Old-7om

<BST-101>

<ENGINEERING PHYSICS-II/Sem/Comm>

[SUMMER-2019]

Q1(a) Basic units in SI system
2m

↳ Metre - Kilogram - Second - Amp - °Kelvin - Candela - Mole

1(b) Velocity of a Particle executing SHM
5m

Velocity $= v =$ (R.O.C) Displacement $= \dfrac{\text{Change is disp}^n}{\text{Change in time}}$

$$\text{or } v = \frac{dy}{dt} = \frac{d}{dt}(a\sin wt)$$

$$= a\frac{d}{dt}(\sin wt)$$

$$\boxed{v = aw\cos wt}$$

Now $\sin^2 wt + \cos^2 wt = 1$

or $\cos^2 wt = 1 - \sin^2 wt$

or $\cos wt = \sqrt{1-\sin^2 wt}$

$y = a\sin wt$ or $\boxed{\sin wt = \frac{y}{a}}$

$$\text{or } v = aw\sqrt{1-\sin^2 wt}$$

$$= aw\sqrt{1-\frac{y^2}{a^2}} = aw\sqrt{\frac{a^2-y^2}{a^2}} = \frac{aw}{a}\sqrt{a^2-y^2}$$

$$\text{or } \boxed{v = w\sqrt{a^2-y^2}} \text{ Ans}$$

1(c) Coefficient of friction (μ)
7m

↳ $\mu = F/R$ → $\dfrac{\text{Applied force}}{\text{Normal Reaction}}$

Methods to Reduce friction

↳ Rubbing and Polishing
→ Use of lubricants
→ Converting sliding into Rolling friction
→ Proper selection of materials
→ By streamlining (body tapered towards rear/front)
↳ sharp edges or corners are avoided

II – S/19 – BST-101 (Jom)

02/13

2(a) (2m) $\vec{A}\cdot\vec{B} = \vec{A}\times\vec{B}$

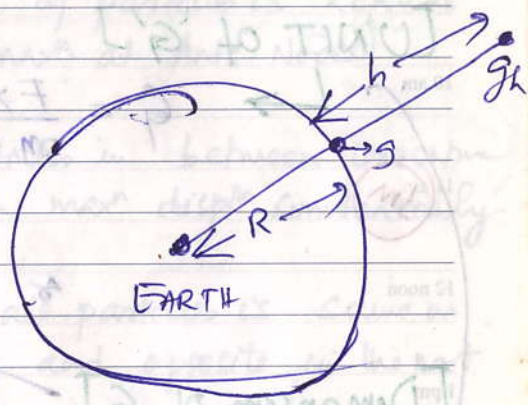
$\downarrow$

$AB\cos\theta = AB\sin\theta\,\hat{n}$

$|AB\cos\theta| = |AB\sin\theta\,\hat{n}|$ & $AB\cos\theta = AB\sin\theta$ as $|\hat{n}| = 1$

$\Rightarrow \cos\theta = \sin\theta \Rightarrow \boxed{\theta = 45^\circ}$ Ans

2(b) 5m 'g' varies with height



$$g_h = g\left(1 - \frac{2h}{R}\right)$$

As such $2h < R$

& $\frac{2h}{R} < 1$

& $1 - \frac{2h}{R} < 1$

Thus $g_h = g \times$ (less than 1)

$= 9.8 \times (< 1)$

& $\boxed{g_h = \text{less than } 9.8\,m/sec^2}$

2(c) 7m Newton's law of Gravitation (statement)

$\hookrightarrow$ Each body in this universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of distance between them.

(3m)

$$\boxed{F = G\frac{m_1 m_2}{d^2}}$$

Appointments ■ Notes

June 2010

Sun	M	T	W	T	F	S	Wk
		1	2	3	4	5	23
6	7	8	9	10	11	12	24
13	14	15	16	17	18	19	25
20	21	22	23	24	25	26	26
27	28	29	30				27

July 2010

Sun	M	T	W	T	F	S	Wk
				1	2	3	27
4	5	6	7	8	9	10	28
11	12	13	14	15	16	17	29
18	19	20	21	22	23	24	30
25	26	27	28	29	30	31	31

$F = G \frac{m_1 m_2}{d^2}$

03/13

[Define G]

