

**B. TECH. CIVIL (CONSTRUCTION  
MANAGEMENT)/B. TECH. CIVIL  
(WATER RESOURCES  
ENGINEERING)/(BTCM/BTWRE)**

**Term-End Examination**

**June, 2019**

**ET-105(A) : PHYSICS**

*Time : 3 Hours*

*Maximum Marks : 70*

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*Note : Attempt any seven questions. All questions carry equal marks. Use of scientific calculator is permitted.*

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1. (a) If 1 kg of a substance is fully converted into energy, how much energy is produced ? 5
- (b) Calculate the frequency of the radio waves transmitted by a station if the wavelength of the wave is 300 m and also calculate its time period. 5

2. (a) Light of wavelength  $5500 \text{ \AA}$  is used in a double slit experiment. The overall separation of 5 fringes on a screen  $200 \text{ cm}$  away from the slits is  $1 \text{ cm}$ . Calculate : 5
- Slit separation
  - The fringe width
- (b) Figure 1 shows a body 'P' resting on a smooth table between two firm supports A, B and controlled by two massless springs of spring constants  $K_1$  and  $K_2$ . If mass of P is  $0.050 \text{ kg}$  and the force constant of the two springs are  $3 \text{ N/m}$  and  $2 \text{ N/m}$ , deduce : 5
- the frequency of small oscillations of 'P'
  - the energy of oscillations for amplitude  $0.004 \text{ m}$
  - the velocity of 'P' when it passes through its mean position.

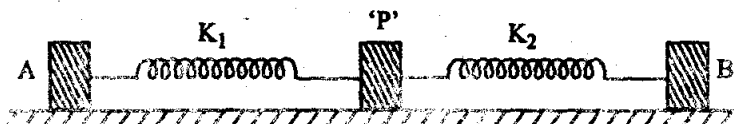


Fig. 1

3. (a) The length as well as the mass of the bob of a simple pendulum is doubled. If the amplitude remains the same, then prove that the maximum velocity of the bob will be increased by a factor of  $\sqrt{2}$ . 5
- (b) A box of mass 20 kg is pulled with a constant speed by applying a constant force at  $30^\circ$  to the horizontal as shown in Fig. 2. The coefficient of friction between the box and the floor is 0.5. How much of work is done by friction in moving the box by 5 m? 5

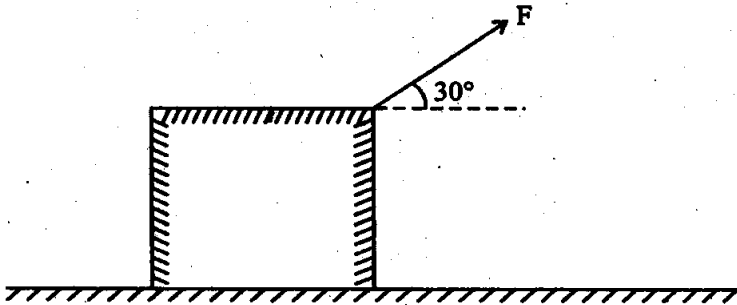


Fig. 2

4. (a) A solid cylinder rolls down without slipping down the inclined plane, as shown in Fig. 3. Find the velocity of the centre of mass when the centre of mass of the cylinder has dropped through a vertical distance  $h$ , assuming that the cylinder started from rest.

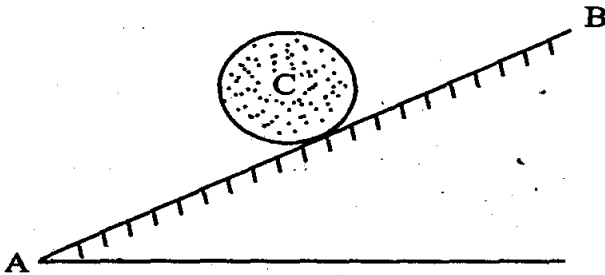


Fig. 3

- (b) Find the equation of motion resulting from superposition of two parallel SHMs, whose equations are :

$$x_1 = 3 \cos 5t, \text{ and } x_2 = 4 \cos(5t + \alpha)$$

with the values of  $\alpha$  being  $0, \frac{\pi}{2}$  and  $\pi$ . 5

5. (a) The displacement of an object is given by :

$$x = 0.05 \sin (2t + 0.5\pi),$$

where  $x$  is in metre and the argument of sine is in radians. Obtain amplitude and the initial phase of the velocity and the acceleration of the object. 5

- (b) State Biot-Savart law. Use it to obtain an expression for magnetic field at the centre of a current carrying circular loop. 5

6. (a) Calculate the resistivity of the material of a wire 2 m long, 0.2 mm in diameter and having a resistance of 4 ohm. 5

- (b) Three resistors  $2 \Omega$ ,  $3 \Omega$  and  $5 \Omega$  are combined in series, and the combination is connected to a battery of 20 volt. Calculate the total resistance of the series

combination and potential drop across each resistors. What would be the total resistance if the resistances are connected in parallel ? 5

7. (a) Calculate the electric force between two charged spheres having charges  $4 \times 10^{-7}$  C and  $6 \times 10^{-7}$  C, and are placed 60 cm apart in air. 5

(b) Calculate the electric potential at a point P due to a charge of  $2 \times 10^{-8}$  C situated 8 cm away. Also determine the work done in bringing a charge of  $2 \times 10^{-9}$  C from infinity to the point P. 5

8. (a) Two square loops of sides 1 cm and 2 cm are kept in the same plane with their centres 40 cm apart. Calculate the mutual inductance. 5

- (b) A 100 mH inductor, a 25  $\mu\text{F}$  capacitor and a 15 ohm resistor are connected in series to a 120 V, 50 Hz a. c. source, calculate : 5
- (i) impedance of the circuit at resonance
  - (ii) current at resonance
  - (iii) resonance frequency