SUMMER– 18 EXAMINATION

Subject Name: Applied Physics **Model Answer** **Subject Code:** 17207

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 judgement 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.

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.		**Attempt any NINE of the following :**	**18**
	a)	**Define i) Angular Displacement ii) Angular Velocity** **Each definition** **Angular displacement: -** It is the angle through which the radius vector turns when the particle in circular motion moves from one position to other. OR It is defined as the angle subtended by the radius vector when a particle in circular motion moves from one position to other. **Angular velocity: -** The rate of change of angular displacement with respect to time is called as angular velocity.	**2** 1
	b)	**State Newton's second law of motion.** **Newton's second law of motion:** The rate of change of momentum of a body is proportional to the applied force and takes place in the direction of the force.	**2**
	c)	**Define ultrasonic waves and infrasonic waves.** **Each definition** **Ultrasonic waves:-** The sound waves having frequency more than 20kHz are called as ultrasonic waves. **Infrasonic waves:- :-** The sound waves having frequency less than 20Hz are called as ultrasonic waves.	**2** 1

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Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	d)	**If the crack is on the surface of job, then which method is used?** If the crack is on the surface of job, then Liquid Penetrant Testing (LPT) method is used.	**2**
	e)	**"X-rays are specifically used to detect the position of bullet inside human body". Give reason.** The penetration power of x-rays through muscle, bone and bullet is different. Due to this we can find the exact position of bullet inside the human body.	**2**
	f)	**State inverse square law of photometry. Write its mathematical formula.** **Law** **Formula** Statement: "The intensity of illumination of a surface due to a point source of light is inversely proportional to the square of distance of the surface from the source." $E \alpha 1/r^2$	**2** 1 1
	g)	**Define photoelectric effect.** **Photoelectric effect**:- When light of suitable frequency is incident on metallic surface, electrons are emitted from the metal surface is called photoelectric effect.	**2**
	h)	**State any two engineering applications of X-rays.** **Each application** 1) X- rays are used to detect the cracks in the body of aero plane or motor car. 2) X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control. 3) X – rays are used to detect flows or cracks in metal jobs. 4) X- rays are used to distinguish real diamond from duplicate one. 5) X- rays are used to detect smuggling gold at airport and docks (ship) yard. 6) X-rays are used to detect cracks in the wall. 7) X- ray radiography is used to check the quality of welded joints. **Any Relevant application**	**2** 1

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Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	i)	**Define kinetic energy. State its equation & SI unit.** **Definition** **Equation and SI unit** **Kinetic energy:-** The energy possed by the body due to its motion is called kinetic energy. $E = \frac{1}{2} mv^2$ S.I.Unit:- Joules	**2** 1 1
	j)	**State any two factors affecting indoor lighting system.** **Each factor** Factors affecting indoor lighting 1) Efficiency of the source 2) Utilization factor 3) Maintenance factor 4) Space to height ratio 5) Glare effect	**2** 1
	k)	**The photoelectric work function of a certain metal is 2.5 eV. Calculate its threshold frequency if Planck's constant is 6.625×10^{-34} J-sec.** **Formula & substitution** **Answer with unit** **Given:** $W_o = 2.5 \text{ eV} = 2.5 \times 1.6 \times 10^{-19}$ J $\nu_o = ?$ $h = 6.625 \times 10^{-34}$ J-sec We have, $W_o = h \nu_o$ $\nu_o = W_o / h$ $\nu_o = 2.5 \times 1.6 \times 10^{-19} / 6.625 \times 10^{-34}$ **$\nu_o = 0.6037 \times 10^{15}$ Hz.**	**2** 1 1
	l)	**A ball is thrown with a velocity of 55 m/sec making an angle of 38^0 with the horizontal. Calculate the range covered by the ball.** **Formula & substitution** **Answer with unit** **Given:**	**2** 1 1

