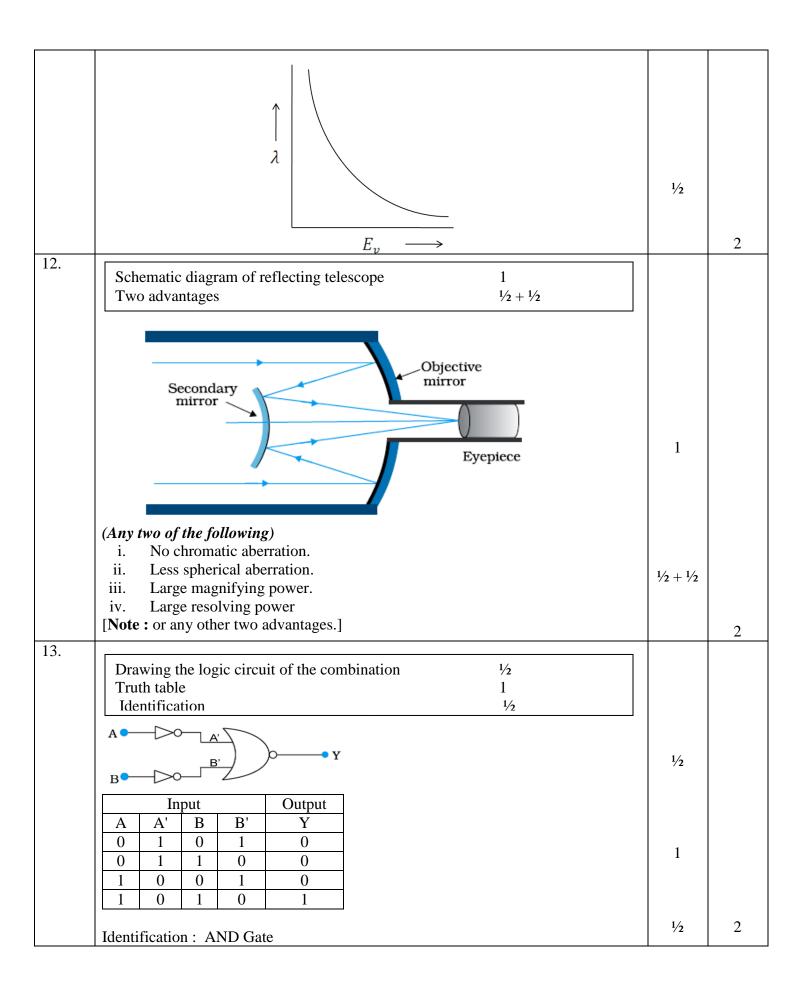
MARKING SCHEME SET 55/1/1 (Compartment)

Q.No.	SET 55/1/1 (Compartment) Expected Answer/Value Points	Marks	Total Marks
1.	i. The two point charges $(q_1 \text{ and } q_2)$ should be of opposite nature.	1/2	
	ii. Magnitude of charge q_1 must be greater than that of charge q_2	1/2	1
2.	Random motion of free electrons gets directed towards the point at a higher	1	
	potential.		
	Alternatively:		1
3.	Random motion becomes a (partially) directed motion. Diamagnetic material	1/2	
3.	$\mu_r = 1 + \chi_m$	1/2	1
1			1
4.	Due to the heating effect of eddy currents set up in the metallic piece.	1	1
5.	Effective power $\alpha \frac{1}{\lambda^2}$	1	
	(Alternatively: Effective power radiated decreases with an increase in		
	wavelength.)		1
	,,,,,,,, .		
6.	Communication System		
	Information Message Transmitted Received User of		
	Source Signal Transmitter Signal Channel Signal Receiver Message Information		
	Signal	1	
		1	
	paraghana;		
	Noise		
	Alternatively: Also accept if the student gives only the following diagram:		
	User		
	Message Transmitter Receiver		
	Signal		1
7.	Two monochromatic sources, which produce light waves, having a constant phase	1	1
	difference, are known as coherent sources.		
8.	When a constant current flows through a wire, the Potential difference, between	1	
	any two points on the wire of uniform cross section, is directly proportional to the		
	length of the wire between these points.		
	Alternatively:		1
9	$V \alpha \ell \text{ or } dV/d\ell = \text{constant}$		1
,	Charges on the inner and outer surfaces $\frac{1}{2} + \frac{1}{2}$		
	Expression for electric field 1		
	Charge on inner surface : - Q	1/2	
	Charge on outer surface : $+Q$	1/2	
	Electric field at point P ₁		
	$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r_1^2}$	1	_
	THC0 11		2

Compartment Page No. 1 20th July, 2014 final

10			
10.	Drawing of magnetic field lines ½		
	Obtaining the expression for magnetic field 1 ½		
		1/2	
	Alternatively:		
	9		
	P		
	B P	1/2	
	Applying Ampere circuital law for the rectangular loop abcd		
	$\oint \overrightarrow{B} \cdot \overrightarrow{d\ell} = \mu_o I$	1/2	
	$Bh = \mu_o I(nh)$ $B = \mu_o nI$	1/2	2
11.			
	Finding the relation 1 ½ Drawing the graph ½		
	$E_v = \phi_o + K_{max}$	1/2	
	As $\phi_o = 0$		
	$\Rightarrow E_v = K_{max}$ $\Rightarrow K_{max} = \frac{p^2}{2m} = E_v$		
	$\Rightarrow R_{max} - \frac{1}{2m} - E_v$ $\Rightarrow p = \sqrt{2mE_v}$	1/2	
	$\therefore \text{ wavelength } (\lambda) \text{ of emitted electrons}, \ \lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE_v}}$	1/2	



Compartment Page No. 3 20th July, 2014 final

14.			
14.	Obtaining the expression for the torque 2		
	Equivalent magnetic moment of the coil		
	$ec{m} = IA\hat{n}$ $\therefore \vec{m} = I\ell b\hat{n}$	1/2	
	$(\hat{n}=\text{unit vector }\perp \text{ to the plane of the coil})$		
	$ \mathbf{\dot{\cdot}}$ Torque = $\overrightarrow{m} \times \overrightarrow{B}$	1/2	
	$= \mathrm{I}\ell\mathrm{b}\widehat{n} imes \overrightarrow{B}$	1/2 1/2	
	= 0 (as \hat{n} and \vec{B} are parallel or antiparallel, to each other) [Note: Also give credit, when student obtains the relation $\tau = mBsin\theta$, and substitutes $\theta = 0$ or 180° and writes $\tau = 0$]	72	2
15.	Drawing the two plots $\frac{1}{2} + \frac{1}{2}$ Explanation of Behaviour $\frac{1}{2} + \frac{1}{2}$		
	(i) Conductor (ii) Semiconductor		
	$ \begin{array}{c c} \hline \text{(ii)} & -0.4 \\ \hline 0.2 & -0.2 \end{array} $ $ \begin{array}{c c} \hline 0.50 & 100 & 150 \end{array} $ $ \begin{array}{c c} \hline \text{Temperature } T(K) \rightarrow \\ \hline \rho = \frac{m}{ne^2\tau} \end{array} $	1/2 + 1/2	
	In conductors, average relaxation time decreases with increase in temperature, resulting in an increase in resistivity.	1/2	
	In semiconductors, the increase in number density (with increase in temperature) is more than the decrease in relaxation time; the net result is, therefore, a decrease in resistivity.	1/2	2
16.	Calculation of i. emf induced in the arm PQ 1 ii. Current induced in the loop 1		
	i. emf induced $e = B\ell v$ $0.1 = 10^{-2} = 20 \text{ V}$	1/2	
	$= 0.1 \times 10 \times 10^{-2} \times 20 \text{ V}$ = 0.2 volt	1/2	
	ii. Current in the loop $i = \frac{e}{R}$	1/2	
	$=\frac{R}{2}A = 0.1 A$	1/2	2

17.			
	Explanation of parts (i) and (ii) 1+1		
	(i) Intensity of incident radiation $I = nh\nu$, where n is number of photons incident per unit time per unit area.		
	For same intensity of two monochromatic radiations of frequency	1/2	
	v_1 and v_2		
	$n_1hv_1=n_2hv_2$		
	$As v_1 > v_2$		
	$\Rightarrow n_2 > n_1$ Therefore the number of electrons emitted for monochromatic radiation of		
	frequency v_2 , will be more than that for radiation of frequency v_1	1/2	
	[Alternatively: Also accept if the student says that, for same intensity of incident		
	radiation, the number of emitted electrons is same for each of the two frequencies		
	of incident radiation.]		
	(ii) $hv = \phi_o + K_{max}$ \therefore For given ϕ_o (work function of metal)	1/2	
	K_{max} increases with v	, -	
	∴ Maximum Kinetic energy of emitted photoelectrons will be more for		
	monochromatic light of frequency v_1 (as $v_1 > v_2$)	1/2	2
18.			
	Obtaining the expression for total work done 2		
	Work done in bringing the charge q_1 from infinity to position r_1	1/2	
	$W_1 = q_1 V(r_1)$ work done in bringing charge q_2 to the position r_2	72	
	$W_2 = q_2 V(r_2) + \frac{q_1 q_2}{4\pi \varepsilon_0 r_{12}}$		
		1/2 +1/2	
	Hence, total work done in assembling the two charges		
	$W = W_1 + W_2$ $q_1 q_2$		
	$= q_1 V(r_1) + q_2 V(r_2) + \frac{q_1 q_2}{4\pi \varepsilon_0 r_{12}}$	1/2	2
	OR		
	Derivation of relation between Electric field and potential gradient 1 Two important conclusions $\frac{1}{2} + \frac{1}{2}$		
	Work done in moving a unit positive charge along distance $\delta \ell$	1/2	
	$ E_l \delta \ell = V_A - V_B$ $= V - (V + \delta V)$	72	
	$= -\delta V$		
	$E=-\frac{\delta V}{\delta \ell}$	1/2	
		17	
	(i) Electric field is in the direction in which the potential decreases steepest.(ii) Magnitude of Electric field is given by the change in the magnitude of	1/2	
	potential per unit displacement, normal to the equipotential surface at the	1/2	
	point.		
			2

