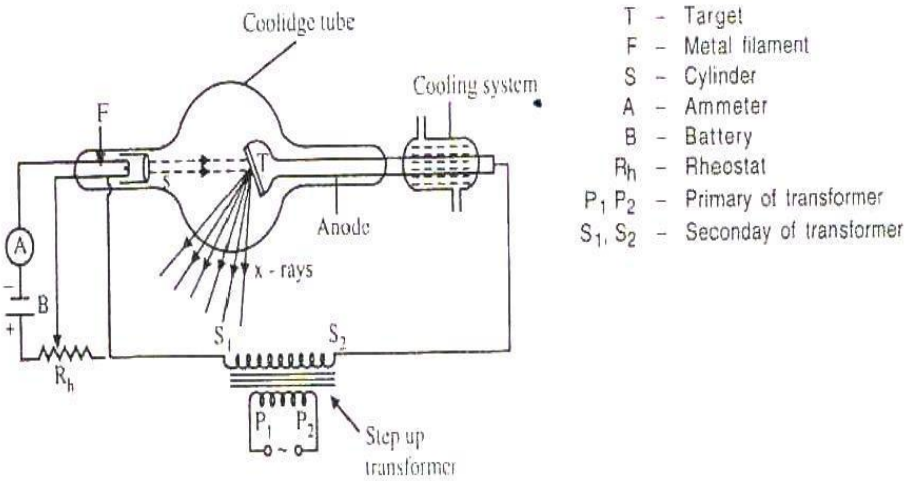
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate. 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills). 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn. 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer. 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding. 7) For programming language papers, credit may be given to any other program based on equivalent concept.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)		**Attempt any Nine**		18
	a)	**Define uniform acceleration and state its S.I. unit.**		
		Definition	1	
		Unit	1	2
		Uniform acceleration If the acceleration of a body is uniform in magnitude and direction w.r.t. time then it is called uniform acceleration. **OR** If change in velocity of a body is constant in every equal interval of time then it is called uniform acceleration. S.I. unit is m/s^2		
	b)	**State equations of K.E. and P.E. also state meanings of symbols used in it.**		
		Two equation	1	2
		Meaning **Potential Energy** = mgh Where**,** m = Mass of body g = Gravitational accelration and h = Height **Kinetic energy** = ½ mv^2 Where, m = mass of body and v = Velocity	1	
	c)	**State any two properties of ultrasonic waves**		2
		Each Property i) Frequency of these sound waves is more than 20kHz. ii) It has shorter wavelength. iii) They carry high amount of sound energy. iv) The speed of propagation of ultrasonic waves increases with increase in frequency. v) They show negligible diffraction. vi) Ultrasonic waves travel over long distance without considerable loss. vii) Ultrasonic waves undergo reflection and refraction at the separation of two media. viii) If it passed through fluid, then temperature of the fluid increases. ix) They travel with constant speed through a homogeneous medium. x) They posses certain vibrations which are used as good massage action in case of muscular pain.	1	

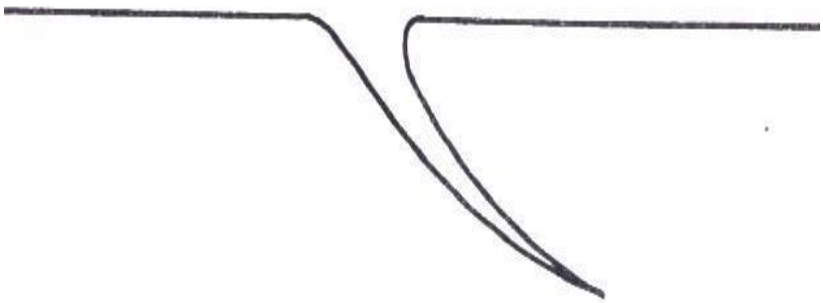
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	d)	**Name any four non-destructive testing methods.** **Each method** **NDT methods:** 1) Liquid penetrant testing (LPT) 2) Ultrasonic testing (UT) 3) Magnetic particle testing (MT) 4) Radiograph testing (RT) 5) Leak testing (LT) 6) Visual testing (VA) 7) Holographic testing (HT) 8) Thermal infra radiography (TR) **Note: Any other relevant factors can be considered.**	½	2
	e)	**Draw a neat labeled diagram of Coolidge X- ray tube.**  	2	2
