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WINTER– 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)	**A flywheel is rotating at 90 rpm. Calculate its angular velocity in radian per second and degree per second.** **Formula & substitution** **Answer with unit** **Given:** ω =90 r.p.m. = 90/60 = 1.5 r.p.s. We know that in 1 rotation it covers angle of 2π radians. **In** 1.5 rotation angle covered is = 1.5 x 2π Angular velocity = 3 π radians/sec **Angular velocity = 9.42 radians/sec** And In 1 rotation angular velocity = 3 π radians/sec = 3 x 180 **Angular velocity = 540 degree/sec**	**2** 1 1

	b)	**State equation of kinetic energy. What is kinetic energy of body**
		    i) at rest ii) when its velocity is doubled?
		For each answer
		Kinetic energy = ½ mv^2
		    i) at rest v = 0 Kinetic energy = 0
		    ii) when its velocity is doubled v = 2v Kinetic energy = ½ m$(2v)^2$ = 2mv^2
			2
			1

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Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	c)	**State the range for infrasonic and ultrasonic waves.** **For each range** **Waves Range** Infrasonic Less than 20 Hz Ultrasonic More than 20 kHz	**2** 1
	d)	**State principle of ultrasonic testing.** **Principle:-** When ultrasonics are introduced into a material, it gets reflected, transmitted, scattered from surface or flaw.	**2**
	e)	**State the range of wavelength of X-rays. Write the formula for minimum wavelength of X-rays.** **Range** **Formula** Range of wavelength of X-ray is 10^{-10} to 10^{-11} m. Formula:- $\lambda min = hc / eV$	**2** 1 1
	f)	**Define luminous flux, lumen.** **Each definition** **Luminous flux: -** The amount of light which flows from a source per second is called as luminous flux. **Lumen: -** lumen is the luminous flux radiated by a uniform point source of one candle power through a unit solid angle.	**2** 1
	g)	**Define photon. Write any two properties of photon.** **Definition** **Any two properties** **Photon:-** The small energy packets or bundles are called Photon. **OR** Radiation of light energy in discrete packets called as photon. **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 considered.**	**2** 1 1

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Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	h)	**State any two scientific applications of X-rays.** **Any two applications** **Scientific Applications:** i. . X – rays are used to study structure of crystal and alloy ii. . X – rays are used to chemical analysis and for determination of atomic number of chemical elements. iii. . X – rays are used to study structure of substances like cellulose , rubber and plastic. iv. . X – rays are used for identification of chemical elements present in the solution. v. . X – rays are used for analysis of structure of organic molecules.	**2** 2
	i)	**What is recoil of gun? Write the equation of recoil of gun.** **Explanation** **Equation** **Recoil of gun:-** When the bullet is fired from gun, then bullet shoots out with a large velocity, at the same time gun moves back with little velocity, this backward moment is called as recoil of gun. **Equation:-** $v_2 = m_1 v_1 / m_2$	**2** 1 1
	j)	**State principle of photometry.** **Principle:-** If two sources of light of illuminating powers I_1 and I_2 are kept at a distances r_1 and r_2 from a screen then the intensities of illumination at a point on the screen due to the two sources are I_1 / r_1^2 and I_2 / r_2^2 respectively.	**2**

	k)	**An accelerated electron emits a quantum of radiation with frequency 8 x 10^8 cycles per second. Calculate the energy of electron. h=6.623 x 10^{-34} Js**
		Formula with substitution
		Answer with unit
		Given
		     $v = 8 \times 10^8$ Hz
		     h=6.623x10^{-34} Js
		     E = ?
		     E = h x v
		     E = (6.623x10^{-34} x 8 x 10^8)
		     E = 52.984 x 10^{-26} joule
			2
			1
			1

	l)	**100 liters of water is pumped to a height of 30 m. Calculate the work done by the pump.** **Formula with substitution** **Answer with unit** **Given** Volume = 100 liters, m = 100 kg (water), h = 30 m, Work done = ? Work done = mgh = 100 x 9.8 x 30 **Work done = 29400 J**	**2** 1 1

