TED (10)—1016A
(RTEVISION—2010)

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**SECOND SEMESTER DIPLOMA EXAMINATION IN ENGINEERING/ TECHNOLOGY-MARCH, 2014**

**APPLIED SCIENCEII (PHYSICS)**
**(Common except for DCM and CABM)**

[time : 1 ½ hours]

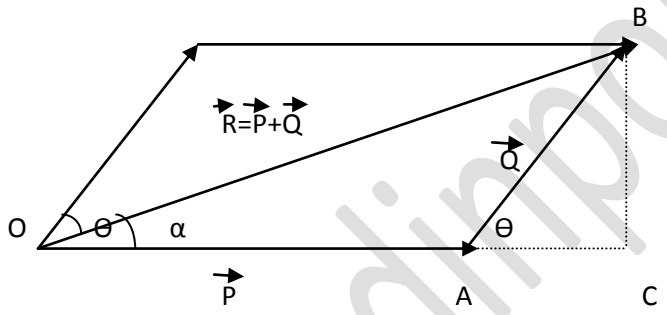
(Maximum mark 50)

**PART-A**

(Answer all questions in one or two sentences. Each question carries 2 marks)

I.a) Define the parallelogram law of vectors.

Ans) If two vectors are represented both in magnitude and direction by the adjacent sides of a parallelogram drawn from a point, their resultant is represented by the diagonal of the parallelogram drawn through the same point.



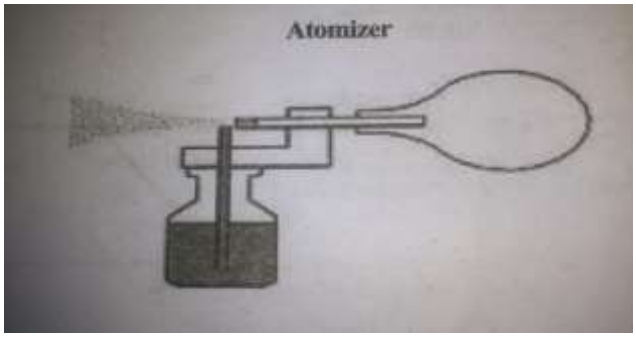

b) Write down the output of AND, NAND,NOR and XOR gates when both inputs are high.

| GATE | A | B | Y |
|---|---|---|---|
| AND | 1 | 1 | 1 |
| NAND | 1 | 1 | 0 |
| NOR | 1 | 1 | 0 |
| XOR | 1 | 1 | 0 |

**PART-B**

(Answer any 2 questions. Each question carries 8 marks.)

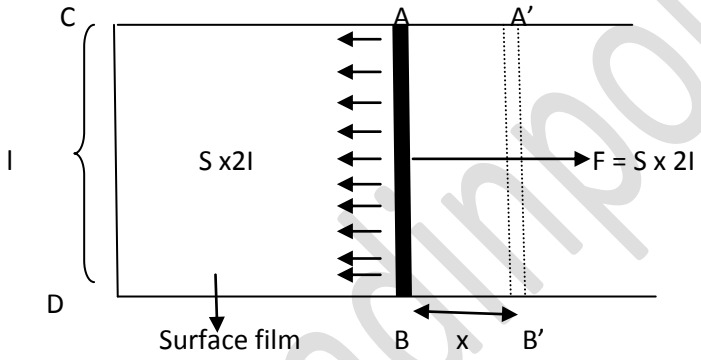
I. a) With a neat diagram explain the working of an atomizer.




Ans) It is used to spray oil,scent etc. When the bulb containing air flows through the nozzle with high velocity. This reduces the pressure at the mouth of the tube,dipped in the liquid as shown in the figure. The atmospheric pressure acting at the surface of the liquid up the tube and is sprayed along with the stream of air.

b) Prove that the intrinsic surface energy of a liquid is numerically equal to surface tension.