	f)	**Define luminous flux. State its symbol and SI Unit.** **Definition** **Symbol and Unit** **Definition luminous flux**: The amount of light which flows from a source per second is called as luminous flux. **Symbol** :- Φ **Unit** :- lumen	1 1	2

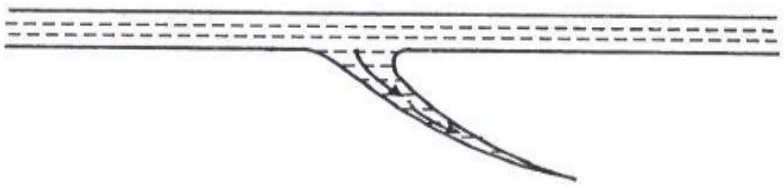
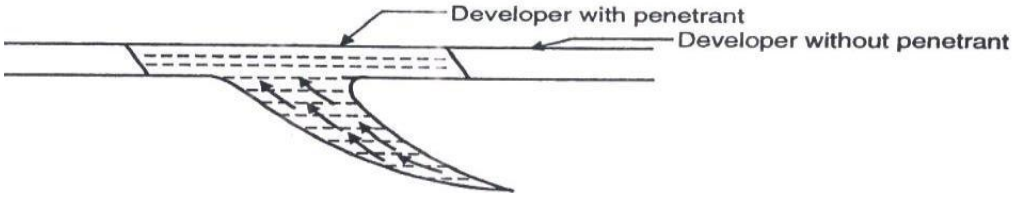
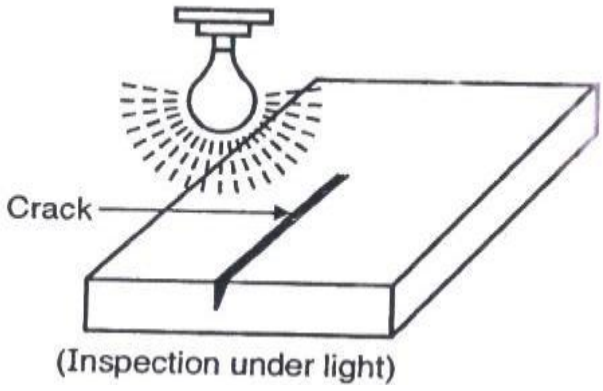
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	g)	**State two properties of photon.** **Any two Properties** i. It is an indivisible entity. The existence of photon is same as existence of electron. ii. Photon is electrically neutral. iii. They cannot be deflected by electric or magnetic field. iv. They travel with speed of light. v. Photon does not ionize. **Any relevant properties may be consider.**	1	2
	h)	**State any two medical applications of X-ray.** **Each application** **Medical Application of X- Rays:** i) X – Rays are used in surgery to detect bone fractured. ii) X- Rays are used to cure skin diseases and destroy tumours. iii) X – Rays are used to cure diseases like cancer. iv) X – Rays are used to detect bullets position inside the body. **Any relevant application may be consider.**	1	2
	i)	**A body of mass 400 kg is being lifted with a uniform velocity of 2 m/s. find the power involved in it.** **Formula & Substitution** **Answer with Unit** Given Mass = 400 kg. Force = Weight = (m x g) = (400 x 9.8) Velocity = 2 m/s. We have, Power = Force x Velocity = (400 x 9.8) x (2) **Power = 7840 watt.**	1 1	2
	j)	**Define maintenance factor. State it's formula.** **Definition** **Formula** **Maintenance factor:** It is the ratio of illuminance obtained under existing condition to the illuminance obtained when everything is clean. Maintenance factor = $\frac{\textit{Illuminance obtained under existing condition}}{\textit{illuminance obtained when everything is clean.}}$	1 1	2

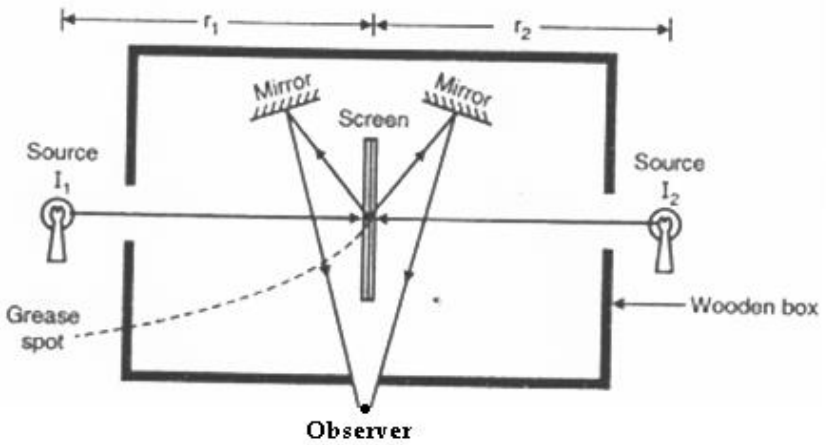
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	k)	**An accelerated electron emits a quantum of radiation with frequency 9 x 10^{19} Hz. Calculate energy of electron. (h=6.63x10^{-34} Js)**		2
		Formula with substitution	1	
		Answer with unit	1	
		Given $\upsilon = 9 \times 10^{19}$ Hz h=6.63x10^{-34} Js E = ? E = h x υ E = (6.63x10^{-34} x 9 x 10^{19}) **E = 59.67 x 10^{-15} joule.**		
	l)	**A Projectile is thrown up with the velocity of 2 m/s at an angle of 60^0. Find the time of flight.**		2