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SUMMER – 18 EXAMINATION

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Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	a)	**Attempt any FOUR of the following:** **Distinguish between Centripetal force and centrifugal force.** **Each point**	**16** **4** 1
		<table><tr><td>**Centripetal force**</td><td>**Centrifugal force**</td></tr><tr><td>It is the force acting on the particle in U.C.M. which is directed along the radius and towards the center of circular path</td><td>It is the force acting on the particle in U.C.M. which is directed along the radius and away the center of circular path</td></tr><tr><td>This is real force</td><td>This is pseudo(imaginary) force</td></tr><tr><td>This force acting towards the center</td><td>This force acting away from the center</td></tr><tr><td>Required to maintain U.C.M.</td><td>This force is required and help to obey Newton's laws of motion in accelerated frame of reference .</td></tr></table>	

	b)	**A water tank of capacity 18000 liter is to be filled in 20 minutes by a pump. This water is to be lifted through a height of 12 m. If efficiency of the pump is 70%. Find the power of the pump.**
		Formula and substitution
		Answer with unit
		Given:-
		     18000 liter = 18000 kg of water.
		     t = 20 min. = 20 x 60 = 1200 sec.
		     h = 12 m.
		     Efficiency = 70% = 70 / 100 = 0.7
		     Power = ?
		 We have,
		     Work = mgh = 18000 x 9.8 x 12
		     Work = 2116800 J
		     Power = Work / time = 2116800 / 1200
		     Power = 1764 Watt.
		     Efficiency = output power / input power
		     Input power = power of pump = output power / efficiency
		     Input power = power of pump = 1764 / 0.7 = 2520 Watt.
			4
			
			2
			2

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Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	c)	**Explain production of ultrasonic waves by piezoelectric method.** **Diagram with label** **Principle** **Working** **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.	**4** 1 1 2

	d)	**A scooter starts with initial velocity of 12 m/s and accelerates at 0.9 m/s^2. Calculate**
		i) the speed of scooter after 200 m of travel.
		ii) Distance travelled by it during 19th second.
		Each formula and substitution
		Each answer with unit
		Given:-
		    $u = 12$ m/s, $a = 0.9$ m/s^2, $s = 200$ m, $v = ?$ and $s^{19th} = ?$
		we have,
		        $v^2 = u^2 + 2as$
		        $v^2 = (12)^2 + (2 \times 0.9 \times 200) = 504$
		        $v = 22.449$ m/s
		also
		        $s^{nth} = u + a/2 (2n - 1)$
		        $s^{19th} = 12 + (0.9/2) (2 \times 19 - 1)$
		        $s^{19th} = 28.65$ m
			4
			
			1
			1

	e)	**What is ultrasonic testing? State two advantages and two industrial application of ultrasonic testing.** **Definition** **Advantages** **Application**	**4** 1 1½ 1½

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2.	e)	**Ultrasonic testing:-** It is method used to detect crack(flaw) which are inside the body and not for the cracks which are on the surface of job. **Advantages** i) High penetrating power, which allows the detection of flaws deep in the part. ii) High sensitivity, permitting the detection of extremely small flaws. iii) Only two nonparallel surfaces need to be accessible. iv) Greater accuracy than other nondestructive methods in determining the depth of internal flaws and the thickness of parts with parallel surfaces v) Capable of portable or highly automated operation. **Any relevant advantages to be considered.** **Industrial application of ultrasonic testing:-** 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.	
	f)	**What is necessity of testing methods used in industries? State the four factors on which NDT method can be selected.** **Necessity of testing methods** **Criteria for selection** **Necessity of testing methods:-** Testing of material for its performance is the necessary part of quality control. i)To detect crack or flaw porosity in the material. ii)To determine breaking stress,Ultimate stress and strength of material iii) To determine microstructure, texture, physical and chemical properties. iv) To check suitability of component. **Criteria for selection:-** 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 equipments available for testing vi)Total cost required to test the material	**4** 2 2

