B. TECH 1st Semester Mid Term Examination, 2018

Engineering Physics 1

UCE/CH/PE/CS/EI/EC/ME/BE/EE 01C03,DSPH11B01, DTPH11B01

Full marks: 50 **Time: 2 hours**

All the questions are compulsory

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

a) When a Polaroid is rotated, the intensity of the light varies but never reduces to zero. It shows that the light is

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

b) The amplitudes of electric and magnetic fields are related to each other by the relation-

(i) $E_oB_o=c$ (ii) $B_o=E_oc$ (iii) $E_o=B_oc$

c) The thickness of a quarter wave plate for light of wavelength 6000 Å, for refractive indices 1.544 and 1.553 for o-ray and E-ray, respectively, will be

(i) $1.67\text{x}10^{-5}$ m (ii) $1.47\text{x}10^{-4}$ m (iii) $1.57\text{x}10^{-3}$ m

d) In double refraction, we get two refracted rays called O-ray and E-ray. Which one of the following statements is true?

(i) Only O-ray is polarized (ii) Only E-ray is polarised (iii) Both O-ray and E-ray are polarized

e) The electrostatic potential at a point is given by V= (2x+4y). The electric field at that point is

(i) $-(2\hat{i}+4\hat{j})$ (ii) $2x\hat{i}+4y\hat{j}$ (iii) $x\hat{i}+y\hat{j}$

f) The displacement current arises due to –

(i) Positive changes only (ii) Negative charges only (iii) Time varying electric field

g) Which of the following is correct in empty space?

(i) $\nabla\times H=\varepsilon_o E$ (ii) $\nabla\times H=\varepsilon_o\frac{\partial E}{\partial t}$ (iii) $\nabla.E=\frac{\rho}{\varepsilon}$

h) The value of the vector integral $\int_c \boldsymbol{r}.\boldsymbol{n}\,dS$, where S is a closed surface enclosing volume V

(i) 2V (ii) 3/2 V (iii) 3V ,

i) Fresnel'sbiprism experiment is based on

(i)Division of amplitude (ii) Division of wavefront (iii) Division of phase

j) If $\vec{\nabla}\times\vec{F}=0$, then $\vec{F}$ is called

(i) Solenoidal vector (ii) Irrotational vector (iii) Null vector

[PTO]

2. (a) From Brewster's law show that light incident on a transparent substance at the polarizing angle gives reflected and refracted rays at right angle to each other.

(b) What are negative and positive crystals? Give examples.

(c) What is a quarter wave plate? How would you use it for the detection of circularly and elliptically polarized light?

(d) Explain the construction and working principle of a Nicol prism as an analyser.

(e) A glass plate ($\mu = 1.55$) is to be used as a polariser. Find the angle of polarisation and show that reflected and refracted rays are at right angles for this angle.

(f) A polarizer and analyser are parallel so that maximum light is transmitted. What will be the percentage reduction in the intensity of the incident light when the analyser is rotated through (i) 45° (ii) 90°?

[2+2+(1+2)+3+2+2=14]

3. (a) What are the laws of Electromagnetic induction? Derive the integral form of Faraday'slaw.

(b) The electric field at a point in a dielectric medium of relative permittivity 1.2 is given by $E = (3t^2 + 2t)\times 10^3$ Volt/m. Obtain the displacement current at t= 100 sec.

(c) Show that Ampere's law is inconsistent in time varying fields. How did Maxwell modify it for time varying field?

(d) Derive the free space electromagnetic wave equations and show that the velocity of the electromagnetic wave is $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

[(2+2)+2+4+3=13]

4. (a) A vector field is defined by $\vec{F} = \frac{\vec{r}}{r^2}$, where $\vec{r} = \hat{i}x + \hat{j}y + \hat{k}z$, then evaluate $\vec{\nabla} \cdot \vec{F}$ and state whether the field is solenoidal or not.

(b) Using Stoke's Theorem evaluate $\int_c [(2x - y)dx - yz^2 dy - y^2 z dz]$ where c is the circle $x^2 + y^2 = 1$, corresponding to the surface of sphere of unit radius.

(c) Find φ(r) such that $\vec{\nabla}\varphi = \frac{\vec{r}}{r^5}$ and $\varphi(1) = 0$

(d) What is interference? What are the conditions for sustained interference pattern?