		Formula with substitution	1	
		Answer with unit	1	
		Given, Velocity = 2 m/s $\theta = 60^0$ T = ? $T = \frac{2v\sin\theta}{g}$ $T = \frac{2\times 2\sin 60}{9.8}$ T = 0.353 sec.		
2)		**Attempt any four.**		16
	a)	**Define angle of projection, maximum height of a projectile. State its formula with meanings of symbols used.**		
		Each Definition	1	
		Each formula with meaning of symbol	1	
		Angle of projection (θ): - Angle of projection in projectile motion is the angle made by the velocity of projection with the horizontal at the original point.		
		Angle of projection (θ) $= \tan^{-1}(\frac{4H}{R})$		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	a)	Where, θ = Angle of projectile with horizontal at the origin. H = Maximum height of projectile. R = Horizontal range of a projectile. **Maximum height of a projectile (H):-** The maximum vertical distance covered by a projectile from the ground level is called height of projectile. **Maximum height of a projectile (H):-** $H = \frac{v^2 \sin^2\theta}{2g}$ **OR** $H = \frac{(v\sin\theta)^2}{2g}$ Where, H = Maximum height of projectile. v = Velocity of projectile. θ = Angle of projection. g = Gravitational acceleration.		
	b)	**A roller is pulled 60 m along the horizontal by a force of 300 N at 60^0 with the horizontal. Calculate workdone.** **Formula with substitution** **Answer with unit** Given, Displacement (s) = 60 m Force (F) = 300 N $\theta = 60^0$ Work = ? We have, Work = (F cos θ) x s = (300 x cos 60^0) x 60 **Work = 9000 J**	2 2	4
	c)	**Describe piezoelectric method for production of ultrasonic waves.** **Diagram with label** **Principle** **Working**  	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	c)	**Principle:** When the electric field is applied across the crystal its dimensions changes and when alternating PD is applied across crystal then the crystal sets into elastic vibrations along the perpendicular axis. **Working:** A chip of piezo-electric crystal like quartz is placed between two plates as shown in figure. A suitable oscillator is connected across it. The electric oscillations along the electric axis produce mechanical vibrations along the mechanical axis. The frequency of oscillator is increased. At a particular frequency of oscillator, the oscillator frequency becomes equal to natural frequency of vibration of crystal. Then the crystal sets into resonance vibration and ultrasonic waves are produced.		
