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10EC64

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Draw diagram wherever necessary.

PART – A

1 a. Obtain relation between directivity and beam width and also write equation for estimating directivity. **(05 Marks)**

b. A parabolic reflector antenna is circular in cross – section with a diameter 1.22 m. If the maximum effective aperture equals 55% of the physical aperture, calculate gain of antenna in dB at 20 GHz. **(07 Marks)**

c. Show that the maximum effective aperture of a $\lambda/2$ dipole is $\frac{30}{73\pi}\lambda^2$ and also obtain radiation resistance of $\lambda/2$ dipole is 73Ω. **(08 Marks)**

2 a. Derive Hansen–Woodyard condition for 'n' element end fire array for enhancing directivity. **(08 Marks)**

b. A linear uniform array of isotropic antennas satisfy the following parameter, obtain the field pattern and find BWFN and HPBW $\eta = 4$; $\delta = 0$; $d = \lambda/2$. **(07 Marks)**

c. Explain in detail pattern multiplication method in array synthesis. **(05 Marks)**

3 a. Derive an expression for power radiated by current element and radiation resistance of short dipole. **(09 Marks)**

b. Obtain an expression for field of dipole in general ($\ell \geq \lambda/4$) for thin linear antenna. **(06 Marks)**

c. A half wave dipole in free space is radiating with a current of 1A(rms) at the antenna terminals. Find the angle θ for maximum field strength and determine the field strength and power density at a point 1 mile from the antenna at the corresponding angle. **(05 Marks)**

4 a. Obtain expression for radiation resistance of loop antenna. **(08 Marks)**

b. The multiturn rod antenna of a broadcast receiver has 10 turns of 1 mm diameter copper wire wound on a ferrite rod 1 cm in diameter and 10cm long. For the ferrite rod $\mu_r = \mu_r' - \mu_r''$ $= 250 - j2.5$. Take the effective relative permittivity of ferrite rod $\mu_{er} = 50$. At 1 MHz find : i) the radiation efficiency ii) the Q factor iii) Half power bandwidth. **(06 Marks)**

c. The diameter of a circular loop antenna is 0.04 λ. How many turns of antenna will give a radiation resistance of 36 Ω? **(06 Marks)**

PART – B

5 a. Explain the radiation mechanism of microstrip patch antenna and its characteristics. **(06 Marks)**

b. Determine length ρ of the horn, H – plane aperture and flare angles θ_E and θ_H in (E and H plane) of a pyramidal horn for which E – plane aperture is 10λ. The horn is fed with a rectangular waveguide with TE_{10} mode. Let $\delta = 0.2\ \lambda$ in E plane and $0.375\ \lambda$ in H plane. Calculate beam width and directivity. **(08 Marks)**

c. Explain the basic concepts of reflector antenna and concepts involved in plane and corner reflector. **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

6 a. Explain with suitable sketches perpendicular mode of radiation in helical antenna and obtain an expression for axial ratio and pitch angle. **(05 Marks)**

b. Write a short note on :
i) Sleeve antenna
ii) plasma antenna
iii) embedded antennas. **(09 Marks)**

c. Explain in brief antenna for satellite communication. What are different design consideration for the same? **(06 Marks)**

7 a. Derive relation between radius of curvature of earth and the change in refractive index with height. **(08 Marks)**

b. Obtain an expression for field strength at receiving antenna for the wave propagation in free space. **(07 Marks)**

c. If a transmitting aerial is located at the top of a tower 200 m above the surface of the earth. Determine the maximum distance at which an air craft flying at an altitude 3000m will be able to receive signal form the transmitter. Assume that only LOS propagation involved. If the transmitting aerial has a power gain of 13 dB in direction of aircraft and the power radiated is 400 watts, determine the electric field strength of signal at the air craft. Assume an earth of 6350 kms radius. **(05 Marks)**

