# OPTO ELECTRONIC DEVICES & CIRCUITS ( SEMESTER - 6 )

## CS/B.TECH (ECE-O)/SEM-6/EC-601/09

**Reg. No.**

**Roll No. of the Candidate**

---

### CS/B.TECH (ECE-O)/SEM-6/EC-601/09
#### ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
## OPTO ELECTRONIC DEVICES & CIRCUITS ( SEMESTER - 6 )

Time : 3 Hours ]                                   [ Full Marks : 70

## INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.

2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question.**

   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.

3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.

4. Read the instructions given inside carefully before answering.

5. You should not forget to write the corresponding question numbers while answering.

6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.

7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**

8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.

9. Rough work, if necessary is to be done in this booklet only and cross it through.

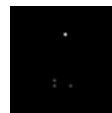**No additional sheets are to be used and no loose paper will be provided**

### FOR OFFICE USE / EVALUATION ONLY
#### Marks Obtained

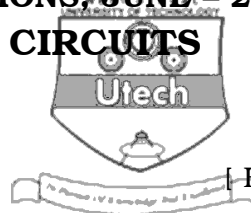| Question Number | Group – A | | | | | | | | | | Group – B | | | Group – C | | | Total Marks | Examiner's Signature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Marks Obtained | | | | | | | | | | | | | | | | | | |

......................................................
**Head-Examiner/Co-Ordinator/Scrutineer**

6603 (03/06) (O)

**DO NOT WRITE ON THIS PAGE**

## ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
# OPTO ELECTRONIC DEVICES & CIRCUITS
## SEMESTER – 6

Time : 3 Hours ]                                                    [ Full Marks : 70

### GROUP – A
### ( Multiple Choice Type Questions )

1.   Choose the correct alternatives for any *ten* of the following :        $10 \times 1 = 10$

   i)   What is the relation between core-cladding refractive index of an optical fibre $( n_1 \rightarrow$ core, $n_2 \rightarrow$ cladding $)$ ?

   a)   $n_1 < n_2$            b)   $n_1 > n_2$

   c)   $n_1 = n_2$            d)   none of these.

   ii)  LED can be used in

   a)   analog communication      b)   digital communication

   c)   both of these             d)   none of these.

   iii) The highest wavelength of radiation which is the most suitable for fibre optic communication system is

   a)   652 nm             b)   1080 nm

   c)   1550 nm            d)   2550 nm.

   iv)  In a birefringent crystal

   a)   the *o*-ray follows Snell's law but the *e*-ray does not

   b)   the *e*-ray follows Snell's law but the *o*-ray does not

   c)   both of the *o*-ray and *e*-ray follow Snell's law

   d)   both of the *o*-ray and *e*-ray do not follow Snell's law.

v)    The Fourier transform of a discrete and periodic sequence is

    a)    discrete and periodic          b)    continuous and aperiodic

    c)    continuous and periodic        d)    discrete and aperiodic.

vi)   Which of the following errors arise(s) due to quantization of numbers ?

    a)    Input quantization error       b)    Product quantization error

    c)    Coefficient quantization error    d)    all of these.

vii)  Which one of the following properties of light beam cannot be modulated ?

    a)    Intensity                     b)    Polarisation

    c)    Speed                       d)    Phase.

viii) Advantage of digital signal processing over analog signal processing is

    a)    greater accuracy           b)    flexibility in configuration

    c)    digital realization is cheaper    d)    all of these.

ix)   Which of the following detectors gives amplified output ?

    a)    PN-photodiode           b)    PIN photodiode

    c)    Avalanche photodiode      d)    Photovoltaic detector.

x)    Which of the following materials is not suitable for making an LED ?

    a)    Ga A S                     b)    Silicon

    c)    In Ga As P              d)    Ga Al As.

xi)   The output of a causal system

    a)    does not depend on the inputs

    b)    depends on the present and past inputs

    c)    depends on the present and future inputs

    d)    depends on the past and future inputs.
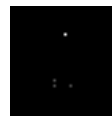
## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following questions.                     3 × 5 = 15

2.  What is the operating principle of a solar cell ? Why are these considered so very important ?

3.  Make a comparison between graded index fibre and step index fibre with regard to multimode propagation.

4.  Write down the advantages of optical fibre communication.

5.  Draw the Direct Form I and Direct Form II realizations for the system described by the difference equation :

    $y ( n ) – 0·75 \, y ( n – 1 ) + 0·11 \, y ( n – 2 ) = x ( n ) – 0·5 \, x ( n – 1 )$.

6.  What is numerical aperture of an optical fibre ? Find out the expression for numerical aperture.

## GROUP – C

### ( Long Answer Type Questions )

Answer any *three* of the following questions.                     3 × 15 = 45

7.  a)  Discuss the operation of Opto-electronic integrated circuits.

    b)  Explain the operation of Front-end photo-receivers.

    c)  Explain the operation of OEIC transmitter.

    d)  Distinguish between hybrid & monolithic integrations and discuss their relative merits & demerits.                     5 + 3 + 3 + 4
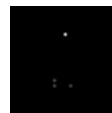
8. a)    What do you mean by MOSFET scaling ? What are different size reduction

strategies ?

b)    What is the effect of scaling on threshold voltage ? Give a comparison between

constant field scaling & constant voltage scaling.

c)    What are the physical parameters on which threshold voltage of a MOS transistor

depends ?                                                                ( 2 + 4 ) + 4 + 5

9. a)    What are the advantages of FIR filter over IIR filter ?

b)    Design an FIR filter with a frequency response

$H ( \omega ) = 1, \quad \pi/4 \le | \omega | \le \pi$

$= 0, \quad 0 \le | \omega | \le \pi/4.$

using Hamming window for $N = 11$. Hence write the transfer function of the

realizable filter.                                                        3 ( 10 + 2 )
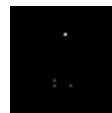
10. a)    What do you mean by population inversion ?

b)    With the help of suitable diagram, show how population inversion is obtained

during the operation of diode laser.

c)    How can electrical & optical confinement be achieved in a double-heterojunction

laser ?

d)    State the principle & construction of quantum well laser.            2 + 7 + 3 + 3

11. a) Define carrier generation rate in photo-detector. How does it depend on incoming photon energy ?

b) Show that, in a photodiode under photoconductive mode of operation, the photocurrent is linearly dependent on the incident optical power.

c) What are the factors that limit the speed on operation of a photodiode ?

d) Light from a Ga As laser at $h\upsilon \sim 1.43$ eV impinges on a Si PIN detector with I-region $\sim 10$ μm. If the optical power of the source $\sim 1$ W/cm$^2$, calculate the photocurrent density of the detector. Use $\alpha$ value of Si at Ga As operating wavelength $\sim 700$ cm$^{-1}$ here.          ( 2 + 2 ) + 5 + 3 + 3

12. Write short notes on any *five* of the following :          $5 \times 3$

a) Chromatic and intermodal dispersions

b) Temporal and spatial coherences

c) Difference between regenerator and optical amplifiers

d) Optical Time Domain Reflectometry

e) Difference between skew rays and leaky rays in a fibre

f) Mode locking in Lasers

g) Quantum efficiency of direct band gap material.

END