WINTER– 17 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.	Answer	Marking Scheme
1		**Attempt any NINE of the following:**	**18**
	a)	**Write formula for angular distance travelled by a particle in n^{th} second with meaning of symbols used.**	**2**
		Formula	1
		Meaning	1
		Angular distance travelled in n^{th} seconds = $\theta^{th} = \omega_0 + \alpha/2\ (2n-1)$ θ= Angular distance travelled in n^{th} seconds ω_0 = Initial angular velocity of a body ω= Final angular velocity of a body t= Time α= Angular acceleration	

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1	b)	**Define: (i) Power (ii) Energy** **Each Definition** **Power:** Power is defined as the rate of doing work. **Energy:** Energy of a body is defined as the capacity of doing work.	**2** 1
	c)	**State any two properties of ultrasonic waves.** **Any two properties** 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. 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.	**2** 2
	d)	**Write any two applications of ultrasonic testing.** **Any two application** i) To detect flaw: flaws in metal, rubber, tyre, concrete, wood composites, plastics components ii) Rail inspection: Rail tracks are tested on the spot which avoids service failure in track iii) Air-craft inspection: To detect crack iv) Tunnel inspection: To detect crack v) Bridge inspection vi) To detect subsurface discontinuities vii) To test plant component viii) Testing: It is used to test casting, forging, welding, fabrication, rolling, heat treatment ix) Monitoring: Monitoring of thermal and atomic power plant, equipment pipe lines and structures x) On line tube testing: Channel ultrasonic flaw detection with thickness measurement of tube and hence corrosion	**2** 2

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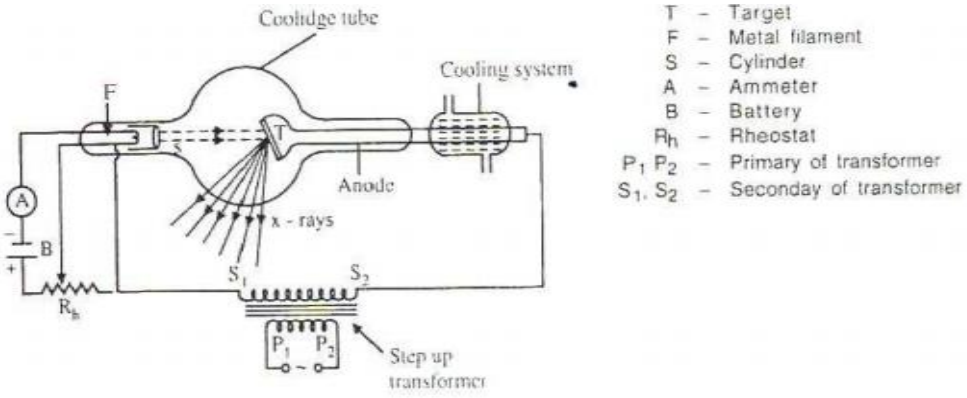
1	e)	**Draw a neat labeled diagram of modern Coolidge X-ray tube.**  	**2**
	f)	**State any two applications of Bunsen's photometer.** **Any two application** 1. To compare the luminous intensities of two sources. 2. If the luminous power of one source is known then that of the other source can be calculated.	**2** 2
	g)	**State the principle of –** **(i)Photo-resistor** **(ii) Photoelectric cell** **Each principal** **Photoresistor:** The electrical resistance of LDR decreases as the intensity of incident light increases. **Photoelectric Cell:** Light energy is converted into electrical energy	**2** 1

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1	h)	**State any two properties of X- rays.** **Any two properties** (1) X-rays are highly penetrating electromagnetic radiations of very short wavelength. (2) X-rays are electrically neutral. (3) X-rays travel with the speed of light. (4) X-rays affects the photographic plate. (5) X-rays are not deflected by electric or magnetic field. (6) X-rays are invisible. (7) They can ionize gases. (8) They cannot be reflected by ordinary mirrors, lenses or by prism. They can be Reflected, refracted and diffracted by crystals under certain conditions. (9) They show interference and polarization like light. (10) They produce fluorescence effect. (11) X-ray kills some animal cells.	**2** 2
	i)	**Why do the passengers fall forward when bus stops suddenly?** This is due to inertia. According to Newton's first law of motion, an object will not change its speed or direction unless an unbalanced force affects it. So when bus stops suddenly the passengers will keep moving forward.	**2**
	j)	**Define intensity of illumination. State its SI unit.** **Definition** **unit** Illumination or intensity of illumination : The illumination or intensity of illumination at point on a surface is defined as the luminous flux received on unit area of surface around the point. **Unit: -** lumens/meter^2.	**2** 1 1