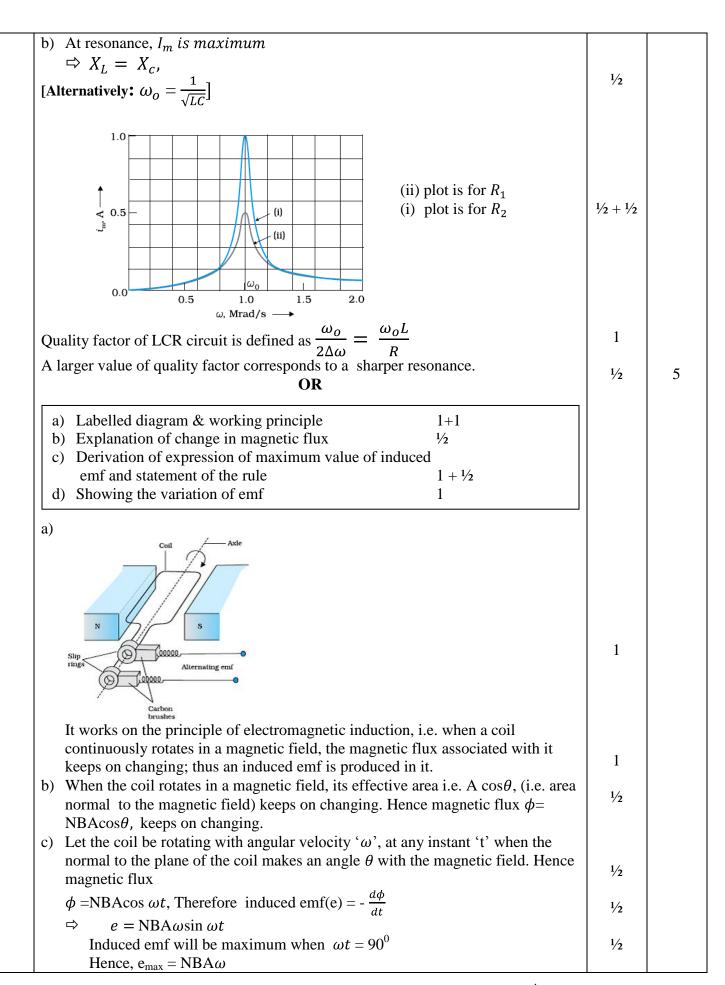
19.	Finding the ratio of		
	i. Net capacitance 1½		
	ii. Energy stored 1½		
	(i) Net capacitance before filling the gap with dielectric slab $C_{initial} = C_1 + C_2 = 2 C_2 + C_2 = 3C_2$	1/2	
	Net capacitance after filling the gap with dielectric slab of dielectric constant 'K' $C_{\text{final}} = KC_1 + KC_2 = 2 \ KC_2 + KC_2 = 3 \ KC_2$	1/2	
	Ratio of net capacitance, $\frac{C_{\text{initial}}}{C_{final}} = \frac{3C_2}{3KC_2} = \frac{1}{K}$,-	
	Ratio of het capacitance, $\frac{1}{C_{final}} - \frac{1}{3KC_2} - \frac{1}{K}$	1/2	
	(ii) Energy stored in the combination before introduction of dielectric slab Q^2		
	$U_{initial} = \frac{Q^2}{3C_2}$	1/2	
	Energy stored in the combination after introduction of dielectric slab Ω^2		
	$U_{final} = \frac{Q^2}{3KC_2}$	1/2	
	Ratio of energy stored $\frac{U_{initial}}{H} = \frac{K}{4}$	1/2	
	$U_{final} = 1$ [Note: Accept any other alternative correct method for part (ii).)	72	3
20.			
	a) Circular path + angular frequency expression 1 + ½ b) Trace of path; justification ½+ 1		
	a) Force acting on the charged particle, moving with a velocity \overrightarrow{v} , in a magnetic		
	field \vec{B} :	1/2	
	$ec{F} = q(ec{v} \times ec{B})$ As, $ec{v} \perp ec{B}$, $ Force = qvB$		
	Since, $\vec{F} \perp \vec{v}$, it acts as a centripetal force and makes the particle move in a	1/2	
	circular path, in the plane, perpendicular to the magnetic field. $\therefore qvB = \frac{mv^2}{}$		
	$r = \frac{mv}{qB}$	1/2	
	Now $\omega = \frac{v}{r}$ $\therefore \omega = \frac{qB}{m}$		
	(b)		
		1/2	
	Z B X		

	Component of velocity \overrightarrow{v} parallel to magnetic field, will make the particle move along the field. Perpendicular component of velocity \overrightarrow{v} will cause the particle to move along a circular path in the plane perpendicular to the magnetic field. Hence, the particle will follow a helical path, as shown OR	1	3
	Schematic sketch and brief description of working 1+1 Justification 1		
	Scale		
	Pointer Permanent magnet Coil	1	
	N Sp S S Pivot Soft-iron core	1	
	Uniform radial		
	When a current, I, flows through the coil, a torque $\tau = NIAB$ acts on it. A spring provides a counter torque ($K\varphi$) which balances the deflecting torque $K\varphi = NIAB$	1/2	
	$\varphi = \left(\frac{NAB}{K}\right)I \text{ ; or } \varphi \propto I$ Current sensitivity = $\frac{NAB}{K}$	1/2	
	NAD		
	Voltage sensitivity = $\frac{NAB}{KR}$	1/2	
21	On increasing number of turns, the resistance of the coil increases proportionally. .: Increase in current sensitivity does not necessarily increase voltage sensitivity.	1/2	3
21.	Answers of part (i), (ii) and (iii) 1+1+1		
	(i) Consider a plane perpendicular to the direction of propagation of the wave. An electric charge, on the plane, will be set in motion by the electric and magnetic fields of em wave, incident on this plane. This illustrates that em waves carry energy and momentum.	1	
	(ii) Microwaves are produced by special vacuum tubes like the klystron,/ Magnetron/ Gunn diode. The frequency of microwaves is selected to match the resonant frequency of	1/2	
	water molecules, so that energy is transferred efficiently to the kinetic energy of the molecules. (iii)	1/2	
	a. Associated with the green house effect.	1/2	_
	b. In remote switches of household electrical appliances. (or any other two uses.)	1/2	3
	(or any once the uses)	1	

22.		
Tracing of the path of the ray		
Calculation of angle of emergence and angle of deviation $1+1$		
P 60° Q 30° C	1	
If i_c is the critical angle for the prism/material, $\mu = \frac{1}{\sin i_c}$	1./	
$\therefore \sin i_{c} = \frac{1}{\mu} = \frac{\sqrt{3}}{2}$	1/2	
$=>i_c=60^{\circ}$		
Angle of incidence at face AC of the prism = 60°	1/2	
Hence, refracted ray grazes the surface AC. \Rightarrow Angle of emergence = 90°	1/2	
\Rightarrow Angle of deviation = 30°	1/2	
[Note: Accept other correct alternative method.]		3
a) Relation for binding energy b) Plot of BE/A versus mass number A Explanation of release of energy 1 Explanation of release of energy		
a) B.E = $[ZM_P + (A - Z)M_n - {}_Z^AM] \times c^2$	1	
b)		
The principal of the pr		
1	1	
From the binding energy per nucleon curve, it is clear that binding energy per nucleon, of the fused nuclei is more than those of the light nuclei taking part in nuclear fusion. Hence energy gets released in the process.	1	3
a) Calculation of radius in n = 3 orbit b) Finding the i. Kinetic energy ii. Potential energy 1+1		
a) Radius of orbit		

	$r_n = n^2 r_o$	1/2	
	where r_0 is Bohr's radius = 5.3 x 10^{-11} m	/2	
	∴ radius of n=3 orbit		
	$r_3 = (3)^2 \times 5.3 \times 10^{-11} m$		
	$ \begin{vmatrix} 7_3 - (3) & 5.3 & 10 & m \\ = 47.7 \times 10^{-11} & m \end{vmatrix} $		
	$= 4.77 \times 10^{-10} \text{m}$ $= 4.77 \times 10^{-10} \text{m}$	1/2	
		1/2	
	(i) kinetic energy = - Total energy = - (- 3.4)eV = 3.4 eV	1/2	
	· · · ·	1/2	
	(ii) Potential energy = -2 x Kinetic energy (or 2 × total energy) = -6.8 eV	1/2	3
25.	0.0 e v	/ 2	
23.			
	(i) Values displayed 1+1		
	(ii) Calculation of maximum distance 1		
	(i) a. Concern		
		1 . 1	
	b. Scientific temperamentc. Keen observer	1+1	
	d. Alertness		
	(or any other two correct values.)		
	` <u> </u>	1/2	
	(ii) $d = \sqrt{2hR}$	72	
	$= \sqrt{2 \times 20 \times 6.4 \times 10^6} \text{ m}$		
	$= 2 \times 8 \times 10^3 \text{m}$	1/2	3
_	= 16 km	72	
26.	Explanation of part (i) and (ii) $1\frac{1}{2} + 1\frac{1}{2}$		
	Explanation of part (i) and (ii)		
	(i) In 1:66	1/	
	(i) In diffraction pattern, intensity will be minimum at an angle $\theta = n\lambda/a$	1/2	
	\therefore There will be a first minimum at an angle $\theta = \lambda/a$, on either side of		
	central maximum	1/-	
	\therefore width of central maxima = $2\lambda/a$,	1/ ₂ 1/ ₂	
	whereas the width of other minimum/ maximum $\approx \lambda/a$	72	
	(ii) The intensity of maxima decreases as the order (n) or diffraction		
	maxima increases. This is because, on dividing the slit into odd number	1/-	
	of parts, the contributions of the corresponding (outermost) pairs cancel	1/2	
	each other, leaving behind the contribution of only the innermost		
	segment. For example, for first maximum, dividing slit into three parts		
	out of these three parts of the slit, the contributions from first two parts		
	cancel each other; only $\frac{1}{3}$ rd portion of the slit contributes to the maxima	1/-	
	of intensity.	1/2	
	Similarly for, second maxima, dividing slit into five parts, contribution	1/-	
	of first four parts will be zero(as they cancel each other). The remaining	1/2	
	$\frac{1}{r}$ th portion, only, will contribute for maxima; and so on.		2
	5	<u> </u>	3