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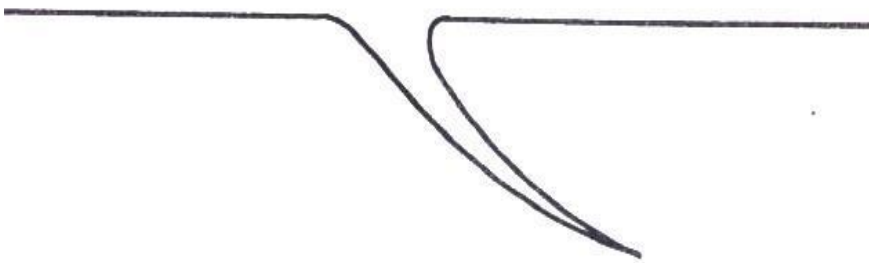
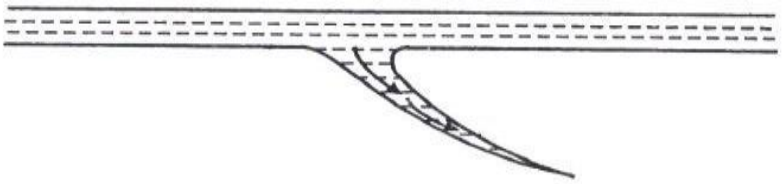
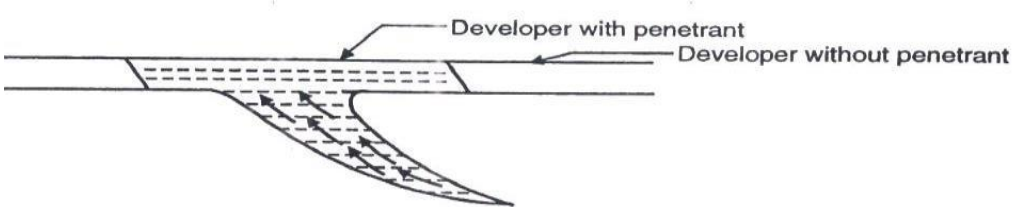
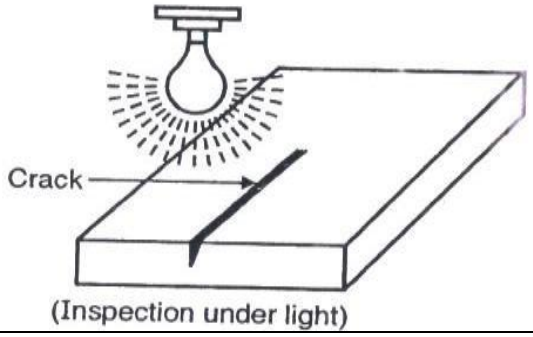
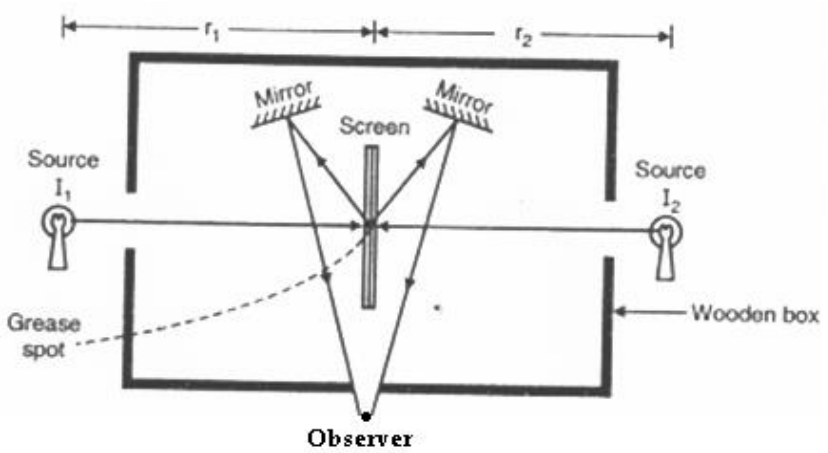
Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	l)	Given V = 55 m/sec $\theta = 38^0$ Range =? We have Range = $\frac{v^2 \sin 2\theta}{g}$ $= (55)^2 \sin 2 \times (38) / 9.81$ **Range = 299.19 m**	
2.		**Attempt any FOUR of the following :**	**16**
	a)	**Define i) Circular motion ii) Trajectory iii) Height of projectile iv) Time of flight.**	**4**
		Each definition	1
		Circular motion:- Circular motion is defined as the motion of a particle along the circumference of circle.	
		Trajectory :- The path along which projectile moves is called trajectory. **OR** It is also defined as the path traced by an object in projectile motion.	
		Height of projectile :- The maximum vertical distance covered by a projectile is called as Height of projectile.	
		Time of flight:- The total time in which projectile covers the entire trajectory is called as time of flight.	
	b)	i) **A lift of mass 1500 kg is being raised with a uniform velocity of 1.3 m/sec. Find the power involved in it.**	**2**
		Formula & substitution	1
		Answer with unit	1
		Given: m =1500 kg, Force = Weight = m x g = 1500 x 9.8 = 14700 N v = 1.3 m/s Power = Force x Velocity Power = 14700 x 1.3 **Power = 19110 watt.**	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	b)	**ii) A body of mass 90 kg is raised to height of 850 cm from ground. Calculate its potential energy.**	**2**
		Formula & substitution	1
		Answer with unit	1
		Given: m = 90 kg h = 850 cm = 8.5 m P.E. = ? We have P.E. = mgh = 90 x 9.81 x 8.5 **P.E. = 7504.65 J**	
	c)	**Explain piezoelectric method for production of ultrasonic waves with diagram and procedure.**	**4**
		Diagram with label	2
		Principle	1
		Working	1
			