8 a. Explain what will happen if a radio wave with a frequency greater than the critical frequency is propagated to the ionosphere? Will it return back? Obtain the condition such that such a wave return back to the earth. **(07 Marks)**

b. Define the following :
i) optimum working frequency
ii) maximum usable frequency. **(06 Marks)**

c. In ionospheric propagation, consider that the reflection takes place at height of 300 km and that the maximum density in ionosphere corresponds to refractive index of 0.8 at 15 MHz frequency. Determine ground range for curved earth for which given frequency is MUF. **(07 Marks)**

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10EC64

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define directivity. Obtain the relationship between directivity and beam area to show that smaller the beam area, larger is the directivity. **(07 Marks)**

b. Define antenna aperture. Derive the relationship between aperture and beam area. **(06 Marks)**

c. Show that maximum effective aperture of a short electric dipole is equal to $0.119\ \lambda^2$. **(07 Marks)**

2 a. Find the power radiated and the directivity for the following:

i) $U = U_m \sin^2\theta \sin^3\phi \quad 0 \le \theta \le \pi \quad 0 \le \phi \le \pi$

ii) $U = U_m \cos^n\theta \quad 0 \le \theta \le \pi/2 \quad 0 \le \phi \le 2\pi$ **(08 Marks)**

b. Obtain the relative field pattern for two isotropic point sources of same amplitude but opposite phase, spaced $\frac{\lambda}{2}$ apart. **(08 Marks)**

c. State and explain power theorem. **(04 Marks)**

3 a. Derive the equation for radiation resistance of a short electric dipole. **(08 Marks)**

b. Explain the following : i) Folded dipole, ii) Rhombic antenna. **(08 Marks)**

c. A half wave dipole radiating in free space is driven by a current of 0.5 amperes at the terminals. Calculate E and H field at a distance 1 km from the antenna at angles of 45° and 90°. **(04 Marks)**

4 a. Obtain the radiation resistance of a small loop antenna. **(07 Marks)**

b. Write short notes on: i) Slot antenna, (ii) Patch antenna. **(08 Marks)**

c. Find the radiation efficiency of a 1 meter diameter loop of 10 mm diameter copper wire at (i) 1MHz, (ii) 10 MHz. **(05 Marks)**

PART – B

5 a. Determine the length L, H plane aperture and flare angles θ_E and θ_H of a pyramidal horn for which E-plane aperture $a_E = 10\ \lambda$. The horn is fed by rectangular waveguide with TE_{10} mode. Let $\delta = 0.2\ \lambda$ in the E-plane and $0.375\ \lambda$ in the H-plane. Also find beam width and directivity. **(08 Marks)**

b. Write short notes on: i) Lens antenna; ii) Log periodic antenna **(08 Marks)**

c. Design a Yagi-Uda six element antenna for operation at 500 MHz with a folded dipole field. What are the lengths of (i) reflector element, (ii) driven element, (iii) four director element? What is the spacing between reflector and driven element? **(04 Marks)**

6 a. Derive an expression for resultant field intensity in the case of a space wave propagation. **(10 Marks)**

b. Evaluate the roughness factors for the earth at 10 MHz, if $\sigma = 5$, for 'θ' equal to (i) 30°, (ii) 45°, (iii) 60°. **(05 Marks)**

c. A transmitting antenna of 100 m height radiates 40 kW at 100 MHz uniformly in azimuth plane. Calculate maximum LOS range and strength of the received signal at 16 m high, receiving antenna at a distance of 10 km. At what distance would the signal strength reduce to 1 mV/m? **(05 Marks)**

7 a. Explain the structure of ionosphere. Derive an expression for refractive index of ionospheric layer. **(10 Marks)**

b. Define the following with respect to ionospheric propagation:
i) Critical frequency
ii) Virtual height **(06 Marks)**

c. Obtain the relationship between maximum usable frequency (MUF) and skip distance. **(04 Marks)**

8 Write short notes on:
a. Principle of pattern multiplication
b. Scanning array
c. Embedded antennas
d. Ground wave propagation **(20 Marks)**

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10EC64

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. With the help of Maxwell's equation, explain how radiation and reception of EM takes place? **(06 Marks)**

b. Explain the following terms as related to antenna system:
i) Directivity; ii) HPBW; iii) Effective length; iv) Beam efficiency. **(08 Marks)**

c. Show that the directivity for unidirectional operation is $2(n + 1)$ for an intensity variation of $u = u_m \cos^n\theta$. **(06 Marks)**

