NEW SCHEME

EC62

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Sixth Semester B.E. Degree Examination, July/August 2005

Electronics and Communication /Telecommunications Engineering

Microwave Communication

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. All questions carry equal marks.
3. State clearly the assumptions made.

1. (a) Why conventional open-wire lines are not suitable for microwave transmission? Indicate the different types of microwave transmission lines commonly used with the mode of transmission used in each type. (7 Marks)

(b) Briefly describe a microstrip line. (9 Marks)

(c) A certain microstrip line has the following parameters :

i) ϵ_r = relative dielectric constant of the board material equal to 5.23.

ii) height from the microstripline to ground = 7 mils

iii) thickness of the microstrip line = 2.8 mils

iv) width of the microstrip line = 10 mils.

Calculate the characteristic impedance of the line.

2. (a) How is a microwave network formed for the transmission of a microwave signal? Explain the theory of the scattering matrix representation of a multiport network. (4 Marks)

(b) Discuss the properties of the S-parameters. (6 Marks)

(c) Two transmission lines of characteristic impedance Z_1 and Z_2 are joined at plane pp'. Express S-parameters in terms of impedances. (8 Marks)

3. (a) Explain briefly the following : (6 Marks)

i) Wave guide flanges

ii) Rotary joints

iii) Magic - T

(11 Marks)

Contd... 2

(b) Design a centre hole Bethe-hole directional coupler with air-filled rectangular wave guide of dimensions $2.286cm \times 1.016cm$ at 9.8 GHz for 20 dB coupling and 40dB directivity respectively. **(9 Marks)**

4. (a) Why conventional electronic vacuum tubes fail to operate at microwave frequencies? **(3 Marks)**

(b) Describe the operating principles of the microwave tube that can be used as a low power microwave oscillator, with neat illustrations. **(10 Marks)**

(c) A TWT operates under the following parameters:

Beam voltage : = 3KV
Beam current : = 30mA
Characteristic impedance of helix = 10Ω
Circuit length = 50
Frequency = 10 GHz

Determine :

i) the gain parameter;

ii) the output power gain in decibels;

iii) the four propagation constants. **(7 Marks)**

5. (a) For what type of applications, can the solid-state microwave devices replace electron beam devices? List the advantages of solid-state devices. **(6 Marks)**

(b) What is a parametric amplifier? When do you call the device as

i) a parametric up-covnerter?

ii) a parametric down-covnerter?

Write the equivalent circuit for a parametric up-converter and describe its features. **(9 Marks)**

(c) An up-covnerter parametric amplifier has the following parameters:

Ratio of output frequency over signal frequency = 25
Figure of merit = 10
Factor of merit figure = 0.4
Diode temperature = $350^0 K$

Calculate :

i) the power gain in decibels

ii) the noise figure in decibels

iii) the bandwidth **(5 Marks)**

Contd.... 3

6. (a) When do you use a magnetron oscillator? Deduce the Hull cut-off magnetic field and voltage equations for the device. (9 Marks)

(b) What is an avalanche transit-time device? Which are the three types of this device? Briefly explain the operation of the IMPATT diode. (9 Marks)

(c) A TRAPATT diode has the following parameters :

Doping concentration = $2 \times 10^{15} cm^{-3}$
Current density = $20 KA/cm^2$
Calculate the avalanche - zone velocity (2 Marks)

7. (a) What is an antenna? Briefly describe the following parameters for an antenna:

i) Radiation pattern;

ii) Directivity;

iii) Gain;

iv) Plarisation (8 Marks)

(b) How are microwave communication systems grouped? Define each one of them. Derive the Friis power transmission formula. (8 Marks)

(c) Calculate the maximum range of a radar system which operates at 3 cm with a peak pulse power of 500KW, if its minimum receivable power is 10^{-13}W, the capture area of its antenna is $5m^2$ and the radar cross-sectional area of the target is $20m^2$. (4 Marks)

8. Explain briefly the following:

a) Microwave oven (6 Marks)

b) Spectrum analyzer (8 Marks)

c) Measurement of insertion loss and attenuation. (6 Marks)

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NEW SCHEME

EC62

Reg. No.

Sixth Semester B.E. Degree Examination, January/February 2006
Electronics & Communication/Telecommunication Engineering
Microwave Communication

Time: 3 hrs.)

