MID SEMESTER TEST - 1

B.TECH. - I Year/I Semester (Branches: BM, CE, CSE, EC and EE)

PH10009: APPLIED PHYSICS (THEORY)

Time : 1 hour | Date: Sept. 25, 2025 | Max Marks : 20

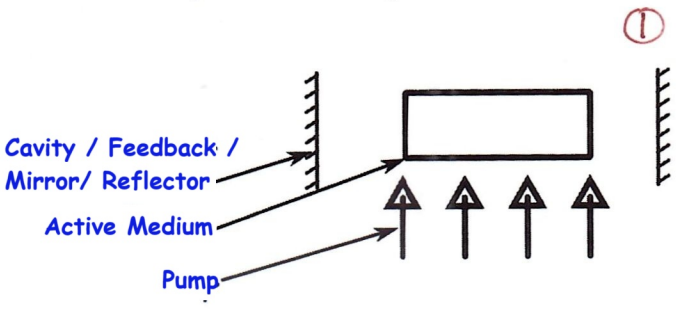
Name: _____ _____ Class Roll Number: 25_ _ _ _ _

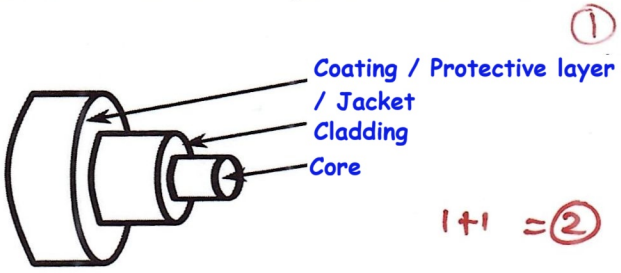
Signature of Student:_____ Signature of Invigilator:_____

Signature of Examiner:_____ _____ _____

All questions are compulsory. Given: $\hbar = 1.054 \times 10^{-34}$Js and $c = 3 \times 10^{8}$m/s.
No extra sheets will be given. If required, use margin space for rough work.

S.No.	Question	Mark	CO	BL
1	Components of an optical fiber and a laser are shown. Name each component.	2	1,2	2





1 + 1 = 2

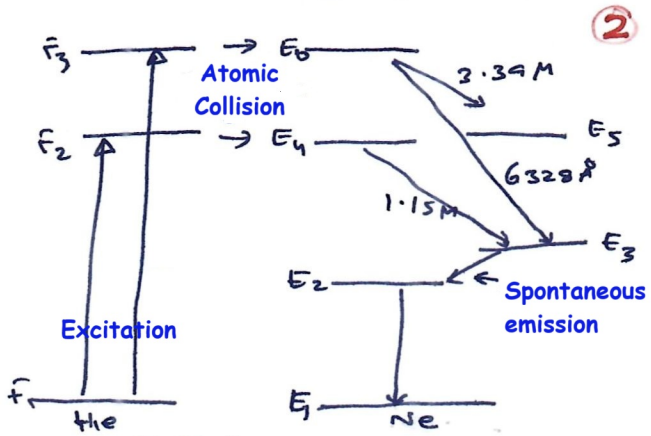
S.No.	Question	Mark	CO	BL
2	Match the following (draw arrows or lines).	1	1,2	4

(a) Numerical aperture — (p) $\hbar\omega^3 n_0^3/\pi^2 c^3$
(b) Population inversion — (q) $V^2/2$
(c) Ratio of Einstein's A/B — (r) $\sqrt{n_{core}^2 - n_{cladding}^2}$
(d) Number of modes of SIF — (s) $N_2 - N_1 \geq 0$.

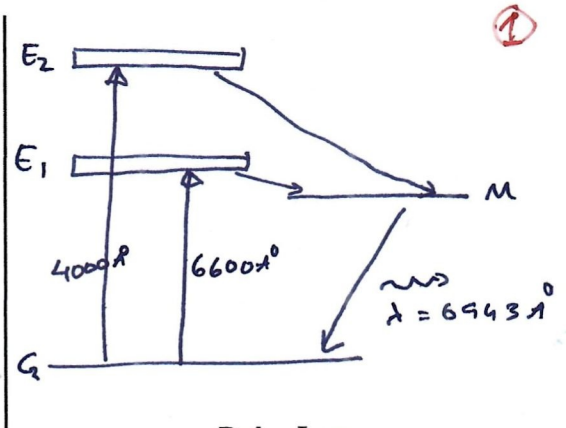
(a) – (r)
(b) – (s)
(c) – (p)
(d) – (q)

