RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

FIRST YEAR [2018-21]

B.A./B.Sc. FIRST SEMESTER (July – December) 2018

Mid-Semester Examination, September 2018

Date : 26/09/2018 **PHYSICS (General)**

Time : 12 noon -1 pm Paper : I Full Marks : 25

(Answer any <u>five questions</u> taking at least <u>one</u> from each group) [5×5]

Group – A

1. (a) If $\vec{A} = A_1\hat{i} + A_2\hat{j} + A_3\hat{k}$ be any vector then prove that $\vec{A} = (\vec{A}.\hat{i})\hat{i} + (\vec{A}.\hat{j})\hat{j} + (\vec{A}.\hat{k})\hat{k}$ [2]

   (b) Find an equation of the plane perpendicular to the vector $\vec{A} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ and passing through the terminal point of the vector $\vec{B} = \hat{i} + 2\hat{j} + 3\hat{k}$ [3]

2. (a) Find $\vec{\nabla}\phi$ if $\phi = \ln|\vec{r}|$ [2½]

   (b) Show $\vec{\nabla}\phi$ in a vector perpendicular to the surface $\phi(x, y, z) = c$ where c is a constant. [2½]

3. (a) Find $\vec{\nabla} \times (\vec{r}\, f(r))$ where f(r) in differentiable. [3]

   (b) State the Green's theorem in the plane. [2]

4. (a) If Y, K and σ represent Young's modules, Bulk modules and Poisson's ratio respectively, then prove that $K = \dfrac{Y}{3(1-2\sigma)}$ [4]

   (b) If η = 8×10^{11} N/m^2 and Y = 20×10^{11} N/m^2 for iron, calculate Poisson's ratio. The symbols above have usual meaning. [1]

5. (a) Obtain the expression for depression of supported and fixed beam, centrally loaded. [4]

   (b) A steel rod of length 50 cm, width 2 cm and thickness 1 cm is bent into the form of an arc of radius of curvature 2 m. Calculate the bending moment. Young's modules of the material of rod =2×10^{11} N/m^2. [1]

Group – B

6. State Fermat's principle ? How can you establish the laws of refraction from the principle. [5]

7. If the refractive index of glass from air is $\dfrac{3}{2}$ and that from air to water is $\dfrac{4}{3}$, show that the focal length of a glass lens in water is four times the focal length in air. [5]

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