Note: *Answer any FIVE full questions.*

(Max.Marks : 100

1. (a) Explain briefly the types of planar transmission lines and bringout their relative merits. **(12 Marks)**

   (b) A micro strip line with W = 2mm, h = 0.4mm has a quartz substrate of $\epsilon_r = 3.84$ and $\tan \delta = 0.0001$. Find:

   i) the effective permitivity

   ii) Z_0

   iii) α_i and α_d at $f = 9GH_z$.

2. (a) Explain the function of i) a four port and ii) a three port circulator with relevant S-matrix. **(8 Marks)**

   (b) A double stub tuner is to be designed with a stub separation of $\frac{3}{8}\lambda$ and the first stub position at the load $Z_L = (80 + j60)\Omega$ to match the load Z_L to a 50Ω line. The generator end is matched (use Smith chart). **(12 Marks)**

3. (a) Explain the following microwave devices:

   i) Phase shifters

   ii) Directional couplers **(8 Marks)**

   (b) Design a microstrip lowpass filter with $f_c = 2GH_Z$ attenuation = 30 dB at $f = 3.5GH_Z$ using the Chebysheve response with 0.2 dB ripple in the pass band. Use alumina substrate of thickness 0.63 mm. **(12 Marks)**

4. (a) Bringout the meaning of electronic admittance of reflex klystron and obtain an expression for the same. **(10 Marks)**

   (b) A pulsed cylindrical magnetron is operated with the following parameters.

   Anode voltage : 25 kV
   Beam current : 25 Amps
   Magnetic field density : 0.34 Wb/sqm
   Radius of cathode cylinder : 5cm
   Radius of anode cylinder : 10cm

   Calculate :

   i) angular frequency ii) the cut-off voltage and iii) cut-off magnetic flux density **(10 Marks)**

5. (a) Write an explanatory note on the following :

   i) GUNN DIODE

   ii) Parametric amplifier **(8 Marks)**

Contd.... 2

(b) An IMPATT diode with nominal frequency $10GH_Z$ has C_j = 0.5 pf, l_p = 0.5nH, C_p = 0.3pf at breakdown bias of 80V and bias current of 80mA. the RF peak current is 0.65A. Evaluate the resonant frequency of oscillation and the efficiency (Assume $R_d = -2\Omega$). **(6 Marks)**

(c) Write a brief note on TWT. **(6 Marks)**

6. (a) With a neat block diagram explain the function of an AM microwave transmitter and receiver. **(8 Marks)**

(b) A microwave link at $4.9GH_Z$ uses transmit and receive antenna with gains of 30dB. If the distance between transmitter and receiver is 27km and it is desired to have a minimum received power of - 60 dBm, calculate the required transmitter power. **(6 Marks)**

(c) A radar system operates at $10GH_Z$ with a common antenna having a gain of 40dB. The receiver has a band width of $1KH_Z$, the noise factor is 5dB, the transmitted power is 1kW, the target echoing area is $10m^2$, calculate the range for S/N = 15. **(6 Marks)**

7. (a) Explain the function of the Dicke Radio meter with a neat block diagram. **(10 Marks)**

(b) Explain the method of measurements of insertion loss and attenuation with relevant block diagram and equations. **(10 Marks)**

8. (a) Explain the term VSWR and explain a method to measure the same for low and high values. **(8 Marks)**

(b) A slotted line used to measure VSWR of the load at $2GH_Z$ by double minima method. If the distance between the positions of twice minimum power is 0.5cm, find the value of VSWR on the line and the magnitude of the reflection co-efficient. **(8 Marks)**

(c) The reflection coefficient of a load is $0.5 \angle -30^0$. Using the Smith chart determine the normalized admittance of the load. **(4 Marks)**

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NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2006
Electronics and Communication Engineering
Microwave Communication

Time: 3 hrs.] [Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***

1 a. What are "Planer transmission Lines"? Describe the different types and their application to microwave systems. **(09 Marks)**

b. What are "Wave guide obstacles"? Explain how they may be used in impedance matching. **(06 Marks)**

c. A rectangular waveguide of 1cm x 2.3 cm is excited in dominant mode at 9.375 GHz. Calculate the breakdown power, (assuming breakdown field to be 30 KV/cm). **(05 Marks)**

