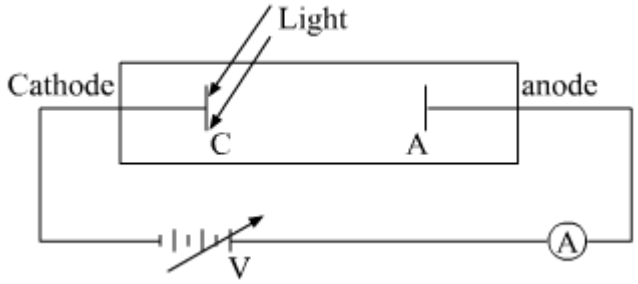
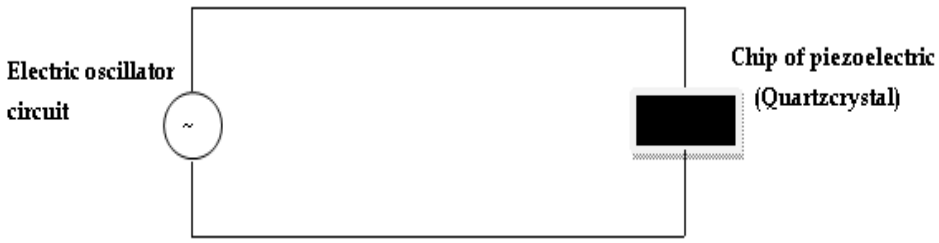
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess 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.		

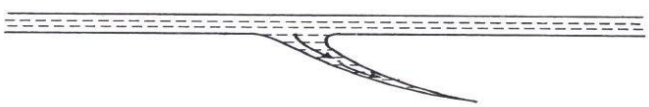
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)		**Attempt any NINE of the following:**		18
	a)	**Define uniform acceleration and state its SI unit.**		
		Definition	1	2
		Unit	1	
		Uniform acceleration:- If the acceleration of a body is uniform in magnitude and direction w.r.t. time then it 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 :-** m / s^2		2
	b)	**State work energy principle**.	2	
		Principle **Work energy principle:** It states that the work done by a system of forces acting on a body between any two points is equal to the change in kinetic energy of a body between these two points.		
	c)	**If a body of mass 160 kg changes its velocity from 18 m/s to 9 m/s, calculate the impulse acting on a body.**		2
		Formula	1	
		Answer with unit	1	
		Given, m = 160 kg u = 18 m/s v = 9 m/s Impulse = ? Impulse = mv – mu = m (v – u) = 160 (9 – 18) **Impulse = - 1440 kg m/s or Nsec** (Negative sign indicates that impulse is in the opposite direction of motion.)		
	d)	**Define projectile motion. Give two examples of projectile motion.**		2
		Definition	1	
		Two examples	1	
		Projectile motion: – Projectile motion is the motion of a body thrown (projected) in air at an angle θ (less than 90^0) with the horizontal. **Examples** 1) Motion of a football kicked in air. 2) Motion of a cricket ball as batsman hits a six. 3) Motion of javelin in the sports event.		

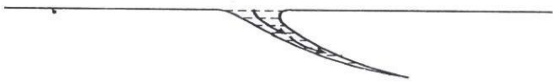
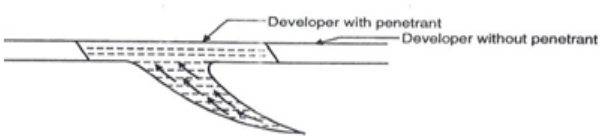
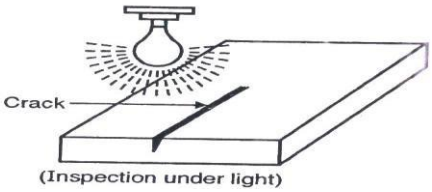
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	e)	**State any two properties of ultrasonic waves** **Each Property** i) Frequency of these sound waves is more than 20 kHz. ii) It has shorter wavelength. iii) They carry high amount of sound energy. iv) The speed of propagation of ultrasonic waves increases with increase in frequency. v) They show negligible diffraction. vi) Ultrasonic waves travel over long distance without considerable loss.	1	2
	f)	**Define neutral temperature and inversion temperature.** **Each definition** **Neutral temperature** – In thermocouple the temperature at which the emf is maximum is called inversion temperature. **Inversion Temperature:** In thermocouple the temperature at which the emf becomes zero and changes its sign (becomes negative) is called as inversion temperature.	1	2
	g)	**Define thermo emf. State factors on which thermo emf is dependent.** **Definition** **Factors** **Thermo emf :-** When two dissimilar metals are joined together, so that two junctions are formed and if one junction is heated and other is cooled then the emf is generated across the junction called as thermo emf. **Factors affecting thermo emf** 1) Pair of metal selected from thermoelectric series. 2) Temperature difference between two junction of thermocouple.	1 1	2
	h)	**State any 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.	2	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	i)	**Draw circuit diagram for the experiment to study photoelectric effect.**  	2	2
	j)	**State two properties of X-rays.** **Any two properties** i. They are electromagnetic waves of very short wavelength ii. They travel with speed of light. iii. They affect photographic plates. iv. They produce fluorescence in many substances. v. They can be reflected or refracted under certain conditions. vi. They are not deflected by magnetic or electric field. vii. They have high penetrating power. viii. They produce photoelectric effect. ix. They are invisible to eyes. x. X-ray kill some form of animal cell.	2	2
	k)	**A X-ray tube works on 40 kV. What will be the wavelength of X-rays emitted by it?** **Formula** **Answer with unit** Given, V = 40 kV = 40 x 10^3 V λ = ? $\lambda = 12400 / V$ $= 12400 / 40 \times 10^3$ $\lambda = 0.310\ A^0$	1 1	2

