K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

May-June 2023	
Program: B. Tech Scheme I/II: II	
Examination: FY Semester: II	
Course Code: BSC202 and Course Name: Physics and Nanotechnology	
Date of Exam: 16-06-2023 Duration: 02 Hours	Max. Marks: 45

Instructions:
(1) All questions are compulsory.
(2) Draw neat diagrams wherever applicable.
(3) Assume suitable data, if necessary.

			Max. Marks	CO	BT level
Q 1	**Solve any 5 questions out of six.**		**15**		
i)	Why meta-stable state is essential for lasing action? Explain significance of population inversion in Lasers.		3	2	2
ii)	What is the advantage of graded index optical fiber over the step index optical fiber?		3	3	2
iii)	Determine the curl of vector field $\vec{B} = yz\,\hat{x} + 4xy\,\hat{y} + y\,\hat{z}$ at point $(1, -1, 0)$		3	4	3
iv)	What do you mean by surface to volume ratio? How surface to volume ratio changes chemical properties in nanomaterials?		3	5	2
v)	Explain the statement: "Magnetic monopole does not exist" using Maxwell's equation.		3	4	3
vi)	For a grating having 25200 lines / inch, how many orders of primary maxima are possible to see, when Na-light is used as an incident ray? (For Sodium λ= 5893 Å)		3	1	3
Q.2	**Solve any three questions out of four.**		**15**		
i)	In Fraunhoffer diffraction at single slit, resultant amplitude of wave disturbance arriving at any point P on screen is $E_\theta = E_m \frac{\sin\alpha}{\alpha}$ where $\alpha = \frac{\pi}{\lambda} a \sin\theta$ (Symbols have their usual meaning). Obtain conditions for principal maxima, minima and secondary maxima.		5	1	2
ii)	Calculate minimum number of lines required on the grating so that it will just resolve the sodium lines in the first order spectrum. The wavelengths are 5890A^0 and 5896A^0.		5	1	3
iii)	With a neat labeled explain construction and working of Nd:YAG laser. What is the wavelength of Nd:YAG laser?		5	2	2

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iv)	Derive the expression for numerical aperture for a step index optical fiber. The numerical aperture of an optical fibre is 0.5 and core refractive index is 1.54. Find refractive index of cladding.	5	3	3
Q.3	**Solve any three questions out of four.**	15		
i)	State Faraday's law and hence obtain differential form of Maxwell's third equation for static field and time varying field.	5	4	2
ii)	Show that divergence of a curl is zero.	5	4	3
iii)	What is gradient of a scalar field? What is its significance? Find the gradient of $V = x^2 + y^2 + z$	5	4	3
iv)	Classify nanomaterials based on dimensions.	5	5	2

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