2 a. What are "S-parameters"? Explain how they are used to describe a microwave junction. What are their properties? **(06 Marks)**

b. Explain the working of a "Magic-Tee" with the help of a neat diagram. Derive its S-matrix. **(09 Marks)**

c. In a H-plane T junction, compute the power delivered to the loads 40 ohms and 60 ohms connected across arms 1 and 2 when 10 mW power is delivered to the matched port 3. (Assume $Z_0 = 50$ ohms) **(05 Marks)**

3 a. What is a "Directional coupler"? Explain its role in a microwave network. Explain the working of two-hole directional coupler. **(08 Marks)**

b. Derive the scatter matrix of a two hole directional coupler. **(07 Marks)**

c. A matched isolator has an insertion loss of 0.5 dB and isolation 30 dB. Derive its S-matrix. **(05 Marks)**

4 a. What are the high frequency limitations of conventional vacuum tubes / transistors? Briefly describe how these are over come in microwave tubes. **(05 Marks)**

b. With the help of neat schematic diagram explain the working of "Reflex Klystron" oscillation. **(10 Marks)**

c. Draw and explain the mode curves of Reflex Klystron. **(05 Marks)**

5 a. Using neat sketches, explain the principle of operation of "Magnetron" oscillator. **(08 Marks)**

b. What is "Transferred Electron effect"? Explain how this is used in a solid state device in generating microwave oscillations. **(07 Marks)**

c. Explain construction of PIN-diode and its applications. **(05 Marks)**

6 a. With the help of neat schematic diagram, explain the working of "Microwave communication system". What are the advantages of microwave carriers over the low frequency carriers? **(10 Marks)**

Contd....2

6 b. A microwave radio link uses transmit and receive antennas with 35 dB power gain, separated by a distance of 70 kms. The receiver sensitivity is –25 dBm. Determine the minimum transmitter power required, if this link were to operate at 4 GHz satisfactorily. **(04 Marks)**

c. Explain the calorimetric method of measuring microwave power. **(06 Marks)**

7 a. Derive Radar Range equation. Explain the effect of each parameter on the maximum range. **(08 Marks)**

b. Using a neat block schematic, explain the working of a pulse radar system. **(07 Marks)**

c. A 10 GHz probe radar has an antenna with 28 db gain, and a transmitter pulse power of 12 KW. If it is desired to detect a target of radar cross section 12 square meters, and the minimum detectable signal of -90 dBm, what is the maximum range of this radar? **(05 Marks)**

8 Write short notes on the following:

a. Impedance measurement at microwave frequencies.

b. Radiometry.

c. Electronic warfare.

d. Microwave radiation Hazards. **(20 Marks)**

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NEW SCHEME

Sixth Semester B.E. Degree Examination, Dec.06 / Jan.07
EC / TE
Microwave Communication

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Take standard values of constants where ever required.
3. Use of smith chart is permitted.

1 a. What are higher order modes in coaxial lines? **(04 Marks)**
b. Distinguish between a coaxial line and a planar transmission line. **(06 Marks)**
c. A microstrip line is composed of negligible thickness copper conductor on a substrate made of Alumina with $G_r = 8.4$ and $\tan\delta = 0.0005$. The thickness of the substrate is 2.5 mm, while the line width is 0.8 mm. If this microstrip is fed with a carrier of frequency of 11.25 GHz, calculate the Z_0 it offers. Also calculate the attenuation in dB/m. σ for copper is 5.8×10^7 mhos. **(10 Marks)**

2 a. Enumerate the need of impedance matching. Derive an expression for the bandwidth and length of a Quarter wave transformer. **(06 Marks)**
b. A 100 ohm line having an air dielectric is terminated by a load impedance of 75 + j 40 ohm and is excited by a carrier of frequency 1 GHz. Find the position of a single matching stub of 100 ohms impedance on the line and determine its length required. **(08 Marks)**
c. How the impedance varies in a tapered transmission line and where this can be used. **(06 Marks)**

3 a. With a neat diagram, explain the working of a precision type variable attenuator, write its S-matrix and get the expression for attenuation in dB. **(08 Marks)**
b. Draw the coupling characteristics of a directional couplers and mention their implementation and advantages. **(08 Marks)**
c. A directional coupler of 10 dB coupling and 40 dB directivity produces a transmission loss of 1 dB. For an input of 10 mW into the main arm, determine the power at other ports. **(04 Marks)**

