Jagannath University

Department of Computer Science & Engineering

1st year 1st Semester Final Examination-2014

Course Title: Physics (Heat and Thermodynamics, Structure of Matter, Waves and Oscillations and Physical Optics)

Course Code:1107

Full Marks: 70 **Total Time: 3 hours**

Answer any five (5) of the following questions. Parts of the same question should be answered consecutively.

1 a) Establish the differential equation of simple harmonic motion. 5
b) Calculate the average kinetic energy and the total energy of a body executing simple harmonic motion. 9

2 a) Two simple harmonic vibrations acting at right angles to each other have the time periods in the ratio 1:2. The phase difference between the two vibrations is $\frac{\pi}{2}$. Show graphically that the resultant curve is parabola. 8

b) A particle executes simple harmonic motion given by the equation 6

$$y = 12\sin(\frac{2\pi t}{10} + \frac{\pi}{4})$$

Calculate (i) amplitude (ii) frequency (iii) epoch (iv) displacement at t=1.25 s (v) velocity at t=2.5 s (vi) acceleration at t= 5 s.

3 a) Define Bravis lattice and unit cell. 4
b) What are the seven crystal systems in three dimensions? Explain their geometrical properties with appropriate figures. 7
c) Draw the planes of the following indices in a cubic crystal: (111), (211) and (233) 3

4 a) Explain photoelectric effect and threshold frequency. 3
b) Establish Einstein's photoelectric equation and explain the characteristics of photoelectric emission based on this equation. 8
c) Calculate the threshold frequency and the corresponding wavelength of radiation incident on a certain metal whose work function is $3.31\times10^{-19}\ j$. Given Planck's constant = $6.62\times10^{-34}\ js$. 3

5 a) Define de Broglie waves? 2
b) Derive the expression of the wavelength of de Broglie waves. 7
c) Find the kinetic energy of a neutron whose de Broglie wavelength is 10^{-14} m. 5

6 a) Explain nuclear fission and nuclear fusion reactions with proper examples. 4
b) Write down the properties of nuclear forces. 3
c) What is radioactivity? Deduce the decay law or equation of a radioactive substance. 7

7 a) Define half-life and mean life of a radioactive substance. 4
b) Deduce the equation of the law of successive disintegration. 6
c) The half-life of a radioactive substance is 30 days. Calculate (i) the radioactive decay constant (ii) the mean life (iii) the time taken for ¾ of the original number of atoms to disintegrate. 4

8 a) Define the term insulator, semiconductor and metal on the basis of band theory 4
b) State and prove the Bragg's law of X-ray diffraction. 6
c) Calculate the glancing angle on the cube (110) of a rock salt crystal ($a = 2.81A^0$) corresponding to second order diffraction maximum for the X-rays of wavelength $0.71A^0$. 4

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Jagannath University

Department of Computer Science and Engineering

1st Year 1st Semester, 1st Mid Term Examination 2016

Course Code: CSER -1107, Course Title: Physics

Time:45 minutes | Total Marks -10

Question 1: Define Stationary and progressive wave. 2

Question 2 : Show that the total energy of the particle executing simple harmonic motion is equal to $2\pi^2n^2a^2m$, Where the symbols have their usual meanings. 5

Question 3: A simple harmonic motion is represented by , $y = 15\sin(10t - \pi/6)$, where y is measured in meters, t in seconds and the phase angle in radians. Calculate (i) the frequency, (ii) the time period and (iii) the maximum displacement (vi) the maximum velocity and (v) the maximum acceleration and (vi) displacement, velocity and acceleration at time t = 0 second. 3

Jagannath University
Department of Computer Science and Engineering
1st Year 1st Semester, 1st Mid Term Examination 2018
Course Code: CSER -1105, Course Title: Physics

Time:40 minutes **Total Marks: 10**

Question 1: Define Longitudinal and transverse wave with example. (1. 5)

Question 2 : Show that total energy of the particle executing simple harmonic motion is equal to (4) $2\pi^2n^2a^2m$, where the symbols have their usual meanings.

