B. TECH 1st Semester End Term Examination, 2018

Engineering Physics 1

UPH11B01(Group I)

Full marks: 100 **Time: 3 hours**

All the questions are compulsory

1. Choose the correct answer. **[2×10=20]**

a. In Newton's rings the fringe width, β is related to order of fringes, n as

i) $\beta \propto \sqrt{n}$ ii) $\beta \propto \frac{1}{\sqrt{n}}$ iii) $\beta \propto n^2$

b. Gas molecules are moving inside a spherical container. Constraint for the said motion is-

i) Holonomic ii) Non-holonomic iii) Rheonomic

c. Number of degrees of freedom for two particles separated by a fixed distance is-

i) 4 ii) 6 iii) 5

d. The charge builds up in the capacitor is due to which quantity?

i) Conduction current ii) Displacement current iii) Convection current

e. Find the charge density when the displacement vector $(\vec{D})$ is given by $2x\hat{\imath} + 3y\hat{\jmath} + 4z\hat{k}$

i) 10 ii) 9 iii) 24

f. The reduction in amplitude over each cycle of vibration is said to be

i) Free vibration ii) Forced vibration iii) Damped vibration

g. What is the Quality factor of a damped harmonic oscillator that oscillates 300times/sec with damping constant 0.38/sec

i) 2478.95 ii) 247.895 iii) 24789.5

h. The optical rotation produced by a quartz crystal is 43.5° for sodium light of wavelength 589.3 nm. The specific rotation produced is 21.72°/mm. What is the required thickness of the quartz crystal?

i) 2 mm ii) 3mm iii) 4mm

i. Which one of the following is one of the essential condition for observing Fresnel diffraction?

i) Both source and screen at infinite distance from the slit

ii) Either the screen or source at infinite distance

iii) The source and the screen at finite distance from the slit

j. Light of wavelength 600 nm is incident on a plane transmission grating having 5000 lines/cm. What is the highest order spectrum observed?

i) 4 ii) 5 iii) 3

2. (a) Find the characteristics of the resultant vibration if two simple harmonic motions of different amplitudes act at right angles to each other with phase difference of $\varphi = 0, \frac{\pi}{2}, \pi, 2\pi$

(b) If $\vec{v} = \vec{\omega} \times \vec{r}$, prove $\vec{\omega} = \frac{1}{2}\vec{\nabla} \times \vec{v}$; where, $\vec{\omega}$ is the angular velocity, $\vec{v}$ is the linear velocity and $\vec{r}$ is the position vector.

(c) In an experiment with a biprism, a convex lens is kept between the eyepiece and the biprism. The distance between the source and the eyepiece is 100 cm. At two different positions of the lens, the distance between the images as seen in the eyepiece are 0.42 mm and 1.21 mm. If the wavelength of light used is 5892 Å, find the fringe width.

(d) In a Newton's ring setup, the diameter of fourth ring is found to be 0.4 cm and that of the 24^{th} ring is 0.8 cm. The radius of curvature of the planoconvex lens is 100 cm. Calculate the wavelength of light used.

(e) Using D'Alembert's principle derive the equation of motion of simple pendulum.

[10+5+5+5+5=30]

3. **(a)** Derive Poynting theorem. How it is related with the sum of energies of electric and magnetic fields during propagation of EM waves in free space?

(b) Obtain the general solution for damped harmonic motion. Obtain the condition for critical damping. Prove that the amplitude of vibration decreases exponentially with time in case of a damped oscillator.

(c) A body of mass 10g is acted upon by a restoring force per unit displacement of 10^7dyn cm^{-1}, a frictional force per unit velocity of 4×10^3 dyn.cm^{-1}.s and driving force of $10^5 cospt$ dyn; where, p is the frequency of applied force. Find the maximum amplitude.

[(6+4)+(5+2+3)+5=25]

4. **(a)** Write a brief note on polaroids.

(b) Write five differences between interference and diffraction.

(c) In a Fraunhofer diffraction pattern of slit width 0.3 mm using a light of wavelength 589 nm, calculate the angles at which the first dark band and the next bright bands are formed.