		1	
27.	Calculation of power consumed by the resistance R 3		
	For loop ABCDA $-12 + 2I_1 + 4(I_1 + I_2) = 0$ $\therefore 3 I_1 + 2I_2 = 6(i)$	1/2	
	For loop ADFEA $-4(I_1 + I_2) + 6 = 0$ $\therefore 2 I_1 + 2I_2 = 3 \qquad(ii)$	1/2	
	Solving (i) and (ii), we get $I_1 = 3A$ $I_2 = -1.5A$	1/2 1/2 1/2	
	Hence, power consumed by the resistor $R = (I_1 + I_2)^2 R$ = $(1.5)^2 \times 4 W$ = 9 watt	1/2	3
28.			
	a) Derivation of expression for amplitude of current and phase angle 1+1 b) Condition at resonance c) Drawing of plot d) Definition of Q factor and its role in tuning 1 +½		
	a) $v_{Cm} - v_{Lm}$		
	ψ v v ωt	1/2	
	From the phasor diagram $\overrightarrow{V} = \overrightarrow{V_L} + \overrightarrow{V_R} + \overrightarrow{V_C}$ Magnitude of net voltage		
	$V_m = \sqrt{(V_{RM})^2 + (V_{Cm} - V_{Lm})^2}$ $V_m = I_m \sqrt{[R^2 + (X_C - X_L)^2]}$	1/2	
	$I_m = \frac{V_m}{\sqrt{[R^2 + (X_C - X_L)^2]}}$ From the figure	1/2	
	$\tan \phi = \frac{V_{Cm} - V_{Lm}}{V_{Rm}}$ $= \frac{I_{m}(X_{C} - X_{L})}{I_{m}R}$		
	$\therefore \phi = \tan^{-1} \left(\frac{X_C - X_L}{R} \right)$	1/2	

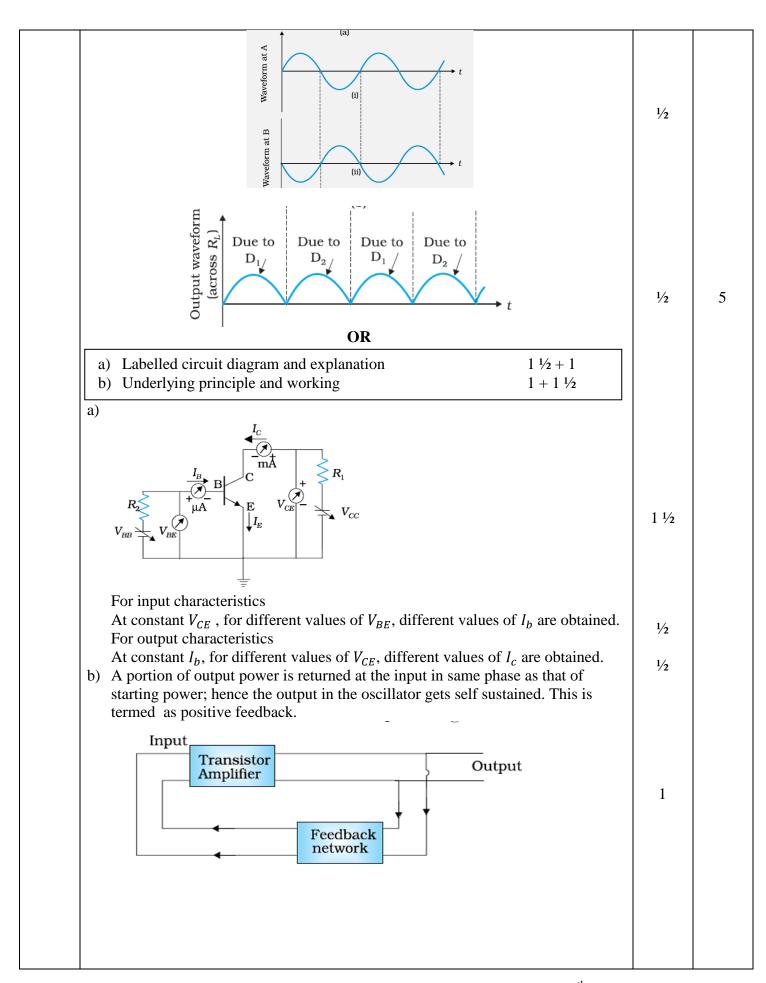


		1	
	Direction of induced emf can be determined using Flemming's Right hand		
	rule. Alternatively: Statement of the above rule.		
	(d)		
	Induced		
	$\begin{array}{c c} emf \\ 0 \end{array}$ 90° 180° 270° 360° time \longrightarrow	1	
		1	
			_
	0 T/4 T/2 3T/4		5
	$\frac{1}{4}$ $\frac{1}{2}$ $\frac{3T}{4}$		
29.			
	Ray diagram 1		
	Derivation of relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$		
	Obtaining the expression $\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 2		
	N/		
	n_i i n_2		
	N_2		
	C C D C C D C C C C C D C	1	
	$R \longrightarrow R$	1	
	$u \rightarrow u \rightarrow n_1$		
	/c		
	The incident rays coming from the object 'O' kept in the rarer medium of		
	refractive index n_1 , incident on the refracting surface NM, produce the real image		
	at I.		
	From the diagram		
	$\angle i = \angle NOM + \angle NCM$		
	$=rac{NM}{OM}+rac{NM}{MC}$	1/2	
	$\angle r = \angle NCM - \angle NIM$		
	$=\frac{NM}{MC}-\frac{NM}{MI}$	1/2	
	From Snell's law	72	
	$\therefore \frac{n_2}{n_1} = \frac{\sin i}{\sin r} \sim \frac{i}{r} \qquad \text{(for small angles } \sin \theta \sim \theta\text{)}$		
	$\therefore n_2 r = n_1 i$		
		1/2	
	$or \ n_2 \left(rac{NM}{MC} - rac{NM}{MI} ight) = n_1 \left(rac{NM}{OM} + rac{NM}{MC} ight)$		
	$or \ n_2 \left(\frac{1}{+R} - \frac{1}{+\nu}\right) = n_1 \left(\frac{1}{-u} + \frac{1}{R}\right)$		
	$\left(\begin{array}{cc} u_1 & u_2 & \overline{}_{+R} & \overline{}_{+v} \end{array}\right) - u_1 \left(\overline{}_{-u} + \overline{}_{R} \right)$		
	or $\frac{n_2-n_1}{R} = \frac{n_2}{v} - \frac{n_1}{u}$	1/	
	Lens makers formula	1/2	
	$egin{array}{cccccccccccccccccccccccccccccccccccc$		
	111 112		
		1/2	
	O_{u} U D v I		
	W .		
	V C		
		1	

The first refracting surface ABC forms the image I_1 of the object O. The image I_1 acts as a virtual object for the second refracting surface ADC which forms the real image I as shown in the diagram : for refraction at ABC $\frac{n_2}{v_1} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1}$ -----(i) For refraction at ADC $\frac{n_1}{v} - \frac{n_2}{v_1} = \frac{n_1 - n_2}{R_2}$ -----(ii) 1/2 Adding equation (i) and equation (ii), we get $\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 1/2 $\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right) \implies \frac{1}{f} = (\mu_{21} - 1) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\frac{1}{2}$ 5 a) Distinguishing between linearly polarized and unpolarized light 1 2 b) Transverse nature c) Rise or fall of intensity of sunlight 2 a) A light wave, in which the electric vector oscillates in all possible directions 1/2 in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, 1/2 in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) 1 Linearly polarized light Unpolarized light passing through Polaroid P₁ gets linearly polarized. 1/2 [As the electric field vector components parallel to the pass axis of P_1 are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P₂, kept crossed with 1/2 respect to P_1 , then these components also gets blocked and no light is transmitted beyond P_2 . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light 1 (Polarised) To Observer

	the molecules acquire components of motion in both these directions. celerating parallel to the double arrows, do not radiate energy towards a since their acceleration has no transverse component. On scattered by the molecule is therefore represented by dots, i.e. it is	1	
potartzed pe	erpendicular to plane of figure.		
b) Circuit	ation of Depletion Layer and barrier potential. 1+1 diagram of full wave rectifier 1 ation of working and drawing of input and output orms $1+\frac{1}{2}+\frac{1}{2}$		
a)			
	← Electron diffusion Electron drift →		
	p ⊝⊖⊕⊕ ⊝⊝⊕⊕ ⊝⊝⊕⊕ ⊝⊝⊕⊕	1/2	
	⊖⊖⊕⊕	,-	
zone, a layer junction is f	diffusion of electrons and the holes, from their majority zone to minority or of positive and negative space charge region on either side of the formed. This is called the depletion region. electrons, from n-region and gain of electrons by the p-region, causes a	1/2	
	of potential across the junction. This tends to prevent the movement of ers across the junction and is, therefore, termed as barrier potential.	1	
charge carrie b)		1	
charge carrie b)	Centre-Tap Transformer Diode 1(D ₁) Centre A X Tap B	1	
charge carrie	ers across the junction and is, therefore, termed as barrier potential. Centre-Tap Transformer Diode 1(D ₁)		

Compartment Page No. 14 20th July, 2014 final



Compartment Page No. 15 20th July, 2014 final

Mutual inductance (Coupling through magnetic field) T ₂ T ₂ Output	1	
S_1 (Switch)		
As the switch S_1 is closed, a surge of collector current flows through coil T_2 ,		
which causes a changing magnetic flux around it. Hence a portion of the output	t 1/2	
is fedback to the coil T_1 , as a result of the positive feedback. The emitter current, therefore, also starts oscillating.	72	5

Compartment Page No. 16 20th July, 2014 final

MARKING SCHEME SET 55/1/2 (Compartment)

O NI	SET 55/1/2 (Compartment)	N/I1	T-4.1	
Q.No.	Expected Answer/Value Points	Marks	Total Marks	
1.	When a constant current flows through a wire, the Potential difference, between any two points on the wire of uniform cross section, is directly proportional to the length of the wire between these points. Alternatively:			
	$V \alpha \ell or dV/d\ell = \text{constant}$		1	
2.	Due to the heating effect of eddy currents set up in the metallic piece.	1	1	
3.	Effective power $\alpha \frac{1}{\lambda^2}$ (Alternatively: Effective power radiated decreases with an increase in wavelength.)	1	1	
4.	TRANSMITTING ANTENNA AMPLITUDE MODULATOR Message signal Carrier	1	1	
5.	i. The two point charges $(q_1 \text{ and } q_2)$ should be of opposite nature.	1/2	1	
٥.	ii. Magnitude of charge q_1 must be greater than that of charge q_2	1/2	1	
6.	Two monochromatic sources, which produce light waves, having a constant phase difference, are known as coherent sources.	1	1	
7.	Ferromagnetic material	1	1	
8.	Random motion of free electrons gets directed towards the point at a higher potential. Alternatively: Random motion becomes a (partially) directed motion.	1	1	
9	Obtaining the expression for total work done 2 Work done in bringing the charge q_1 from infinity to position r_1 $W_1 = q_1 V(r_1)$ work done in bringing charge q_2 to the position r_2 $W_2 = q_2 V(r_2) + \frac{q_1 q_2}{4\pi \varepsilon_o r_{12}}$ Hence, total work done in assembling the two charges $W = W_1 + W_2$ $= q_1 V(r_1) + q_2 V(r_2) + \frac{q_1 q_2}{4\pi \varepsilon_o r_{12}}$ OR	1/2 1/2 +1/2	2	

