POSSESSION OF MOBILES IN EXAM IS UFM PRACTICE

Name of student ____________________ **Enrollment No.**__________

BENNETT UNIVERSITY, GREATER NOIDA

B. TECH/ TEST – Make up Minor (17.11.17): FALL SEMESTER A.Y. 2017-2018

COURSE CODE	EPHY103L	MAX. TIME:	1 hour
COURSE NAME	: **Electromagnetism and Mechanics**		
COURSE CREDIT:	5	MAX. MARKS:	30

ALL QUESTIONS CARRYING MARKS 7.5 EACH ARE COMPULSORY

Q1. A point charge Q is placed at the center of a dielectric spherical shell of inner radius R and outer radius $2R$. The dielectric constant of the spherical shell is K. The region $r > 2R$ is free space.

a) Obtain the electric field everywhere.

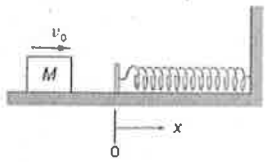
b) Obtain the surface bound charge densities on the two surfaces of the dielectric.

Q2. Consider an infinitely long cylindrical hollow conductor of inner radius a and outer radius b surrounded by a medium from radius b to c of a material of magnetic permeability μ. If the conductor carries a current I,

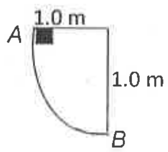
a) Obtain the magnetic field $\vec{B}$ in all regions.

b) Calculate the bound surface current on the inner surface of the cylindrical medium.

Q3 a) A golfer hits a golf ball of mass 51 gm and the ball leaves the golfer's club with a velocity of 80 m/s. If the ball and the club were in contact for 0.006 s, find the average force exerted by the club on the ball.



b) A block of mass M slides along a horizontal table with speed v_0. At $x = 0$ it hits a spring with spring constant k and begins to experience a variable friction force. Coefficient of friction μ is given by $\mu = bx$, where b is a constant. Find the distance the block travels before coming to rest.



Q4. a) AB is quadrant of a circle of 1.0 m radius. A block of mass m is released with a velocity of 3 m/s at A which slides without friction till it reaches point B. How fast is it moving at B?

b) Three particles of masses 2 kg, 4 kg and 6 kg are located at vertices of an equilateral triangle of side 0.5 m. Find the centre of mass (c.m.) coordinates of this collection given that origin of the system coincides with location of the 2 kg particle, and 4 kg particle is located along the positive x-axis.

P.T.O

Some useful formulas

- In Cartesian coordinates:

$$\nabla f = \frac{\partial f}{\partial x}\hat{\imath} + \frac{\partial f}{\partial y}\hat{\jmath} + \frac{\partial f}{\partial z}\hat{k}$$

$$\nabla.\vec{F} = \frac{\partial F_x}{\partial x} + \frac{\partial F_y}{\partial y} + \frac{\partial F_z}{\partial z}$$

$$\nabla\times\vec{F} = \left[\frac{\partial F_z}{\partial y} - \frac{\partial F_y}{\partial z}\right]\hat{\imath} + \left[\frac{\partial F_x}{\partial z} - \frac{\partial F_z}{\partial x}\right]\hat{\jmath} + \left[\frac{\partial F_y}{\partial x} - \frac{\partial F_x}{\partial y}\right]\hat{k}$$

- In spherical polar coordinates:

$$\nabla f = \frac{\partial f}{\partial r}\hat{r} + \frac{1}{r}\frac{\partial f}{\partial \theta}\hat{\theta} + \frac{1}{r\sin\theta}\frac{\partial f}{\partial \phi}\hat{\phi}$$

$$\nabla.\vec{F} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 F_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta\, F_\theta) + \frac{1}{r\sin\theta}\frac{\partial F_\phi}{\partial \phi}$$

$$\nabla\times\vec{F} = \frac{1}{r\sin\theta}\left[\frac{\partial}{\partial \theta}(\sin\theta\, F_\phi) - \frac{\partial F_\theta}{\partial \phi}\right]\hat{r} + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial F_r}{\partial \phi} - \frac{\partial}{\partial r}(rF_\phi)\right]\hat{\theta} + \frac{1}{r}\left[\frac{\partial}{\partial r}(rF_\theta) - \frac{\partial F_r}{\partial \theta}\right]\hat{\phi}$$

- In cylindrical coordinates:

$$\nabla f = \frac{\partial f}{\partial r}\hat{r} + \frac{1}{r}\frac{\partial f}{\partial \phi}\hat{\phi} + \frac{\partial f}{\partial z}\hat{z}$$

$$\nabla.\vec{F} = \frac{1}{r}\frac{\partial}{\partial r}(rF_r) + \frac{1}{r}\frac{\partial F_\phi}{\partial \phi} + \frac{\partial F_z}{\partial z}$$

$$\nabla\times\vec{F} = \left[\frac{1}{r}\frac{\partial F_z}{\partial \phi} - \frac{\partial F_\phi}{\partial z}\right]\hat{r} + \left[\frac{\partial F_r}{\partial z} - \frac{\partial F_z}{\partial r}\right]\hat{\phi} + \frac{1}{r}\left[\frac{\partial}{\partial r}(rF_\phi) - \frac{\partial F_r}{\partial \phi}\right]\hat{z}$$