6701 – RF AND MICROWAVE ENGINEERING
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. What are the limitations in measuring Z, Y and ABCD parameters at microwave frequencies.
2. Write down the merits and demerits of microwave frequency over lower frequencies.
3. Define unconditional stability with regard to microwave transistor amplifier.
4. Draw any two matching networks used in microwave frequencies.
5. Which has lesser coupling in the following ?
   i) 3 dB coupler
   ii) 6 dB coupler
   iii) 10 dB coupler.
6. What are ferrites and write its properties. Give some examples of ferrite devices.
7. What is the purpose of slow wave structures used in TWT amplifiers ?
8. What do you mean by O type tube ? Name some O type tubes.
9. Define return loss and insertion loss in RF networks.
10. What are the uses of network analyzer ? What are the types of network analysers ?

PART – B (5×16=80 Marks)

11. a) The S-parameters of a two-port network are given by $S_{11} = 0.2 \angle 90°$, $S_{22} = 0.2 \angle 90°$ $S_{12} = 0.5 \angle 90°$, $S_{21} = 0.5 \angle 0°$.
    a) Determine whether the network is lossy or not.
    b) Is the network symmetrical and reciprocal
    c) Find the insertion loss of network
    d) Find the return loss at Port 1 when Port 2 is short circuited.

(OR)

b) i) Derive the S-matrix of multiport network and explain the properties of S matrix. (12)
   ii) Write the property of S-matrix. (4)

12. a) An RF amplifier has the following S-parameters. $S_{11} = 0.3 \angle -70°$, $S_{21} = 3.5 \angle 85°$, $S_{12} = 0.2 \angle -10°$ and $S_{22} = 0.4 \angle -45°$. Furthermore, the input side of the amplifier is connected to a voltage source with Vs = 5V∠ 0° and source impedance Zs = 40 Ω . The output is utilized to drive an antenna which has an amplifier of $Z_L = 73\,\Omega$. Assuming that the S-parameters of the amplifier are measured with reference to a $Z_0 = 50\,\Omega$ characteristics impedance. Find the transducer gain G_T, unilateral transducer gain G_{TU}, available gain G_A, Operating gain G. (16)

(OR)

b) Discuss the following :
   i) Single stub impedance matching. (8)
   ii) Double stub impedance matching. (8)

13. a) Discuss the following : (8+8)
    i) Quarter wave transformer ii) Gunn diode oscillator.

(OR)

b) Derive the S-matrix of hybrid Tee and discuss the properties and applications. (16)

14. a) Explain the operation of reflex klystron oscillator with neat diagram. Write the performance characteristics and applications of the reflex klystron.

(OR)

b) Write a detailed notes on the following :
   i) Travelling wave tube amplifier. (8)
   ii) Cylindrical magnetron. (8)

15. a) i) Explain the principle of operation of VSWR meter. (8)
    ii) Discuss the measurement of power at microwave frequency in detail. (8)

(OR)

b) i) Discuss the slotted line method of impedance measurement. (8)
   ii) Explain how low VSWR can be measured using a microwave bench. (8)

15/12/18

Reg. No. :

Question Paper Code : 20427

B. E./B. Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Seventh Semester

Electronics and Communication Engineering

EC 6701 — RF AND MICROWAVE ENGINEERING

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the X- band frequency range.
2. Define lossless network.
3. Define noise figure of a two port network.
4. Why is it necessary to go for microstrip line matching networks?
5. What is meant by phase shifter?
6. Draw the equivalent circuit of a Gunn diode.
7. How to minimize the lead inductance and inter electrode capacitance effects?
8. Distinguish between O-type and M-type tubes.
9. Compare thermistor and baretter.
10. Why direct microwave measuring instruments are not used in laboratory?

PART B — (5 × 13 = 65 marks)

11. (a) Define scattering matrix. Explain the following properties of S-matrix
    (i) Symmetry property
    (ii) Unitary property
    (iii) Phase shift property. (13)

    Or

    (b) Determine the transmission matrix of a two port network. (13)

12. (a) (i) Derive the equations for power gain, available power gain and transducer power gain. (7)

(ii) Analyze mathematically about amplifier stability. (6)

Or

(b) (i) Illustrate the design of L-matching network using smith chart. (7)

(ii) Explain constant VSWR circles. (6)

13. (a) (i) Explain the construction of Magic Tee and derive its S-matrix. (6)

(ii) Derive the scattering matrix for a directional coupler. (7)

Or

(b) (i) Describe the Gunn effect with the aid of two valley model theory. (7)