Compartment Page No. 1 20th July, 2014 final

	Derivation of relation between Electric field and potential gradient 1		
	Two important conclusions $\frac{1}{2} + \frac{1}{2}$		
	Work done in moving a unit positive charge along distance $\delta \ell$ $ E_l \delta \ell = V_A - V_B$ $= V - (V + \delta V)$	1/2	
	$ = - \delta V $ $ E = - \frac{\delta V}{\delta \ell} $	1/2	
	 (i) Electric field is in the direction in which the potential decreases steepest. (ii) Magnitude of Electric field is given by the change in the magnitude of 	1/2	
	potential per unit displacement, normal to the equipotential surface at the point.	1/2	2
10.	Charges on the inner and outer surfaces $\frac{1}{2} + \frac{1}{2}$ Expression for electric field 1		
	Charge on inner surface : - Q Charge on outer surface : + Q	1/2 1/2	
	Electric field at point P ₁ $E = \frac{1}{4\pi\epsilon_0} \frac{Q}{r_1^2}$	1	2
11.	Obtaining the expression for the torque 2		
	Equivalent magnetic moment of the coil $\vec{m} = IA\hat{n}$		
	$\therefore \overrightarrow{m} = \mathbf{I} \cdot \mathbf{l} \cdot \mathbf{l}$	1/2	
	$(\hat{n}=\text{unit vector} \perp \text{ to the plane of the coil})$		
	$Torque = \overrightarrow{m} \times \overrightarrow{B}$	1/2	
	$= I \ell b \hat{n} \times \vec{B}$	1/2 1/2	
	$=0$ $(3.6) \Rightarrow 4.7 \Rightarrow 4.7$,2	
	(as \hat{n} and \vec{B} are parallel or antiparallel, to each other) [Note: Also give credit, when student obtains the relation $\tau = mBsin\theta$, and substitutes $\theta = 0$ or 180° and writes $\tau = 0$]		2
12.	Calculation of		
	i. emf induced in the arm PQ 1 ii. Current induced in the loop 1		
	i. emf induced $e = B\ell v$	1/2	
	$= 0.2 \times 20 \times 10^{-2} \times 15$		
	= 0.6 volt ii. Current in the loop	1/2	
	$i = \frac{e}{R}$	1/2	
	$=\frac{0.6}{5} = 0.12 \text{ A}$	1/2	2

		1	
13.	Drawing of magnetic field lines ½ Obtaining the expression for magnetic field 1½		
		1/2	
	Alternatively:		
	P		
	B P	1/2	
	Applying Ampere circuital law for the rectangular loop abcd	17	
	$ \oint \overrightarrow{B} \cdot \overrightarrow{d\ell} = \mu_o I $ $ Bh = \mu_o I(nh) $	1/2	
	$B = \mu_o n I$	1/2	2
14.	Finding the relation Drawing the graph $E_v = \phi_o + K_{max}$ As $\phi_o = 0$ $\Rightarrow E_v = K_{max}$	1/2	
	$\Rightarrow K_{max} = \frac{p^2}{2m} = E_v$	1/2	
	$\Rightarrow p = \sqrt{2mE_v}$		
	\therefore wavelength (λ)of emitted electrons, $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE_v}}$	1/2	

	$ \uparrow \\ \lambda \\ E_{v} \longrightarrow $	1/2	2
15.	Drawing the two plots $\frac{1}{2} + \frac{1}{2}$ Explanation of Behaviour $\frac{1}{2} + \frac{1}{2}$		
	(i) Conductor (ii) Semiconductor		
	$ \begin{array}{c c} \hline \text{(II)} & 0.4 \\ \hline 0.2 \\ \hline 0 & 50 & 100 & 150 \\ \hline \text{Temperature } T(K) \rightarrow \\ \hline \rho = \frac{m}{ne^2\tau} \end{array} $	1/2 + 1/2	
	In conductors, average relaxation time decreases with increase in temperature, resulting in an increase in resistivity.	1/2	
	In semiconductors, the increase in number density (with increase in temperature) is more than the decrease in relaxation time; the net result is, therefore, a decrease in resistivity.	1/2	2
16.	Naming of gates P and Q $\frac{1}{2} + \frac{1}{2}$ Truth table & Identification $\frac{1}{2} + \frac{1}{2}$		
	P: OR Gate Q: NOT Gate Inputs Output	1/2 1/2	
	A B Y 0 0 1 0 1 0 1 0 0 1 1 0 1 1 0	1/2	
	NOR Gate	1/2	2

17.			
17.	Schematic diagram 1		
	Two important limitations $\frac{1}{2} + \frac{1}{2}$		
	i. It suffers chromatic aberration ii. It has spherical aberration	1	
	iii. Magnifying power small.		
	iv. Small resolving power (Any two)	1/2 + 1/2	2
18.	Explanation of parts (i) and (ii) 1+1		
	(i) Intensity of incident radiation $I = nhv$, where n is number of photons incident per unit time per unit area. For same intensity of two monochromatic radiations of frequency v_1 and v_2 $n_1hv_1 = n_2hv_2$ As $v_1 > v_2$	1/2	
	 ⇒ n₂ > n₁ Therefore the number of electrons emitted for monochromatic radiation of frequency v₂, will be more than that for radiation of frequency v₁ [Alternatively: Also accept if the student says that, for same intensity of incident radiation, the number of emitted electrons is same for each of the two frequencies of incident radiation.] 	1/2	
	(ii) $hv = \phi_o + K_{max}$ \therefore For given ϕ_o (work function of metal)	1/2	
	K_{max} increases with v \therefore Maximum Kinetic energy of emitted photoelectrons will be more for monochromatic light of frequency v_1 (as $v_1 > v_2$)	1/2	2
19.	a) Circular path + angular frequency expression 1 + ½ b) Trace of path; justification ½+ 1		
	a) Force acting on the charged particle, moving with a velocity \overrightarrow{v} , in a magnetic field \overrightarrow{B} : $\overrightarrow{F} = q(\overrightarrow{v} \times \overrightarrow{B})$	1/2	

As, $\vec{v} \perp \vec{B}$, $ Force = qvB$		
Since, $\vec{F} \perp \vec{v}$, it acts as a centripetal force and makes the particle move in a	1/2	
circular path, in the plane, perpendicular to the magnetic field.	/ 2	
$\therefore qvB = \frac{mv^2}{r}$		
	1/	
qB	1/2	
Now $\omega = \frac{v}{r}$ $\therefore \omega = \frac{qB}{m}$		
b)		
Z pitch	1/2	
Component of velocity \overrightarrow{v} parallel to magnetic field, will make the particle		
move along the field.		
Perpendicular component of velocity \overrightarrow{v} will cause the particle to move along a		
circular path in the plane perpendicular to the magnetic field. Hence, the particle will follow a helical path, as shown	1	3
OR	1	3
Schematic sketch and brief description of working 1+1 Justification 1		
- Tastification		
Scale		
Pointer — Permanent magnet		
Coil		
	4	
N Sp Sp	1	
Pivot		
Soft-iron		
Uniform radial magnetic field		
When a current, I, flows through the coil, a torque $\tau = NIAB$ acts on it.	1/2	
A spring provides a counter torque ($K\varphi$)which balances the deflecting torque $\therefore K\varphi = NIAB$		
$\varphi = \left(\frac{NAB}{K}\right)I \text{ ; or } \varphi \propto I$	1/2	
	/ 4	
Current sensitivity = $\frac{NAB}{K}$	4.7	
Voltage sensitivity = $\frac{NAB}{KR}$	1/2	
On increasing number of turns, the resistance of the coil increases proportionally. • Increase in current sensitivity does not necessarily increase voltage sensitivity.	1/2	3

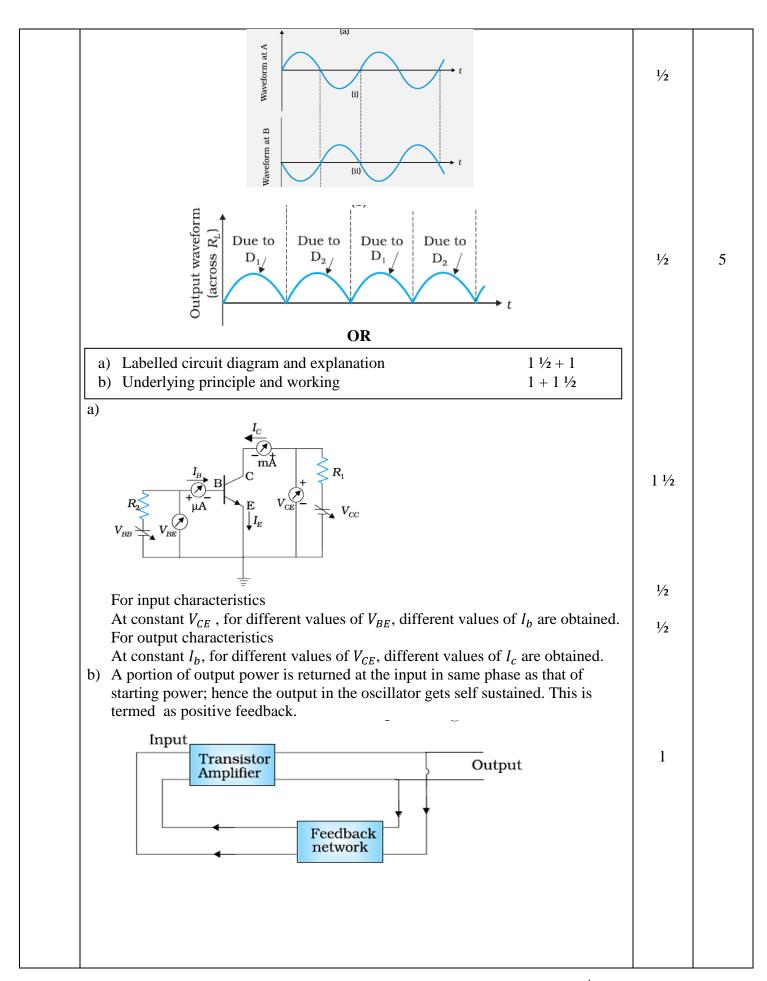
20.			
20.	(i) Values displayed 1+1 (ii) Calculation of maximum distance 1		
	(i) a. Concern		
	b. Scientific temperamentc. Keen observerd. Alertness	1+1	
	(or any other two correct values.) (ii) $d = \sqrt{2hR}$	1/2	
	$= \sqrt{2 \times 20 \times 6.4 \times 10^6} \text{ m}$ = 2 x 8 x 10 ³ m = 16 km	1/2	3
21.	Calculation of power consumed by the resistance R 3		
	For loop ABCDA -12 + $4I_1$ + $8(I_1 + I_2) = 0$	1/2	
	$12 I_1 + 8I_2 = 12$ $3 I_1 + 2I_2 = 3 \qquad (i)$ For loop A DEE A	1/2	
	For loop ADFEA $-8(I_1 + I_2) + 8 = 0$ $I_1 + I_2 = 1$ (ii)	1/ ₂ 1/ ₂	
	Simplifying (i) and (ii) For loop ABCDA $I_1 = 1A$		
	$I_2 = 0A$ Hence, power consumed by the resistor = $(I_1)^2R$ = 9 watt	1/2 1/2	3
22.	Finding the rate of i. Net capacitance 1½ ii. Energy stored 1½		
	i. Net capacitance before filling the gap with dielectric $C_{initial} = C_1 + C_2 = \frac{C_2}{2} + C_2 = \frac{3}{2}C_2$	1/2	
	Net capacitance after filling the gap with dielectric slab of dielectric constant 'K' $C_{final} = KC_1 + KC_2 = \frac{KC_2}{2} + KC_2 = \frac{3}{2}KC_2$	1/2	
	Ratio of net capacitance : Hence, $\frac{C_{initial}}{C_{final}} = \frac{1}{K}$	1/2	
	ii. Energy stored in the combination before introduction of dielectric slab $U_{initial} = \frac{2Q^2}{3C_2}$	1/2	