[3+4+4+2=13]

S/UPH11B03, UPHB1203, DSPH11B01, DTPH11B01

B. TECH 1st Semester Mid Term Examination, 2017

Engineering Physics I

UPH11B03, UPHB1203, DSPH11B01, DTPH11B01

Full marks: 50 **Time: 2 hours**

(All the questions are compulsory)

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

(a) Two sources will be coherent if they

(i) Maintain a constant phase difference and wavelength

(ii) Cannot maintain a constant phase difference

(iii) Maintain a constant amplitute

(b) if $\vec{\nabla}\times\vec{F}=0$ then

(i) $\vec{F}=\text{grad}\phi$ (ii) $\vec{F}=\text{div}\phi$ (iii) $\vec{F}=\text{curl}\phi$

(c) Fresnel's biprism experiment is based on

(i) Division of amplitude (ii) Division of wavefront (iii) Division of phase

(d) The direction of induced e.m.f in a circuit is given by

(i) Faraday's law (ii) Lenz's law (iii) Ampere's law

(e) An electromagnetic field satisfies

(i) Gauss's law and Faraday's law (ii) Peltier law (iii) Newton's law

(f) If vector F is always normal to the given closed surface S, then $\iint(\vec{\nabla}\times\vec{F})dS=$

(i) 0 (ii) 1 (iii) -1

(g) The displacement current though a circuit is given by

(i) $\varepsilon\frac{\partial\phi}{\partial t}$ (ii) $\varepsilon\frac{\partial\vec{E}}{\partial t}$ (iii) $\varepsilon\mu\frac{\partial\phi}{\partial t}$

(h) In the fabrication of a Nicol prism the original opposite angles of a calcite crystal 71° and 109° are made into

(i) 68° and 112° (ii) 61°and 119° (iii) 75°and 105°

(i) For producing an elliptically polarized light, two waves of unequal amplitudes have to be superposed with their phase difference equal to

(i) $\pi/2$ (ii) $\pi/4$ (iii) π

(j) Substances which can rotate the plane of vibration of plane polarised light are called as

(i) Optically active substances

(ii) Optical resistive substances

(iii) Photoactive substances

2. (a) Find the divergence of $\frac{\vec{r}}{r^3}$.

(b) Using Stoke's Theorem evaluate $\int_c[(2x-y)dx - yz^2dy - y^2zdz]$ where c is the circle $x^2+y^2=1$, corresponding to the surface of sphere of unit radius.

(c) Two coherent sources are 0.18 mm apart and the fringes are observed on a screen 80 cm away. It is found that with a certain monochromatic source of light, the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light.

(d) Define temporal and spatial coherence. [3+4+3+3=13]

3. (a) Write the Maxwell's equations and state their respective physical significances.

(b) Show how Maxwell modified Ampere's circuital law for time varying field.

(c) What is the difference between Conduction Current and Displacement Current?

(d) Show that electromagnetic wave can propagate with the speed of light in free space.

[4+ (4+2) +3 =13]

4. (a) Describe Huygen's theory of double refraction in uniaxial crystals.

(b) What are retardation plates? Discuss the working principle of any one wave plate.

(c) What is Babinet compensator? Describe working principle of a Babinet compensator.

(d) What are the advantages of a Polaroid over a Nicol Prism?

(e) At a certain temperature the critical angle of incidence at the water-air interface for total internal reflection is 45° for a certain wavelength. What is the polarising angle and the angle of refraction for the light incident on water at an angle that gives maximum polarization of the reflected light. (Given $\tan^{-1}\sqrt{2} = 54.73$)

(f) Two Nicol prisms are adjusted so as to obtain maximum intensity. Through what angle should analyser be rotated to reduce the intensity to (i) one third and (ii) one fourth of incident intensity? (Given $\cos^{-1}\frac{1}{\sqrt{3}} = 54.73$) [2+3+4+1+2+2=14]

S1(UCE/CH/PE/CS/EI/EC/ME/BE/EE 01C03)UPH

B. TECH 1st Semester Mid Term Examination, September 2016

Engineering Physics 1

UCE/CH/PE/CS/EI/EC/ME/BE/EE 01C03

Full marks: 50 Time: 2 hours

All the questions are compulsory

1. Choose the correct answer. [1×11=11]

(a) If curl $\bar{F} = 0$, then

(i) $\bar{F} = grad\phi$ (ii) $\bar{F} = div\phi$ (iii) $\bar{F} = 0$

(b) If a vector $\bar{A} = \bar{A}(t)$ has a constant magnitude then $\bar{A}.\frac{d\bar{A}}{dt}$ is equal to_____.