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SUMMER – 18 EXAMINATION

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3.	a)	**Attempt any FOUR of the following:** **Why is acoustical planning of an auditorium necessary? Which factors affects the acoustical planning of auditorium?** **Any four point** **Any four factors** 1. To distribute the sound uniformly throughout the hall. 2. To hear the sound in the hall sufficiently loudly. 3. To avoid the mixing up between two successive sounds. 4. To maintain the proper value of reverberation time. 5. To avoid echelon effect. **Factors affecting acoustical planning** 1) Echo 2) Reverberation 3) Reverberation time 4) Creeping of sound 5) Echelon effect 6) Noise 7) Intensity and Loudness 8) Balconies **Any other relevant factor**	**16** **4** 2 2
	b)	**State and explain the factors affecting the indoor lighting scheme.** **Statement of factors** **Explanation** **i) Efficiency of the source**:-It is the ratio of luminous flux obtained from the source to the light energy utilized. **ii) Utilization factor or coefficient of utilization**:-It is defined as the ratio of luminous flux received by working area to luminous flux emitted by a source. **iii) Maintenance factor**:-It is defined as the ratio of illuminance obtained under existing conditions to the illuminance that can be obtained when everything is clean. **iv) Space to height ration**:-For uniform lighting the ratio between spacing of lamp and their height of working plane should be in between 1 and 1.5 **v) Glare effect:** – Operator facing towards lamp or window while working may not be able to concentrate fully on work because of glaring effect. Hence glare control is essential. For this lamps should have glare shields or shades.	**4** 2 2

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3.	c)	**State 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)	**Find the minimum wavelength and maximum frequency of X-rays produced by an X-ray tube working on 50kV.** **Each formula** **Each answer with unit** Given $V=100 \text{ kV}=100 \times 10^3 V$ $h = 6.63 \times 10^{-34} Js$ $e=1.6 \times 10^{-19} C$ $c = 3 \times 10^8 \text{ m/s}$ We have, $$\lambda_{min} = \frac{hc}{eV}$$ $$\lambda_{min} = \frac{(6.62 \times 10^{-34})(3 \times 10^8)}{(1.6 \times 10^{-19})(50 \times 10^3)}$$ $$\lambda_{min} = \textbf{0.248 x 10}^{\textbf{-10}} \textbf{ m.}$$ $$\lambda_{min} = \textbf{0.248 A}^{\textbf{0}}$$ $$f = \frac{c}{\lambda_{min}}$$ $$f = \frac{(3 \times 10^8)}{(0.248 \times 10^{-10})}$$ $$f = \textbf{120 x 10}^{\textbf{17}} \textbf{ Hz.}$$	**4** 1 1

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3.	e)	**Define reverberation of sound. Write sabines formula for reverberation time. State the factors on which reverberation time depends.**	**4**
		Definition	1
		Formula	2
		Factors	1
		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 :- $t = 0.164\ V / A$	
		$t = 0.164\ V / \Sigma\ aS$	
		Factors on which reverberation time depends:-	
		1. It depends upon the types of sound produced e.g-Human speech, Musical Sound Noise.	
		2. Total volume of the hall.	
		3. Coefficient of absorption.	
		4. Surface area.	
	f)	**A wheel of diameter 3 m increases its speed uniformly from 150 rpm to 300 rpm. in 30 second. Calculate i) Angular acceleration ii) Linear acceleration**	**4**
		Each formula	1
		Each answer with unit	1
		Given:- Diameter = 3 m radius (r) = 1.5 m	
		$\omega_1 = 150$ r.p.m.	
		$n_1 = 150/60$ rps = 2.5 Hz	
		$\omega_2 = 300$ r.p.m	
		$n_2 = 300/60 = 5$ Hz	
		t = 30 sec	
		i) Angular acceleration $(\alpha) = (\omega_2 - \omega_1) / t = (2\pi n_2 - 2\pi n_1) / t$	
		$\alpha = 2\pi (n_2 - n_1) / t = (2 \times 3.14 (5 - 2.5)) / 30$	
		$\alpha = 0.524$ rad / s^2	
		ii) Linear acceleration (a) = r α = 1.5 x 0.524	
		a = 0.786 m / s^2	