Ans) consider a rectangular wire frame ABCD with side AB as a smooth movable side. Let 'l' be the length Of side AB. A liquid film of surface tension S is formed on the wire frame




The force in side AB due to surface tension of the film F = 2Sl {since the film has two surface}
Let the side AB be pulled down through a small distance x to the position A'B'

Workdone for this W = 2Slx

This work done is stored in the increased area as its PE

PE stored in the increased area = 2Slx

The increase in the surface area = 2lx

PE stored per unit area = 2Slx = S

= 2lx

Ie, surface energy = S , the surface tension.

III a)Explain total internal reflection. What are the conditions to be satisfied for a light to suffer total internal reflection

Ans) a ray of light travelling from a denser medium to a rarer medium deviates away from the normal when the angle of incidence is equal to critical angle of the medium, the angle of refraction in the rarer medium will be 90°. If the angle of incidence exceeds the critical angle, the ray gets reflected back to the denser medium itself. This phenomenon is called total internal reflection.

The two conditions to be satisfied are,

1) Light must travel from a denser medium to rarer medium

2) The angle of incidence must be greater than critical angle.

b) A galvanometer of resistance 100 Ω gives full scale deflection for 1 mA. Calculate the shunt resistance needed to construct an ammeter of range 100A.

$S = \frac{I_g G}{I - I_g}$ G=100 Ω

Ig= 1mA

I= 100A

$= \frac{1X10^{-3}X100}{100-(1X10^{-3})}$

$= 1X10^{-3}\ \Omega = 1m\ \Omega$

IV a) Explain the principle of laser action .What are the characterestics that made the LASER light different from ordinary light?

Ans) It is the stimulated emission that makes laser action possible, If we choose a suitable material whose atoms can be excited to well defined energy state by supplying energy, a spontaneously emitted photon can induce an excited atom to emit an identical photon. This two photons will stimulate two more atoms and so on. If there is a large no. of photons all with the same wavelength and phase moving in the same direction. This is the principle of laser action.

Characteristics of laser action

1) Monochromaticity:- Ordinary light sources use a mixture of several colours, But laser gives ou monochromatic light.
2) Coherence: _ unlike normal light, the laser beams are always in phase.
3) High intensity:- Laser light is highly intense
4) Low divergence:- Unlike light from an electric bulb, the powercontained in the laser beam is not spread in all directions

b) Discuss the variation of viscosity with temperature.

Ans) Viscosity of a liquid is found to decrease with temperature. The viscosity of a gas is found to increase with temperature.

**PART-C**

(Answer one full question from each unit. Each question carries 15 mark)

**UNIT-1**

V a) A body is acted upon by two forces 3N & 10N. The angle between the forces is 60°. Find out the magnitude and direction of the force to be applied to keep the body in equilibrium.

Ans) $R=(P^2+Q^2+2PQ\cos\theta)^{1/2}$

$=3^2+10^2+2X3X10\cos\theta$

$= 11.78\ N$

$\alpha = \tan^{-1}(Q\sin\theta/P+Q\cos\theta)$

$=47.27°$

The magnitude and direction of the resultant with Q are 11.78 N and 47.27°. The magnitude of equilibrant also will be the same. And its direction will be (180°-α). Ie, 180-47.27 = 132.73° with Q.

b) Describe Stokes method to calculate the viscosity of highly viscous liquid.(3)

Ans) When a spherical body is falling freely through a viscous medium the weight of the body is acting downwards, wherever the viscous force and buoyant force are acting upwards,. At certain points, the net downward force becomes equal to the net upward force, and thereafter the body moves with a uniform velocity called terminal velocity,

A spherical body of radius 'v' , and density ρ falling freely through a viscous medium of coefficient of viscosity η and density σ attains a terminal velocity v. Then, net downward force= net upward force.

Weight of the body= buoyant force + viscous force.