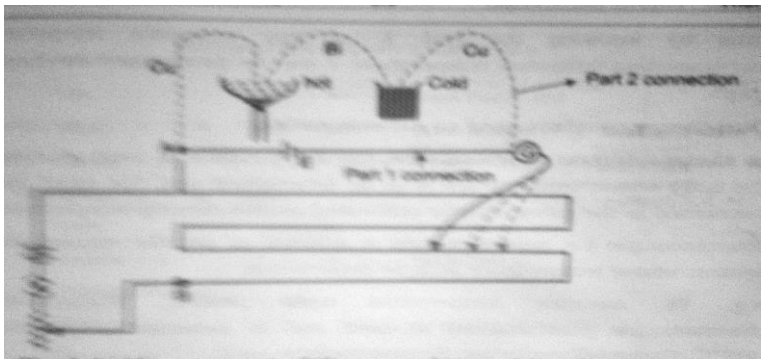
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	l)	**Explain population inversion.** Normally the population of lower energy level (ground state) is higher than higher energy level (excited state) but to produce stimulated emission population of higher energy level (excited state) should be greater than lower energy level (ground state). Making population of higher energy level (excited state) more than lower energy level (ground state) is called as population inversion. It is achieve by different methods like optical pumping, chemical reaction, ete..	2	2
2)		**Attempt any FOUR of the following:**		16
	a)	**A bullet of mass 30 gm leaves the barrel of a gun with muzzle velocity of 800 m/s. If the length of barrel is 1 m find the impulse and the impulsive force.**		4
		Each Formula	1	
		Answer with unit	2	
		Given : m = 30 gm = 0.03kg u= 0 v = 800 m/s s =1 m Impulse =? Impulsive force =? We have , Impulse = m x (v – u) = 0.03 x (800 – 0) **Impulse = 24 kg m/s OR Ns** We have $v^2 = u^2 + 2as$ $a = v^2 - u^2 / 2s$ $a = (800)^2 / 2$ **$a = 320000\ m/s^2$** Impulsive force = mass x acceleration = 0.03 x 320000 **Impulsive force = 9600 N**		
	b)	**State the three equations of motion when a body is moving vertically upwards against gravity along with meanings of symbols.**		4
		Three equation	3	
		meaning	1	
		$v = u - gt$ $s = ut - 1/2gt^2$ $v^2 = u^2 - 2gs$ Where, u = Initial velocity, v= final velocity, t= time, s = distance travelled, g = gravitational acceleration.		

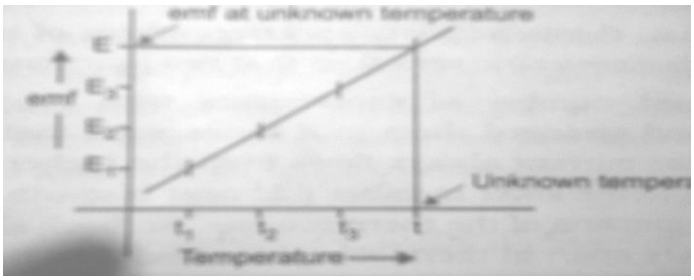
2)	c)	**A bullet is fired with a velocity of 350 m/s in the direction making an angle of 35^0 with the horizontal calculate i) Maximum height reached ii) Range**		4
		Each formula	1	
		Answer with unit	2	
		Given : v = 350 m/s $\theta = 35^0$ $g = 9.81\ m/s^2$ H = ? R = ?		
		Maximum height $H = (v \sin\theta)^2 / 2g$ $H = (350 \times \sin 35^0)/ 2 \times 9.81$ **H = 2056.185 m**		
		Range $R = v^2 \sin 2\theta / g$ $R = (350)^2 \times \sin 2(35)/ 9.81$ **R = 11746.35 m**		
	d)	**Explain production of ultrasonic waves using piezoelectric method.**		
		Diagram with label	1	4
		Principle	1	
		Working	2	
				