	1	
Energy stored in the combination after introduction of dielectric slab $U_{final} = \frac{2Q^2}{3KC_2}$	1/2	
$\frac{U_{initial}}{U_{final}} = \frac{K}{1}$	1/2	
[Note: Accept any other alternative correct method.]		3
a. Calculation of radius in n = 2 orbit b. Finding of i. Kinetic energy ii. Potential energy 1		
a. Radius of nth orbit = $n^2 r_o$ \therefore radius of n=2 orbit $r_2 = (2)^2 \times 5.3 \times 10^{-11}$	1/2	
$= 21.2 \times 10^{-11} \text{m}$ b. As kinetic energy = - Total energy = - (- 1.51)eV	1/2 1/2	
$= 1.51eV$ Potential energy = 2 x Total energy $= -2 \times 1.51 = -3.02 \text{ eV}$	1/2 1/2 1/2	3
a) Relation for binding energy b) Plot of BE/A versus mass number A Explanation of release of energy 1 Explanation of release of energy		
a) B.E = $[ZM_P + (A - Z)M_n - {}^A_ZM] \times c^2$	1	
b) Note: The control of the control		
0 50 100 150 200 250 Mass number (A)	1	
From the binding energy per nucleon curve, it is clear that binding energy per nucleon, of the fused nuclei is more than those of the light nuclei taking part in nuclear fusion. Hence energy gets released in the process.	1	3
Explanation of part (i) and (ii) $1 \frac{1}{2} + 1 \frac{1}{2}$		
(i) In diffraction pattern, intensity will be minimum at an angle $\theta = n\lambda/a$ \therefore There will be a first minimum at an angle $\theta = \lambda/a$, on either side of central maximum	1/2	

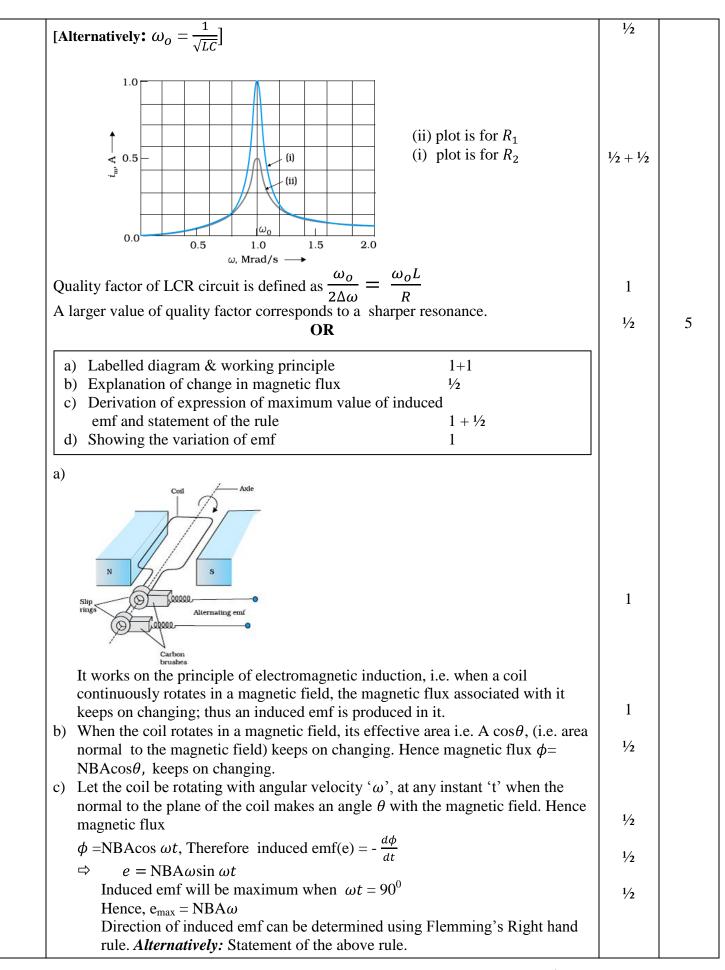
1/2	
1/2	
1/2	
1/2	
1/2	
	3
1	
1/	
1/2	
1/	
1/2	
1/	
1/2	3
1	
1	
1/2	
1	
	1/2

[Note: Accept of	leviation = 30 t her correct a l		thod.1			1/ ₂ 1/ ₂
a) Explanation ob) Circuit diagra	of Depletion La	ayer and barri	er potenti		1+1 1 1+ ½ + ½	,,2
a)						
		← Elect	ron diffu	sion		
	Electron dri	it →				
	p	9900 9900 9900 9900	n			1/2
	Hole diffusio	$\stackrel{\mid}{\longrightarrow}_{\text{Hole}}$	-	ion regior	1	
Due to the diffusion of a layer of population is formed	ositive and neg l. This is called	ative space ch the depletion	arge region.	on on eithe	r side of the	1/2
The loss of electrodifference of potentials charge carriers across	ntial across the	junction. Thi	s tends to	prevent th	e movement of	1
b)					Tot poolition.	
Cent	re-Tap sformer Centro	Diode 1(D		X Y R_L Ou		1

Compartment Page No. 10 20th July, 2014 final



As the switch S ₁ is closed, a surge of collector current flows through coil T ₂ , which causes a changing magnetic flux around it. Hence a portion of the output is fedback to the coil T ₁ , as a result of the positive feedback. The emitter current, therefore, also starts oscillating.	1/2	5
29.	1	
a) Derivation of expression for amplitude of current and phase angle 1+1 b) Condition at resonance $\frac{1}{2}$ c) Drawing of plot 1 d) Definition of Q factor and its role in tuning $\frac{1}{2}$ $\frac{1}{$	1/2	
$V_{m} = \sqrt{(V_{RM})^{2} + (V_{Cm} - V_{Lm})^{2}}$ $V_{m} = I_{m} \sqrt{[R^{2} + (X_{C} - X_{L})^{2}]}$	1/2	
$I_m = \frac{V_m}{\sqrt{[R^2 + (X_C - X_L)^2]}}$ From the figure	1/2	
From the figure $\tan \phi = \frac{V_{Cm} - V_{Lm}}{V_{Rm}}$ $= \frac{I_m(X_C - X_L)}{I_m R}$ $\therefore \phi = \tan^{-1} \left(\frac{X_C - X_L}{R}\right)$ b) At resonance, I_m is maximum	1/2	
$\Rightarrow X_L = X_C$		



Compartment Page No. 13 20th July, 2014 final

d) $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	1	5
Ray diagram Derivation of relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ Obtaining the expression $\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $n_1 \qquad \qquad 1$		
The incident rays coming from the object 'O' kept in the rarer medium of refractive index n_1 , incident on the refracting surface NM, produce the real image at I. From the diagram	1	
$\angle i = \angle NOM + \angle NCM$ $= \frac{NM}{OM} + \frac{NM}{MC}$ $\angle r = \angle NCM - \angle NIM$	1/2	
$= \frac{NM}{MC} - \frac{NM}{MI}$ From Snell's law $\therefore \frac{n_2}{n_1} = \frac{\sin i}{\sin r} \sim \frac{i}{r}$ (for small angles $\sin \theta \sim \theta$)	1/2	
$ \begin{array}{c} \therefore n_2 r = n_1 i \\ or \ n_2 \left(\frac{NM}{MC} - \frac{NM}{MI}\right) = n_1 \left(\frac{NM}{OM} + \frac{NM}{MC}\right) \\ or \ n_2 \left(\frac{1}{+R} - \frac{1}{+\nu}\right) = n_1 \left(\frac{1}{-u} + \frac{1}{R}\right) \end{array} $	1/2	
$or \frac{n_2 - n_1}{R} = \frac{n_2}{v} - \frac{n_1}{u}$ Lens makers formula $N_1 \qquad N_2$	1/2	
	1/2	
The first refracting surface ABC forms the image I_1 of the object O. The image I_1 acts as a virtual object for the second refracting surface ADC which forms the real image I as shown in the diagram		

