

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: M.Sc./I.M.Sc./Pre-PhD
BRANCH: PHYSICS

SEMESTER : III/IX/I
SESSION : MO/2023

SUBJECT: PH503 LASER PHYSICS AND APPLICATIONS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1(a)	Compare the phenomena of spontaneous emission and stimulated emission.	[5]	01 02
Q.1(b)	Explain the mechanism of natural broadening in atomic lines.	[5]	01 02
Q.2(a)	For a rectangular cavity of size $2a=2b=d=500$ nm, estimate the wavelength of oscillation for (i) $m=0, n=1, q=0$ (ii) $m=1, n=1, q=0$ (iii) $m=1, n=1, q=1$ and (iv) $m=2, n=0, q=0$.	[5]	02 05
Q.2(b)	The output of a He-Ne laser ($\lambda = 6328$ Å) can be assumed to be Gaussian with plane phase front. For $w_0 = 1$ mm and $w_0 = 0.2$ mm, estimate the beam diameter at $z = 20$ m.	[5]	02 05
Q.3(a)	Outline two methods for Q-switching.	[5]	03 02
Q.3(b)	A Rh6G dye laser operating over its entire gain bandwidth (570-640 nm) with the cavity mirror separated by 2m. The RI of the dye solution is 1.4. Estimate the mode-locked pulse width Δt_p and the pulse separation Δt_{sep} . Consider the central wavelength as the laser wavelength.	[5]	03 05
Q.4(a)	Design and discuss He-Ne laser operation.	[5]	04 06
Q.4(b)	Discuss the working principle of Ruby laser.	[5]	04 06
Q.5(a)	Analyze the role of laser in metal cutting.	[5]	05 04
Q.5(b)	Explain the process involved in laser Doppler velocimetry.	[5]	05 02

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