(i) 1 (ii) 0 (iii) -1

(c) Two overlapping waves produce a stable interference pattern; their amplitudes must be

(i) Vastly different (ii) Equal (iii) Comparable

(d) According to Maxwell's equations, what can produce magnetic fields?

(i) Time-varying electric field penetrating a closed imaginary loop in space

(ii) Presence of electrical current (iii) All the above

(e) Steady magnetic fields are governed by

(i) Biot–Savart's law (ii) Ampere's Circuital law (iii) Both (i) & (ii)

(f) A 10 μF electrolytic capacitor connected to a 6 V power supply is fully charged. The displacement current flowing through the dielectric is

(i)100 mA (ii) 10 mA (iii) Zero

(g) The statement/s which is correct under all circumstances is

(i) Curl B =0 (ii) Curl E =0 (iii) Div. B =0

(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) Eliiptically polarized (b) Plane polarized (iii) Circularly polarized

(i) If v_o is the velocity of the o-ray, v_e is the velocity of e ray, then for a quartz crystal

(i) $v_o > v_e$ (ii) $v_o < v_e$ (iii) $v_o = v_e$

(j) If an unpolarised light beam of intensity $I_o/2$ is incident on a polarizer, the intensity of the light transmitted through the polarizer will be

(i) I_o (ii) $I_o/2$ (iii) $I_o/4$

(k) Nicol prism is based on the action of

(i) Refraction (ii)Double refraction (iii) Scattering

P.T.O.

2. (a)Prove that $\vec{\nabla}\left(\frac{\vec{r}}{r^3}\right) = 0$.

(b) Evaluate, $\int \vec{r} \cdot \hat{n} ds$ where S is a closed surface.

(c) Verify the divergence theorem for the vector function $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$; taken over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.

(d) How can one determine the thickness of a thin sheet of transparent material using a Fresnel's bi-prism set up? **[3+2+5+3=13]**

3. (a) Write down the differences between Conduction current and Displacement current.

(b)State Faraday's law and derive its differential form.

(c) Derive the differential form of Ampere's circuital law and explain the necessity of introducing the concept of Displacement current for time varying electric field.

(d) If in some region of space conduction current density ($\vec{J}$) is zero, then calculate the displacement current density and its maximum value for a magnetic field $\vec{H} = H_o Sin(\omega t - \alpha x)\hat{k}$.

[2+(2+2)+ (2+2)+3 = 13]

4. (a) Show that when a ray is incident at the Brewster's angle, the reflected ray is perpendicular to the refracted ray. A light is incident on a water-glass interface at such an angle that the reflected light is completely plane polarized. If the light is incident on a glass-water interface, what is the angle of polarization? Find the angle of polarization for water-glass interface. Which polarizing angle is larger?

(b) State and explain Malus' law. Two polarizing sheets have polarizing directions parallel so that the intensity of the transmitted light is maximum. Through what angle must either sheet be turned if the intensity is to drop by half?

(c) Explain the phenomenon of double refraction on the basis of Huygen's theory.

(d) Give a brief account of Polaroid and their uses.

[(3+2)+(3+2)+2+2=13]

B TECH 1ST SEMESTER MID TERM EXAMINATION, SEPTEMBER 2015

Engineering Physics I

UCE/CH/PE/CS/EI/EC/ME/BE/EE 01C03

Full Marks: 50 Time: 2 Hrs.