is for refraction at ABC			
For refraction at ADC $\frac{v_1}{v_2} = \frac{v_2}{n_3} = \frac{v_3}{n_2} = \frac{v_2}{n_3} = \frac{v_3}{n_2} = \frac{v_3}$	∴ for refraction at ABC		
For refraction at ADC $\frac{v_1}{v_2} = \frac{v_2}{n_3} = \frac{v_3}{n_2} = \frac{v_3}$	$\frac{n_2}{n} - \frac{n_1}{n} = \frac{n_2 - n_1}{n}$ (i)		
Page			
Adding equation (i) and equation (ii), we get \[\frac{n_1}{n_1} - \frac{n_1}{n_1} = (n_2 - n_1) \left(\frac{1}{n_1} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(n_2 - \frac{1}{n_2}) \right) \left(\frac{1}{n_1} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(\left(\left(n_2 - \frac{1}{n_2}\right) - \frac{1}{n_1} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(\left(\left(n_2 - \frac{1}{n_2}\right) - \frac{1}{n_1} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(\left(\left(n_2 - \frac{1}{n_2}\right) - \frac{1}{n_1} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(\left(\left(n_2 - \frac{1}{n_2}\right) - \frac{1}{n_1} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(\left(\left(\left(n_2 - \frac{1}{n_2}\right) - \frac{1}{n_2} - \frac{1}{n_2}\right) = \frac{1}{n_1} = (\left(\left(\left(\left(n_2 - \frac{1}{n_2}\right) - \frac{1}{n_2} - \frac{1}{n_2}\right) = \frac{1}{n_2} = \frac{1}			
\[\frac{\partial_2}{\pu} - \frac{\partial_2}{\pu} = (n_2 - n_1) \left(\frac{1}{\mathral{R}_1} - \frac{1}{\mathral{R}_2}\right) = \frac{1}{\mathral{R}_1} = (\mu_{21} - 1) \left(\frac{1}{\mathral{R}_1} - \frac{1}{\mathral{R}_2}\right) = \frac{1}{\mathral{R}_2} = (\mu_{21} - 1) \left(\frac{1}{\mathral{R}_1} - \frac{1}{\mathral{R}_2}\right) \[\text{OR} \] a) Distinguishing between linearly polarized and unpolarized light 1 b) Transverse nature c) Rise or fall of intensity of sunlight 2 a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polariod P₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P₂, kept crossed with respect to P₁, then these components also gets blocked and no light is transmitted beyond P₂. c) It is due to scattering of light by molecules of earth's atmosphere linearly light (Unpolarised)	$\frac{-}{v} - \frac{-}{v_1} = \frac{-}{R_2}$ (11)	1/2	
1			
1	$\left \frac{n_1}{n_1} - \frac{n_1}{n_2} \right = (n_2 - n_1) \left(\frac{1}{n_1} - \frac{1}{n_2} \right)$	1/2	
a) Distinguishing between linearly polarized and unpolarized light 1 b) Transverse nature 2 c) Rise or fall of intensity of sunlight 2 a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lincident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
a) Distinguishing between linearly polarized and unpolarized light 1 b) Transverse nature 2 c) Rise or fall of intensity of sunlight 2 a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lincident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	$\left(\frac{1}{n} - \frac{1}{n} = (\frac{n_2}{n} - 1)(\frac{1}{n} - \frac{1}{n})\right) = \frac{1}{n} = (\mu_{21} - 1)(\frac{1}{n} - \frac{1}{n})$	1/2	5
a) Distinguishing between linearly polarized and unpolarized light 1 b) Transverse nature c) Rise or fall of intensity of sunlight 2 a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lipeduresced) **To Observer** Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
b) Transverse nature c) Rise or fall of intensity of sunlight a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Impolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lineatent Sunlight (Inpolarized) light in the pass accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere light light sunlight (Unpolarised). To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	c) Rise or fall of intensity of sunlight 2		
in a plane perpendicular to the direction of propagation, is known as unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	a) A light wave in which the electric vector oscillates in all possible directions		
unpolarized light. If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		1/2	
If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lineatent Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. b) Linearly polarized light Unpolarized light passing through Polaroid P1 gets linearly polarized. [As the electric field vector components parallel to the pass axis of P1 are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P2, kept crossed with respect to P1, then these components also gets blocked and no light is transmitted beyond P2. c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	÷		
light is known as linearly polarized light. b) Linearly polarized light Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lineident Sunlight (Inpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	· ·	1/2	
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere lineident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		, -	
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	• 1		
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	b)		
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	90"/		
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	$\langle P_2 \rangle$		
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		1	
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		1	
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	// No light		
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
Unpolarized light passing through Polaroid P ₁ gets linearly polarized. [As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised)			
[As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	polarized light		
[As the electric field vector components parallel to the pass axis of P ₁ are transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	Unpolarized light passing through Polaroid P ₁ gets linearly polarized.	1/	
transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		/ /2	
When this polarized light is incident on a Polaroid P ₂ , kept crossed with respect to P ₁ , then these components also gets blocked and no light is transmitted beyond P ₂ . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised)			
respect to P_1 , then these components also gets blocked and no light is transmitted beyond P_2 . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots , i.e. it is	<u> </u>	4.6	
transmitted beyond P_2 . c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots , i.e. it is		1/2	
c) It is due to scattering of light by molecules of earth's atmosphere Incident Sunlight (Unpolarised) Scattered Light (Polarised) To Observer Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	· -		
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	Incident Sunlight (Unpolarised)		
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	<u> </u>		
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	Scattered Light		
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		1	
Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is	↓		
electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is			
the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is 1 5	± ±		
The radiation scattered by the molecule is therefore represented by dots, i.e. it is 1			
	the observer since their acceleration has no transverse component.		
polarized perpendicular to plane of figure.	The radiation scattered by the molecule is therefore represented by dots, i.e. it is	1	5
	polarized perpendicular to plane of figure.	•	

MARKING SCHEME SET 55/1/3 (Compartment)

Q.No.	Expected Answer/Value Points	Marks	Total Marks
1.	Random motion of free electrons gets directed towards the point at a higher potential.	1	
	Alternatively: Random motion becomes a (partially) directed motion.		1
2.	Two monochromatic sources, which produce light waves, having a constant phase difference, are known as coherent sources.	1	1
3.		1	
	$\xrightarrow{\text{AM Wave}} \xrightarrow{\text{RECTIFIER}} \xrightarrow{\text{ENVELOPE}} \xrightarrow{m(t)} \text{OUTPUT}$		
4.	Paramagnetic material	1	1 1
5.	Effective power $\alpha \frac{1}{\lambda^2}$	1	
	(Alternatively: Effective power radiated decreases with an increase in wavelength.)		1
6.	Due to the heating effect of eddy currents set up in the metallic piece.	1	1
7.	When a constant current flows through a wire, the Potential difference, between any two points on the wire of uniform cross section, is directly proportional to the length of the wire between these points. Alternatively: $V \alpha \ell \text{ or } dV/d\ell = \text{constant}$	1	1
8.	i. The two point charges $(q_1 \text{ and } q_2)$ should be of opposite nature.	1/2	1
	ii. Magnitude of charge q_1 must be greater than that of charge q_2	1/2	1
9	Drawing of magnetic field lines ½ Obtaining the expression for magnetic field 1½		
		1/2	

Alternatively:		
P		
B P	1/2	
Applying Ampere circuital law for the rectangular loop abcd	1/2	
$ \oint \overrightarrow{B} \cdot \overrightarrow{d\ell} = \mu_o I $	72	
$Bh = \mu_o I(nh)$ $B = \mu_o nI$	1/2	2
10. Explanation of parts (i) and (ii) 1+1		
(i) Intensity of incident radiation $I = nhv$, where n is number of photons incident per unit time per unit area. For same intensity of two monochromatic radiations of frequency v_1 and v_2 $n_1hv_1 = n_2hv_2$ As $v_1 > v_2$	1/2	
 ⇒ n₂ > n₁ Therefore the number of electrons emitted for monochromatic radiation of frequency v₂, will be more than that for radiation of frequency v₁ [Alternatively: Also accept if the student says that, for same intensity of incident radiation, the number of emitted electrons is same for each of the two frequencies of incident radiation.] 	1/2	
(i) $hv = \phi_o + K_{max}$ \therefore For given ϕ_o (work function of metal)	1/2	
K_{max} increases with v		
∴ Maximum Kinetic energy of emitted photoelectrons will be more for monochromatic light of frequency v_1 (as $v_1 > v_2$)	1/2	2

11.			
	Ray diagram of formation of image by a compound microscope 1 Expression for total magnification 1		
	Expression for total magnification		
	A B' Eyepiece B' B Objective A' Objective A'	1	
	Total magnification		
	$m = m_o \times m_e$ $= \frac{L}{f_o} \times \frac{D}{f_e}$	1	2
12.	Obtaining the expression for total work done 2		
	Work done in bringing the charge q_1 from infinity to position r_1 $W_1 = q_1 V(r_1)$ work done in bringing charge q_2 to the position r_2	1/2	
	$W_2 = q_2 V(r_2) + \frac{q_1 q_2}{4\pi \varepsilon_o r_{12}}$ Hence, total work done in assembling the two charges	1/2 +1/2	
	$W = W_1 + W_2$ = $q_1 V(r_1) + q_2 V(r_2) + \frac{q_1 q_2}{4\pi \varepsilon_0 r_{12}}$ OR	1/2	2
	Derivation of relation between Electric field and potential gradient 1 Two important conclusions $\frac{1}{2} + \frac{1}{2}$		
	Work done in moving a unit positive charge along distance $\delta \ell$ $ E_l \ \delta \ell = V_A - V_B$ $= V - (V + \delta V)$	1/2	
	$ = - \delta V $ $ E = - \frac{\delta V}{\delta \ell} $	1/2	
	(i) Electric field is in the direction in which the potential decreases steepest.	1/2	
	(ii) Magnitude of Electric field is given by the change in the magnitude of potential per unit displacement, normal to the equipotential surface at the point.	1/2	2