	d)	**A flywheel is rotating at 1000 revolution per minute. It is brought to rest in 50 revolutions. Calculate uniform retardation.**		4
		Formula with substitution	2	
		Answer with unit	2	
		Given, ω_0 = 1000 r.p.m. $= \frac{1000 \times 2\pi}{60}$ ω_0 = 104.667 rad/sec $\omega = 0$ Flywheel is brought to rest in 50 revolutions. θ = 50 revolution θ = 50 x 2π θ = 314.16 rad We have, $\omega^2 = \omega_0^2 + 2\alpha\theta$ $\alpha = \frac{\omega^2 - \omega_0^2}{2\theta}$ $\alpha = \frac{(0)^2 - (104.667)^2}{2 \times 314.16}$ **α = -17.435 rad/sec^2** **Retardation = 17.435 rad/sec^2**		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	e)	**State any four advantages of NDT methods.** **Any four advantages** **Advantages of non-destructive testing** 1. Rapid inspection of each & every component is possible. 2. 100 % examination of material or production is possible. 3. NDT methods can be automated to lower their costs. 4. Testing is possible on shop, floor because of portable equipments; this controls the equality of further production. 5. Permanent record of testing can be made during the testing process. 6. The destructed parts can be separated in the early stages of manufacturing. This saves the time & production cost. 7. Higher accuracy, reliability & repeatability in the test result can be obtained. **Any other relevant advantage**	4	4
	f)	**State principle and experimental procedure of LPT method.** **Principle** **Diagram** **Procedure** **Principle:** It works on the principle of capillarity. **Experimental Procedure:** 1.Surface Preparation: Initially the surface of the specimen is cleaned. Because the presence of flakes, dirt, grease etc on the surface of work piece prevents penetrant to be slip into the cracks. This gives wrong information.  2. Application of Dye penetrant: Suitable fluorescent dye is mixed in penetrant so that its viscosity remains low. This dye penetrant is applied evenly on specimen. Due to capillary action the penetrant goes into the surface open discontinuities. It takes some time. In general case this “dwell time” is 20-30 minutes	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	f)	 3. Excess penetrant removal: After dwell time is over, the excess penetrant is removed from the surface carefully  4.Application of developer: A thin layer of developer is applied over the surface. The role of developer is to pull the trapped penetrant out of the crack this provides good visibility of crack.  5.Inspection & evalution of defects: Surface of the specimen is seen under white light or ultraviolet or laser light. The crack can be visualized under light.  **6. Post cleaning:** After inspection the surface of the specimen is cleaned & the specimen can be used for its intended purpose.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)		Attempt any four.		16
	a)	**State conditions for good acoustics of an auditorium.**		4
		Any four	4	
		Requirements of good acoustics: 1. The sound produced should be clear & should be uniformly distributed through out the hall. 2. The sound produced should be heard at all points in the hall sufficiently loudly. 3. The sound produced should not overlap. 4. There should not be focusing of sound. 5. There should not be any dead spot or silence zones in the hall. 6. The reverberation time should have proper value. 7. The echelon effect should be absent. 8. The external sound should not enter the hall. 9. There should be no resonance within the building. **Any other relevant requirement.**		
	b)	**Explain principle and working of Bunsen's photometer. Draw neat labeled ray diagram.**		4
		Principle	1	
		Diagram	1	
		Construction	1	
		Working	1	
		Principle:- It works on the principle of photometry. **OR** If two source of light of illuminating powers I_1 & I_2 are kept at a distance r_1 and r_2 from a screen then the intensities of illumination at a point on the screen due to two source are $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$	1	
				

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	b)	**Construction-** It consists of a white paper called screen with a grease spot at its center. This screen is mounted centrally in a wooden box. The grease spot is easily differentiated from rest of the screen because most of the light transmits through grease spot than the rest of the screen. Two mirrors are adjusted in inclined position on either side of the screen such that both sides of the screen can be seen at a time. The box is provided with two co-axial windows. The box is mounted on a vertical stand of adjustable height. An observer can watch the screen through central window. **Working:** The two sources of intensity I_1 & I_2 are placed at a distance r_1 & r_2 from the screen respectively. Position of source are adjusted such that image of the grease spot seen in two mirrors is equally bright. Then the luminous intensities of 2 sources can be compared using relation $$\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$$ The same procedure is repeated by changing the position of two sources.		