		Principle: When the electric field is applied across the piezoelectric 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.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	e)	**State the criteria for selection of NDT method.** **Four Points** i) Codes or standard requirement. ii) Specification of material to be tested, for example, nature of material, its size and shape. iii) Type of disorders to be detected, also depend on nature of disorders. iv) Testing also depends on manufacturing process of material to be tested. v) It is also depending on the equipment available for testing. vi) Total cost required to test the material.	4	4
	f)	**Describe LPT with its i) Principle ii) Experimental Procedure** **Principle** **Experimental 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 discontinuities, it takes some time in general case dwell time required is 20-30 minutes. 	1 3	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 of the following:**		16
	a)	**A train crosses a tunnel in 25 sec. At the entry of tunnel, its velocity is 36 km/hr and at the exit of tunnel, velocity becomes 72 km/hr. find length of the tunnel.**		4
		Formula and conversion	2	
		Answer with unit	2	
		Given, t = 25 sec. u = 36 km/hr $u = \frac{36 \times 1000}{60 \times 60}$ **u = 10 m/s.** v = 72 km/hr. $v = \frac{72 \times 1000}{60 \times 60}$ **v = 20 m/s** Length of tunnel = Distance covered = s = ? We have, $a = \frac{v-u}{t} = \frac{20-10}{25}$ **a = 0.4 m/s^2** Now, $v^2 = u^2 + 2as$ $s = \frac{v^2-u^2}{2a} = \frac{(20)^2-(10)^2}{2\times(0.4)}$ **s = 375 m**. **Length of tunnel = s = 375 m**		

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Stepwise Solution</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>3)</td><td>b)</td><td>Compare Peltier effect and Joules effect.
Any Four points
<table>
<tr><th>S. No</th><th>Peltier effect</th><th>Joules effect</th></tr>
<tr><td>1</td><td>When electric current flows through a junction of two metals of thermocouple, then heat is generated at one end and heat is absorbed at the other end.</td><td>When electric current flows through conductor then it get heated</td></tr>
<tr><td>2</td><td>One junction gets heated and other get cooled</td><td>heat is produced through out the conductor</td></tr>
<tr><td>3</td><td>Heat generated or absorbed is small</td><td>Heat generated is large</td></tr>
<tr><td>4</td><td>This effect is reversible</td><td>This effect is irreversible</td></tr>
<tr><td>5</td><td>Amount of heat generated depends on pair of metals and current through it.</td><td>Amount of heat generated depends on value of resistance, current, time</td></tr>
<tr><td>6</td><td>e.g. thermocouple</td><td>e.g. electric heater, electric iron</td></tr>
</table></td><td>4</td><td>4</td></tr>
<tr><td></td><td>c)</td><td>Explain use of thermocouple to measure temperature.
Thermocouples are used as thermometer to measure the temperature from 0^0 C to neutral temperature. Thermo e.m.f produced is measured using potentiometer.connections are shown in figure.
 
</td><td>4</td><td>4</td></tr>
</table>

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	c)	In first part only battery cell of known emf E is taken in a circuit and balancing length L is determined. Potential gradient = E / L Now, Thermocouple is taken in a circuit for different temperatures t_1,t_2,t_3 different balancing lengths L_1,L_2,L_3 are recorded then using formulae E_1 = Potential gradient x L_1 E_2 = Potential gradient x L_2 E3 = Potential gradient x L_3 Different emfs at different temperatures are recorded and the graph is plotted.  Thus by knowing emf E at any unknown temperature, its corresponding unknown temperature t can be determined as shown in graph. Thus thermouple is used as a thermometer.		
	d)	**If a light of wavelength 3000 A^0 is incident on metal surface of work function 5 eV,will the electron be ejected or not?** **Given h= 6.63 x 10^{-34} Js, C = 3 x 10^8 m/s.** **Each Formula** **Answer with Unit** **Conclusion** $$\nu = \frac{c}{\lambda} = \frac{3\times10^{8}}{3000\times10^{-10}}$$ **ν = 1 x 10^{15} Hz** $$\nu_0 = \frac{w_0}{h} = \frac{5\times1.6\times10^{-19}}{6.63\times10^{-34}}$$ **ν_0 = 1.206 x 10^{15} Hz** **Since ν < ν_0 electrons will not be emitted.**	1 1 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	e)	**State engineering and scientific applications of X-rays.** **Two Engineering application.** **Two Scientific application.** **Engineering Application of X- Rays** i. X- rays are used to detect the cracks in the body of aero plane or motor car. ii. X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control. iii. X – rays are used to detect flaws or cracks in metal jobs. iv. X- rays are used to distinguish real diamond from duplicate one. v. X- rays are used to detect smuggling gold at airport and docks (ship) yard. vi. X-rays are used to detect cracks in the wall. vii. X- ray radiography is used to check the quality of welded joints. **Scientific Application of X- Rays** **i.** X-rays are used to study structure of crystal. ii. They are used in a chemical analysis. iii. They are used to study structure of rubber, plastic ,cellulose. iv) They are used for analysis of structure of organic molecules.	 2 2	4
	f)	**State any four properties of LASER light .** **Any four properties** **Properties** i) **The light is coherent:** The light with waves, all exactly in same phase. ii) **The light is monochromatic:** The light whose waves all have the same frequency or wavelength. iii) **The light is unidirectional:** The light produces sharp focus. iv) **The beam is extremely intense:** The light has extreme brightness	 4	4