		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. **Procedure:** 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 car has initial velocity of 3 m/s. it accelerates for 12 seconds at the rate of 3.5 m/s^2. Determine the final velocity and distance travelled during this time.**	**4**
		Each Formula	1
		Each answer with unit	1
		Given: u = 3 m/s t = 12 sec a = 3.5 m/s^2 v =? s =? v = u + at v = 3 + (3.5) x (12) **v = 45 m/s** s = ut + (1/2)at^2 s = (3 x 12) + (1/2)(3.5)(12)^2 **s = 288 m**	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	e)	**Name any four NDT methods used in industry. State any two criteria for selection of NDT method.** **Any four method** **Any two criteria** **Non Destructive Testing 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.** **Any two criteria** 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's available for testing vi) Total cost required to test the material.	**4** 2 2
	f)	**Explain LPT method with the help of principle, diagram and experimental procedure.** **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. 	**4** 1 1½ 1½

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	f)	**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  **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. 	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	f)	**6. Post cleaning:** After inspection the surface of the specimen is cleaned & the specimen can be used for its intended purpose.	
3.		**Attempt any FOUR of the following :**	**16**
	a)	**State the requirements of good acoustics of building. (any four points)**	**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, construction and working of Bunsen's photometer.**	**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 $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$  	

Q. No.	Sub Q. N.	Answers	Marking Scheme
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
	d)	**i) The energy of X-ray spectrum is 4.4 eV. Find its wavelength. (Given : Planck's constant, h = 6.63 x 10^{-34} J-sec; speed of light, c = 3 x 10^8 m/sec)** **Formula & substitution** **Answer with unit** Given: E = 4.4 eV = 4.4 x 1.6 x 10^{-19} J , λ = ? E = h υ = hc / λ λ = hc / E = (6.63 x 10^{-34}) x (3 x 10^8) / (4.4 x1.6 x 10^{-19}) **λ = 2.825 x 10^{-7} m.**	**2** 1 1

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	d)	**ii) Determine the operating voltage of an X-ray tube which emits X-rays of wavelength 0.38 A^0.**	**2**
		Formula & substitution	1
		Answer with unit	1
		Given $\lambda = 0.38\ A^0$, V = ? $\lambda = 12400 / V$ $V = 12400 / \lambda$ **V = 32631.5 volts.**	
	e)	**Define echo, reverberation. State sabine's formula for reverberation time. Explain the terms used in it.**	**4**
		Each Definition	1
		Formula with meaning	2
		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. **Sabine's Formula:** $t = \frac{0.164V}{A}$ $t = \frac{0.164V}{\Sigma aS}$ Where, t = Reverberation time. V = volume. A = Total absorption. a = Absorption coefficient. S = Surface area.	

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3.	f)	**i) A stone is released with zero velocity from the top of the tower. If the stone reaches ground in 5 seconds, find the height of the tower.**	**2**
		Formula & substitution	1
		Answer with unit	1
		Given: u = 0, t = 5sec, Height = distance =?	
		We have, $s = ut + \frac{1}{2} gt^2$	
		$s = (0 \times 5) + \frac{1}{2} (9.8) \times (5)^2$	
		s = 122.5 m.	
		ii) A body moves along a circular path of radius 60 cm at 3 revolutions / sec. Calculate its linear speed.	**2**
		Formula & substitution	1
		Answer with unit	1
		Given: r = 60 cm = 0.6 m , n = 3	
		v = ?	
		$v = r\omega = r (2\pi n)$	
		$v = 0.6 \times 2 \times 3.14 \times 3$	
		v = 11.31 m/s.	