



SUMMER- 18 EXAMINATION

17202

Subject Name: Applied Physics

Model Answer

Subject Code:

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:	18
	a)	<p>State the equations of motion for a body falling freely under gravity with meaning of each symbol.</p> <p>Equation</p> <p>Meaning</p> <p>i) $v = u + gt$</p> <p>ii) $s = ut + \frac{1}{2}gt^2$</p> <p>iii) $v^2 = u^2 + 2gs$</p> <p>Where, u = Initial velocity, v= final velocity, t= time s= distance travelled, g = gravitational acceleration.</p>	<p>2</p> <p>1</p> <p>1</p>
	b)	<p>Define power. State it's S.I.unit.</p> <p>Definition</p> <p>Unit</p> <p>Power:- Power is defined as rate of doing work.</p> <p>S.I.Unit:- Watt</p>	<p>2</p> <p>1</p> <p>1</p>
	c)	<p>Define impulse and impulsive force.</p> <p>Each Definition</p> <p>Impulse: It is defined as change in momentum.</p> <p>Impulsive force: It is defined as a large force acts on a body for very small time .</p>	<p>2</p> <p>1</p>



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1.	d)	<p>An object is projected upwards making an angle of 35^0 with horizontal with an initial speed of 45 m/s. Calculate the time required for object to reach the ground .</p> <p>Formula with substitution</p> <p>Answer with unit</p> <p>Given,</p> $\theta = 35^0$ $v = 45 \text{ m/s}$ $T = ?$ $T = \frac{2v \sin \theta}{g}$ $T = (2 \times 45 \times \sin 35^0) / 9.8$ <p>T = 5.267 sec.</p>	2 1 1
	e)	<p>State any two properties of ultrasonic waves</p> <p>Each Property</p> <ul style="list-style-type: none">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.	2 1
	f)	<p>Calculate amount of heat generated when current of 1.5A flows for 10 minutes through resistance of 21Ω. (Given $J=4200 \text{ J/kcal}$)</p> <p>Formula Substitution</p> <p>Answer with unit</p> <p>Given: $I = 1.5 \text{ A}$, $t = 10 \text{ min} = 10 \times 60 = 600 \text{ s}$, $R = 21\Omega$, $J = 4200 \text{ J/kcal}$, Required: $H = ?$</p> <p>We have, $H = I^2 R t / J$</p> $H = (1.5)^2 \times 21 \times 600 / 4200$ <p>H = 6.75 kcal.</p>	
g)	<p>Distinguish between Seebeck's effect and peltier effect.(any two points)</p> <p>Any two points</p>		2 2



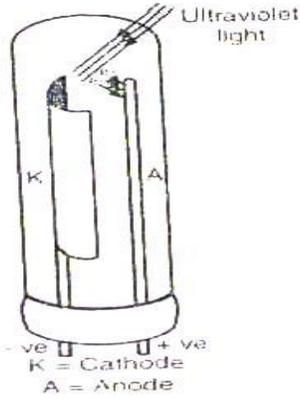
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Q. No.	Sub Q. N.	Answers	Marking Scheme										
1.	g)	<table border="1"> <thead> <tr> <th data-bbox="323 422 756 464">Seebeck's effect</th> <th data-bbox="756 422 1190 464">Peltier effect</th> </tr> </thead> <tbody> <tr> <td data-bbox="323 464 756 684">When two dissimilar metals are joined together so that two junctions are formed and if one junction is heated and other is cooled then electric current flows through it.</td> <td data-bbox="756 464 1190 684">When electric current flows through a junction of two metals of thermocouple, then heat is generated at one junction and heat is absorbed at the other junction.</td> </tr> <tr> <td data-bbox="323 684 756 758">emf is developed across the two junction.</td> <td data-bbox="756 684 1190 758">One junction gets heated and other get cooled.</td> </tr> <tr> <td data-bbox="323 758 756 831">emf generated is small in mV.</td> <td data-bbox="756 758 1190 831">Heat generated or absorbed is small.</td> </tr> <tr> <td data-bbox="323 831 756 934">Amount of emf generated depends on pair of metals and temperature difference.</td> <td data-bbox="756 831 1190 934">Amount of heat generated depends on pair of metals and current through it.</td> </tr> </tbody> </table>	Seebeck's effect	Peltier effect	When two dissimilar metals are joined together so that two junctions are formed and if one junction is heated and other is cooled then electric current flows through it.	When electric current flows through a junction of two metals of thermocouple, then heat is generated at one junction and heat is absorbed at the other junction.	emf is developed across the two junction.	One junction gets heated and other get cooled.	emf generated is small in mV.	Heat generated or absorbed is small.	Amount of emf generated depends on pair of metals and temperature difference.	Amount of heat generated depends on pair of metals and current through it.	
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	h)	<p>State Planck's Hypothesis.</p> <p>Statement</p> <p>Planck's Hypothesis:</p> <p>Planck's proposed the quantum theory for explanation of energy distribution in a black body radiation. According to this theory energy is not emitted or absorbed continuously but in a discrete units or packets called photon or quanta. The photons are electrically neutral and traveled with speed of light i.e. the radiation considers as shower of photons. The energy E associated with photon is directly proportional to frequency of light.</p>	2 2										
	i)	<p>Draw neat labeled diagram of photoelectric cell.</p> <p>Diagram</p> <p>Labels</p> 	2 1 1										