(d) Write an expression for the resultant intensity of a Fraunhofer diffraction at double slit. Find out the positions of Central maxima, minima and secondary maxima.

(e) Explain the construction and working principle of Babinet compensator.

[(5+5+5+5+5)=25]

Roll No.

B. TECH 1st Semester End Term Examination, 2017

Engineering Physics 1

UPHI1B03, UPH12B03, DSPH11B01, DTPH11B01

Full marks: 100 Time: 3 hours

All the questions are compulsory

1. Choose the correct answer. [2×10=20]

(a) For a conservative system, Hamiltonian $H = \sum_j^n p_j \dot{q}_j - L$ is ____

(i) A conserved quantity

(ii) not conserved

(iii) Same as the lagrangian of the system.

(b) Which of the following constraints are true for a rigid body?

(i) Rheonomic and non-holonomic

(ii) Rheonomic and holonomic

(iii) Scleronomic and holonomic

(c) The central fringe of Fresnel Biprism has been shifted to a position occupied by 6th fringe after introduction of a thin transparent sheet of thickness ~6.3×10^{-4} cm in the path of one of the interfering beam. If wavelength λ~5460 Å, the refractive index of the sheet is

(i) 1.1 (ii) 1.52 (iii) 1.62

(d) If a pendulum oscillates 100 times /sec and the quality factor is 1000, the relaxation time is

(i) 15.9 sec (ii) 1.59 sec (iii) 0.159 sec

(e) What is the Quality factor of a damped harmonic oscillator that oscillates 300 times/sec with damping constant 0.38/sec

(i) 2478.95 (ii) 247.895 (iii) 24789.5

(f) Unless Maxwell's contribution is added, Ampere's circuital law is valid for

(i) Varying current only (ii) Alternative current only (iii) Steady current only

(g) When a plane polarized light is incident on a quarter wave plate with its vibrations making an angle of with the optic axis, the emergent light is

(i) Elliptically polarized (ii) Plane polarized (iii) Circularly polarized

(h) A polarizer and analyser are parallel so that the maximum light is transmitted. When the analyser is rotated through 45°, to what percentage of its maximum value is the intensity of transmitted light reduced?

(i) 0% (ii) 50% (iii) 25%

(i) Which property of light is confirmed by diffraction?

(i) Wave nature (ii) Particle nature (iii) Longitudinal nature

(j) The ratio of intensities of double –slit principal maximum to single slit principal maximum is

(i) 1:4 (ii) 4:1 (iii) 1:2

2(a) Why Newton's rings are circular in nature? In Newton's ring experiment using a monochromatic [illegible] wavelength λ, derive an expression for the diameter of the circular rings with the radius of curvature [illegible] plano convex lens of refractive index μ.

(b) Prove that in Newton's rings pattern the fringe width, $\beta \propto \frac{1}{\sqrt{n}}$, where n is the order of the rings.

(c) What will happen to the Newton's rings if a droplet of water is introduced between the glass plate and lens

(d) Calculate the unit vector which is normal to the surface $\varphi = x^2y + xy^2 + xyz$ at the point (1,1,-1).

(e) In a Newton's ring experiment the diameter of the 8th ring changes from 1.25 cm to 1.14 cm when a liquid of refractive index μ replaces air in the space between the lens and the plate. Determine the refractive index of the liquid. [(1+3)+2+2+3+3=14]

3(a) Show that if a given coordinate is cyclic in the Lagrangian, it will also be cyclic in Hamiltonian.

(b) If a Lagrangian of a system is given by $L = \frac{1}{2}\dot{x}^2 + \dot{x} - \frac{x^2}{2}$, find Hamiltonian of the system.

(c) What is D' Alembert's principle? Using D' Alembert's principle prove that the acceleration of the masses m_1 and m_2 under a gravitational field g in an Atwood Machine can be written as, $a = \frac{m_1 - m_2}{m_1 + m_2} g$.