Question 3(a) : Derive the relation $\frac{d^2y}{dt^2} = v^2.\frac{d^2y}{dx^2}$

Or

Question 3(b) : What is meant by particle velocity and wave velocity ? (2)

Question 4: A simple harmonic motion is represented by $y = 10\ sin(10t - \frac{\pi}{6})$, where y is measured in metres, t in seconds and the phase angle in radians. Calculate (i) the frequency, (ii) the time period, (iii) the maximum displacement, (iv) the maximum velocity and (v) the maximum acceleration and (vi) displacement, velocity and acceleration at time t=0 and t= 1 second. (2.5)

Jagannath University
Department of Computer Science and Engineering
1st Year 1st Semester, 1st Midterm Examination - 2019
Course Code: CSER -1105, Course Title: Physics

Time:45 minutes **Total Marks: 10**

Question 1(a): Define mechanical and Electromagnetic Waves. (1.5)

Or, Question 1(b): Explain simple harmonic motion and discuss its characteristics.

Question 2 : Show that total energy of the particle executing simple harmonic motion is equal to $2\pi^2n^2a^2m$, where the symbols have their usual meanings. (4)

Question 3(a) : Derive the relation $\frac{d^2y}{dt^2} = v^2.\frac{d^2y}{dx^2}$ (2)

Or, Question 3(b) : What is meant by particle velocity and wave velocity ? Define Longitudinal and transverse wave with example.

Question 4(a): A simple harmonic motion is represented by $y = 10\ sin(10t - \frac{\pi}{6})$, where y is measured in metres, t in seconds and the phase angle in radians. Calculate (i) the frequency, (ii) the time period, (iii) the maximum displacement, (iv) the maximum velocity and (v) the maximum acceleration and (vi) displacement, velocity and acceleration at time t=0 and t= 1 second. (2.5)

Or, Question 4(b): A source of sound has an amplitude of 0.25 cm and frequency of 512 Hz. If the velocity of sound in air is ***340 m/s*** and the density of air is **0.00129 gm/cm^3**, what is the rate of flow of energy per square cm?

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Jagannath University

Department of Computer Science and Engineering

1st Year 1st Semester, 2nd Mid Term Examination - 2016

Course Code: CSER -1104, Course Title: Physics

Time:40 minutes | Total Marks -10

Question 1: Define entropy ? What is its physical significance? 2.5

Question 2 : Describe a Carnot cycle and obtain expression for the work done in each operation of the cycle and the net work done in the cycle. 5.0

Question 3: At what Celsius temperature will Nitrogen molecules have the same root mean square velocity as that of hydrogen molecules at -100°C ? 2.5

Jagannath University

Department of Computer Science and Engineering

1st Year 1st Semester, 2nd Mid Term Examination 2018

Course Code: CSER -1105, Course Title: Physics

Time:40 minutes Total Marks -10

Question 1: Two simple harmonic motions acting simultaneously on a particle are given by the equations

$$y_1 = 2\,sin\,(wt + \frac{\pi}{6})$$

$$y_2 = 3sin\,(wt + \frac{\pi}{3})$$

Calculate (i) amplitude, (ii) phase constant and (iii) time period of the resultant vibration. What is the equation of the resultant vibration ? (2)

Question 2: Define specific heat of a gas at constant volume and constant pressure. (2)
Explain why $C_p > C_v$?

Question 3: State the second law of thermodynamics. Describe a Carnot cycle and obtain expression for the work done in each operation of the cycle and the net work done in the cycle. (4)

Question 4: A Carnot's engine is operated between two reservoirs at temperatures of 450k and 350k. If the engine receives 1000 calories of heat from the source in each cycle, calculate the amount of heat rejected to the sink in each cycle. Calculate the efficiency of the engine and the work done by the engine in each cycle. ($1\ calorie = 4.2\ joules$)

(2)

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Jagannath University
Department of Computer Science and Engineering
1st Year 1st Semester, 2nd Mid Term Examination - 2019
Course Code: CSER -1105, Course Title: Physics

Time:40 minutes **Total Marks -10**

Question 1: Define root mean square velocity and mean free path. Derive the differential equation for forced oscillatory motion. (2)

Question 2: State the first law of thermodynamics. Describe a Carnot cycle and show how the work done in each operation is represented on a P- V diagram. (4)

Question 3: What do you mean by entropy and efficiency of engine? Show that the entropy of a perfect reversible engine is zero. (2)

Question 4: The efficiency of a Carnot engine is 1/6. If on reducing the temperature of the sink by 65^0C, the efficiency becomes 1/3, find the temperatures of the source and the sink between which the engine is working. (2)