2 a. With a neat diagram, obtain an expression for maximum effective aperture of a $\lambda/2$ dipole. **(07 Marks)**

b. Derive relationship between maximum effective aperture and directivity of an antenna. **(08 Marks)**

c. Find the maximum power received at a distance of 0.75km over free space 110 Mhz circuit consisting of a transmitting antenna of 30dB gain and a receiving antenna of 25dB gain, if the power i/p to the transmitting antenna is 120 watts. **(05 Marks)**

3 a. Starting from fundamentals derive the equation for radiation resistance of Hertzian dipole. **(08 Marks)**

b. A dipole antenna of length 5cm is operated at a frequency of 100MHz with terminal current, $I_0 = 120$mA. At time, $t = 1$ sec, $\theta = 45°$ and $r = 3$m. Find: i) E_r; ii) E_θ and iii) H_ϕ. **(08 Marks)**

c. Calculate the radiation resistance of a dipole of length = $\lambda/5$. (Assume triangular current distribution). **(04 Marks)**

4 a. Derive the far field expressions for small loop antenna. **(08 Marks)**

b. Derive an expression and draw the field pattern for an array of two isotropic point sources with equal amplitude and opposite phase. Take $d = \lambda/2$. **(08 Marks)**

c. Find half power beam width and directivity of a linear broadside array of four isotropic point sources of equal strength with $d = \lambda/2$? **(04 Marks)**

PART – B

5 a. Write explanatory note on: i) Folded – dipole antenna; ii) Yagi-uda antenna. **(10 Marks)**

b. Find the length, L, H-plane aperture and flare angles θ_E and θ_H of a pyramidal horn for which E-plane aperture is 10λ. Horn is fed by a rectangular waveguide with TE_{10} mode. Assume $\delta = 0.2\lambda$ in E-plane and 0.375λ in H-plane. Also find E-plane, H-plane beam widths and directivity. **(06 Marks)**

c. A dish antenna operating at a frequency of 1.43 GHz has a diameter of 64mts and is fed by a directional antenna. Calculate HPBW, BWFN and gain with respect to $\lambda/2$ dipole with even illumination. **(04 Marks)**

6 a. Write short notes on: i) Parabolic reflectors; ii) Log – periodic antenna. **(12 Marks)**

b. Determine the cut-off frequencies and bandpass of a log periodic dipole array with a design factor of 0.7. Ten dipoles are used in the structure, the smallest having a dimension L/2 equal to 0.3m. **(08 Marks)**

7 a. Define a wave tilt of a surface wave propagation. Also, prove that

$$\text{Wave tilt, } \alpha = \tan^{-1}\frac{E_n}{E_v} = \tan^{-1}\left[\frac{1}{\sqrt{\epsilon_r}} \cdot \frac{1}{\left[1+x^2\right]^{1/4}}\right]. \quad \textbf{(10 Marks)}$$

b. Derive the expression for resultant field strength at a point due to space wave propagation. **(05 Marks)**

c. For a VHF communication link, a 35 watt transmitter is operating at 90MHz. Determine the distance upto which LOS would be possible given that height of the transmitting and receiving antenna are 40m and 25m respectively. Evaluate the field strength at the receiving point. **(05 Marks)**

8 a. Define the following: i) MUF; ii) Critical frequency; iii) Virtual height; iv) Skip distance. **(08 Marks)**

b. Calculate the value of the operating frequency of the ionosphere layer specified by refractive index of 0.85 and an electron density 5×10^5 electrons/m^3. Calculate the critical frequency and MUF of the system with $\theta_i = 30°$. **(06 Marks)**

c. Calculate the critical frequencies for f_1, f_2 and E layers, for which, the maximum ionic densities are 2.3×10^6, 3.5×10^6 and 1.7×10^6 elections/cm^3 respectively. **(06 Marks)**