$4/3\ \pi r^3 \rho g = 4/3\ \pi r^3 \sigma g + 6\pi r \eta v$

$\eta = 2r^2(\rho-\sigma)g/9v$

c) The surface tension of a soap solution is $30X10^{-3}$ N/m. How much work is done to increase the radius of soap bubble from 1.5 cm to 3 cm.?

S= 30X 10 -3

r= 1.5 cm=1.5 x10 -3

Area of the bubble= 2X 4πr 2= 8 π r 2

Surface energy= work done/area difference

We have, surface energy= surface tension

Therefore, work done = surface tension X area difference

$= 30X10^{-3} X 8 X3.14 X (1.5 X 10^{-3})^2$

$= 1.69 X 10^{-5}$

d) Define wavelenghth(λ), wave velocity (v), frequency (f) and amplitude (a) of a wave. Derive the relation connecting wave velocity, wavelenghth and frequency of a wave.

Ans) Wavelenght(λ):- It is the length of a complete wave. It is measured as the distance between consecutive crest or trough.

Wave velocity(v):- It is the distance travelled by the wave in 1 second,

Frequency(f):- It is the no of vibrations in 1 second.

Amplitude(a):- It is the maximum displacement of the particle executing simple harmonic motion.

<u>Relation between v, f &C</u>:-

Distance travelled by a complete wave is λ. The time taken for a wave to pass is its time period.T

Therefore Wave velocity, v= λ /T

But 1/T= f (frequency)

Therefore v = f λ

VI a) Explain the equation of continuity in the case of a fluid flowing through a pipe of varying cross section.

Ans) Equation of continuity states that, in a stream lined flow of an incompressible and non viscous fluid through a tube of non uniform cross section, the product of area of cross section and velocity of flow remains the same at every point in the tube.

That is, a1v1=a2v2 = constant

b) Explain the term angle of contact. How does it depend on the capillary height.

Ans) The angle between the tangent to the liquid surface at the point of contact and the solid surface inside the liquid is called the angle of contact.

The capillary rise or depression 'h' is given by the formula, h= 2s cos θ/rdg

Whre θ is the angle of contact

S is the surface tension of the liquid

R is the radius of the tube

D is the density of the liquid

And g is the acceleration due to gravity.

C) A bat emits ultrasonics of frequency 1000 kHz in air. If the sound meets the water surfsce , what is the wavelenghth of the reflevted sound.? Speed of sound in air is 340 m/s.

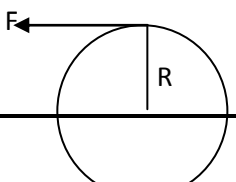
Ans) f= 1000kHz

V= 340 m/s

λ=v/f = 340/1000*103= 3.4 *10 -4 m

D) Derive an expression for work done by a couple and , hence, deduce the equation for power.

Ans) the cross-section of a shaft of radius R driven by an engine. The two equal and opposite force F AND F constitute a couple.



F

There for the moment of couple, C=F x 2R ———— (1)
When the shaft is rotated once, each force move through a distance of 2πR
There for work done by the couple of forces

$$W=F \times 2\pi R + F \times 2\pi R$$
$$=2F \times 2\pi R$$
$$=2\pi F \times 2R$$
$$=2 \pi C$$

If the shaft makes 'N' revolutions in one sec.
There for work done in one second= 2πNC
i.e, power of the engine = 2πNC

## UNIT-II

VII. a) a convex lens made of refractive index 1.5 has a focal length of 12 cm. If one of its radius of curvature is 10 cm, find the other radius .

Ans) $1/f = (\mu-1)(1/R_1 + 1/R_2)$

$1/12 = (1.5-1)(1/10 + 1/R_2)$

$1/10 + 1/R_2 = 2/12 = 1/6$

$1/R_2 = 1/6 - 1/10 = 1/15$

$R_2 = 15$ cm

b) State and explain Biot Savarts law

Ans) Biot- Savart law states that the magnetic field dB produced by the elementary length dl of the current carrying conductor at the point P is given by the

$$dB = (\mu_0/4\pi)\ I\ dl \sin\theta / r^2$$

where I is the current through the conductor
r is the distance between the middle point of the segment and the point P
θ is the angle between dl and the line joining the middle point of dl and the point P.

c) Mention any three applications of laser.