'G' is defined as the force acting between 02 unit masses placed UNIT DISTANCE apart in the universe

2m

$$G = \frac{F \times d^2}{m_1 m_2}$$

[UNIT of 'G']

1m

$$G = \frac{F \times d^2}{m_1 m_2} \longrightarrow \frac{MLT^{-2} \times L^2}{M \times M} = \frac{ML^3T^{-2}}{M^2} = M \times M^{-2} \times L^3 T^{-2}$$

$$\boxed{M^{-1} L^3 T^{-2}}$$

[Demension of G]

1m

$$G = \frac{F \times d^2}{m_1 m_2} \longrightarrow \frac{Nt \times mt^2}{Kg \times Kg} = \boxed{\frac{Nt - mt^2}{Kg^2}}$$

3(a) 1st law of Thermodynamics

2m

When heat is supplied to a system a part of it is used to increase the internal energy of the system and the rest of the heat is used for doing work.

$$dQ = dU + dW$$

BST-101
II - S/19 (old)
70m

PROGRESSIVE WAVE	STATIONARY WAVE
1) Each particle of medium transfers disturbance to the other	1) Disturbance is not communicated from one particle to the next : remains fixed
2) Amplitude of each particle is the same →	(2) Amplitude of particles is ZERO at nodes and max^n at Anti-Nodes
3) Consecutive particles reach the max^n disp^n positions at different times	(3) All the particles in between consecutive nodes reach max^n disp^n simultaneously
4) Gradual change of phase from one particle to next	4) Phase of all particles is same in one segment and opposite in the next segment.
5) No particle is permanently at rest	(5) Particles at nodes are permanently at rest
6) There is flow of energy across the medium	(6) No flow of energy across the medium
7) Every region passes through successive compression/rarefactions AND crests/troughs.	(7) Compr/rare and crests/troughs remain fixed in their position
8) While passing through mean position every particle acquires maximum velocity.	(8) Maximum velocity is diff^n for diff^n particles at mean positions

■ Appointments

■ Notes

July 2010

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11	12	13	14	15	16	17	29
18	19	20	21	22	23	24	30
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August 2010

Sun	M	T	W	T	F	S	Wk
1	2	3	4	5	6	7	32
8	9	10	11	12	13	14	33
15	16	17	18	19	20	21	34
22	23	24	25	26	27	28	35
29	30	31					36

05/13

3(C) Relation between specific heats of a Gas
FM

$C_p - C_v = R.$

→ Consider one mole of ideal gas in a cylinder of initial volume 'V' by a frictionless and weightless piston

(AT CONSTANT VOLUME)

Pressure
→ volume
→ temp.

Gas heated at constant volume and temp increases by dT

$dQ = C_v \times 1 \times dT$ $[Q = mst \text{ or } dQ = m \times s \times dT]$

As there is no change in volume, no work is done by heating the gas. The entire heat is used for raising the internal energy and hence temperature of the gas.

Now again $dQ = dU + \cancel{dW}^{\to 0 \text{ (here)}}$

As $dQ = C_v dT \Rightarrow \boxed{dU = C_v dT}$ — (1)

(AT CONSTANT PRESSURE)

When the same 1 mole of ideal gas is heated at C.P., temp increases by the same dT

Gen → $dQ = m\ s\ dT$
here → $dQ' = 1 \times C_p \times dT$

The heat supplied (dQ') apart from increasing the temperature is also used for doing EXTERNAL WORK as the gas expands by dV

Now $dQ' = dU + dW$ (1st law of thermodynamics)

$$C_p dT = C_v dT + P dV \quad \text{——} (2)$$

from eqn(1)

It is know that $PV = nRT$ ($n = 1$ here)

So ~~$PV = RT$~~ $\Rightarrow P(V + dV) = R(T + dT)$

$$PV = RT \quad \text{——} (3)$$

and $P(V+dV) = R(T+dT)$ —— (4)

Subtracting eqn(4) from eqn(3)

$$\cancel{PV} - \cancel{PV} - PdV = \cancel{RT} - \cancel{RT} - RdT$$

$$\Rightarrow -PdV = -RdT \text{ or } \boxed{PdV = RdT} \text{ — } (5)$$

Using eqn(5) in eqn(2)

$$C_p dT = C_v dT + R dT$$

or

$$C_p dT - C_v dT = R dT$$

or

$$(C_p - C_v)\cancel{dT} = R\cancel{dT} \Rightarrow \boxed{C_p - C_v = R}$$ Proved.