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10EC64

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Define the following with respect to antenna :
   i) Directivity
   ii) Radiation pattern
   iii) Effective aperture
   iv) Antenna field zones. **(08 Marks)**

b. Derive the relation between maximum effective aperture and directivity. **(06 Marks)**

c. The effective apertures of transmitting and receiving antennas in a communication system are $8\lambda^2$ and $12\lambda^2$ respectively, with a separation of 1.5km between them. The electromagnetic wave is travelling with a frequency of 6MHz and the total input power is 25KW. Find the power received by the receiving antenna. **(06 Marks)**

2 a. Derive an expression for the total field and plot the field pattern for two isotropic point sources with same amplitude and equal phase spaced $\lambda/2$ apart. **(08 Marks)**

b. A linear array consists of 4 isotropic point sources. The distance between the adjacent elements is $\lambda/2$. The power is applied with equal magnitudes and a phase difference – dr. Obtain the field pattern and find BWFN (Beam width first Null) and HPBW. **(08 Marks)**

c. What are broadside and End fire arrays. **(04 Marks)**

3 a. A magnetic field strength of $5\mu A/m$ is required at a point on $\theta = \pi/2$, 2km away from an antenna in free space. Neglecting ohmic loss, how much power must the antenna transmit if it is,
   i) A hertzian dipole of length $\lambda/25$?
   ii) A half wave dipole?
   iii) A quarter wave monopole? **(08 Marks)**

b. Derive the radiation resistance of short dipole. **(06 Marks)**

c. Explain basic concept of folded dipole antenna and show how impedance transformation is possible using folded dipole. **(06 Marks)**

4 a. Derive an expression for the far field components of a loop antenna. **(08 Marks)**

b. Show that the radiation resistance of a small loop antenna consisting 'N' turns is given by

$$R_{rad} = 31200\left(\frac{NA}{\lambda^2}\right)^2 \Omega.$$ **(08 Marks)**

c. Write short notes on slot antenna. **(04 Marks)**

PART – B

5 a. Explain with a neat figure the working of a Yagi–uda antenna. Mention the general characteristics and salient features of Yagi – uda antenna. **(10 Marks)**

b. A parabolic dish provides a power gain of 50dB at 10 GHz with 70% efficiency. Find out, i) HPBW ii) BWFN iii) Diameter. **(06 Marks)**

c. Write a note on Lens antenna. **(04 Marks)**

6 a. Write a note on :
i) Ultra wideband antennas
ii) Turnstile antenna. **(08 Marks)**

b. Discuss the design considerations of an antenna used for satellite communications. **(08 Marks)**

c. Discuss briefly about antennas for ground penetrating radar. **(04 Marks)**

7 a. Describe ground wave propagation. **(08 Marks)**

b. Derive an expression for resultant electric field strength (E_R) at a point due to space wave propagation. **(06 Marks)**

c. The transmitting and receiving antennas with heights 50metre and 25metre are used to establish a communication link at 150MHz with 100 watts power of transmission. Determine : i) LOS distance ii) strength of received signal. **(06 Marks)**

8 a. Define Maximum Usable Frequency (f_{MUF}). Derive an expression of f_{MUF} for curved surface of earth. **(08 Marks)**

b. Explain skip distance. Derive an expression for skip distance (D), for flat earth surface. **(06 Marks)**

c. Assume that reflection takes place at a height of 400 km and that the maximum electron density in the ionosphere corresponds to a 0.9 refractive index at 10 MHz. What will be the range for which MUF is 10 MHz? i) for flat earth ii) for curved earth. **(06 Marks)**

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10EC64

Sixth Semester B.E. Degree Examination, June/July 2017

Antenna and Propagation

Time: 3 hrs. Max. Marks: 100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define the term directivity and effective aperture of an antenna. Derive the relation for D in terms of Ae. **(08 Marks)**

b. Define the following parameters of antenna:
i) Beam area
ii) Radiation pattern **(08 Marks)**

c. An antenna has a field pattern given by $E(\theta) = \cos\theta \cos 2\theta$ for $0 \le \theta \le 90^\circ$. Find:
i) The half-power beam width
ii) The beam width between first nulls. **(04 Marks)**