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1	k)	**Calculate frequency of radiation if energy of photon emitted is 5×10^{-19} J. Planck's constant (h) = 6.62×10^{-34} Js.**	**2**
		Formula with substitution	1
		Answer with unit	1
		Given $E = 5 \times 10^{-19}$ J $h = 6.63 \times 10^{-34}$ Js $\upsilon = ?$ We have $\upsilon = E/h$ $= 5 \times 10^{-19} / (6.63 \times 10^{-34})$ **$\upsilon = 0.754 \times 10^{15}$ Hz**	
	l)	**A body is projected with velocity of 20 m/s at an angle of 30^0 with the horizontal. Calculate the time of flight ($g = 9.81$ m/s^2)**	**2**
		Formula with substitution	1
		Answer with unit	1
		Given: $V = 20$ m/s $\theta = 30^0$ $g = 9.81$ m/s^2 $T = ?$ $T = 2 v \sin\theta / g$ $T = 2 \times 20 \times \sin(30) / 9.81$ **$T = 2.038$ sec**	

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Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any FOUR of the following:**	**16**
	a)	**Define centrifugal force. State any three applications of it.**	**4**
		Definition	1
		Any three application	3
		Centrifugal force – It is defined as the force acting on a particle performing uniform circular motion which is directed away from center and along the radius of the circular path**.** **OR** A particle performing uniform circular motion experiences force which is along the radius and away from the center is called Centrifugal force. **Application:** **1. Banking of curved road:** The outer edge of curved road is raised above than the inner edge is called banking of road. This avoids skidding of speedy vehicle along a curved road. **2. Centrifuge machine:** It is machine used to separate heavier particles in a mixture from lighter one. **3. Drive in a washing machine:** Wet clothes are dried by rotating it speedily in a cylindrical porous drum. **4. Centrifugal governor:** Speed of an engine can be controlled by using governor, which makes use of centrifugal force. **5. Centrifugal pump:** To transfer liquid, centrifugal force is used in this process. **6. Centrifugal blower:** To blow air.	
	b)	**A bullet of mass 100 gm is fired with a velocity of 300 m/s from a gun. Find the mass of the gun if it recoils with a velocity of 3 m/s.**	**4**
		Formula with substitution	2
		Answer with unit	2
		Given: m_1= 100 gm = 0.1 Kg v_1= 300 m/s v_2= 3 m/s m_2= ? $m_1 v_1 = m_2 v_2$ $m_2 = m_1 v_1 / v_2 = (0.1 \times 300) / 3$ **m_2 = 10 kg**	

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	c)	**With a neat diagram, explain production of ultrasonic waves by piezo-electric method.** **Diagram** **Explanation**  **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. **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.	**4** 1 3
	d)	**A body starts rectilinear motion with a velocity of 10 m/s. It accelerates uniformly and gains a velocity of 13 m/s in 6 seconds. Find the uniform acceleration. Also calculate the distance travelled in 6 seconds.** **Each Formula** **Each answer with unit** **Given:** u = 10m/s v = 13 m/s t =6 s a =? s = ? a= (v-u) / t = (13 – 10) / 6 **a= 0.5 m/s^2** s = ut + ½ at^2 = (10 x 6) + ½ (0.5 x 6^2) **s = 69 m**	**4** 1 1

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Q. No.	Sub Q. N.	Answer	Marking Scheme
2	e)	**Write two advantages and two limitations of non-destructive testing methods.** **Any two advantages** **Any two limitations** **Advantages:-** 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. **Limitations:-** 1. Minimum two methods for complete examination of material are required. With only one method, testing for all parameters of materials is not possible. 2. Cost of equipment's is high and thus testing charges are more as compared to destructive testing. 3. NDT interpretations are relative. One should know the standard results first. 4. Trained and certified persons are authorized to conduct the test (Level I, II, III) as per American Society for NDT (ASNT). 5. Qualitative testing is possible, however quantitative testing is difficult.	**4** 2 2
	f)	**State any four criteria for selection of non-destructive testing methods.** **Any four 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** 4

