Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

I SEMESTER B.S. DEGREE EXAMINATION – APRIL/ MAY 2017

SUBJECT: PHYSICS - I (PH 111) - OLD SCHEME

(BRANCH: COMMON TO ALL)

Monday, 08 May 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**

Physical Constants:

Elementary charge : 1.6×10^{-19}C

Mass of electron : 9.1×10^{-31}kg

Boltzmann constant : 1.38×10^{-23}J/K

Planck's constant : 6.625×10^{-34} J.s

Stefan-Boltzmann constant: 5.67×10^{-8}W/m^{2}K^4

1A. (a) What are simple harmonic motions? Give two examples

(b) Explain the concept of mechanical resonance

1B. Derive the equation of motion of a simple harmonic oscillator. Obtain a solution for it and hence find an expression for its period

1C. (a) A damped harmonic oscillator involves a block (m=1.91kg), a spring (k =12.6N/m), and a damping force F = $-bv_x$. Initially, it oscillates with amplitude of 26.2cm; because of the damping, the amplitude falls to three-fourths of this initial value after four complete cycles. (i) What is the value of b? (ii) How much energy has been lost during these four cycles?

b) An oscillator consists of a block attached to a spring (k=456N/m). At some time t, the position (measured from the equilibrium location), velocity and acceleration of the block are x = 0.112m, $v_x = -13.6ms^{-1}$, $a_x = -123m/s^{-2}$. Calculate (i) frequency, (ii) the mass of the block **(4+8+8)**

2A. Obtain an expression for the intensity of light in double slit interference using phasor diagram.

2B. Describe young's double slit experiment and hence obtain an expression for the fringe-width in the case of interference of light of wavelength λ, from a double-slit of slit-separation d.

2C. (a) In a Newton's ring experiment, the radius of curvature R of the lens is 5.0m and its diameter is 20mm. How many rings are produced? How many rings would be seen if the arrangement is immersed in water (n = 1.33)? (Assume wavelength = 589nm)

(b) Find the sum of the following quantities graphically, using phasors;
$y_1 = 10 \sin(\omega t)$ and $y_2 = 8.0 \sin(\omega t + 30°)$ **(4+8+8)**

3A. With relevant diagram, state and prove Brewster's law.

3B. Obtain an expression for the intensity in single-slit diffraction pattern, using phasor-diagram. State the conditions for maxima and minima. Show the variation of intensity with distance representing primary and secondary maxima

3C. (a) If superman really had X-ray vision at 0.12nm wavelength and a 4.3mm pupil diameter, at what maximum altitude could be distinguish villains from heroes assuming the minimum detail required was 4.8cm?

(b) A slit of width 'a' is illuminated by white light. For what value of 'a' does the first minimum for red light (λ = 650nm) fall at $\theta = 15^o$? **(4+8+8)**

4A. Distinguish between Fresnel and Fraunhofer Diffraction.

4B. (a) Explain circular polarization of light and its production with a diagram.

(b) Explain optical activity with a diagram.

4C. (a) A grating has 40000 ruling spread over 76 mm. (i) What is its expected dispersion **D** in ° /nm for sodium light of wavelength 589 nm in the first three orders? (ii) What is its resolving power in these orders?

(b) The first-order diffraction maximum is observed at 12**.**6° for a crystal having spacing between planes of atoms of 0**.**250 nm. What wavelength x-ray is used to observe this first order pattern? **(4+8+8)**

5A. (a) Explain the usefulness of diffraction grating

(b) State and explain Bragg's law

5B. Obtain an expression for the width of the central maximum and also width of a principal maximum at an angle in diffraction pattern due to multiple slits.

5C. (a) Light of wavelength 540 nm passes through a slit of width 0.200 mm. (i) The width of the central maximum on a screen is 8.10 mm. How far is the screen from the slit? (ii) Determine the width of the first bright fringe to the side of the central maximum.

(b) Unpolarized light passes through two ideal Polaroid sheets. The axis of the first is vertical, and the axis of the second is at 30.0° to the vertical. What fraction of the incident light is transmitted? **(4+8+8)**

6A. Explain (a) Stefan's law (b) Wien's displacement law

6B. (a) what are the observations in the experiment on photoelectric effect? With the help of Einstein's photoelectric equation, explain those observed results

6C. (a) X-rays having energy of 300 keV undergo Compton scattering from a target. The scattered rays are detected at 37.0° relative to the incident rays. Find (a) the Compton shift at this angle, (b) the energy of the scattered x-ray, and (c) the energy of the recoiling electron.

(b) A 0.00160 nm photon scatters from a free electron. For what photon scattering angle does the recoiling electron have kinetic energy equal to the energy of the scattered photon? **(4+8+8)**

7A. What is a wave function ? What is its physical interpretation ? What are the mathematical features of a wave function?

7B. Apply the Schrodinger equation to a particle in a one-dimensional "box" of length L and obtain the energy values of the particle. Also, Sketch the lowest three energy states, wave-functions, probability densities for the particle in a one-dimensional "box".

7C. **(a) A** 30-eV electron is incident on a square barrier of height 40 eV. What is the probability that the electron will tunnel through the barrier if its width is (A) 1.0 nm? (B) 0.10 nm?

(b) The wave function for a quantum particle is given by $\psi(x) = A x$ between x = **0** and x = **1.00**, and $\psi(x) = 0$ elsewhere. Find the value of the normalization constant **A**

(4+8+8)

8A. (a) Distinguish particle velocity from wave velocity

(b) State the principle of superposition of waves? Mention one application of it.

8B. Derive an expression for velocity of transverse waves in a stretched string from Newton's second law. Mention any two characteristics of standing waves.

8C. (a) A 1.48m long wire has a mass of 8.62 g and is held under a tension of 122N. The wire is held rigidly at both ends and set into vibration. Calculate (i) the speed of waves on the wire (ii) the wavelengths of the waves that produce one and two loop standing waves on the wire, and (iii) the frequencies of the waves in (ii).

(b) A violin string tuned to concert A (440 Hz) has a length of 0.34m. What are the three longest wavelengths of the resonances of the string? **(4+8+8)**