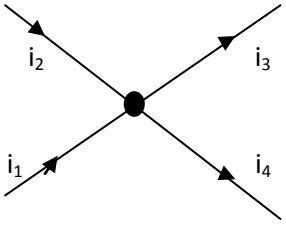
- Laser can be used as a tool for surgery
- Laser is used in material processing such as cutting, drilling and welding.
- Laser is used as a carrier in communicative field.

d) Using Kirchoffs law derive the balancing conditions of Wheastone's bridge.

**Kirchoff's laws**

1. **Current law (I law)**

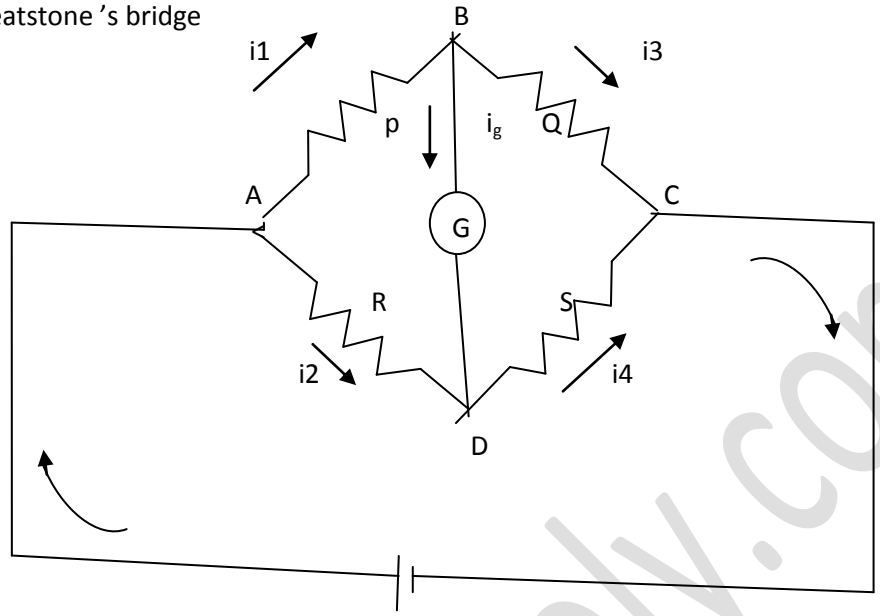
   It states that the algebraic sum of current meeting at any junction in an electrical circuit is zero.



**2. Voltage law (Mesh law)**

it states that ,in any closed mesh of an electrical circuit the algebraic sum of the product of current and resistance of various branches of the mesh and algebraic sum emf's in that mesh is equal to zero.

Wheatstone 's bridge




In Wheatstone 's bridge four resistors of resistances P, Q, R and S are connected to form a network ABCD. A cell is connected between A and C and a galvanometer of resistance G is connected between A and D.

Applying mesh law for ABCD

$i_1P + i_g G + i_2 R = 0$ ----------( 1 )

For the mesh BCDB

$I_3Q - i_4 S - i_g G = 0$ ----------( 2 )

The resisters P,Q and R are adjusted so that the galvanometer deflects zero. In this condition the bridge is said to be balanced then

$i_g = 0$, $i_1 = i_3$ and $i_2 = i_4$

there for Eqn( 1 )

$i_1P - i_2 R = 0$

ie, $i_1P = i_2 R$ .....( 4 )

Eqn( 2 )

$I_3Q - i_4 S = 0$

I e, $I_3Q = i_4 S$

i e, $I_1Q - i_2 S$ .....(5) {since $i_1=i_3$ , $i_2=i_4$}

Eqn( 4 ) / Eqn ( 5 )

$P / Q = R/S$

This is the condition for balance.