07/13

07

158 - 207 Days 24 Weeks

MONDAY

June

2010

4(a) 2m → Coefficient of Cubical Expansion of Solids (γ)

'γ' ~~is def~~ of a solid (material) is defined as the change in volume per unit original volume (increase) per unit degree rise in temperature.

4(b) 5m Kepler's laws of Planetary Motion

1st law (Law of orbits)

→ Every planet moves round the sun in elliptical orbits with the sun at one foci

2nd law (Law of Areas)

→ A line joining any planet to the sun sweeps out equal areas in equal times.

OR

Areal velocity of a planet around the sun is constant

Area swept out by it per unit time

OR

Radius vector from the sun to the PLANET sweeps ~~out~~ equal areas in equal time.

(2m)

May 2010							
Sun	M	T	W	T	F	S	Wk
30	31					1	18
2	3	4	5	6	7	8	19
9	10	11	12	13	14	15	20
16	17	18	19	20	21	22	21
23	24	25	26	27	28	29	22

June 2010							
Sun	M	T	W	T	F	S	Wk
		1	2	3	4	5	23
6	7	8	9	10	11	12	24
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Appointments

Notes

3rd Law (Harmonic Law) OR (Law of Periods)

The square of time period of revolution of any planet round the sun is directly proportional to the cube of Semi-major axis of the orbit ($T^2 \propto R^3$)

OR

The square of time period of revolution any planet around the sun is directly proportional to the cube of planet's average distance from the sun ($T^2 \propto R^3$).

OR

4(C) → KIRCHOFF'S LAWS (Statement and Explanation)
2nd pt (5m)

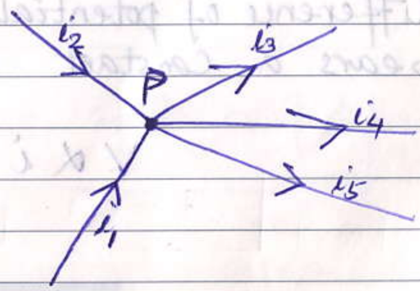
[1st law or Current law (KCL)]

Statement (1m)
The algebraic sum of current meeting at a junction of conductors is ZERO.

OR

Algebraic sum of currents meeting at a point is ZERO

Explanation (1m)
Incoming current → +ve
Outgoing current → −ve



$$i_1 + i_2 - i_3 - i_4 - i_5 = 0$$

OR $\Sigma i = 0$

Appointments ■ Notes

OR $i_1 + i_2 = i_3 + i_4 + i_5$

July 2010

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August 2010

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[KIRCHOFF's 2ND LAW OR VOLTAGE LAW (KVL)]

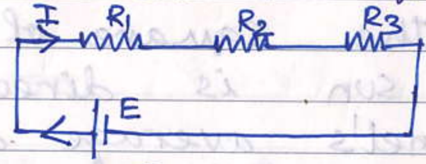
Statement [1½ or 2m]

In a closed el. ckt, the algebraic sum of emf is equal to the algebraic sum of product of resistances and currents flowing through them.

OR

The algebraic sum of product of current and resistance in each part of an closed electric ckt is equal to the total emf of the ckt

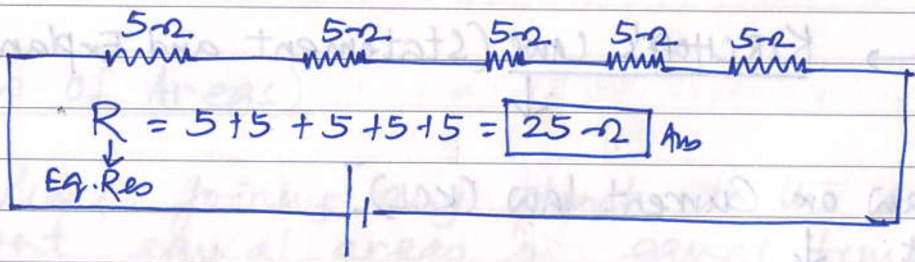
$$\boxed{E = IR_1 + IR_2 + IR_3}$$



OR

The algebraic sum of voltages in each part of a closed electric ckt is equal to the total emf of the ckt.