2 a. State and prove the power theorem and explain its application to an isotropic source. **(04 Marks)**

b. The radiation intensity of an antenna is given by $U = U_m \sin^2\theta$ for $0 \le \theta \le \pi/2$ and $0 \le \phi \le 2\pi$. Find the directivity. **(04 Marks)**

c. Explain field and phase pattern. **(05 Marks)**

d. Derive an expression for total field in case of two isotropic points with same amplitude and phase. Plot the relative field pattern when these two isotropic sources are spaced $\lambda/2$ apart. **(07 Marks)**

3 a. Derive the expression for the radiation resistance of short dipole. **(08 Marks)**

b. Show that the radiation resistance of a linear $\lambda/2$ antenna with sinusoidal current distribution is equal to 73Ω. **(08 Marks)**

c. For a short dipole $\lambda/15$ long, find the efficiency, radiation resistance if loss resistance is 1Ω. Find also the effective aperture. **(04 Marks)**

4 a. Derive Far field expressions for small loop antenna. **(08 Marks)**

b. State and explain Babinet's principle. **(06 Marks)**

c. Write notes on patch antenna with applications. **(06 Marks)**

PART – B

5 a. Explain the Yagi-Uda array antenna. **(08 Marks)**

b. Explain the working of log periodic antenna. **(08 Marks)**

c. A 16-turn helical beam antenna has a circumference of λ and turn spacing of $\lambda/4$. What is (i) HPBW, (ii) Axial ratio, (iii) Gain? **(04 Marks)**

6 Write short notes on:
a. Sleeve antenna **(05 Marks)**
b. Antennas for ground penetrating radars (GPR) **(05 Marks)**
c. Ultra wide band antennas **(05 Marks)**
d. Plasma antenna **(05 Marks)**

7 a. Find the approximate formula for the filed strength in VHF propagation and explain how it varies sinusoidally. **(10 Marks)**

b. Explain about the diffraction with two basic models. **(06 Marks)**

c. A VHF communication is to be established at 90 MHz, with the transmitter power of 35 watts. Calculate the LOS communication distance, if the heights of transmitter and receiver antennas are 40 m and 25 m respectively. **(04 Marks)**

8 a. Derive the expression for refractive index of an ionospheric layer. **(10 Marks)**

b. Explain the effects of earth's magnetic field. **(06 Marks)**

c. A HF radio link is established for a range of 2000 km. If the reflection region of the ionosphere is at a height of 200 km and has a critical frequency of 6 MHz. Calculate MUF. **(04 Marks)**

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10EC64

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. With the help of Maxwell's equation, explain how radiation and reception of EM takes place? **(06 Marks)**

b. Explain the following terms as related to antenna system:
i) Directivity; ii) HPBW; iii) Effective length; iv) Beam efficiency. **(08 Marks)**

c. Show that the directivity for unidirectional operation is $2(n + 1)$ for an intensity variation of $u = u_m \cos^n\theta$. **(06 Marks)**

2 a. With a neat diagram, obtain an expression for maximum effective aperture of a $\lambda/2$ dipole. **(07 Marks)**

b. Derive relationship between maximum effective aperture and directivity of an antenna. **(08 Marks)**

c. Find the maximum power received at a distance of 0.75km over free space 110 Mhz circuit consisting of a transmitting antenna of 30dB gain and a receiving antenna of 25dB gain, if the power i/p to the transmitting antenna is 120 watts. **(05 Marks)**

3 a. Starting from fundamentals derive the equation for radiation resistance of Hertzian dipole. **(08 Marks)**

b. A dipole antenna of length 5cm is operated at a frequency of 100MHz with terminal current, $I_0 = 120$mA. At time, $t = 1$ sec, $\theta = 45°$ and $r = 3$m. Find: i) E_r; ii) E_θ and iii) H_ϕ. **(08 Marks)**

c. Calculate the radiation resistance of a dipole of length = $\lambda/5$. (Assume triangular current distribution). **(04 Marks)**