0.25 × 4 = 1

S.No.	Question	Mark	CO	BL
3	Draw the energy diagrams only for the He-Ne and Ruby Lasers	3	1	1



He-Ne Laser



Ruby Laser

2 + 1 = 3

S.No.	Question	Mark	CO	BL
4	An optical fiber of core radius 10μm. guides light of wavelength 1500nm having core and cladding refractive index of 1.48 and 1.46, respectively. Calculate the following:	4	2	5

(a) Numerical Aperture = 0.242
(b) V-parameter = 10.157
(c) Number of modes guided = 51
(d) Acceptance angle = 14°

1 × 4 = 4

S.No.	Question	Mark	CO	BL
5	Mention the major contribution (Device/Phenomenon/Invention) of following Indians:	2	1.2	6

$\frac{1}{2} \times 4 = 2$

(a) C.K.N. Patel = CO_2 Laser

(b) N.S. Kapany = Fiber Optics / Optical fiber

(c) M.L. Bhaumik = Excimer Laser

(d) S.N. Bose = distribution function / BBD Theory / Boson / identical particle

6	The ^2P to ^2S transition of Hydrogen atom corresponds to emission of photon wavelength 121.6nm. The spontaneous emission lifetime of ^2P state is 1.6ns. Find the Einstein's A and B Coefficients. Assume $n_0 = 1$.	4	1	4

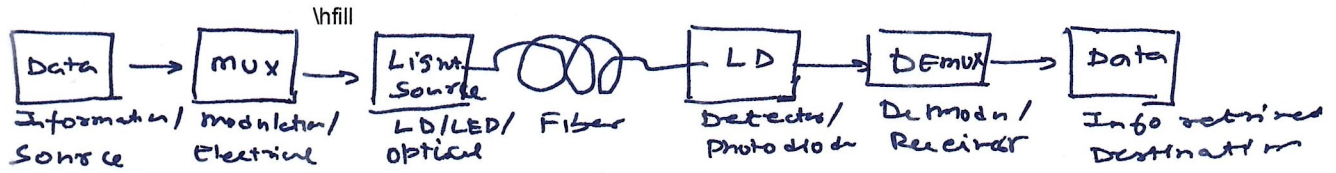
1 + 2 = 3

(a) A_{21} = 6.25×10^8 Hz (or s^{-1}) $1 + \frac{1}{2} = 1\frac{1}{2}$ for correct units = 1

(b) B_{21} = 5.94×10^{-15} kg/sm (or J.s/m) $2 + 1/2 = 2\,1/2$

3 + 1 = 4

7	Draw a neat sketch of fiber optic communication system for long distance communication of data with all components. Use pen or pencil only.	2	2	3

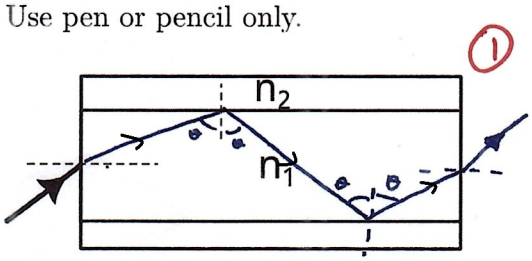


2

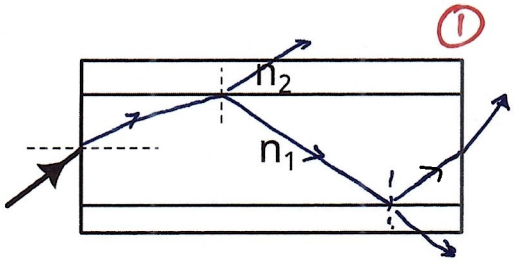
FOC for long distance communication

8	A input ray is launched to an optical fiber. In case -1, $n_1 > n_2$ and in case -2, $n_1 < n_2$, complete the raytracing all the rays till end of the fiber in both cases. Use pen or pencil only.	2	2	6

1 + 1 = 2



Case -1



Case -2

USE THIS SPACE FOR ROUGH WORK