4(c) 2ND part (2m) →



$R = 5+5+5+5+5 = \boxed{25\,\Omega}$ Ans

Eq. Res

5(a) (2m) ⟨Ohm's law (statement)⟩

For a conductor of uniform area of cross-section, difference of potential (V) across the ends of a conductor bears a constant ratio with the current flowing through it.

$$V \propto i \quad \text{or} \quad \frac{V}{i} = \text{constant} = R \text{ (resistance of conductor)}$$

May 2010

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■ Appointments

■ Notes

[CAPACITY OF A PARALLEL PLATE CAPACITOR]

Let $A \rightarrow$ Area of each plate

$d \rightarrow$ distance between the plates

$V \rightarrow$ P.D across the plates

$Q \rightarrow$ Charge on each plate

$D/\sigma \rightarrow$ Surface charge density on either plate $= \frac{Q}{A}$

$|\vec{E}| = E$ (magnitude of electric intensity between the plates which is uniform)

Now $E = \frac{\sigma}{\epsilon}$ as $\sigma = \epsilon E$ or $D = \epsilon E$

Also $E = \frac{V}{d}$ (from defⁿ)

Comparing both equations $\frac{\sigma}{\epsilon} = \frac{V}{d}$ or $\frac{Q/A}{\epsilon} = \frac{V}{d}$.

or $\frac{Q}{A\epsilon} = \frac{V}{d} \Rightarrow \frac{Q}{V} = \frac{\epsilon A}{d}$ $\boxed{\underset{\text{from defn}}{C} = \frac{\epsilon A}{d}} \rightarrow$ any med

AIR MED $\rightarrow$ $\boxed{C = \frac{\epsilon_0 \epsilon_r A}{d}}$

Notes

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BST-101 II-S/19(OLD) 7om

11/13

5(C) → EINSTEIN'S PHOTOELECTRIC EQUATION
7m

↳ State – Explain – symbols used

(*) When a single photon is incident upon a metal surface, it is completely absorbed and imparts energy $h\nu/hf$ to a single electron attached to the surface.

2m This energy $h\nu/hf$ is utilised (expended) in 02 ways

(i) A part of it is used by the electron to liberate (free) itself from the metal surface

OR

$h\nu_0$ 2m Electron overcomes the surface barrier to come out of the metal surface. → This energy used/required is called WORK FUNCTION $(h\nu_0)$

$\frac{1}{2}mv_{max}^2$ (ii) The rest/balance/other part of energy is used by the electron to gain K.E with which it is emitted from the metal surface with velocity (v_{max}) 2m

$$\boxed{K.E = \frac{1}{2}mv_{max}^2}$$

1m

$$\boxed{h\nu = h\nu_0 + \frac{1}{2}mv_{max}^2}$$

OR

$$\boxed{hf = hf_0 + \frac{1}{2}mv_{max}^2}$$

ν_0 / f_0 → Threshold frequency → Min. freq of incident light capable of emitting electrons from metal surface.

12/13

6(a) Fleming's Left Hand Rule

2m

Stretch the forefinger - middle finger - thumb of the left hand mutually $\perp^r$ to each other.

If the ff → magnetic field MF → dir^n of current in the conductor then thumb → indicates dir^n of ~~the~~ Motion (force) of the C.C. Conductor

6(b) Properties of Magnetic lines of force

5m

→ Lines of force are directed away from north pole and towards the south pole

OR

→ Line of force starts from a north pole and ends on a south pole if they are isolated poles.

→ Tangent at any point on the magnetic line of force gives the dir^n of M. Intensity at that point

→ 02 lines of force never cross (intersect) each other as at the point of intersection — 02 tangents are possible indicating 02 dir^n of m. I at that point.

→ More concentration of lines of force indicate stronger magnetic field.

→ Lines of force tend to contract longitudinally or lengthwise - possess longitudinal strain.

BST-101
II-9/19 (0)
Form

13/13

6(c) FARADAY'S LAWS OF EM. INDUCTION

1st law $\xrightarrow{1m}$ When m·flux linked with a el·ckt changes, an emf is induced in it.

2nd law $\xrightarrow{1m}$ Ind· emf exists (lasts) in the ckt so long as change in m·flux linked with it continues.