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Q. No.	Sub Q. N.	Answer	Marking Scheme
3		**Attempt any FOUR of the following:**	**16**
	a)	**Define reverberation and reverberation time. Write Sabine's formula for reverberation time with meaning of symbols used.**	**4**
		Each Definition	1
		Formula with meaning	2
		Reverberation: It is the persistence of sound due to multiple reflections in a hall even after the source of sound is cut-off. **Reverberation time:** The time for which sound persists in a hall even after the source of source is cut-off is called as reverberation time. **Sabine's Formula:** $t = \frac{0.164V}{A}$ $t = \frac{0.164V}{\Sigma aS}$ Where, t = Reverberation time. V = volume of hall. A = Total absorption in hall. a = Absorption coefficient. S = Surface area.	
	b)	**State and explain any two indoor lighting schemes.**	**4**
		Any two schemes	4
		1.Direct lighting scheme: • In this system, light directly falls on the working area. • While operating a patient in the operation theatre, focusing of light at a particular part with sufficient illumination is required. Hence direct lighting system is preferred. • In a gymnasium hall, direct lighting system is preferred for a badminton court. Also for table tennis, carom direct lighting system is preferred. To control the glare effect, lamps with shaded or glare shields are used.	

Q. No.	Sub Q. N.	Answer	Marking Scheme
3	b)	**2.Indirect lighting system:** • In this case, light reflected from various surfaces (walls, ceilings etc.) falls indirectly on the working area. • This can be achieved by indirect reflection in which light is concentrated towards ceilings and illuminating the room by diffuses reflection from ceilings indirectly. • Indirect lighting system is preferred in workshop, drafting offices to avoid shadow effect and glaring effects, because of which, accuracy and efficiency of work can be maintained. **3.Semi- indirect lighting system:** • In this system, partly directed light and partly reflected light fall on the working area. • Semi-indirect lighting system is preferred in most of the hotels. Also it is preferred in lecture halls and seminar halls. Under this system, the person can see some of the lamps directly while some of the lamps are hidden.	
	c)	**State any four properties of photons.**	**4**
		Any four 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.	4
	d)	**The minimum wavelength of X-ray produced by an X-ray tube is 0.2 x 10^{-10} m. Find the potential difference between anode and cathode of the tube.[h= 6.62 x 10^{-34} Js, C= 3 x 10^{8} m/s, e = 1.6 x 10^{-19} C]**	**4**
		Formula with substitution	2
		Answer with unit	2
		Given: $\lambda = 0.2 \times 10^{-10}$ m $h = 6.62 \times 10^{-34}$ Js $C = 3 \times 10^{8}$ m/s $e = 1.6 \times 10^{-19}$ C V= ? $\lambda = hc / eV$ $V = hc / e\lambda$ $= (6.62 \times 10^{-34} \times 3 \times 10^{8}) / (1.6 \times 10^{-19} \times 0.2 \times 10^{-10})$ **$V = 62.062 \times 10^{3}$ volts**	

Q. No.	Sub Q. N.	Answer	Marking Scheme
3	e)	**Explain how loudness and focusing of sound can be adjusted for good acoustics.** **Loudness:** The sound produced should be heard clearly at all points in the hall. The loudness of sound depends upon the sound energy at the source. Loudness can be adjusted by arranging no. of loud-speakers at different locations in the hall, depending upon the size of hall. **Focusing of sound:** If the auditorium has dome shaped ceiling then sound produced may concentrate at the center of the hall. And thus, sound does not get equally distributed. To avoid focusing of sound, dome shapes are avoided and if they are necessary such ceilings are covered by sound absorbing material like POP or wood.	**4**
	f)	**A stone is dropped from the top of a tower 100 m high. After what time will it reach the ground? ($g = 9.81\ m/s^2$)** **Formula with substitution** **Answer with unit** **Given:** $u = 0$ $g = 9.81\ m/s^2$ $s = 100\ m$ $t = ?$ **Formula :** $s = ut + \frac{1}{2} gt^2$ $100 = 0 \times t + \frac{1}{2} (9.81) (t)^2$ $(t)^2 = 20.387$ **$t = 4.515\ s$**	**4** 2 2