4 a. Derive the far field expressions for small loop antenna. **(08 Marks)**

b. Derive an expression and draw the field pattern for an array of two isotropic point sources with equal amplitude and opposite phase. Take $d = \lambda/2$. **(08 Marks)**

c. Find half power beam width and directivity of a linear broadside array of four isotropic point sources of equal strength with $d = \lambda/2$? **(04 Marks)**

PART – B

5 a. Write explanatory note on: i) Folded – dipole antenna; ii) Yagi-uda antenna. **(10 Marks)**

b. Find the length, L, H-plane aperture and flare angles θ_E and θ_H of a pyramidal horn for which E-plane aperture is 10λ. Horn is fed by a rectangular waveguide with TE_{10} mode. Assume $\delta = 0.2\lambda$ in E-plane and 0.375λ in H-plane. Also find E-plane, H-plane beam widths and directivity. **(06 Marks)**

c. A dish antenna operating at a frequency of 1.43 GHz has a diameter of 64mts and is fed by a directional antenna. Calculate HPBW, BWFN and gain with respect to $\lambda/2$ dipole with even illumination. **(04 Marks)**

6 a. Write short notes on: i) Parabolic reflectors; ii) Log – periodic antenna. **(12 Marks)**

b. Determine the cut-off frequencies and bandpass of a log periodic dipole array with a design factor of 0.7. Ten dipoles are used in the structure, the smallest having a dimension L/2 equal to 0.3m. **(08 Marks)**

7 a. Define a wave tilt of a surface wave propagation. Also, prove that

$$\text{Wave tilt, } \alpha = \tan^{-1}\frac{E_n}{E_v} = \tan^{-1}\left[\frac{1}{\sqrt{\epsilon_r}} \cdot \frac{1}{\left[1+x^2\right]^{1/4}}\right]. \quad \textbf{(10 Marks)}$$

b. Derive the expression for resultant field strength at a point due to space wave propagation. **(05 Marks)**

c. For a VHF communication link, a 35 watt transmitter is operating at 90MHz. Determine the distance upto which LOS would be possible given that height of the transmitting and receiving antenna are 40m and 25m respectively. Evaluate the field strength at the receiving point. **(05 Marks)**

8 a. Define the following: i) MUF; ii) Critical frequency; iii) Virtual height; iv) Skip distance. **(08 Marks)**

b. Calculate the value of the operating frequency of the ionosphere layer specified by refractive index of 0.85 and an electron density 5×10^5 electrons/m^3. Calculate the critical frequency and MUF of the system with $\theta_i = 30°$. **(06 Marks)**

c. Calculate the critical frequencies for f_1, f_2 and E layers, for which, the maximum ionic densities are 2.3×10^6, 3.5×10^6 and 1.7×10^6 elections/cm^3 respectively. **(06 Marks)**

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10EC54

Fifth Semester B.E. Degree Examination, December 2012
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of smith chart is permitted.

PART – A

1 a. Derive transmission – line equations by the methods of distributed circuit theory. **(09 Marks)**

b. A single stub turner is to match a lossless line of 400 Ω to a load of (800 + j300)Ω. The frequency is 3 GHz
i) Find the distance in meters from the load to the turning stub
ii) Determine the length in meters of the short – circuited stub. **(06 Marks)**

c. Define reflection coefficient and derive an expression for reflection coefficient at load in terms of load impedance. **(05 Marks)**

2 a. Using the Helmholtz equation, derive the field equations for TE modes in rectangular waveguides. **(09 Marks)**

b. With a neat sketch, explain the four – port microwave circulator and also obtain the S – matrix. **(08 Marks)**

c. An air – filled rectangular waveguide of inside dimensions 7 × 3.5 cm operates in the dominant TE_{10} mode. Find
i) the cutoff frequency
ii) the phase velocity of the wave in the guide at a frequency of 3.5 GHz
iii) the guided wavelength at the same frequency. **(03 Marks)**