Jagannath University, Dhaka
Department of Computer Science & Engineering
1st Year 1st Semester Final Examination 2016
Course Code: CSER-1104
Course Title: Physics

Full Marks: 70 **Time: 3 Hours**

Answer Any Five of the following questions

1. a) Define Stationary and Progressive waves. 2
   b) Obtain an expression for a plane progressive wave travelling in the positive X-direction in the form $y = a \sin\frac{2\pi}{\lambda}(vt - x)$, where the symbols have their usual meanings. 7
   c) Derive the relation $\frac{d^2y}{dt^2} = v^2 . \frac{d^2y}{dx^2}$ 5

2. a) What is meant by simple harmonic motion (SHM)? Find the differential equation of SHMs. 5
   b) What are Lissajou's figures? Deduce the resultant equation when two SHMs acting on a particle at a straight line. 5
   c) A particle is influences by two SHMs is given by the equation 4
   $y_1 = 4sin\left(\omega t + \frac{\pi}{2}\right)$ cm
   $y_2 = 3sin\left(\omega t + \frac{\pi}{3}\right)$ cm
   Calculate the resultant amplitude and phase constant of the vibration.

3. a) Define root mean square velocity & degrees of freedom. Derive the expression PV= nRT for an ideal gas. 5
   b) What do you mean by entropy and efficiency of engine? Show that the entropy of a perfect reversible engine is zero. 5
   c) Find the difference in entropy between 1 gm of water at 100^0C and 1 gm of steam at 100^0C and at atmospheric pressure. (Latent heat of steam at $100^0C = 540$ cals/gm). 4

4. a) What are the origins of Vander Waals' equation? Define critical temperature (Tc), critical pressure (Pc) and critical volume (Vc). 4
   b) State second law of thermodynamics. Find the total work done by a Carnot's engine in its Complete Cycle. 6
   c) A Carnot's engine is operated between two reservoirs at temperatures of 450 K and 350

K. If the engine receives 1000 calories of heat from the source in each cycle, calculate (i) the amount of heat rejected to the sink in each cycle, (ii) the efficiency of the engine in each cycle. 4

6. a) Define lattice, basis and crystal. Find the structure factor (f) for the following atoms sites : 5

(i) Na (4 atoms) : (0,0,0) (1/2, 1/2, 0) (1/2, 0, 1/2) (0, 1/2, 1/2);

(ii) Cl (4 atoms) : (1/2, 1/2, 1/2) (0, 0, 1/2) (0, 1/2, 0) (1/2, 0, 0);

b) Show that for a cubic lattice the distance between the successive planes of Miller indices (hkl) is given by an expression $d_{hkl} = \frac{a}{\sqrt{(h^2+k^2+l^2)}}$ 5

c) The Bragg's angle corresponding to the first order reflection from (111) planes in a crystal is 30^0, when X-rays of wavelength 1.75 Åare used. Calculate the interatomic spacing. 4

7. a) What is interference of light? Deduce the theory of interference fringes and show that the fringes width is equal to $\frac{\lambda D}{d}$, where the symbols have their usual meaning. 8

b) What do you mean by coherent source? 2

c) Orange light of wavelength 5600$\dot{A}$ from a narrow slit is incident on a double slit. If the overall separation of 8 fringes on a screen 200 cm away is 1.5 cm, find the slit separation. 4

8. a) What is the main difference between Fresnel and Fraunhofer diffraction? 2

b) What is meant by the term polarization of light? Show that at the polarizing angle of incidence, the reflected and refracted rays are mutually perpendicular to each other. 7

c) In a Newton's ring experiment, the diameters of the 5^{th} and 11^{th} rings are 4.21 mm and 5.45 mm respectively. If the wavelength of light used is 6145 A.U., what is the radius of curvature of the face of the convex lens in contact with plane glass plate? 5

9. a) State and explain Coulomb's law for a point charge. 4

b) What is meant by polarization of a dielectric material? Derive an expression for polarization charge density. 4

c) Discuss the charging and discharging properties of a capacitor for RC circuit. 6

Jagannath University
Department of Computer Science and Engineering
1st Year 1st Semester Final Examination 2018
Course Code: CSER-1105
Course Title: Physics
Full Marks: 70 **Time: 3 Hours**

NB: Figures in the margin indicate the full marks. Answer any FIVE questions

1. (a) Define Stationary and Progressive waves. Two simple harmonic motions acting simultaneously on a particle are given by the equations 2+3=5

$y_1 = 2\sin(wt + \frac{\pi}{6})$

$y_2 = 3\sin(wt + \frac{\pi}{3})$

Calculate (i) amplitude, (ii) phase constant and (iii) time period of the resultant vibration. What is the equation of the resultant vibration?