4 a. Starting from the expression for velocity modulation, show that the maximum theoretical efficiency of a Reflex Klystron oscillator is 22.7%. **(08 Marks)**
b. A Reflex Klystron operates at a peak mode of n = 2 with a V_0 of 300 V. The beam current is 20 mA at the load. If the signal voltage is 40 volts, determine the input dc power, output power and efficiency under matched conditions. **(06 Marks)**
c. Prove that the impedance and admittance matrices are symmetrical for a reciprocal junction. **(06 Marks)**

5 a. What are the major differences between a Klystron amplifier and a TWT amplifier? **(06 Marks)**

Contd...2

b. Design a c-band TWT to the following specifications :

5 fc = 5.9 to 6.4 GHz,
Beam voltage = 7.5 kV,
Small signal gain = 45 dB,
RF power required at output = 250 – 300 W
Gain at rated power = 40 dB
$\eta = 0.16$, $Z_0 = 40\ \Omega$ **(08 Marks)**

c. Why mode separation is necessary in magnetron? How is it achieved? **(06 Marks)**

6 a. What causes a Gunn diode to exhibit negative resistance? Explain two principal modes of Gunn operation. **(08 Marks)**

b. Draw the schematic of a harmonic crystal mixer and explain conversion loss and output noise ratio of such a mixer. **(06 Marks)**

c. The output noise power of a mixer is -145 dBW, calculate the output noise ratio if the equivalent noise temperature of mixer is 150°K and the band width 10 MHz. **(06 Marks)**

7 a. What is Doppler Effect? How is it applied to locate and track moving targets? **(08 Marks)**

b. Draw the equivalent circuit of a tunnel diode reflection amplifier and explain its operation. What is power gain of such an amplifier? **(06 Marks)**

c. Describe a method of double minimum VSWR measurement. What are the sources of error in this measurement? **(06 Marks)**

8 Write short notes on:

a. Magic Tee.
b. Parametric Amplifier.
c. Losses in microwave propagation.
d. Reflectometer. **(20 Marks)**

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EC62

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2007
Electronics & Communication Engineering
Microwave Communication

Time: 3 hrs.] [Max. Marks:100

Note :1. ***Answer any FIVE full questions.***
2. ***Smith charts will be provided.***
3. ***Missing data may be assumed suitably.***

1 a. With neat sketch and necessary equations explain the strip lines. **(08 Marks)**

b. A microstrip line is composed of zero thickness copper conductors on a substrate having $\epsilon_r = 8.4$, $\tan\delta = 0.0005$ and thickness 3 mm. If the width of the strip is 1 mm and operated at 12 GHz, calculate
i) The characteristic impedance.
ii) The attenuation due to dielectric loss and conductor loss.
The conductivity of the Cu is 5.8×10^7 $\mho$/m. **(08 Marks)**

c. Derive the expression for power flow through a co-axial line starting from field equations. **(04 Marks)**

2 a. Explain the properties of S-parameters and write the advantages of S-parameters. **(09 Marks)**

b. With neat sketch explain how the waveguide irises can be used for impedance matching. **(04 Marks)**

c. Derive the expression for bandwidth of a single section quarter wave transformer in terms of reflection coefficient. **(07 Marks)**

3 a. With neat sketch explain the following passive devices:
i) Flap attenuator.
ii) Precision phase shifter. **(09 Marks)**

b. Explain the properties of a Magic Tee and mention its applications. **(07 Marks)**

c. A matched isolator has insertion loss of 0.8 db and isolation of 25 db. Find its scattering coefficients. **(04 Marks)**

4 a. With neat schematic diagram explain the operation of traveling wave tube amplifier. **(08 Marks)**

b. Derive the expressions for Hall cut off magnetic field and voltage in a Magnetron Oscillator. **(07 Marks)**

c. A reflex klystron operates at the peak mode of n = 2 with $V_0 = 280$ V, $I_0 = 22$ mA and $V_1 = 30$ V. Determine
i) The input power.
ii) The output power.
iii) The efficiency. **(05 Marks)**

