13-05-2026 FE SEM-II (ALL BRANCHES) C SCHEME EP-II QP CODE: 20012539

Time: 2 Hours **Maximum Marks: 60**

i. Question number 1 is compulsory
ii. Attempt any three questions from Q2 to Q6
iii. Assume suitable data wherever required
iv. Figures to the right indicate full marks for that question

Q 1 Attempt any five out of six (3 marks each) **15**

A Explain the concept of metastable state in lasers.
B Find the gradient at a point (1, 1, 1) for a scalar field F = x^2yz^3
C Calculate the rate of decrement in mass if a star is radiating energy at the rate of $5 \times 10^{-20} Js^{-1}$.
D What is diffraction? Illustrate by drawing a neat diagram of any one type of diffraction. How can the resolving power of a grating be increased?
E A step index fibre has a core diameter of 29 μm. The refractive indices of core and cladding are 1.52 and 1.5189 respectively. If the light of wavelength 1.3 μm is transmitted through fibre, determine normalized frequency and the number of modes the fibre will support.
F Explain the method of Ball Milling to prepare nanomaterial.

Q.2. Attempt All Questions **15**

A Discuss with diagram the phenomenon of Fraunhofer diffraction at a single slit and write the conditions for its maxima and minima. **8**
Find the order of diffraction if a diffraction grating is used at normal incidence for a line 'A' of wavelength 6000 Å in a certain order being superimposed on another line 'B' of the next higher order having wavelength 4000 Å. Now if the angle of diffraction for the line A is 45°, then how many lines per cm are there in this grating for the above obtained order?
B Explain the working of Nd-YAG laser with a neat labelled energy diagram and its applications. **7**

Q.3. Attempt All Questions **15**

A What are Lorentz transformations? Obtain transformation equation for Time dilation. **8**
B What are the different types of Sensors? Explain the Resistive sensor in detail. **7**

Q.4. Attempt All Questions (5 marks each) **15**

A What is Plane transmission grating? Explain resolving power of the diffraction grating.
B What is the divergence of a vector field? Compute divergence of vector field $\overrightarrow{F} = xyz\,\hat{\imath} - 3x^3y^2z^2\hat{\jmath} + xy^2z\,\hat{k}$ at (1, 1, -1).
C Write applications of nanotechnology in different fields.

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Q.5. Attempt All Questions (5 marks each) **15**

A Explain Gauss's laws for static electric and static magnetic fields in differential and integral forms.

B Explain the Piezoelectric sensor in detail.

C What is Holography? Explain the reconstruction process of a hologram with a neat labelled diagram.

Q.6. Attempt three questions (5 marks each) **15**

A With a neat labelled diagram explaining the construction and working of a Tunneling electron microscope (TEM).

B Differentiate between Step index and Graded Index.

C With a neat labelled diagram explain the construction and advantages of a PT100 temperature sensor.

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