2021

ELECTRONICS — HONOURS

Fifth Paper

Full Marks : 100

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Group - A

(Marks : 50)

Answer **question no.** **1** and **four** other questions taking **two** from each **Unit**.

1. Answer **any five** of the following :   2×5

   (a) What is Skin effect?

   (b) State Poynting Theorem.

   (c) State and explain the Third Electromagnetic equation of Maxwell.

   (d) What do you mean by normal and anomalous dispersion?

   (e) What is reflection coefficient in a transmission line?

   (f) Explain the characteristic impedance of a transmission line.

   (g) Why FM is considered better than AM?

   (h) What are 'partition noise' and 'flicker noise' ?

Unit - I

2. (a) Using Poynting theorem, show that the power flow along a concentric cable is the product of dc voltage between the conductors and steady current flowing in the conductors.

   (b) How Maxwell modified Ampere's Law?

   (c) Starting from Maxwell's equations show that in a non-conducting medium

   $$\nabla^2 \vec{E} - \mu \in \frac{\partial^2 \vec{E}}{\partial t^2} = 0$$

   where μ and ε are the permeability and permittivity of the medium respectively.   3+2+5

3. (a) What is phase velocity?

   (b) Explain how the terms 'good' and 'poor' conductors depend on frequency.

   (c) What are Fresnel's equations?

Please Turn Over

(d) Given two media of which medium-1 is free space and medium-2 is a dielectric with $\varepsilon_2 = 4\varepsilon_1$ and $\mu_1 = \mu_2$. Determine the reflection coefficient for oblique incidence with $\theta_1 = 30°$ for perpendicular polarization. 2+3+2+3

4. (a) Discuss the possible reasons for distortion in a transmission line. Derive the condition for distortion-less line and show that it is unique for each case.

(b) What is standing wave in a transmission line?

(c) State the advantages of waveguide over transmission line. (2+4)+2+2

5. (a) For transverse electric waves perfectly propagating in a rectangular wave guide with perfectly conducting walls, find

(i) the group velocity in the guide, and

(ii) the Cut-off wavelength.

(b) What are TE and TM modes? Why TM_{10} mode is not possible in a rectangular wave guide?
(3+3)+(2+2)

Unit - II

6. (a) What are the different ways by which radio waves propagate?

(b) Show that in space wave propagation the height of the antenna determines the range of line of sight propagation.

(c) Illustrate pictorially the structure of Ionosphere above Earth's surface showing typical heights of different layers. 2+4+4

7. (a) What is modulation index for amplitude modulation?

(b) What are the different kinds of AM?

(c) Why cannot SSBSC signal be used for 'compatible' AM broadcasting? What form of SSB can be used for this purpose?

(d) What do you mean by demodulation? 2+2+4+2

8. (a) Explain how a signal can be reconstructed from its samples. What will happen if the samples are taken at a rate less than Nyquist rate?

(b) Explain the advantages of pulse modulation over CW modulation.

(c) What is pulse width modulation (PWM)? How does it differ from pulse position modulation (PPM)? (3+1)+2+(2+2)

Group – B

(Marks : 50)

Answer question no. **9** and *four* other questions taking at least *one* from each **Unit**.

9. Answer *any five* of the following : 2×5

   (a) State the merits and demerits of IMPATT diode.

   (b) State Fermat's principle.

   (c) How does strapping prevents mode jumping in cavity magnetron?

   (d) What is Rayleigh criterion for limit of resolution?

   (e) What do you mean by numerical aperture of a step index fibre?

   (f) What is population inversion?

   (g) Explain the concepts of temporal and spatial coherence of light.

   (h) What do you mean by optic axis?

Unit - I

10. (a) What are the functions of the two cavities in klystron amplifier? Describe how 'velocity modulation' and 'current modulation' are achieved in a two-cavity klystron amplifier.

    (b) Why is a two cavity klystron amplifier not usually constructed? (2+6)+2

11. (a) Why is reflex klystron much less efficient than multi-cavity klystron?

    (b) What is transit time as applied to the reflex klystron? Why is it so important in this device?

    (c) What is mode number? Establish its relationship with transit time. 3+(2+2)+(1+2)

Unit - II

12. (a) Using energy band diagrams, explain the tunnel diode characteristic (I-V curve). Draw the equivalent circuit of the tunnel diode.

    (b) What is transferred electron mechanism?

    (c) Why elemental semiconductors like Si, Ge are not suitable for fabrication of Gunn diode?
    (3+3)+2+2

13. Write down the full from of IMPATT. Draw the schematic diagram of an IMPATT diode and explain how negative resistance is achieved in this device. How does the tunnel diode differ from the usual rectifier diode? 1+7+2

Unit - III

14. (a) Explain how the wavelength of light can be measured with the help of a Fresnel bi-prism. Deduce the theory you use.

    (b) Distinguish between interference and diffraction.

    (c) Why is interference not observed by two ordinary and independent sources? (2+4)+2+2

Please Turn Over

15. (a) Explain the terms (i) uni-axial crystal and (ii) optic axis of a crystal.

 (b) What do you mean by double refraction of light? Distinguish between ordinary and extra-ordinary rays.

 (c) What is Brewster's law? 4+4+2

16, (a) Establish the relation between the Einstein's A and B coefficients.

 (b) What do you mean by optical pumping?

 (c) What is stimulated emission? 6+2+2

17. (a) What do you mean by a mode as applied to an optical fibre? Distinguish between single mode and multimode fibres.

 (b) If the core and cladding of an optical fibre has refractive indices μ_1 and μ_2 respectively, prove that the maximum value of the entrance angle from air is

$$\sin^{-1}\sqrt{\mu_1^2 - \mu_2^2}\,.$$

(2+3)+5

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