5 a. Explain the construction and various modes of operation of a Gunn diode. **(10 Marks)**

b. Explain principle of operation of parametric amplifier. **(06 Marks)**

c. With neat diagram explain the operation of a crystal diode. **(04 Marks)**

Contd....2

6 a. With neat block diagram explain the operation of a Doppler radar. **(08 Marks)**

b. A 1 KW, 4 GHz radar uses single antenna with a gain of 30 db. The receiver has noise bandwidth of 1 KHz and noise factor 5 db. A target echoing area of 10 m^2 at a range of 10 nautical miles is to be detected. Calculate the minimum S/N ratio. **(08 Marks)**

c. Define the antenna parameters,
   i) Directivity.
   ii) Beam width. **(04 Marks)**

7 a. With neat diagram describe the cavity wave meter method of frequency measurement. **(06 Marks)**

b. Explain the method to measure low range VSWR using VSWR meter. **(08 Marks)**

c. Explain the applications of microwave in Radiometry. **(06 Marks)**

8 a. A load impedance of 73-j80Ω is required to be matched to a 50Ω co-axial line having lossless dielectric of dielectric constant 4. Design a short circuited single stub for impedance matching operating at 500 MHz. Use smith chart. **(06 Marks)**

b. Explain the working principle of Bethe-Hole directional coupler. **(08 Marks)**

c. Compare the performance characteristics of Reflux Klystron with Magnetron oscillator. **(06 Marks)**

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EC62

Sixth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Microwave Communication

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions.***
2. ***Take standard value of constants wherever required.***

1 a. Explain the types of microwave transmission line structures with example and mode of transmission. **(07 Marks)**

b. Explain the following with reference to micro-strip lines:
i) Structure.
ii) Effective dielectric constant for $\frac{\omega}{h} >> 1$.
iii) Characteristic impedance for $\frac{\omega}{h} >> 1$.
iv) Losses and
v) Excitation. **(10 Marks)**

c. An air filled co-axial line is operating at $\lambda = 4$ cm in TEM mode. Assuming the ratio of outer and inner conductor is $b/a = 4$ and $a = \left(\lambda/4\pi\right)$. Calculate the breakdown power. **(03 Marks)**

2 a. Derive the general condition for impedance matching. **(05 Marks)**

b. With the help of the figure explain the difference between waveguide H-stub and H-plane quarter-wave waveguide transformer. **(06 Marks)**

c. An empty rectangular waveguide is matched to a dielectric ($\epsilon_r = 2.56$) filled waveguide in TE_{10} mode at 10 GHz by means of $\lambda/4$ transformer. Find the dielectric constant of the matching section. The broader dimension of the wave guide is a = 2.5 cm. **(09 Marks)**

3 a. Define the following in terms of S-parameters : i) Insertion loss ii) Transmission loss iii) Reflection loss iv) Return loss. **(08 Marks)**

b. Explain the characteristics of Magic Tee. **(04 Marks)**

c. With the help of the figure explain the application of Magic Tee as,
i) E – H Tuner.
ii) Microwave mixer. **(08 Marks)**

4 a. Define the following performance parameters of a directional coupler, when all the ports are matched,
i) Coupling
ii) Directivity
iii) Transmission loss
iv) Return loss **(04 Marks)**

b. A three-port circulator has an insertion loss of 1 dB, isolation 30 dB and VSWR = 1.5. Find the S-matrix? **(10 Marks)**

c. How to realize the following:
i) Microwave low pass filter using micro-strip π and T section.
ii) Microwave high pass filter using co-axial line π and T section. **(06 Marks)**

5 a. Write a note on:
   i) Amplitude modulation of reflex klystron oscillator by square wave.
   ii) Applegate diagram of two-cavity klystron amplifier. **(06 Marks)**

b. With the help of a neat schematic diagram explain the working of a traveling wave tube amplifier. **(08 Marks)**

c. A normal circular magnetron has the following parameters:
   Inner radius = 0.15 m
   Outer radius = 0.45 m
   Magnetic flux density 1.2 milli weber/m^2
   Determine
   i) Hull cut off voltage.
   ii) Hull cut off magnetic flux density if the beam voltage is 6000 V. **(06 Marks)**