(d) Show that the resultant of two SHMs of the same period but different amplitudes and phases acting at right angles to each other gives an elliptical motion. For what condition will the path of resultant motion be circular? [2+3+(1+3)+(3+1)=13]

4(a) Derive the complete general solution to the differential equation of forced damped harmonic oscillator. For a system of unit mass, natural angular frequency is 4rad./Sec. in absence of damping. If it is subjected

(b) to a damping force (proportional to the velocity of the system) with a constant of proportionality 10/Sec, show the system is overdamped. Obtain the general expression for displacement of the oscillator

(c) Explain and derive the Amplitude Resonance condition? Discuss the amplitude resonance conditions with the help of suitable plots. [6+(2+2)+(2+1)=13]

5(a) State and prove Poynting theorem.

(b) A LASER beam has a diameter of 2mm. What are the amplitudes of the electric field and magnetic field in the beam in vacuum if the power of the LASER is 1.5mW?

(c) Show that the energy of the EM wave is shared equally between the $\vec{E}$ and $\vec{B}$ during EM wave propagation through free space. [(5+4)+5=14]

6(a) What are the techniques used to obtain a plane polarized light? If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of extraordinary ray and ordinary ray.

(b) Why the wave front describing an ordinary ray is spherical while that of an extraordinary ray is elliptical?

(c) A plane polarized light is incident on a quartz plate that is cut parallel to the axis. Determine the least thickness of the half wave plate that ensures that the o-ray and e-ray recombine to form a plane polarized light.

(d) Define Optical activity and Specific rotation.

(e) Explain Rayleigh's criterion of resolution of spectral lines? How does resolving power of a grating vary with the order of spectrum and total number of lines on the grating surface? [(1+2)+2+3+2+3=13]

7(a) Explain the conditions for maxima and minima in the case of a single slit diffraction. Illustrate graphically the intensity distribution due to a single slit Fraunhoffer diffraction and hence specify the positions of maxima and minima on the graph.

(b) In a single slit Fraunhoffer diffraction experiment using monochromatic light of 589 nm wavelength and a slit width of 6μm, calculate the angular separation between the first order minima on either side of central maximum.

(c) Give an account on the missing orders in a double slit diffraction pattern. Deduce the missing orders for a double slit Fraunhoffer diffraction pattern if the opaque space is exactly twice the slit width.

What is the highest order spectrum which can be seen with a monochromatic light of 600 nm wavelength by means of a diffraction grating having [illegible] lines? [5+3+2=]

B TECH 1ST SEMESTER END TERM EXAMINATION 2015

Engineering Physics I

UME/EE02C07, UEC/EI/CS/PE/CH/CE/BE02C08

Full Marks: 100 *Answer all the Questions* Time: 3 hours

1. Choose the correct answer 11×2

(a) If *div* $\vec{F} = 0$ then

(i) $\vec{F} = \vec{\nabla} \times \vec{A}$ (ii) $\vec{F} = \vec{\nabla} \bullet \vec{A}$ (iii) $\vec{F} = 0$ (iv) $\vec{F} = \vec{\nabla}\vec{A}$

(b) Nature of constraint of a particle in a cubical box is

(i) holonomic (ii) non-holonomic (iii) rheonomic (iv) bilateral

(c) Fresnel's biprism experiment is based on

(i) division of amplitude (ii) division of wavefront (iii) polarization (iv)none

(d) A particle of mass m executes simple harmonic motion in a straight line with amplitude A and frequency f. Which one of the following expressions represents the total energy of the particle?

(i) $2\pi^2$ mfA^2 (ii) $2\pi^2$ mf^{2}A^2 (iii) $4\pi^2$ m^{2}f^{2}A (iv)$4\pi^2$ mf^{2}A^2

(e) A body moves with simple harmonic motion of amplitude A and frequency b/2π .What is the magnitude of the acceleration when the body is at maximum displacement?

