

**NATIONAL GRADUATE PHYSICS EXAMINATION – 2016**  
**NGPE PART C EXAMINATION [EXPERIMENTAL SKILL]**

**Held at**

**Department of Physics**

**INDIAN INSTITUTE OF ENGINEERING SCIENCE AND  
TECHNOLOGY, SHIBPUR (HOWRAH)**

**JUNE 9-10, 2016**

- 1. Studies on damped oscillation:** Time: 1 hr 50 min; Marks: 80  
You have been provided with a spring and three spherical bobs. Mass of the brass bob and diameter of the larger plastic bob are supplied. A camera interfaced with a PC and stand clamp etc. are provided. Video recording software AMCAP and tracking software TRACKER are installed in the PC.
- A) Video record and track the vertical oscillations of the spring mass system using the given three bobs. (20+20)
  - B) Estimate the spring constant. (6)
  - C) Estimate the average density of the material of the plastic bobs. (10)
  - D) Estimate the damping constant by drawing a suitable graph for the system with the smaller plastic bob. (12)
  - E) The damping of the system comes into play due to viscosity of air and other resistive losses. If the effective coefficient of viscosity is denoted by  $\eta_{eff}$  and the viscous drag is given by  $F = 6\pi\eta_{eff}av$  then give an estimate of  $\eta_{eff}$ . Here  $v$  is the instantaneous velocity and  $a$  is the radius of the bob. (12)
- 2. Diffraction through Compact Disc:** Time: 50 min; Marks: 35  
You have been given a transmission grating made by cutting a CD and lifting off the metallic coating. You have also been provided with a key ring laser of 630nm emission wavelength and a CFL lamp. A drawing board, drawing sheet, board pin, pencil, scale, plastic clips, metal clip etc. and a graph sheet are supplied. The graph sheet can be wrapped on the scale and be used as a screen to observe the diffraction pattern formed by the laser incident on the grating. You may use the metallic

clip to keep the laser switched on. The clips, box etc. can be used to arrange the setup.

A) Determine the grating element of the given CD. (11)

B) Suitably place the CFL and the grating on the drawing board such that you can see the virtual diffraction pattern of the Lamp by looking very closely through the CD. Mark the extreme red, green and extreme violet lines using the board pin/pencil in the both sides of the central line. Measure the angle of diffraction and hence wavelength for each colour. (3X8)

**3. Visualization of probability distribution:** Time: 50 min; Marks: 35

You have been given the following circuit containing a step down transformer (220V, to  $4.5 V_{\text{rms}}$ , 50 Hz) and a capacitor connected to either the transformer or a DC voltmeter through a two way switch (S). You need to press the switch to take the voltmeter reading. Since the reading keeps on decaying with time, take only the reading with maximum magnitude. After each observation switch it back to the original position. You are also provided with a sheet with bins of 1 V between -6V and +6V.

A) Take at least 200 random readings of the voltmeter and fill up the sheet by putting a tick ( $\checkmark$ ) mark on the appropriate box. Any reading beyond  $\pm 5V$  should be counted in the extreme bins. (16)

B) Draw a histogram of the randomly taken voltage values ranging between -6V to +6 V. (5)

C) Explain the nature of the histogram you obtain. (14)