3 a. With neat sketches, explain the IMPATT diode and draw the negative resistance curve. **(10 Marks)**

b. Explain the parametric amplifier with equivalence circuit. **(10 Marks)**

4 a. For a two port network, explain the S – parameters and properties of S – parameters. **(10 Marks)**

b. Explain the phase shifter, with neat sketches. **(10 Marks)**

PART – B

5 a. With neat sketch, explain the operation of E – plane tee and also obtain its S- matrix. **(10 Marks)**

b. With neat sketch, explain the operation of magic tee and mention its application. **(10 Marks)**

6 a. With neat schematic diagram, explain the coplanar strip lines. **(06 Marks)**

b. A lossless parallel strip line has a conducting strip width ω. The substrate dielectric separating the two conducting strips has a relative dielectric constant ϵ_{rc} of 6 and a thickness of 4 mm. Calculate :

i) The required width ω of the conducting strip in order to have a characteristics impedance of 50Ω

ii) The strip- line capacitance

iii) The strip – line inductance

iv) The phase velocity of the wave in the parallel strip – line. **(08 Marks)**

c. Write a note on shielded strip lines. **(06 Marks)**

7 a. Derive an expression for simple form of the radar range equation. **(05 Marks)**

b. With a neat block diagram, explain the conventional pulse radar with a super heterodyne receiver. **(08 Marks)**

c. Explain the applications of radar. **(07 Marks)**

8 a. Explain single delay – line canceller and frequency response of the single delay – line canceller, and also obtain the expression for blind speeds. **(10 Marks)**

b. A VHF radar at 220 MHz has a maximum unambiguous range of 180 nmi. What is its first blind speed? **(04 Marks)**

c. With neat block diagram, explain the original moving target detector signal processor. **(06 Marks)**

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10EC54

Fifth Semester B.E. Degree Examination, June/July 2017

Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Usage of Smith chart is permitted.***

PART – A

1 a. Define standing wave ratio. Why the high value of SWR is undesirable? **(05 Marks)**

b. Deduce the expression for reflection co-efficient when the transmission line is terminated by load impedance (Z_L). **(08 Marks)**

c. A transmission line of 100m length and a characteristic impedance of 100 ohms is terminated by a load $Z_L = 100 - j200$ ohms. Using the Smith chart, determine the line impedance and also admittance at 25m from the load end at a frequency of 10MHz. **(07 Marks)**

2 a. What are microwave isolators? Explain the operation of a Faraday rotation ferrite isolator. List applications of an isolator. **(10 Marks)**

b. What are cavity resonators? What applications do they have? **(05 Marks)**

c. With the aid of neat sketch, explain the operation of a two-hole wave guide directional coupler. **(05 Marks)**

3 a. With the aid of energy band diagram, explain two-valley model theory for Gunn diodes. **(07 Marks)**

b. A typical n-type GaAs Gunn diode has the following parameters :

Threshold field E_{th} = 2800V/cm
Applied field E = 3200V/cm
Device length L = 10 μm
Doping concentration n_0 = 2×10^{14} cm^{-3}
Operating frequency f = 10 GHz

i) Compute the electron drift velocity
ii) Calculate the current density
iii) Estimate the negative electron mobility **(06 Marks)**

c. Draw the schematic of an IMPATT diode and explain the its operation. **(07 Marks)**

4 a. What are S – parameters of two part network? Why these parameters are preferred to Z and Y parameters for operation in microwave frequencies? **(08 Marks)**

b. State the properties of S – parameters. Prove the unitary property of S – parameters. **(08 Marks)**

c. Write the S – matrix for E – plane Tee. **(04 Marks)**

PART – B

5 Write note on :

a. Hybrid – Tee and its applications **(08 Marks)**

b. Mircrowave attenuator **(05 Marks)**

c. Coaxial connectors **(07 Marks)**

6 a. A lossless parallel strip line has a conducting strip width W. The substrate dielectric separating the two conducting strips has a relative dielectric constant ϵ_{rd} of 6 (Beryllium oxide Beo) and a thickness d of 4mm.
Compute :
i) The required width 'W' of the conducting strip in order to have a characteristic impedance of 50Ω
ii) The strip line capacitance
iii) The strip line inductance
iv) The phase velocity of the wave in the parallel strip line. **(08 Marks)**

b. What are the advantages of coplanar strip lines over parallel strip lines? **(05 Marks)**

c. Derive the expression for attenuation constants for the conductor and dielectric losses of a parallel strip line at microwave frequencies. **(07 Marks)**