(i) zero (ii) $4\pi^2$Ab^2 (iii) Ab^2 (iv) $4\pi^2$Ab^2

(f) The ratio of the electric field to the magnetic field in free space is given as

(i) the velocity of light (ii) the negative velocity of light (iii) the product of permeability and permittivity in free space (iv) the ratio of permeability of permittivity in free space

(g) The equation of continuity explains

(i) non-conservative nature of charge (ii) conservation of charge for a static electric field (iii) conservation of charge for a non-static electric field (iv) non-destructive nature of charge

(h) When a plane polarized light is incident on a quarter wave plate with its vibrations making an angle of 45° with optic axis, the emergent light is

(i) elliptically polarized (ii) plane polarized (iii) circularly polarized(iv)un polarized

(i) The separation between the slits in a double-slit experiment increases, the fringes become

(i) closer (ii) fainter (iii) larger (iv)no change

(j) The ratio of intensities of double slit principal maximum to single slit principal maximum is

(i) 1:4 (ii) 4:1 (iii) 1:2 (iv) 2:1

(k) The refractive index of Canada balsam in a Nicol prism is

(i) less than O and E ray of calcite (ii) greater than O and E ray of calcite (iii) in between O and E ray of calcite (iv) equal to O and E ray of calcite

[P.T.O]

2. (a) Find $\nabla\phi$ if (i) ϕ [illegible] and (ii) $\phi =$ [illegible] where [illegible]

(b) State the Gauss's Divergence theorem with mathematical equation.

(c) Prove that generalised momentum corresponding to cyclic coordinate is constant of motion.

(d) Find out the Lagrangian & hence the equation of motion of a simple pendulum.

(e) Write two limitations of Newtonian mechanics. 4+3+2+

3. (a) Describe the formation of interference pattern by Fresnel's biprism. Hence discuss how the wavelength of unknown light can be measured.

(b) A bi-prism is placed at a distance of 5cm in front of a narrow slit illuminated by Sodium light and virtual images of the slit formed by the prism are 0.5 mm apart. Find the width of the fringes formed on a screen placed 75 cm in front of the bi- prism. The wave-length of light used is 5.89×10^{-5} cm.

(c) Why the Newton's rings are circular? Why the central ring is dark?

(d) Newton's rings are observed with reflected light of wavelength 6000 Å. The diameter of the 10^{th} dark ring is 0.52 cm. Calculate the radius of curvature of the lens and the fringe width.

4+3+3+3

4. (a) What is Lissajou's figure? Derive the equation of the resultant vibration if two simple harmonic motions of different amplitudes act at right angles to each other. Find the nature of resultant motion when phase difference $\phi = \pi$ and $\phi = \frac{\pi}{2}$.

(b) Find the skin depth δ at a frequency 30 kHz in aluminium where $\sigma = 38.2 \times 10^6 \text{mho.m}^{-1}$ and $\mu = 4\pi \times 10^{-7} \text{henry.m}^{-1}$.

(c) Show that $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ and write down its physical significance. (1+3+2)+2+(3+2)

5. (a) Establish the equation of motion for damped harmonic oscillation and solve the equation. Explain the physical significance when i) $K^2 > \omega_n^2$ ii) $K^2 = \omega_n^2$ iii) $K^2 < \omega_n^2$, where, K is the damping constant and ω_n is the natural angular frequency.

(b) Show that magnetic field H follows the general wave equation in free space (2+5+3)+3

6. (a) Describe the Fraunhofer diffraction due to a single slit and deduce the position of maxima and minima. Illustrate graphically the intensity distribution due to a single slit Fraunhofer diffraction.

(b) How many rulings must a gating have if it is barely to resolve the sodium doublet (5890 Å and 5896 Å) in the third order?

(c) What is missing order of a plane transmission grating. In a double slit diffraction experiment, the slit width is 2 mm and the separation between the slits is 4 mm. Find out the missing order of the diffraction pattern.

7. (a) Define dispersive power of a gratings and obtain an expression for it. (5+1)+3+(2+2)

(b) Refractive index of glass & water are 1.54 and 1.33. which will be greater than polarizing angle for a beam incident from water to glass or that for a beam incident from glass to water.

(c) Explain how polarized light can be produced by reflection at the interface between two dielectric media.

(d) Distinguish between positive and negative uniaxial crystals.

