# PRABHAT KUMAR COLLEGE, CONTAI

**M. Sc. 4$^{TH}$ Semester Examinations 2021**
**(Under CBCS pattern)**

**Subject    :    Physics**

**PAPER/COURSE – PHS: 403**

**FULL MARKS : 40**

**TIME : 02 Hr.**

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

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

## 403.1: Semiconductor devices

*Attempt any Two (02) of the following:*                    *2 x 10 = 20*

**1 a.** Write down the working principle of a phototransistor?                    2
b. Draw a circuit diagram to study the current-voltage characteristics of SCR and explain the working mechanism of the SCR.                    6
c. Make a comparison between thyristor and transistor.                    2

**2 a.** Assuming Boltzmann transport equation derive the expression of electron mobility $\mu_n$ in terms of relaxation time $\tau$ for non-degenerate semiconductor. Show that in case of ionized impurity scattering $\mu_n$ vary with temperature as $T^{3/2}$.                    8
**b.** What is meant by nondegenerate semiconductor? Which statistics is valid for carrier distribution in nondegenerate semiconductor?                    2

**3 a.** Draw a band diagram of an abrupt p-n junction diode of degenerate semiconductors under zero bias condition. Explain the current flow through this junction under forward bias condition and draw the corresponding band diagram                    7
**b.** Explain the origin of negative differential mobility in Gunn diode.                    3

**4 a.** Explain the working principle of DIAC.                    3

**b.** Describe the population inversion of a semiconductor laser                    3

**c.** Explain mini band formation in case of super lattice structure                    4

**(**Internal Assessment - 5)

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## 403.2: Applied Optics

*Attempt any Two (02) of the following:* **2 x 10**

1. Write some characteristics of V-parameter. Show that the ray path in a graded index fiber is sinusoidal. A multimode fiber has a core r.i. 1.46 and diameter 60 μm. The relative r.i. difference is 2.0%. Its operating wavelength is 8.0 μm. Calculate (i) r.i. of cladding, (ii) V-number, and (iii) total number of guided modes supported by the fiber.

$$2+4+(1.5+1.5+1)$$

2. What is multipath broadening in an optical fiber? Obtain an expression for this multipath broadening of pulse. Obtain the expression for TE symmetric mode of light in a planer waveguide. $1+3+6$

3. What do you mean by second harmonic generation of laser? What do you mean by phase matching condition? Discuss, the method of obtaining the second harmonic light from a non-linear material with supporting figure. $1+2+7$

4. What is Raman-Nath diffraction? Explain various diffraction modes in Raman-Nath diffraction with necessary mathematical analysis. $2+8$

(Internal Assessment - 05)