Mahindra University Hyderabad

École Centrale School of Engineering

Minor-2

Program: B. Tech. Branch: All Year: 2022 Semester:2

Subject: Physics (PH1201)

Date: 2-05-2023 **Start Time: 2.00 pm**

Time Duration: 1 Hour 30 minutes **Max. Marks: 60**

Instructions:

1) **All the questions are compulsory**
2) **Calculator is allowed**

~~Q1.~~ (10+10)

~~(a)~~ An orange light is present whose frequency is $5^* 10^{14}$ Hz. What is the wavelength of this light? Calculate the energy of a single photon in joules and electron volts.

~~(b)~~ The work function of tungsten is 4.50 eV. What is the minimum energy required for photoelectric emission? What wavelength of light must be used in order for electrons to be ejected with a maximum kinetic energy of 1.5 eV?

Q2. (7+7+6)

(a) Find the de Broglie wavelength of an electron with a velocity of $5 * 10^6$ m/s.

(b) Find the phase and group velocity of the de Broglie waves of an electron whose speed is 0.85 c. Here c is the velocity of light.

~~(c)~~ A 1 gm marble is in a 1D box of length L = 1 m. Find the permitted energies in joules?

Q3. 10+10

(a) A 200-g block connected to a light spring for which the force constant (k) is 5.00 N/m is free to oscillate on a horizontal, frictionless surface. The stationary block is released at a position that is 3.00 cm from the equilibrium position. Find the angular frequency and time period. Express the position as a function of time.

If the same block is released from rest at a different position (for example x=5 cm at t=0), what parts of the solution will change (give proper reasoning in 1-2 sentences)?

(b) A tuning fork is oscillating at a natural frequency 400Hz. A sound meter level indicates the sound intensity decreases by a factor of 2 in 2 seconds. What is the quality factor Q of the tuning fork?

Useful constants:

$c = 3 * 10^8 m/s$

$mass\ of\ electron = 9 * 10^{-31}\ kg$

$h = 6.6 * 10^{-34}$ J.s