(b) Obtain an expression for a plane progressive wave travelling in the positive X-direction in the form $y = a\sin\frac{2\pi}{\lambda}(vt - x)$, where the symbols have their usual meanings 5

(c) Derive the relation $\frac{d^2y}{dt^2} = v^2 \cdot \frac{d^2y}{dx^2}$ 4

2. (a) Define particle velocity and wave velocity? Draw Lissajous' figures for phase angle (i) $\varphi=0$, (ii) $\varphi=\frac{\pi}{4}$, (iii) $\varphi=\frac{3\pi}{4}$, and (iv) $\varphi=\frac{\pi}{2}$ (when a=b). 4

(b) Derive the equation of a travelling wave. 6

(c) A simple harmonic motion is represented by $y = 10\sin(10t - \frac{\pi}{6})$ where y is measured in meters, t in seconds and the phase angle in radians. Calculate (i) the frequency, (ii) the time period, (iii) the maximum displacement, (iv) the maximum velocity and (v) the maximum acceleration and (vi) displacement, velocity and acceleration at time $t=0$ and $t=1$ second. 4

3. (a) What are the origins of Van der Waals' equation? Define critical temperature (Tc), critical pressure (Pc) and critical volume (Vc). 4

(b) State the second law of thermodynamics. Describe a Carnot cycle and show how the work done in each operation is represented on a P-V diagram. 6

(c) The efficiency of a Carnot engine is 1/6. If on reducing the temperature of the sink by 65^0C, the efficiency becomes 1/3, find the temperatures of the source and the sink between which the engine is working. 4

4. (a) What is band theory? Explain with diagrams the behavior of conductor, semiconductor and insulator in the light of band theory. 5

(b) Define lattice, basis and crystal. Write down the crystal structure of *NaCl*. 5

(c) Derive the Bragg Equation for X-ray diffraction. 4

5. (a) Define para, dia, ferro, antiferro magnetism. 6

(b) An electron in an atom circulating in an assumed circular orbit of radius r behaves like a tiny current and has an orbital magnetic dipole moment usually represented by μ_L. Derive a connection between μ_L and the orbital angular movement L_l. 6

(c) What is superconductivity? Explain Meissner effect. 2

6. (a) State and explain Huygens' principle of secondary waves and Young's principle of superposition. 4

(b) By using the theory of interference fringes show that Phase difference $= \frac{2\pi dx}{\lambda D}$, where the symbols have their usual meanings and prove that the distance X, between two successive bright or dark fringes is given by $X = \frac{D\lambda}{d}$. 6

(c) A biprism is placed 5 cm from a slit illuminated by sodium light($\lambda = 5890$ Å). The width of the fringes obtained on a screen 75 cm from the biprism is 9.424×10^{-2} cm. What is the distance between two coherent sources? 4

7. (a) Distinguish between Fresnel and Fraunhofer classes of diffraction. 4

(b) What are Newton's rings? Show that the diameter of a Newton's dark rings is proportional to square roots of natural numbers. 6

(c) In a Newton rings experiment the diameter of the 15^{th} ring was found to be 0.59 cm and that of the 5^{th} ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of light used. 4

8. (a) Explain conservation and quantisation of charge. 3

(b) What do you mean by Electric dipole? Find an expression for Electric potential at a point due to an electric dipole. 6

(c) Let the total positive and the total negative charges in a copper penny be separated to a distance such that their force of attraction is 1.0 lb (= 4.5 nt). How far apart must they have? [Charge of the copper penny is 1.3×10^5coulomb] 5

Jagannath University

Department of Computer Science & Engineering

1st Year 1st Semester Final Examination - 2019

Course Title: Physics, Course Code: CSER- 1105

Time: 3 Hours **Total Marks -70**

[The numbers in the right margin indicate marks. Answer any ***FIVE*** of the following ***EIGHT*** questions]

