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ET-105(A)

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) / BTCLEVI / BTMEVI / BTELVI / BTECVI / BTCSVI

Term-End Examination

00947 **December, 2017**

ET-105(A) : PHYSICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt* ***all*** *questions. Internal choices are provided. Assume missing data suitably, if any. Symbols have their usual meanings. Use of scientific calculator is permitted.*

1. (a) Derive the relation $s = s_0 + ut + \frac{1}{2} at^2$. Is this relation valid when acceleration is not uniform ? *4*

OR

A point performs SHM of period T and the equation of motion is given by

$$x = A \sin\left(\omega t + \frac{\pi}{6}\right).$$

After what fraction of T, will the velocity of the point be equal to half of its maximum velocity ? *4*

(b) A conducting wire is stretched to n times its length. Find the factor by which the resistance has changed by stretching. *6*

(c) A particle is launched at an angle to the horizontal direction. Find an expression for its path. *4*

OR

Distinguish between free and forced oscillations, giving examples. Sketch amplitude-frequency curve for forced oscillations. *4*

2. (a) A car is moving on a road inclined at an angle θ to the horizontal. Suppose that there is no friction between the road and the tyres of the car. Get an expression for the maximum speed of the car on that road. *4*

OR

Examine if the expression $y(x, t) = (2x - t)^2$ represents a wave. If so, find the velocity of the wave. *4*

(b) State Lenz's law and explain it with the help of an example. Does it violate conservation of energy ? *4*

(c) Explain the phenomenon of total internal reflection. Calculate the critical angle of incidence if the ray is incident from a medium of refractive index μ_1 to a medium of refractive index μ_2. Write one application of this phenomenon. *6*

OR

Standing on a pavement you hear a siren of frequency 612 Hz from an ambulance. When the ambulance recedes away, you hear the siren of frequency 544 Hz. What is the speed of the ambulance ? What is the frequency of the siren ? (Velocity of sound = 340 m/s) *6*

3. (a) In a Young's experiment, the aperture to screen distance is 3 m and the wavelength is 500 nm. It is desired to have a fringe spacing of 1 mm. Find the slit separation and angular separation of the first minima for the above arrangement. *6*

OR

Show that the kinetic energy of a system of particles may be written as

$$K_E = \frac{1}{2} MV_{CM}^2 + \frac{1}{2} \sum_i m_i v_i^2$$

where m_i is the mass of the i^{th} particle and v_i is its velocity with respect to the centre of mass. *6*

(b) Explain the phenomenon of beats in sound. Two tuning forks produce progressive waves given by

$$Y_1 = 4 \sin 500 \pi t \text{ and } Y_2 = 2 \sin 506 \pi t.$$

What is the number of beats produced per minute ? *4*

(c) Define displacement vector, speed and velocity of a particle. How are the three related to one another ? 4

OR

Find the capacity of a parallel plate capacitor of area of cross-section A and separation between the plates as d. 4

4. (a) State Huygens principle. On the basis of this principle prove the laws of reflection. 4

OR

Find the weight of a person on the top and the bottom of a vertical circular track. 4

(b) A negative point charge is brought near an isolated conducting sphere. Sketch the electric field lines around the sphere. Explain the process. 6

(c) Given the time period of the moon as 27·3 days and its distance from the Earth as 60 Earth radii, find the time period of a satellite at 1/5 Earth radius from the surface of the Earth. State Kirchhoff's laws and establish that for a balanced Wheatstone bridge $R_1/R_2 = R_3/R_4$. 4

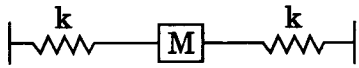
5. (a) A diffraction grating has 4200 lines per centimetre. Calculate the angular separation for the two wavelengths of a sodium lamp 5890 Å and 5896 Å in the second order. *4*

OR

A train is moving at a speed of 10 m/s when the driver applies brakes which provide deceleration of 1/20 m/s^2 for a distance of 750 m. How much time does the train take to travel this distance ? *4*

(b) Two SHMs of the same amplitude and frequency are travelling on a string in opposite directions. Show that the resulting wave is a stationary wave. Sketch this wave. *6*

(c) Two identical springs of spring constant k are connected as shown.



Find the time period of small oscillations of the system. *4*

OR

Find the electric field at a point on the equatorial line of a dipole of moment $\vec{p}$. *4*