	c)	**State any four characteristics of photoelectric effect.** **Any four characteristics** 1) A metal emits electrons only when the incident (light) radiation has frequency greater than critical frequency (υ_0) called threshold frequency. Threshold frequency is different for different metals. 2) Photoelectric current is directly proportional to intensity of light and independent of frequency. 3) The velocity of photoelectron is directly proportional to the frequency of light. 4) For a given metal surface, stopping potential is directly proportional to the frequency and is not dependent on intensity light. 5) The rate of emission of photoelectrons from the photocathode is independent of its temperature i.e. photoelectric emission is different from thermionic emission. 6) The process is instantaneous.	4	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	d)	**Find the minimum wavelength and frequency of X-ray tube working on 100kV.** **[Given h=6.634 X 10^{-34}Js, e =1.6 X 10^{-19}C and c =3 X 10^{8} m/s)** **Each formula** **Answer with unit** Given V=100kV=100X10^{3}V h = 6.63 X 10-^{34}Js e =1.6 X 10^{-19}C c =3 X 10^{8} m/s We have, $\lambda_{min} = \frac{hc}{eV}$ $\lambda_{min} = \frac{(6.634\times10^{-34})(3\times10^{8})}{(1.6\times10^{-19})(100\times10^{3})}$ $\lambda_{min} =$ **0.124 x 10^{-10} m.** $\lambda_{min} =$ **0.124 A^{0}** $f = \frac{c}{\lambda_{min}}$ $f = \frac{(3\times10^{8})}{(0.124\times10^{-10})}$ $f =$ **24.193 x 10^{18} Hz.**	 1 2	4
	e)	**Define echo, reverberation. Also state sabine's formula with meanings of symbol used.** **Each Definition** **Formula with meaning** **Echo:** The echo is defined as the same sound heard again after an interval of 1/10th second due to reflection of the original sound from a surface which is at a distance greater than 16.5m from the source of sound. **Reverberation:** It is the persistence of sound due to multiple reflections in a hall even after the source of sound is cut-off.	 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	e)	Sabine's Equation: $t = \frac{0.164V}{A}$ $t = \frac{0.164V}{\Sigma aS}$ Where, t = Reverberation time. V = volume. A = Total absorption. a = Absorption coefficient. S = Surface area.		
	f)	**A train crosses a tunnel in 30 second. At the entry of tunnel its velocity is 60 km/hr. and at the exit of tunnel its velocity becomes 30 km/hr. find length of the tunnel.** **Formula and conversion** **Answer with unit** Given, t = 30 sec. u = 60 km/hr $u = \frac{60 \times 1000}{60 \times 60}$ u = 16.667 m/s. v = 30 km/hr. $v = \frac{30 \times 1000}{60 \times 60}$ v = 8.333 m/s Length of tunnel = Distance covered = s = ? We have, $a = \frac{v-u}{t} = \frac{8.333-16.667}{30}$ a = -0.2778 m/s^2 Now, $v^2 = u^2 + 2as$ $s = \frac{v^2-u^2}{2a} = \frac{(8.333)^2-(16.667)^2}{2\times(-0.2778)}$ **s = 374.73 m.** **Length of tunnel = s = 374.73 m**	2 2	4