(ii) Explain with neat diagrams the fabrication process of MMIC's. (6)

14. (a) (i) Draw the schematic of two cavity Klystron amplifier and explain the process of velocity modulation and bunching. Also derive the equation of velocity modulation. (8)

(ii) With neat diagram, explain how amplification of RF wave is accomplished in Helix type TWT. (5)

Or

(b) (i) Draw the cross sectional view of Magnetron, tube and explain the process of bunching. Derive the expression for Hull cut off voltage. (7)

(ii) Compare TWT and Klystron. (6)

15. (a) (i) Draw the block diagram of a spectrum analyzer and explain its working. (6)

(ii) With neat diagram, explain the measurement of frequency using slotted line technique. (7)

Or

(b) (i) With neat diagram, explain the Impedance measurement using Reflectometer. (6)

(ii) With neat experimental set up, describe the dielectric constant measurement. (7)

PART C — (1 × 15 = 15 marks)

16. (a) A two cavity Klystron amplifier has the following specifications: (15)

Beam voltage, $V_0 = 900$ V

Beam current, $I_0 = 30$ mA

Frequency f = 8 GHz

Gap spacing in either cavity, d = 1 mm

Spacing between center of cavities, L = 4 cm

Effective shunt impedance, $R_{sh} = 49\ K\Omega$

Determine

(i) Electron velocity

(ii) dc transit time of electron

(iii) Maximum input voltage

(iv) Voltage gain.

Or

(b) A slotted line is used to measure the frequency and it was found that the distance between the nulls is 1.85 cm. Given the guide dimension as 3 cm × 1.5 cm, calculate the frequency. (15)

22/11/19/FN

Reg. No. :

Question Paper Code : 91461

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Seventh Semester

Electronics and Communication Engineering

EC 6701 – RF AND MICROWAVE ENGINEERING

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. State the limitations of measuring Z, Y and ABCD parameters at Microwave frequencies.
2. Draw the equivalent circuit of a practical capacitor.
3. Define Noise figure.
4. List the factors to be considered for the selection matching network.
5. Mention the application of quarter wave transformer.
6. What is negative resistance ? Give example for NDR device.
7. State the reason for not using conventional signal sources at frequencies above 1GHz.
8. List the effects of high frequency in vaccum tubes.
9. Define Q-factor.
10. A 50Ω lossless line connects a matched signal of 100 KHz to a load of 100Ω. Determine the voltage standing wave ratio of the load.

PART – B (5×13=65 Marks)

11. a) i) Prove that it is impossible to construct a perfectly matched lossless, reciprocal three port junction. (7)

ii) Discuss the importance of s parameter and give the relation between s and Z parameter. (6)

(OR)

b) i) What are the properties of S matrix ? Explain. (7)

ii) Discuss the RF behavior of resistors, capacitors and inductors. (6)

12. a) i) Derive the amplifier power relations. (6)

ii) Discuss on broadband amplifiers and derive the necessary equations. (7)

(OR)

b) i) Explain the significance of impedance matching and tuning. (6)

ii) What are the design issues in T and Pi matching network and explain. (7)

13. a) i) Explain the structure and working of circulator. (6)

ii) What is a directional coupler ? Derive the s matrix of direction coupler. (7)

(OR)

b) i) Explain with diagram the Schottkey diode detector. (6)

ii) Define Gunn effect. Explain the working of Gunn diode oscillator. (7)

14. a) Explain the working of two cavity klystron amplifier and derive velocity modulated wave equation.

(OR)

b) What is cross field device ? Explain the working of cylindrical magnetron and compare its characteristics with two cavity klystron device.

15. a) Explain the principle operation of (i) VSWR meter (ii) Power meter.

(OR)

b) Explain in detail the impedance and frequency measurement using microwave devices.

PART – C (1×15=15 Marks)

16. a) Analyse the stability considerations and stabilization methods of RF amplifier. A silicon bipolar junction transistor has the following scattering parameters at 1.0 GHz, with a 50Ω reference impedance.

$S11 = 0.38 \angle 158°$

$S12 = 0.11 \angle 54°$

$S21 = 3.50 \angle 80°$

$S22 = 0.40 \angle 43°$. The source impedance is ZS = 25Ω and the load impedance is ZL = 40Ω. Compute the power gain, the available power gain and the transducer power gain.

(OR)

b) i) Explain the working of magic tee and its application as duplexer. (12)

ii) A lossless T-junction power divider has a source impedance of 50 output characteristic impedances so that the input power is divided in a 2:1 ratio. Compute the reflection coefficients seen looking into the output ports. (3)