1. Choose the correct answer. 11x1=11

(a) If $\vec{\nabla} \cdot \vec{A} = 0$ then $\vec{A}$ is called _____ vector.

i) irrotational ii) solenoidal iii) null iv) conservative

(b) According to Stokes theorem $\int_c \vec{A}.\vec{dl} =$ _____

i) $\iint (\vec{\nabla} \times \vec{A}) \cdot ds$ ii) $\iiint (\vec{\nabla} \times \vec{A}) \cdot dv$ iii) $\int (\vec{\nabla} \cdot \vec{A}) dl$ iv) $\iint (\vec{\nabla} \cdot \vec{A}) \cdot d\vec{s}$

(c) The value of $\vec{\nabla} \cdot \vec{r}$ is equal to _____

i) 1 ii) 2 iii) 3 iv) 0

(d) Chose the correct relation in free space

(i) $\vec{\nabla} \cdot \vec{E} = j$ (ii) $\vec{\nabla} \cdot \vec{E} = 0$ (iii) $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ iv) $\vec{\nabla} \times \vec{E} = 0$

(e) Equation of continuity is represented by

(i) $\vec{\nabla} \cdot \vec{J} + \frac{\partial \rho}{\partial t} = 0$ (ii) $\vec{\nabla} \cdot \vec{J} + \frac{\partial \rho}{\partial x} = 0$ (iii) $\vec{\nabla} \cdot \vec{J} = \frac{\partial \rho}{\partial t}$ iv) $\vec{\nabla} \cdot \vec{J} = 0$

(f) For an ideal capacitor

(i) Displacement current is greater than conduction current
(ii) Displacement current is equal to conduction current
(iii) Displacement current is less than conduction current
(iv) Displacement current is zero

(g) $\vec{\nabla} \cdot \vec{B} = 0$ signifies that

(i) $\vec{B}$ is a conservative field (ii) Magnetic poles appear in pair
(iii) $\vec{B} = 0$ (iv) Magnetic force is no work force.

(h) Calcite crystal is:

(i) Uniaxial positive crystal (ii) Uniaxial negative crystal
(iii) Biaxial negative crystal (iv) Biaxial positive crystal.

(i) Along the optic axis----------

(i) Velocity of O-ray is larger than E-ray (ii) Velocity of E-ray is larger than O-ray
(iii) Both the rays have the same velocity (iv) Both the rays have the zero velocity.

(j) Brewster's angle for glass is----------

(i) 57 (ii) 67 (iii) 90 (iv) 45

(k) The substances that rotate the plane of polarization are said to be

(i) Optically active (ii) Optically inactive (iii) Opaque (iv) Polaroid's

2. (a) Find the directional derivative of $\phi = x^2y + xy^2$ at the point (2,-1,-4) along the direction of the vector $i + 2j - k$

(b) If $\vec{v} = \vec{\omega} \times \vec{r}$, then prove that $2\vec{\omega} = \vec{\nabla} \times \vec{v}$, where $|r| = \sqrt{(x^2 + y^2 + z^2)}$ and $\vec{\omega}$ is a constant vector.

(c) If $\vec{A}$ and $\vec{B}$ are each irrotational, then show that $\vec{A} \times \vec{B}$ is solenoidal.

(d) Evaluate the line integral of $\vec{a} = y\hat{i} + x\hat{j} + x\hat{k}$ on the curve defined by $x + y + z = 2$ & $x^2 - y = 0$ between the points (1,1,0) & (0,0,2).

(e) Check whether the vector field $\vec{F} = \vec{\nabla}(x^3 + y^3 + z^3 - 3xyz)$ is conservative or not.

3+3+2+3+ 2=13

3. (a) Show that Ampere's circuital law doesn't satisfy equation of continuity for time varying currents unless displacement current is considered.

(b) What is the significance of displacement current? State two differences between conduction current and displacement current.

(c) Find the magnetic field B of an EM wave propagating in free space with components of E as $E_x = E_y = 0$ and $E_z = E_0 \text{Cos } kx \text{ Sin}\omega t$.

(d) Write the physical significances of Maxwell's equations.

3+(2+2)+3+3=13

4. (a) If the plane of vibration of the incident beam makes an angle of 30 with the optic axis, compare the intensity of E-ray and O-ray.

(b) Describe the construction of a nicol prism and show how it can be used as a polarizer and an analyser.

(c) Explain the working of a half-wave plate.

(d) Calculate the thickness of a calcite plate which would convert plane polarised light into circularly polarised light. Principal refractive indices are $\mu_0 = 1.658$ and $\mu_E = 1.486$ at the wave length of light used as 5890 Å.

3+4+3+3=13