3rd law $\xrightarrow{2m}$ Ind·emf $\propto$ -ve of time rate of change of magnetic flux linked with the ckt. $e \propto -\frac{d\phi}{dt}$

4th law $\xrightarrow{2m}$ Ind·emf $\propto$ No: of turns of coil linked with the ckt $e \propto N$

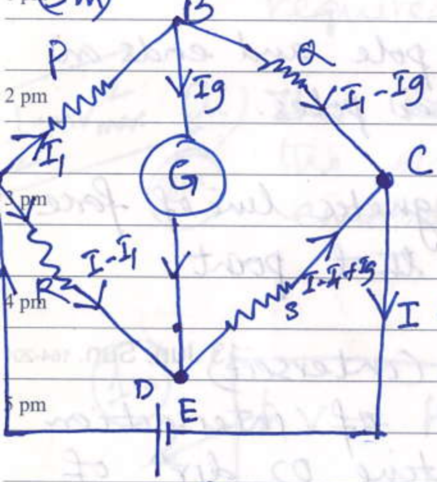
or $e \propto -N\frac{d\phi}{dt}$ or $e = -KN\frac{d\phi}{dt}$ or $\boxed{e = -N\frac{d\phi}{dt}}$

(1m) $K = 1$ (units of e, N, $\frac{d\phi}{dt}$ are so chosen)

7(a) 2m → LASER RADIATION (02 char. properties)

Directionality (highly parallel) — Intensity (Highly intense) — Monochromatic (single colour) — Coherence.

7(b) (5m) → [BALANCED CONDITION OF A WHEATSTONE BRIDGE]



Loop ABDA: $I_1 P + I_g G - (I - I_1)R = 0$ — (1)

Loop BCDB: $(I_1 - I_g)Q - I_g G - (I - I_1 + I_g)S = 0$

When the W·B is in a balanced Condn $V_B = V_D \Rightarrow V_B - V_D = 0 \Rightarrow \boxed{I_g = 0}$

Putting $I_g = 0$ in eqn (1) and eqn (2)

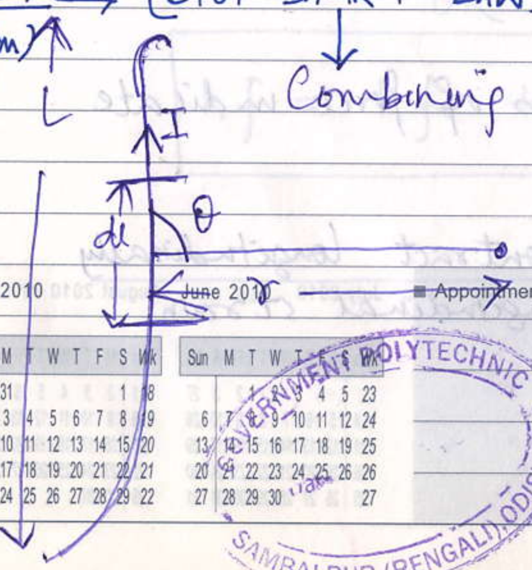
$I_1 P - (I - I_1)R = 0 \Rightarrow I_1 P = (I - I_1)R$ — (4)

AND $I_1 Q - (I - I_1)S = 0 \Rightarrow I_1 Q = (I - I_1)S$ — (5)

Div — 4/5 $= \frac{I_1 P}{I_1 Q} = \frac{(I - I_1)R}{(I - I_1)S} \Rightarrow \boxed{\frac{P}{Q} = \frac{R}{S}}$

7(c) (7m) → [BIOT-SAVART LAW]

$dB \propto dl \,/\, dB \propto I \,/\, dB \propto \sin\theta \,/\, dB \propto \frac{1}{r^2}$



Combining $dB \propto \frac{I\, dl \sin\theta}{r^2}$ or $\boxed{dB = K\frac{I\, dl \sin\theta}{r^2}}$

$K = \frac{\mu}{4\pi}$ So $\boxed{dB = \frac{\mu}{4\pi}\frac{I\, dl \sin\theta}{r^2}}$

$K = \frac{\mu_0}{4\pi}$ (air)

$$\boxed{dB = \frac{\mu_0}{4\pi}\frac{I\, dl \sin\theta}{r^2}}$$