13.			
13.	Naming of gates P and Q $\frac{1}{2} + \frac{1}{2}$		
	Truth Table of combination & Identification $\frac{1}{2} + \frac{1}{2}$		
	P: NOT Gate	1/ ₂ 1/ ₂	
	Q: AND Gate Input A Output Y	1/2	
	Input A Output Y 0 1	1/2	
		, 2	
	NOT gate	1/2	2
14.			
	Obtaining the expression for the torque 2		
	Equivalent magnetic moment of the coil		
	$\overrightarrow{m} = IA\widehat{n}$	1/2	
	$\therefore \overrightarrow{m} = \mathbf{I} \cdot \mathbf{l} \cdot \mathbf{n}$, 2	
	$(\hat{n}=\text{unit vector }\perp \text{ to the plane of the coil})$		
		1/2	
	$= \mathbf{I} \ell \mathbf{b} \hat{n} \times \vec{B}$	1/2	
	=0	1/2	
	(as \hat{n} and \vec{B} are parallel or antiparallel, to each other)		
	[Note: Also give credit, when student obtains the relation		2
1.5	$ au = mBsin\theta$, and substitutes $\theta = 0$ or 180^o and writes $\tau = 0$		
15.	Finding the relation 1 ½		
	Drawing the graph \frac{1}{2}		
	$E_v = \phi_o + K_{max}$	1/2	
	As $\phi_0 = 0$		
	$\Rightarrow E_v = K_{max}$		
	$\Rightarrow K_{max} = \frac{p^2}{2m} = E_v$	1/	
	$\Rightarrow p = \sqrt{2mE_{\nu}}$	1/2	
	· ·	1/2	
	∴ wavelength (λ)of emitted electrons, $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE_v}}$	/ 2	
	↑ \ \		
	λ		
		1/2	
		/ 2]
		/2	
	$E_v \longrightarrow$	/2	2

16.			
10.	Calculation of		
	i. emf induced in the arm PQ		
	ii. Current induced in the loop 1		
	i. emf induced		
	$e = B\ell v$	1/2	
	$= 0.25 \times 15 \times 10^{-2} \times 25$ = 0.9375 volt	1/	
	= 0.9373 Volt $= 0.94 volt$	1/2	
	ii. Current in the loop		
	1	1/2	
	$i = \frac{e}{R}$		
	$=\frac{0.94}{4} = 0.23 \text{ A}$	1/2	2
17.			
	Drawing the two plots $\frac{1}{2} + \frac{1}{2}$		
	Explanation of Behaviour $\frac{1}{2} + \frac{1}{2}$		
	(ii) Conductor (ii) Semiconductor		
	(m 0.4		
	ρ (100) P	1/2 + 1/2	
		/2 1 /2	
	stivi		
	Sesii		
	0 50 100 150 Temperature $T(K) \rightarrow T$		
	$\rho = \frac{m}{ne^2\tau}$		
	In conductors, average relaxation time decreases with increase in temperature,	1/2	
	resulting in an increase in resistivity.	72	
	In semiconductors, the increase in number density (with increase in temperature)		
	is more than the decrease in relaxation time; the net result is, therefore, a decrease	1/2	2
18.	in resistivity.		
10.	Charges on the inner and outer surfaces $\frac{1}{2} + \frac{1}{2}$		
	Expression for electric field 1		
	Charge on inner surface: - Q	1/2	
	Charge on outer surface : + Q	1/2	
	Electric field at point P ₁		
	$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r_1^2}$	1	2
10	**************************************	-	2
19.	Explanation of part (i) and (ii) $1\frac{1}{2} + 1\frac{1}{2}$		
	(i) In diffraction pattern, intensity will be minimum at an angle $\theta = n\lambda/a$	1/2	
	$\therefore \text{ There will be a first minimum at an angle } \theta = \lambda/a, \text{ on either side of }$, -	
	central maximum		
	central maximum		

	An electric charge, on the plane, will be set in motion by the electric and magnetic fields of em wave, incident on this plane. This illustrates that em waves carry energy and momentum. (ii) Microwaves are produced by special vacuum tubes like the klystron,/ Magnetron/ Gunn diode. The frequency of microwaves is selected to match the resonant frequency of water molecules, so that energy is transferred efficiently to the kinetic	1 1/2	
21.	Answers of part (i), (ii) and (iii) 1+1+1 (i) Consider a plane perpendicular to the direction of propagation of the wave.		
21.	[Note: Accept any other alternative correct method.]		3
	$\frac{U_{initial}}{U_{final}} = \frac{K}{1} = K:1$	1/2	
	$U_{final} = \frac{Q^2}{4KC_2}$	1/2	
	$U_{initial} = \frac{Q^2}{4C_2}$ Energy stored in the combination after introduction of dielectric slab	1/2	
	Hence Net capacitance, $\frac{C_{initial}}{C_{final}} = \frac{1}{K}$ ii. Energy stored in the combination before introduction of dielectric slab	1/2	
	$C_{\text{final}} = KC_1 + KC_2 = 3KC_2 + C_2 = 4KC_2$	1/2	
	i. Net capacitance before filling the gap $C_{\text{initial}} = C_1 + C_2 = 3 C_2 + C_2 = 4C_2$ Net capacitance after filling the gap $C_{\text{one}} = KC_1 + KC_2 = 2KC_1 + C_2 = 4KC_1$	1/2	
20.	Finding the ratio of i. Net capacitance 1½ ii. Energy stored 1½		
20.	of intensity. Similarly for, second maxima, dividing slit into five parts, contribution of first four parts will be zero(as they cancel each other). The remaining $\frac{1}{5}$ th portion, only, will contribute for maxima; and so on.	1/2	3
	whereas the width of other minimum/ maximum $\approx \lambda/a$ (ii) The intensity of maxima decreases as the order (n) or diffraction maxima increases. This is because, on dividing the slit into odd number of parts, the contributions of the corresponding (outermost) pairs cancel each other, leaving behind the contribution of only the innermost segment. For example, for first maximum, dividing slit into three parts out of these three parts of the slit, the contributions from first two parts cancel each other; only $\frac{1}{3}$ rd portion of the slit contributes to the maxima	1/2	
	$\therefore \text{ width of central maxima} = 2\lambda/a,$	1/2	

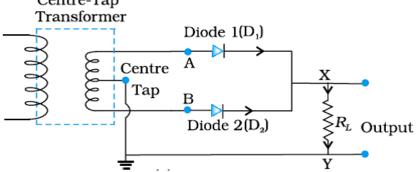
		I	1
	energy of the molecules. (iii)	1/2	
	a. Associated with the green house effect.	1/2	
	b. In remote switches of household electrical appliances.	1/2	3
	(or any other two uses.)		
22.	a) Circular path + angular frequency expression 1 + ½ b) Trace of path; justification ½+ 1		
	a) Force acting on the charged particle, moving with a velocity \overrightarrow{v} , in a magnetic field \overrightarrow{B} : $\overrightarrow{F} = q(\overrightarrow{v} \times \overrightarrow{B})$	1/2	
	$As, \vec{v} \perp \vec{B}, Force = qvB$		
	Since, $\vec{F} \perp \vec{v}$, it acts as a centripetal force and makes the particle move in a circular path, in the plane, perpendicular to the magnetic field.	1/2	
		1/2	
	Now $\omega = \frac{v}{r}$ $\therefore \omega = \frac{qB}{m}$ b)		
	pitch pathus	1/2	
	Component of velocity \overrightarrow{v} parallel to magnetic field, will make the particle move along the field. Perpendicular component of velocity \overrightarrow{v} will cause the particle to move along a circular path in the plane perpendicular to the magnetic field. Hence, the particle will follow a helical path, as shown OR	1	3
	Schematic sketch and brief description of working 1+1 Justification 1		
	Scale Pointer Permanent magnet Coil		
	Pivot Soft-iron core Uniform radial magnetic field	1	

	When a current, I, flows through the coil, a torque $\tau = NIAB$ acts on it. A spring provides a counter torque ($K\varphi$) which balances the deflecting torque $\therefore K\varphi = NIAB$	1/2	
	$\varphi = \left(\frac{NAB}{K}\right)I \text{ ; or } \varphi \propto I$ Current sensitivity = $\frac{NAB}{K}$	1/2	
	Voltage sensitivity = $\frac{NAB}{KR}$ On increasing number of turns, the resistance of the coil increases proportionally.	1/2	
	: Increase in current sensitivity does not necessarily increase voltage sensitivity.	1/2	3
23.	Tracing of the path of the ray Calculation of angle of emergence and angle of deviation 1 1 1 1		
	A 60° Q 30°	1	
	If i_c is the critical angle for the prism/material, $\mu = \frac{1}{\mathrm{Sin}i_c}$		
		1/2	
	$=>i_c=60^o$ Angle of incidence at face AC of the prism $=60^o$	1/2	
	Hence, refracted ray grazes the surface AC. ⇒ Angle of emergence = 90° ⇒ Angle of deviation = 30° [Note: Accept other correct alternative method.]	1/2 1/2	3
24.	a) Relation for binding energy b) Plot of BE/A versus mass number A Explanation of release of energy 1 1 1		
	a) B.E = $[ZM_P + (A - Z)M_n - {}^A_ZM] \times c^2$	1	
	b) \$ 10		
	10 8 9 10 10 8 11 10 10 10 10 10 10 10 10 10 10 10 10	1	

	From the binding energy per nucleon curve, it is clear that binding energy per	1	
	nucleon, of the fused nuclei is more than those of the light nuclei taking part in	1	3
	nuclear fusion. Hence energy gets released in the process.		
25.			
	a. Calculation of radius in n = 3 orbit		
	b. Finding of		
	i. Kinetic energy		
	ii. Potential energy 1		
	a. Radius of orbit		
	$r_n = n^2 r_o$	1/2	
	$\frac{r_3}{r_2} = \frac{n_3^2 r_0}{n_2^2 r_0}$		
	$\frac{1}{r_2} = \frac{1}{n_2^2 r_0}$		
	9		
	$= 4.77 \times 10^{-10} m$	1/2	
	b. As kinetic energy = - Total energy	1/2	
	= -(-13.6) eV		
	= 13.6 eV		
	∴ Kinetic energy in first excited state = $\frac{+13.6}{4}$ =3.4eV		
	\therefore Kinetic energy in first excited state = $\frac{1}{4}$ = 3.4eV	1/2	
	Potential energy = $-2 \times KE$	1/2	_
	=-6.8 eV	1/2	3
26.			
	(i) Values displayed 1+1		
	(ii) Calculation of maximum distance 1		
	(i)		
	a. Concern		
	b. Scientific temperament	1+1	
	c. Keen observer		
	d. Alertness		
	(or any other two correct values.)		
	(ii) $d = \sqrt{2hR}$	1/2	
	$= \sqrt{2 \times 20 \times 6.4 \times 10^6} \text{ m}$		
	$= 2 \times 8 \times 10^3 \text{m}$		_
	= 16 km	1/2	3
27.			
	Calculation of power consumed by the resistance R 3		
	For loop ABCDA	1/2	
	$-8 + I_1 + 8(I_1 + I_2) = 0$		
	$9 I_1 + 8I_2 = 8$ (i)	1/2	
	For loop ADFEA		
	$-8(I_1 + I_2) + 4 = 0$	1/2	
	$8I_1 + 8I_2 = 4$		
	$2 I_1 + 2I_2 = 1$ (ii)	1/2	
	Simplifying (i) and (ii)		
	$I_1 = 4A$		

