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B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, MAY 2024

Fourth Semester

Core Course—MICROWAVE ELECTRONICS

(For the Programme B.Sc. Electronics)

[2013–2016 Admissions]

Time : Three Hours   Maximum Marks : 80

Part A

Answer **all** *questions.*
Each question carries 1 *mark.*
Choose the most appropriate alternate.

1. An electromagnetic wave having a frequency of 1 GHz is travelling in a dielectric medium of dielectric constant 2.25. Its velocity of propagation is :

   (a) 1.33×10^8 m/s.   (b) 2×10^8 m/s.

   (c) 3×10^8 m/s.   (d) 4.5×10^8 m/s.

2. A transmission line when terminated in a certain load has a reflection coefficient of $\frac{1}{3}$. VSWR is :

   (a) $\frac{1}{3}$.   (b) 2.

   (c) 3.   (d) 4.

3. The dominant mode in a waveguide is characterised by :

   (a) Longest cutoff wavelength.   (b) Shortest cutoff wavelength.

   (c) Infinite attenuation.   (d) Zero attenuation.

4. The characteristic impedance of a transmission line is :

   (a) Directly proportional to its length.

   (b) Inversely proportional to its length.

   (c) Directly proportional to square root of its length.

   (d) Independent of its length.

Turn over

5. A branch waveguide is connected in series with the main waveguide by :

    (a) An E-plane tee.   (b) an H-plane tee.

    (c) A magic tee.   (d) None of these.

6. Electron bunching in a 2-cavity klystron occurs in :

    (a) Buncher cavity.

    (b) Catcher cavity.

    (c) Free drift space between the two cavities.

    (d) None of these.

7. One of the following is a crossed field device :

    (a) TWT.   (b) Magnetron.

    (c) Reflex klystron.   (d) 2 cavity klystron.

8. Which one of the following is an active microwae device ?

    (a) Strip line.   (b) Microstrip.

    (c) SAW device.   (d) IMPATT.

9. Which one of the following devices is better suited to fabrication of MMICs ?

    (a) GaAs MESFET.   (b) IMPATT.

    (c) Bipolar transistor.   (d) Gunn diode.

10. In cavity magnetron, strapping is used to :

    (a) Prevent mode jumping.   (b) Prevent cathode back heating.

    (c) Ensure bunching.   (d) Improve the phase focussing effect.

$(10 \times 1 = 10)$

Part B

Answer any **eight** *questions.*
Each question carries 2 marks.

11. "A waveguide acts like a high pass filter." Justify.

12. Define the characteristic impedance of a transmission line.

13. Write the condition for distortionless transmission line.

14. Define the standing wave ratio.

15. Which are the excitation modes in a rectangular waveguide ?

16. Clearly explain what is meant by cutoff wavelength of a waveguide.

17. What are the limitations of reflex klystrons ?

18. What do the acronyms IMPATT and TRAPPAT stand for ?

19. What are the applications of Gunn oscillators and amplifiers ?

20. List the drawbacks of avalanche devices ?

21. Why it is possible to obtain amplification by using a device which exhibits negative resistance ?

22. Explain the need of a Twist.

$(8 \times 2 = 16)$

Part C

Answer any **six** *questions.*
Each question carries 4 *marks.*

23. With a cross-section, explain the working of magic tee.

24. A 6 GHz signal is to be propagated in the dominant mode in a rectangular waveguide. If its group velocity is to be 90 % of the free space velocity of light, calculate the breadth of the waveguide ?

25. Explain the differences between propagation in waveguides and in transmission lines.

26. Explain the methods used to tune cavity resonators ?

27. In a rectangular waveguide with $a = 2b$ and $a = 2.286$ cm, calculate the frequency over which only TE_{10} mode will propagate.

28. Explain how does the function of the magnetic field in a TWT differ from its function in a magnetron.

29. Discuss the performance and operation of a Gunn diode amplifier.

30. Discuss the performance and applications of Schottky-barrier diode.

31. Show an encapsulated IMPATT diode, and describe one of its applications.

$(6 \times 4 = 24)$

Part D

Answer any **two** *questions.*
Each question carries 15 *marks.*

32. Derive the expression for line impedance of a transmission line at a distance from the load. Show that infinite line is equivalent to a finite line terminated on its characteristic impedance.

Turn over

33. Describe with necessary diagrams, explain the TE, TM and TEM waves in a rectangular waveguide. What are the differences in propagation among them ?

34. Name the three important microwave tubes that can be used as microwave amplifiers. Briefly describe the principle of operation of each one of them.

35. What are avalanche transit time devices ? Explain the operation, construction and applications of : (i) IMPATT ; (ii) TRAPATT.

$(2 \times 15 = 30)$