VIII. a) State Flemings left hand rule. Write down the expressions for the force on a current carrying conductor placed in a magnetic field.

Ans) If you stretch forefinger, middle finger, and thumb of your left hand to represent three mutually Perpendicular directions with forefinger pointing in the directions of magnetic field, middle finger In the direction of current, then thumb will point in the direction of force.

F= IL b sin θ where I is the current through the cconductor of lenghth l which is placed in magnetic field B at an angle θ with B.

*

b) The threshold wavelenghth for photoelectric emission in a metal is 600 nm. Find the maximum kinetic energy of the electron emitted when it is exposed to a radiation of wavelength 200 nm.

Ans) $hc/\lambda = hc/\lambda_0 + KE$

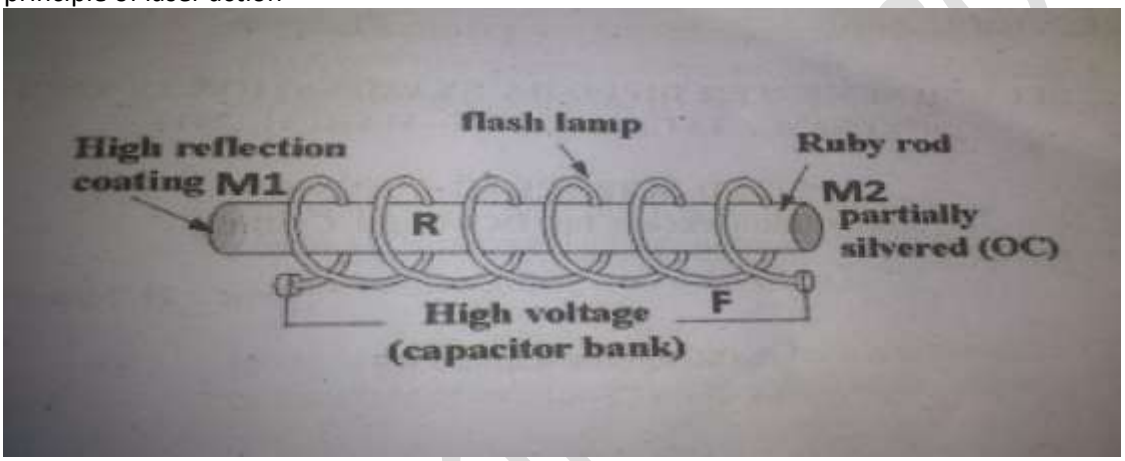
$KE = hc(1/\lambda - 1/\lambda_0)$

$= 6.6 \times 10^{-23} \times 3 \times 10^{8} (10^{9}/200 - 10^{9}/600)$

$= 6.63 \times 10^{-19}$ J

d) With the help of a neat diagram explain the working of a ruby laser.

It is the stimulated emission that makes laser action possible. If we choose a suitable material whose Atoms can be excited to well defined energy state by supplying energy, a spontaneously emitted photon can be induce an excited atom to emit an identical photon. These two photons will stimulate two more atoms and so on. If there is large number atoms in the excited state we can obtain a large number of photons all with the same wave length and phase moving in the same direction. This is the principle of laser action




In figure R is the ruby rod. The end face M1 is completely silvered and M2 is partially silvered and They are perfectly flat. The ruby rod is surrounded by the coil of flash lamp.

The chromium ions in the ruby absorb the light and make transition to higher energy states. The spontaneously emitted photons travelling through the ruby rod will stimulate additional radiation. Since the end faces of the rod are reflecting surfaces, the radiation produced in the rod bounces back and forth between the mirrors M1 and M2. In this way its gets amplified. An avalanche of photons thus develops which emerges from the system through the semi-silvered surface M2. The out put radiation has a wave length of 694.3 nm.