

**Total Pages—8**

**UG/II/ELECT/H/IV/16(Old)**

**2016**

**ELECTRONICS**

**[ Honours ]**

**PAPER – IV (Theory)**

*Full Marks : 90*

*Time : 4 hours*

*The figures in the right hand margin indicate marks  
Candidates are required to give their answers in their  
own words as far as practicable*

*Illustrate the answers wherever necessary*

**[ OLD SYLLABUS ]**

**GROUP – A**

**Answer any two questions : 15 × 2**

**1. (a) Starting from Maxwell's field equation.**

**(i) Derive the wave equation for electric and magnetic fields in free space.**

*( Turn Over )*

(ii) Show that electric, magnetic field vectors and propagation vector are all mutually perpendicular.

(iii) Show that

$$\vec{B} = \frac{1}{c} (\hat{n} \times \vec{E})$$

(Symbols have their own meanings)

(b) Describe the state of polarization of EM wave represented by

$$\vec{E}(z,t) = \hat{i} E_0 \cos(kz - \omega t) - \hat{j} E_0 \cos(kz - \omega t)$$

(c) State and establish Poynting theorem. Express this theorem in the following differential form,

$$\frac{\partial u}{\partial t} + \nabla \cdot \vec{S} = 0$$

where,  $\vec{S}$  is the Poynting vector and  $U$  is the total *em* energy density.

(2+3+2)+3+(1+2+2)

2. (a) Describe with suitable diagrams the principle, construction and working of a Ruby laser.

(b) What is high power laser ?

(c) Calculate the gain constant of a laser having the parameter : Inversion density  $(n_2 - n_1) = 5 \times 10^{22}/\text{m}^3$ , wavelength = 650 nm; life-time for spontaneous emission =  $2 \times 10^{-4}\text{S}$  and line width  $\Delta\lambda = 15 \text{ \AA}$ . 15

3. (a) Consider an em wave travels through an ionised medium containing  $N$  electron/CC, each of charge and mass  $e$  and  $m$  respectively, then prove that the refractive index of the ionised layer is given by

$$\mu = \sqrt{1 - \frac{Ne^2}{\pi m f^2}}$$

where  $f$  is the frequency of the *em* wave.

(b) Using the above calculation explain 'skip distance' and 'maximum usable frequency'. 15

4. (a) What are the importance of algorithm and flowchart ?

(b) Write a flowchart to pick the largest of three numbers.

- (c) What is looping ? Explain the term 'endless loop' ?
- (d) Describe the meaning of the following batch file command
- (i) ECHO
  - (ii) REM
  - (iii) CALL
  - (iv) SHIFT
- (e) Write a short note about constants in BASIC.
- $3+3+(1+1)+4+3$

GROUP – B

Answer any five questions : 8 × 5

5. (a) What do you mean by half wave dipole and oscillating electric dipole ?
- (b) Derive an expression of powers radiated by a current element. (2 + 2) + 4
6. (a) Write differences between Laser and Maser.

- (b) What do you mean by population inversion? Explain, how population inversion is done by optical pumping, excitation by electron and collision between atoms.  $2+(1+5)$
7. (a) What is fading? What are the reasons of fading?
- (b) An em wave is incident at an angle of  $50^\circ$  on an ionospheric layer with peak electron density of  $7 \times 10^{11}/\text{m}^3$ . Calculate the maximum frequency for which the wave will be received at the skip distance. Find the skip distance if the virtual height of reflection is 200 km.  $(2+2)+(2+2)$
8. (a) What do you mean by single mode and multimode optical fibre?
- (b) The core diameter of a multimode fibre is  $70 \mu\text{m}$  and the relative refractive index difference is of 1.5%. If the refractive index of the fiber is 1.46, then calculate the refractive index of the cladding.
- (c) Write the difference in principle of light emitting diode (LED) and photodiode.  $3+2+3$

9. (a) Write the basic assumption, assumed by Lorentz to explain dispersion effect.
- (b) Derive Lorentz dispersion equation and explain normal and anomalous dispersion effect.  $2+(3+3)$
10. (a) Write basic principle of operation of a photo transistor.
- (b) Write principle of holographic recording and reconstruction. Write some application of holography.  $3 + (3 + 2)$
11. (a) What is Disk operating system ? What are the main functions of DOS ?
- (b) Write the uses and the syntax of the following Dos command :  $(1\frac{1}{2}+2) + (1\frac{1}{2}\times 3)$
- (i) Copy
- (ii) DEL
- (iii) MOVE.
12. (a) What are system and application softwares ? Give examples.

- (b) Explain translators, compiler, interpreter and assembler. (1 + 1) + (1½ × 4)

GROUP – C

Answer any five questions : 4 × 5

13. Draw a flowchart to calculate the product of  $2 \times 2$  matrices. 4
14. Write the characteristic feature of 'Ethernet Protocol'. 4
15. What do you mean by LAN? Write the difference between LAN and WAN. Write one example each. 1+2+1
16. Show that the magnetic vector potential  $\vec{A}$  satisfies the equation  $\nabla^2 \vec{A} = -\mu_0 \vec{J}$  provided  $\nabla \cdot \vec{A} = 0$ ,  $\vec{J}$  being current density. 4
17. "Sky wave reception is better at night than at day" – Why? 4
18. What is troposphere? How does it help in radio wave Propagation? 2+2

19. What is wave guide ? What do you mean by TE, TM and TEM waves ? 1+(1×3)
20. What is microcomputer ? How do micro-computers differ from main frame and mini computers ? 1+3

[ *Internal Assessment* – 10 marks ]

---