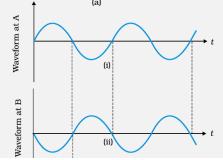
	$I_2 = -3.5A$ Hence, power consumed by the resistor = $(I_1 + I_2)^2 R$ = $(0.5)^2 \times 8$	1/2	
	= 2 watt	1/2	3
28.	Ray diagram Derivation of relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ Obtaining the expression $\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ 2		
	n_1 n_2 n_3 n_4 n_5 n_7 n_8 n_8 n_8 n_9	1	
	The incident rays coming from the object 'O' kept in the rarer medium of refractive index n_1 , incident on the refracting surface NM, produce the real image at I. From the diagram		
	$ \angle i = \angle NOM + \angle NCM = \frac{NM}{OM} + \frac{NM}{MC} \angle r = \angle NCM - \angle NIM $	1/2	
	$= \frac{NM}{MC} - \frac{NM}{MI}$ From Snell's law $\therefore \frac{n_2}{n_1} = \frac{\sin i}{\sin r} \sim \frac{i}{r}$ (for small angles $\sin \theta \sim \theta$)	1/2	
	$ \begin{array}{l} \therefore n_2 r = n_1 i \\ or \ n_2 \left(\frac{NM}{MC} - \frac{NM}{MI} \right) = n_1 \left(\frac{NM}{OM} + \frac{NM}{MC} \right) \\ or \ n_2 \left(\frac{1}{+R} - \frac{1}{+\nu} \right) = n_1 \left(\frac{1}{-u} + \frac{1}{R} \right) \end{array} $	1/2	
	$or \frac{n_2 - n_1}{R} = \frac{n_2}{v} - \frac{n_1}{u}$ Lens makers formula A N ₁ N ₂	1/2	
		1/2	
	The first refracting surface ABC forms the image I_1 of the object O. The image I_1 acts as a virtual object for the second refracting surface ADC which forms the real image I as shown in the diagram \therefore for refraction at ABC $\frac{n_2}{v_1} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} \qquad(i)$		

For refraction at ADC		
$\left \frac{n_1}{v} - \frac{n_2}{v_1} \right = \frac{n_1 - n_2}{R_2}$ (ii)	1/2	
Adding equation (i) and equation (ii), we get		
$\left \frac{n_1}{v} - \frac{n_1}{u} \right = (n_2 - n_1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$	1/2	
	, 2	
$\left \frac{1}{v} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1 \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \right \Rightarrow \frac{1}{f} = (\mu_{21} - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$	1/2	5
OR		
a) Distinguishing between linearly polarized and unpolarized light 1		
b) Transverse nature 2 c) Rise or fall of intensity of sunlight 2		
c) Rise or fall of intensity of sunlight 2		
a) A light wave, in which the electric vector oscillates in all possible directions		
in a plane perpendicular to the direction of propagation, is known as unpolarized light.	1/2	
If the oscillations of the electric vectors are restricted to just one direction,		
in a plane perpendicular to the direction of propagation, the corresponding	1/2	
light is known as linearly polarized light.		
b)		
90'		
No. 13-14	1	
↓ ↓ ↓		
Linearly		
polarized light		
Unpolarized light passing through Polaroid P ₁ gets linearly polarized.		
[As the electric field vector components parallel to the pass axis of P_1 are	1/2	
transmitted whereas the others are blocked]. When this polarized light is incident on a Polaroid P ₂ , kept crossed with		
respect to P_1 , then these components also gets blocked and no light is	1/2	
transmitted beyond P_2 .	72	
c) It is due to scattering of light by molecules of earth's atmosphere		
Incident Sunlight (Unpolarised)		
‡		
Scattered Light (Polarised)		
(i diametr)	1	
To Observer		
Under the influence of the electric field of the incident (unpolarized) wave, the		
electrons in the molecules acquire components of motion in both these directions.		
Charges, accelerating parallel to the double arrows, do not radiate energy towards		
the observer since their acceleration has no transverse component. The radiation scattered by the molecule is therefore represented by dots, i.e. it is		
polarized perpendicular to plane of figure.	1	5
	1	J



For positive half cycle of input ac, one of the two diodes gets forward biased and conducts and output is obtained across the load $R_{\rm L}$

For negative half cycle of input ac, the other diode gets forward biased and thus output is obtained due to it. Therefore, output is obtained for both the cycles of input ac.

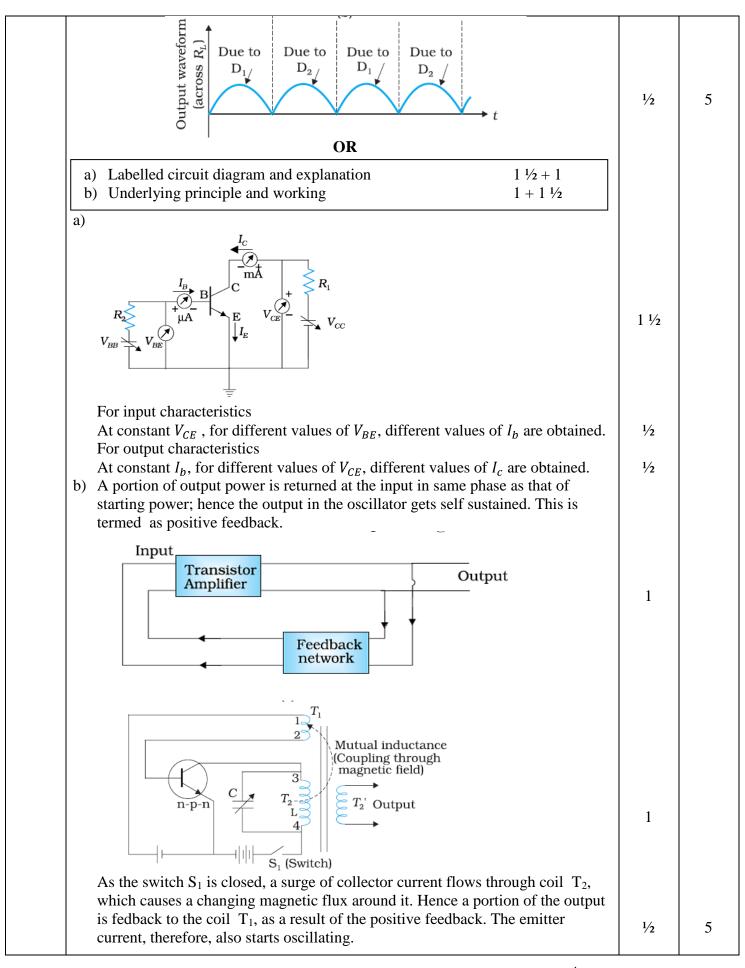


1/2

1

1

Compartment Page No. 12 20th July, 2014 Final



Compartment Page No. 13 20th July, 2014 Final

- a) Derivation of expression for amplitude of current and phase angle 1+1
- b) Condition at resonance

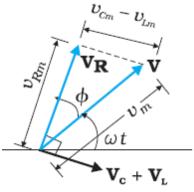
c) Drawing of plot

1

d) Definition of Q factor and its role in tuning

 $1 + \frac{1}{2}$

 \overline{a}



1/2

From the phasor diagram

$$\overrightarrow{V} = \overrightarrow{V_L} + \overrightarrow{V_R} + \overrightarrow{V_C}$$

Troin the phasor diagram
$$\overline{V} = \overline{V_L} + \overline{V_R} + \overline{V_C}$$
Magnitude of net voltage
$$V_m = \sqrt{(V_{RM})^2 + (V_{Cm} - V_{Lm})^2}$$

$$V_m = I_m \sqrt{[R^2 + (X_C - X_L)^2]}$$

$$I_m = \frac{V_m}{\sqrt{[R^2 + (X_C - X_L)^2]}}$$

$$I_m = \frac{v_m}{\sqrt{[R^2 + (X_C - X_L)^2]}}$$

1/2

From the figure
$$\tan \phi = \frac{V_{Cm} - V_{Lm}}{V_{Rm}}$$

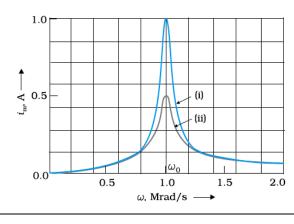
$$= \frac{I_{m}(X_{C} - X_{L})}{I_{m}R}$$

$$\therefore \phi = \tan^{-1} \left(\frac{X_{C} - X_{L}}{R}\right)$$

b) At resonance, I_m is maximum $\Rightarrow X_L = X_c$

[Alternatively:
$$\omega_o = \frac{1}{\sqrt{LC}}$$
]

1/2



- (ii) plot is for R_1
- (i) plot is for R_2

 $\frac{1}{2} + \frac{1}{2}$

20th July, 2014 Final Compartment Page No. 14

Quality factor of LCR circuit is defined as $\frac{\omega_o}{2\Delta\omega} = \frac{\omega_o L}{R}$	1	
A larger value of quality factor corresponds to a sharper resonance. OR	1/2	5
 a) Labelled diagram & working principle b) Explanation of change in magnetic flux c) Derivation of expression of maximum value of induced emf and statement of the rule d) Showing the variation of emf 		
Alternative and	1	
It works on the principle of electromagnetic induction, i.e. when a coil continuously rotates in a magnetic field, the magnetic flux associated with it	1	
keeps on changing; thus an induced emf is produced in it. b) When the coil rotates in a magnetic field, its effective area i.e. A $\cos\theta$, (i.e. area normal to the magnetic field) keeps on changing. Hence magnetic flux ϕ = NBA $\cos\theta$, keeps on changing.	1/2	
c) Let the coil be rotating with angular velocity ' ω ', at any instant 't' when the normal to the plane of the coil makes an angle θ with the magnetic field. Hence magnetic flux	1/2	
$\phi = \text{NBAcos } \omega t$, Therefore induced emf(e) = $-\frac{d\phi}{dt}$	1/2	
$e = \text{NBA}\omega\sin\omega t$ Induced emf will be maximum when $\omega t = 90^{0}$ Hence, $e_{\text{max}} = \text{NBA}\omega$ Direction of induced emf can be determined using Flemming's Right hand	1/2	
rule. Alternatively: Statement of the above rule.		
d) $\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1	
$\frac{1}{0}$ $\frac{1}{T_4'}$ $\frac{1}{2}$ $\frac{3T_4'}{4}$		5