

2007**ELECTRONICS****PAPER-IV***Full Marks ' 75**Time : 3 hours*

The figures in the right-hand margin indicate full marks.

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

Write the .answers questions of each Group in separate books.

Answer Q.No..1 and any three from the rest in each.grouip.

Group - A*(Marks : 40)*

1. (a) Is it possible for the contact potential V_0 of a p-n junction to exceed the band gap E_g ? Explain.
- (b) Draw the energy-band diagram of a metal-p type semiconductor in intimate contact.
- (c) What is a hot electron ?
- (d) Neatly draw I-V characteristics of a JFET. Show different regions, V_p , I_{sat} and V_{sat} in the drawn figure.
- (e) Show the structure and the circuit representation of an SCR. 2x5

(Turn Over)

2. (a) **Deduce** Shockley equation for a p-n junction diode.
- (b) Draw the ideal and experimental I-V characteristics of a p-n junction diode. 7+(12 + 1 2)
3. (a) What is a Schottky effect ? Calculate the Schottky barrier lowering to metal-semiconductor systems.
- (b) Giving a diagram, explain different current transport processes in metal-semiconductor contacts under forward bias.
- (c) When does a metal-semiconductor contact behave as an ohmic contact? Explain. (1+3)+(1+2)+(1+2)
4. (a) Draw a neat diagram of a microwave transistor.. Deduce an explicit expression of cut-off frequency **relating to** the physical structure of the transistor.
- (b) What are first and second breakdowns ? (2+5)+(12 + 1 2)
5. (a) Derive the current-voltage characteristics for a long and uniformly doped channel FET.
- (b) What is a multichannel FET? Explain. 6+(1+3)
6. (a) **Explain** the principle of operation of an SCR. Mention **some its uses**.
- (b) What are the basic requisites for the design of a good rectifying diode ? How can its switching speed be increased ? (4+2)+(2+2)

Group - B

(Marks : 35)

1. Answer the following : 5
 - (a) Write an example of 4-level laser system.
 - (b) Tick the right answer
The unit of numerical aperture is -
(i) °(degree), (ii)- cm², (iii) -°(degree)/cm², (iv) unitless.
 - (c) Write down the symbol of LDR.
 - (d) Give an example of a non-linear material.
 - (e) In holography what do we record?

2. (a) Explain Q-factor of a passive resonator. 2
 - (b) Discuss with necessary mathematical steps why we should adopt three or four level laser system instead of two level one. 6
 - (c) What is the photon-energy for a laser beam of wavelength 0.6 μm ? 2

3. (a) **Discuss**, in brief, why Q-switching is required for laser beam. Explain the concept of shutters used in **laser emission**. **1+2**
 - (b) Describe Q-switching process using electrooptic and acoustroptic methods. 4+3

4. (a) What are the advantages of optical fibre in connection with communication ? 3

- (b) Explain different types of optical fibres. 2
- (c) What do you mean by intermodal and intramodal dispersion ? 1+1
- (d) An optical fibre has refractive indices of the core and cladding as $\mu_{\text{core}} = 1.52$, $\mu_{\text{clad}} = 1.49$.
Determine – (i) the critical angle at the core-cladding interface, (ii) numerical aperture of the fibre, (iii) acceptance angle when the fibre is surrounded by air. 3
5. (a) What are meant by linear and non-linear media? 3
- (b) Discuss how second harmonic of an incident wave could be generated in a non-linear material. 5
- (c) What is meant by - self focussing ? 2
6. Write short ' notes on (any two) : 5'x 2'
- (a) LED as optical source.
- (b) Any semiconductor laser.
- (c) Basic holographic equations.
- (d) Principle of operation of PIN photodiode.