7 a. Derive the radar range equation as governed by the minimum receivable echo power. **(08 Marks)**

b. List the applications of Radar. **(05 Marks)**

c. Draw a functional block diagram of a pulsed radar- and describe the function of each block. **(07 Marks)**

8 a. With the aid of neat block diagram, explain the operation of an MTI system. **(08 Marks)**

b. What is blind speed? **(05 Marks)**

c. Describe digital MTI system. **(07 Marks)**

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10EC54

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of Smith chart is permitted.
3. Missing data, if any, may be suitably assumed.

PART – A

1 a. Derive equations for voltage and currents for a transmission line. **(08 Marks)**

b. The characteristic impedance of a certain line is $\neg 10 \lfloor -16°$, when frequency is 1 KHz. At this frequency the attenuation is 0.071 NP/km phase constant is 0.035 rads/km. Calculate resistance, inductance, capacitance for 1 km and also velocity of propagation. **(06 Marks)**

c. Determine the input impedance of a 200Ω line, 3/8 wavelengths long terminated in a 100Ω resistance, using smith chart. Also find k in magnitude and angle. **(06 Marks)**

2 a. What are the properties of wave guide? Obtain the expression for Hz in the case of T.E. waves applying all boundary conditions. **(08 Marks)**

b. The cut-off wave lengths of a rectangular waveguide was measured to be 8 cm and 4.8 cm when excited in TE_{10} and TE_{11} modes respectively. Determine the dimensions of the wave guide. **(06 Marks)**

c. Explain the working of a four port circulator. **(06 Marks)**

3 a. With a neat sketch explain how PIN diode acts as a switch. Find the expression for insertion loss. **(08 Marks)**

b. Explain RWH theory in GUNN diodes and give its constructional details. **(06 Marks)**

c. Calculate the operating frequency of a silicon based IMPATT diode with drift length of 2 μm and drift velocity of 10^7 cm/sec. **(06 Marks)**

4 a. Give the S–matrix representation for multiport network. Also explain the properties of S – matrix. **(08 Marks)**

b. What is an H-plane Tee junction? Derive its S-matrix. **(06 Marks)**

c. What are phase shifters? Explain a rotary precision phase shifter with a neat sketch. **(06 Marks)**

PART – B

5 a. Explain a magic Tee structure and its S-matrix. Also give its various applications. **(08 Marks)**

b. What are micro strip lines? Explain the field distribution with a neat sketch. **(06 Marks)**

c. A micro strip line is composed of zero thickness copper conductors on a substrate having $\epsilon_r = 8.4$, $\tan\delta = 0.0005$ and thickness and thickness 2.4 mm. If the line width is 1 mm and operated at 10 GHz. Calculate Z_0, the attenuation due to conductors and dielectric loss. **(06 Marks)**

6 a. Name the various types of RADAR. Derive the radar range equation. **(08 Marks)**

b. A 1 kW, 3 GHz radar uses single antenna with a gain of 30 dB. The receiver has noise band width of 1 KHz and noise factor of 5 dB. A target of echoing area of 10 m^2 at a range of 10 nautical miles is to be detected. Calculate the minimum S/N. **(06 Marks)**

c. Explain block diagram of a radar with a neat diagram and explain each block **(06 Marks)**

7 a. Explain with a neat diagram the working of a coherent MTI radar. **(08 Marks)**

b. Explain the various applications of radar. **(06 Marks)**

c. Explain the need of delay line cancellers in MTI radars. Also give the characteristics of a single delay line canceller. **(06 Marks)**

8 a. Explain with a neat block diagram the working of a simple digital MTI signal processor. **(07 Marks)**

b. Explain the working of a moving target detector with block diagram. **(07 Marks)**

c. Explain with a neat block diagram the working of a pulse Doppler RADAR. **(06 Marks)**

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