KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

Marks Scored:

Level : B.E.
Year : IV
Course : ETEG 408
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 20
Registration No:
Date : MAR 2 6 2017

SECTION "A"
[20 Q. × 1 = 20 marks]

Choose the most appropriate answer.

1. PPI display of radar is/are _____.
   a. intensity modulation type
   b. intensity modulation and deflection type
   c. deflection type
   d. intensity modulation or deflection type

2. A-SCOPE display plots_____.
   a. range versus amplitude
   b. azimuth versus rang
   c. elevation versus range
   d. elevation versus azimuth

3. If the peak transmitted power in a RADAR system is increased 81 times, then the maximum range will be increased by a factor of, _____.
   a. 3 b. 9 c. 27 d. 81

4. In microwave communication links, path diversity and frequency diversity are adopted to overcome fading in the path due to, _____.
   a. rain attenuation
   b. phase lagging
   c. polarization shifting
   d. fog accumulation

5. A reflex klystron is capable of generating such high frequencies as, _____.
   a. 0.1 GHz b. 1 GHz c. 10 GHz d. 100 GHz

6. TWT is basically, _____.
   a. an oscillator
   b. a low gain amplifier
   c. a tuned amplifier
   d. a wideband amplifier

7. The dominant TM mode in a rectangular waveguide is _____.
   a. TM_{10} b. TM_{21} c. TM_{11} d. TM_{32}

8. Which of the following modes is most difficult to excite in a waveguide?
   a. TE_{10} b. TM_{11} c. TE_{11} d. TE_{35}

9. The variation of attenuation constant with frequency is known as, _____.
   a. Frequency distortion
   c. Modulation
   c. Phase distortion
   d. Fading

10. The free space attenuation between two microwave antennas 40 km apart operating at 8 GHz is _____.
    a. 146.7 dB b. 142.55 dB c. 82.5 dB d. 86.7 dB

11. The characteristic impedance of a lossless transmission line is, _____.

a. $\sqrt{\frac{R+j\omega L}{G+j\omega C}}$

b. $\sqrt{\frac{G+j\omega L}{R+j\omega C}}$

c. $\sqrt{\frac{L}{C}}$

d. $\sqrt{\frac{C}{L}}$

12. What is the most common problems of microwave tubes?
a. Radiation leakage.
b. Large physical size.
c. Low efficiency.
d. Electrical breakdown.

13. What is the primary purpose of the helix in a travelling wave tube?
a. To reduce noise figure.
b. To prevent the electron beam from spreading in the long tube.
c. To reduce the axial velocity of the RF field.
d. To ensure broadband operation.

14. In a magnetron why does the electron travel in a cycloid path?
a. Strong field is supplied by the permanent magnet.
b. The anode is negative.
c. The cathode is positive.
d. The cavities are resonant.

15. Let the generator's transmitting frequency be 3 GHz. A target is moving radially towards generator with a velocity of 360 Km/hour. The frequency of the target will be, _____.
a. 1 KHz b. 1.5 KHz c. 2 KHz d. 300 Hz

16. The cavity resonator, _____.
a. is equivalent to an LC resonant circuit
b. is part of klystron to take output from the reflector plate
c. is used to amplify frequency
d. has a low Q factor for narrow operation

17. which of the following is not an application of microwave cavities, _____.
a. Band pass filter
b. Oscillator frequency control
c. Band stop filter
d. Detector

18. The time from the transmission of a radar pulse to its reception is 0.12 ms., The distance to the target is how many nautical miles?
a. 4.85 nmi b. 9.7 nmi c. 11.2 nmi d. 18.4 nmi

19. In a microwave communications system free space path loss calculation formula uses is _____.
a. 94.2 + 20 log f + 20 log d
b. 92.4 + 20 log f + 20 log d
c. 94.2 + 10 log f + 20 log d
d. 92.3 + 10 log f + 20 log d

20. At what frequency does oxygen cause excessive attenuation?
a. 60 GHz b. 50 GHz c. 40 GHz d. 30 GHz

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SECTION "B"

Attempt *ANY FIVE* questions. Missing data may be suitably assumed. Each symbol carries their usual meaning.

1. a. Enlist the advantages of microwave frequencies over lower frequency. Make a list of important applications and the corresponding characteristics of microwave systems. [4]
   b. Explain the types of microwave transmission lines used in microwave circuits? [4]
   c. A dielectric filled rectangular waveguide has a cut-off frequency of 4 GHz for the TE_{10} mode and 7.5 GHz for the TE_{11} mode. If the relative permittivity of the dielectric material is 3.7, calculate the dimensions of the guide. [3]

2. a. Explain Gunn Effect. With a neat sketch explain the working principle of a Gunn diode. [3]
   b. Why we need FMCW radar, explain its working mechanism. [6]
   c. An aircraft is flying at a speed of 250 Km/h. Compute the Doppler frequency for radar operating at a wavelength of 5 cm when aircraft it is coming toward and receding away. [2]

3. a. Draw the block diagram of microwave link repeater and explain the function of each block. [4]
   b. What are the important issues must be considered during the route planning of terrestrial link. [2]
   c. A rectangular waveguide cavity resonator having dimensions a = 22.86 mm and b =10.16 mm and operating in the TE_{101} mode, has a resonance frequency of 10GHz. Now, the resonator is required to operate at 12 GHz in the same mode. Find the change in d. [5]

4. a. Explain the properties and advantage of geostationary orbit for telecommunications. [3]
   b. Differentiate between VOR and DVOR. [3]
   c. Two rectangular waveguides are joined end to end and have the same dimension a x b. if the first guide is air filled and the second is filled with dielectric of relative permittivity of ε_r , then find the limit of ε_r such that a single dominant mode operation is possible in both the guides. [5]

5. a. With the suitable figure, describe the basic operation of a travelling wave tube and magnetron. [4]
   b. explain the significance of G/T ratio in satellite communication, with example [2]
   c. Consider a satellite transmitting 25 W at a frequency of 4G Hz via an antenna of 18 dB gain. An earth station uses an antenna of 12 m diameter with an efficiency of 60%. Determine the gain of the earth station antenna, path loss, flux density at the earth station and power received at the output of the earth station antenna assuming the satellite earth station range to be 40, 000 km. Repeat the question for a down frequency of 12 GHz. Compare the two sets of results and comment. [5]

6. a. A 35 GHz pulse radar having following parameters,
   P_t = 2000KW T = 290 K G = 66 dB B = 250 MHz
   Lsys = 10 dB F = 5 dB n = 10 $(S_0/N_0)_{min}$ = 10 dB
   is used to detect and track the target. Assume the radar cross section of 4.45×10^{-5} m^2.
   i. Find the maximum range of radar?
   ii. If the maximum range of radar is reduced by 10 km, what will be the degradation in receiver sensitivity in dB? [2+4]
   b. Explain how to calculate the width of stripline for given characteristic impedance. [5]