4+3+3+3

B TECH 1ST SEMESTER END TERM EXAMINATION 2014

Engineering Physics-I

Full Marks: 50

Time: 3 Hrs

Answer all the questions

10x1

1. Choose the correct answer.

a. When Newton's rings are observed in transmitted light, the central ring is_____.
(i) dark (ii) bright (iii) half dark half bright

b. Example of heavily damped harmonic oscillator is _____.
(i) dead beat galvanometer (ii) tangent galvanometer (iii) ballistic galvanometer

c. When a plane polarized light is incident on a quarter wave plate with its vibrations making an angle of 45 with optic axis, the emergent light is_____.
(i) elliptically polarized (ii) plane polarized (iii) circularly polarized

d. What is the magnetic field ($\vec{B}$) of EM wave in free space if the components of electric field ($\vec{E}$) are $E_x=E_y=0$ and $E_z= E_o \text{Cos}Kx\text{Sin}\,\omega t$.
(i) $\frac{E_o K}{\omega} SinKxSin\omega t\hat{j}$ (ii) $E_o KSinKxSin\omega t\hat{j}$ (iii) $\frac{E_o K}{\omega} SinKxSin\omega t\hat{k}$

e. Hamiltonian for a conservative system can be written as _____
i) $\sum_j p_j \dot{q}_j + L$ ii) $\sum_i p_i \dot{q}_j - L$ iii) $\sum p_j q_{j-L}$

f. For a Holonomic system the number of generalized coordinates is_____
(i) Greater than the number of degrees of freedom
(ii) Less than the number of degrees of freedom
(iii) Equal to the number of degrees of freedom

g. If the width of a grating element is less than twice the wavelength, then for maximum diffraction angle, the possible order is_____
(i) only first order (ii) no spectrum is visible (iii) first and second order.

h. Degrees of freedom of an atom in a hydrogen molecule are _____
(i) 1 (ii) 2 (iii) 5

i. In damped vibration the damping or retarding force is proportional to _____
(i) displacement (ii) momentum (iii) instantaneous velocity

j. If the critical angle of light in a certain substance is 45, the polarizing angle for it will be
(i) 45 (ii) 54.7 (iii) 90

a) Describe the construction of Nicol prism and show how it can be used as a polarizer and as an analyzer.

(b) Two Nicols are crossed to each other. Now one of them is rotated through 60. What percentage of incident unpolarized light will pass through the system?

(c) Consider a double slit arrangement with slits of width 0.0001 cm separated by a distance of 0.0002 cm, wavelength of light used is 5000 Å. Draw the corresponding diffraction pattern. Calculate the angular width of the principle maximum? What will be the missing orders?

5+2+3=10

3. a) Why are the Newton's rings in reflecting geometry circular in nature and the central ring is dark?

b) A bi-prism is placed at a distance of 5cm in front of a narrow slit illuminated by Sodium light and virtual images of the slit formed by the prism are 0.5 mm apart. Find the width of the fringes formed on a screen placed 75 cm in front of the bi- prism. The wave-length of light used is 5.89×10^{-5} cm.

d) Derive the Lagrange's equation of motion for series LCR circuit.

3+3+4=10

4. (a) What is sharpness of resonance? Explain and show graphically the variation of amplitude with applied frequency for different damping constant.

(b) What is the resultant motion of two S.H.Ms acting perpendicular to each other having same time period but different amplitudes and phases? Discuss the resultant motions when the phase difference is 0 and $\pi/2$.

(c) The amplitude of damped oscillatory motion of frequency 300/s decays to $\frac{1}{10}$ of its initial value after 1800 cycles. Find its i) damping constant ii) quality factor iii) relaxation time.

(1+2)+(2+2)+3=10

5. (a) Show that during propagation of EM waves in free space, Electric Field ($\bar{E}$) is perpendicular to Propagation vector ($\bar{K}$).

(b) A Laser beam has a diameter of 2 mm. What is the amplitude of electric field ($\bar{E}$) and magnetic field ($\bar{B}$) in the beam in vacuum if the power of the Laser is 1.5 mW [Given $\mu_o = 4\pi \times 10^{-7}$ H/m, $\varepsilon_o = 8.85 \times 10^{-12}$ F/m].

(c) Calculate the unit vector, which is normal to the surface $\phi = x^2y^2+xy^2+3xyz$ at the point (1,1,-1).

4+3+3=10