6 a. Briefly describe the working of the following with a diagram:
   i) Gunn diode oscillator.
   ii) Tunnel diode oscillator.
   iii) Microwave field effect transistor oscillator. **(12 Marks)**

b. What are the advantages and limitations of parametric amplifier? **(04 Marks)**

c. The S-parameters of a transistor at 5 GHz for conjugate matched transistor amplifier are given
   $S_{11} = 0.9\angle -100^\circ$
   $S_{21} = 2.4$
   $S_{12} = 0$
   and $S_{22} = 0.8\angle 40^\circ$
   Determine the maximum gain. **(04 Marks)**

7 a. An earth station with a transmitter power of 120 W, a frequency of 6 GHz and an antenna gain of 42 dB transmits to a satellite repeater. The receiver antenna on the satellite has a gain of 31 dB and the satellite is in a synchronous orbit 35900 km above the earth. What is the receiver power in dBM? Also derive the necessary formula. **(12 Marks)**

b. Explain the function of the Dicke Radiometer with a neat block diagram. **(08 Marks)**

8 a. Describe the method of impedance measurement using slotted line. **(10 Marks)**

b. With a neat block diagram explain the down conversion method of frequency measurement. **(10 Marks)**

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EC62

Sixth Semester B.E. Degree Examination, June/July 08
Microwave Communication

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions.***
2. ***Smith charts may be provided.***

1 a. Discuss briefly the Microstrip lines. **(06 Marks)**

b. An air filled rectangular waveguide of dimension 2.3 cm × 1 cm is operating in dominant mode at a frequency of 9.35 GHz. If the electric break down occurs at 30 kV/cm, determine the break down power. Derive the expression used starting from field components. **(08 Marks)**

c. What are higher order modes in coaxial lines? **(06 Marks)**

2 a. Design a microstrip quarter wave impedance transformer which can be used to match the two impedances 100 Ω and 50 Ω. The microstrip line made up of Cu conductors is composed of a substrate having thickness 3 mm and $\tan\delta = 0.0005$. If the strip width is 1 mm and operated at 8.85 GHz, determine the dielectric constant of the substrate and attenuation of the transformer in dBs. The conductivity of Cu is 5.8×10^7 mho/m. Ignore thickness of the strip. **(10 Marks)**

b. Design a double stub tuner with a stub separation of $3\lambda/8$ and first stub position at the load $Z_L = 80 + j50\ \Omega$ to match the load Z_L to a 50 Ω line. The generator side is matched. Realize using coaxial cables. Use Smith chart. **(07 Marks)**

c. With neat sketch explain the working principle of tuning screws. **(03 Marks)**

3 a. What is S-parameter? State and prove unitary and phase shift properties of [S]. **(07 Marks)**

b. With neat diagram explain the principle of working of two hole directional coupler and derive its S-matrix with usual notations. **(08 Marks)**

c. A 20 mW signal is fed into sum port of H-plane T junction of impedance 50 Ω. Calculate the output power at all the ports if the collinear ports are terminated in impedance 100 Ω and 150 Ω. **(05 Marks)**

4 a. With the help of neat schematic diagram and applegate diagram explain two cavity klystron amplifier. Mention its applications. **(10 Marks)**

b. A reflex klystron operates at 8 GHz at the peak of n = 2 mode with $V_0 = 300V$, $R_{Sh} = 20\,k\Omega$ and L = 1 mm. Find i) Repeller voltage ii) beam coupling coefficient iii) beam current necessary to obtain a RF gap voltage of 200 V and iv) the electronic efficiency. **(10 Marks)**

5 a. With neat diagram explain the mechanism of oscillations in cylindrical Magnetron. Also explain how the mode separation can be achieved in Magnetron. **(10 Marks)**

b. Assume that TWTA uses a helix of diameter 1 cm, length of 20 cm and characteristic impedance 30 Ω. The axial RF field travels with a speed of beam which is 0.8893×10^8 m/sec. TWTA operates at 5 GHz under a beam current of 500 mA. Determine i) pitch of the helix ii) Output power gain iii) Propagation constant of the growing wave. **(07 Marks)**

c. With the help of diagrams show the realization of microwave filter elements using waveguides and coaxial lines. **(03 Marks)**