1.a) Define mechanical and Electromagnetic Waves. Explain simple harmonic motion and discuss its characteristics. **Derive the differential equation for forced oscillatory motion.** (5)

1.b) What do you mean by longitudinal and transverse wave? Show that the total energy of the particle executing simple harmonic motion is equal to $2\pi^2n^2a^2m$, where the symbols have their usual meanings. (6)

1.c) A simple harmonic motion is represented by , $y = 15\sin(10t - \pi/6)$, where y is measured in meters, t in seconds and the phase angle in radians. Calculate (i) the frequency, (ii) the time period and (iii) the maximum displacement, (iv) the maximum velocity and (v) the maximum acceleration and (vi) displacement, velocity and acceleration at time t= 0 second. (3)

2.a) Define particle velocity and wave velocity . Obtain an expression for a plane progressive wave travelling in the positive X-direction in the form $y = a\sin\frac{2\pi}{\lambda}(vt - x)$, where the symbols have their usual meanings. (5)

2.b) Draw Lissajous' figures for phase angle (i) φ=0, (ii) φ=$\frac{\pi}{4}$, (iii) φ=$\frac{3\pi}{4}$, and (iv) φ=$\frac{\pi}{2}$ (when a=b) (2)

2.c) Find the resultant of two simple harmonic motions of periods in the ratio 1:2 and having (i) zero phase difference and (ii) phase difference of 45^0. (5)

2.d) A source of sound has an amplitude of 0.25 cm and frequency of 512 Hz. If the velocity of sound in air is ***340 m/s*** and the density of air is **0.00129 gm/cm^3**, what is the rate of flow of energy per square cm? (2)

3.a) **Define root mean square velocity and mean free path.** Write down the fundamental postulates of kinetic theory of gases. Derive the expression PV= nRT for an ideal gas. (5)

3.b) Define reversible and irreversible processes. Show that the entropy of a perfect reversible engine is zero. Find the difference in entropy between 1 gm of water at 100^0C and 1 gm of steam at 100^0C and at atmospheric pressure. (Latent heat of steam at $100^0C = 540$ cals/gm). (6)

3.c) At what celsius temperature will oxygen molecules have the same root mean square velocity as that of hydrogen molecules at -100°C ? (3)

4.a) State the fundamental assumptions of the Kinetic theory of gases. (3)

4.b) Obtain an expression for the pressure exerted by an ideal gas on the basis of Kinetic theory of gases. (5)

4.c) Write short notes on: (i) Equipatition of energy; (ii) Mean free path of a gas molecule. (3+3=6)

5.a) Explain first law of thermodynamics. (3)

5.b) What is entropy and efficiency of heat engine? (3)

5.c) Find the total work done by a Carnot's engine of it complete cycle. (6)

5.d) What is the main difference between heat and temperature? (2)

[Please turn over]

6.a) What is interference of light? Discuss the important conditions for the interference of light. (2)

6.b) What do you mean by coherent source? Describe Young's double-slit experiment. (3)

6.c) By using the theory of interference fringes show that Phase difference $=2\pi dx/\lambda D$, where the symbols have their usual meanings and prove that the distance X, between two successive bright or dark fringes is given by $X=D\lambda/d$. (6)

6.d) Green light of wavelength 5100 Å from a narrow slit is incident on a double slit. If the fringe spacing on a screen 2 meter away is 2 mm, find the separation of the slits. (3)

7.a) Define unit cell. Show that the spacing 'd' of a plane (h k l) in a simple cubic lattice of side 'a' is

$$d = \frac{a}{\sqrt{h^2+k^2+l^2}}$$ (1+5=6)

7.b) Explain Miller indices. Draw (100), (200), (111) and (110) planes. (3)

7.c) Explain different types of magnetic materials. (5)

8.a) Explain conservation and quantization of charge. Write down the four fundamental Maxwell's equations for electro-magnetic field. (4)

8.b) What do you mean by Electric dipole? Find an expression for Electric potential at a point due to an electric dipole. (6)

8.c) Let the total positive and the total negative charges in a copper penny be separated to a distance such that their force of attraction is 1.0 lb (= 4.5 nt). How far apart must they have? [Charge of the copper penny is 1.3×10^5 coulomb] (4)

Best of luck