6 a. Explain with neat sketch the application of PIN diode in 4 bit phase shifter used in the design of phased arrays. **(05 Marks)**

b. With necessary diagrams explain the working principle of Gunn diode and its characteristics. **(08 Marks)**

c. With neat diagram explain the principle of operation of TRAPATT diode. Mention its disadvantages. **(07 Marks)**

7 a. With a neat block diagram explain the operation of CW Doppler radar. **(07 Marks)**

b. Write a note on:

i) Plasma effects.

ii) Microwave heating. **(06 Marks)**

c. With basic block diagram explain the operation of spectrum analyzer. **(07 Marks)**

8 a. With neat block diagram explain the method of determining the return loss using Reflectometer. **(08 Marks)**

b. A radar system operates at 10 GHz with a common antenna with gain of 30 dB. The receiver has a bandwidth of 1 KHz and the noise factor is 5 dB. The transmitted power is 1 KW and the target echoing area is 10 m^2. Calculate its range for S/N = 10. **(08 Marks)**

c. Explain the application of Magic – T as a duplexer. **(04 Marks)**

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2002 SCHEME

USN | | | | | | | | | | |

EC62

Sixth Semester B.E. Degree Examination, Dec.09-Jan.10
Microwave Communication

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. Smith chart is permitted to be used.

1 a. Explain the Power handling capability of Co-axial line with necessary equations. **(07 Marks)**
b. Compare microstrip lines with strip lines. **(05 Marks)**
c. A micro strip line with width w = 2 mm, h = 0.4 mm has a quartz substrate of $\epsilon_r = 3.80$ and tan $\delta = 0.0001$. Find Z_0, α_c, α_d at 9 GHz. **(08 Marks)**

2 a. What are Irises? Explain Symmetrical and asymmetrical capacitive irises with necessary equations. **(06 Marks)**
b. Sketch and explain frequency response of Quarter wave transformer. **(06 Marks)**
c. A line of $R_0 = 400\Omega$ is connected to a load of 200+j300 Ω, which is excited by a matched generator at 800 MHz. Find the location and length of a single stub nearest to the load to produce impedance matching using Smith chart. **(08 Marks)**

3 a. Compare S parameter with Z and Y parameters. **(04 Marks)**
b. Explain the following : i) 3 part circulator ii) π section of low pass microwave filter iii) Precision attenuator **(12 Marks)**
c. A 20mW signal is fed into one of the collinear port of a lossless H plane Tee junction. Calculate the Power delivered through each port when other ports are terminated in matched load. **(04 Marks)**

4 a. Explain velocity modulation and bunching process of Klystron Oscillator with necessary derivations. **(06 Marks)**
b. What are slow wave guide structures? Name the important types. **(03 Marks)**
c. What are Resonant modes in Cavity Magnetron? Explain the need for mode separation and how it can be done. **(05 Marks)**
d. An identical two cavity klystron amplifier operates at 10 GHZ with $V_0 = 1200V$, $I_0 = 30mA$ d = 1 mm, L = 4cm and $R_{sh} = 40$ k ohm. Neglecting beam loading, calculate input RF voltage for a maximum output voltage, voltage gain and efficiency. **(06 Marks)**

5 a. Explain the construction, operation, mechanism of oscillations of IMPATT diode. **(08 Marks)**
b. What are Manley-Rowe relations? Explain its application in microwave amplifier. **(06 Marks)**
c. Compare Tunnel diode with normal p-n diode. **(06 Marks)**

6 a. What is Background temperature and Brightness temperature? Illustrate with an example. **(08 Marks)**
b. What are the effects of MW propagation? **(08 Marks)**
c. A high gain antenna array operating at 2.4 GHZ is pointed towards the region of the sky for which the background can be assumed to be at uniform temperature of 5K. A noise temperature of 105K is measured for the antenna temperature. If the physical temperature of antenna is 290K, what is its radiation efficiency? **(04 Marks)**

7 a. Explain with block diagram Dick Radiometer. **(06 Marks)**
b. Explain Power measurement using Calorimetric and Power meter method. **(08 Marks)**
c. Explain with block diagram Working of Spectrum analyzer. **(06 Marks)**

8 Write short notes on :
a. PIN diode and its application
b. Microwave transistors
c) Tapered sections
d) Bethehole Directional Coupler **(20 Marks)**