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1.	j)	State any 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)	Give any two engineering applications of X-rays. Any two applications 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. X-rays are used to detect cracks in the wall. vii. X- ray radiography is used to check the quality of welded joints.	2 2
	l)	Explain the term population inversion. Explanation 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, etc..	2 2



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2.	a)	<p>Attempt any four: Distinguish between centripetal force and centrifugal force. (any four points) Any four points</p> <table border="1"> <thead> <tr> <th>Centripetal force</th> <th>Centrifugal force</th> </tr> </thead> <tbody> <tr> <td>Centripetal force is the force acting on a particle performing uniform circular motion which is along the radius and towards the center of circular path.</td> <td>Centrifugal force is the force acting on a particle performing uniform circular motion which is along the radius and away from the center of circular path.</td> </tr> <tr> <td>It is a real force</td> <td>It is a imaginary(pseudo) force</td> </tr> <tr> <td>It is acting along the radius and towards the center</td> <td>It is acting along the radius and away from the center</td> </tr> <tr> <td>It maintains uniform circular motion</td> <td>It helps to obey Newton's laws of motion in accelerated frame of reference.</td> </tr> <tr> <td>E .g. stone tied at one end of string and whirled, electron revolving around the nucleus . etc</td> <td>E.g. Person sitting in merry go round or giant wheel, Motor cyclist driving in a artificial death well. etc</td> </tr> </tbody> </table>	Centripetal force	Centrifugal force	Centripetal force is the force acting on a particle performing uniform circular motion which is along the radius and towards the center of circular path.	Centrifugal force is the force acting on a particle performing uniform circular motion which is along the radius and away from the center of circular path.	It is a real force	It is a imaginary(pseudo) force	It is acting along the radius and towards the center	It is acting along the radius and away from the center	It maintains uniform circular motion	It helps to obey Newton's laws of motion in accelerated frame of reference.	E .g. stone tied at one end of string and whirled, electron revolving around the nucleus . etc	E.g. Person sitting in merry go round or giant wheel, Motor cyclist driving in a artificial death well. etc	16 4 4
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	b)	<p>A train crosses a tunnel in 20 sec. At the entry of tunnel its velocity is 72 km/hr and at the exit of tunnel its velocity is 36 km/hr. Find length of the tunnel. Formula and conversion Answer with unit Given, $t = 20 \text{ sec.}$ $u = 72 \text{ km/hr}$ $u = \frac{72 \times 1000}{60 \times 60}$ $u = 20 \text{ m/s.}$ $v = 36 \text{ km/hr.}$ $v = \frac{36 \times 1000}{60 \times 60}$ $v = 10 \text{ m/s}$ Length of tunnel = Distance covered = $s = ?$ We have,</p>	4 2 2												



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2.	b)	$a = \frac{v - u}{t} = \frac{10 - 20}{20}$ $a = -0.5 \text{ m/s}^2$ <p>Now,</p> $v^2 = u^2 + 2as$ $s = \frac{v^2 - u^2}{2a} = \frac{(10)^2 - (20)^2}{2 \times (-0.5)}$ $s = 300 \text{ m.}$ <p>Length of tunnel = s = 300 m</p>	
	c)	<p>i) State the law of conservation of momentum for a system of two colliding bodies. Also state its mathematical formula.</p> <p>Statement</p> <p>Formula</p> <p>Statement: It states that the total momentum of system consisting of two or more colliding bodies before impact remains unchanged after impact provided no external force acts on it.</p> <p>Formula:- $m_1u_1 + m_2u_2 + \dots + m_nu_n = m_1v_1 + m_2v_2 + \dots + m_nv_n$</p> <p>ii) A bullet of mass 40 gm is fired with a muzzle velocity of 500 m/sec. from a gun of mass 4 kg. Calculate the recoil velocity of the gun.</p> <p>Formula Substitution</p> <p>Answer with Unit</p> <p>Given;</p> <p>Mass of bullet (m_2) = 40 gm = 40×10^{-3} kg</p> <p>Velocity of bullet (v_2) = 500m/s</p> <p>Mass of gun (m_1) = 4 kg.</p> <p>Velocity of gun (v_1) = ?</p> <p>We have</p> $m_1 v_1 = m_2 v_2$ $v_1 = m_2 v_2 / m_1$ $v_1 = (40 \times 10^{-3}) \times 500 / (4)$ $v_1 = 5 \text{ m/s.}$	<p>2</p> <p>1</p> <p>1</p> <p>2</p> <p>1</p> <p>1</p>



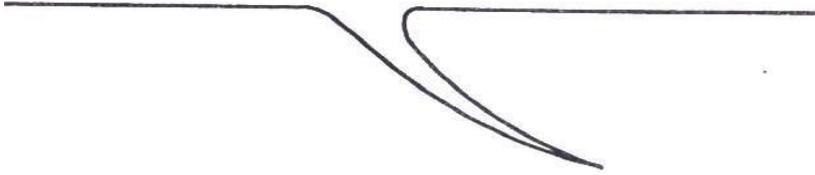
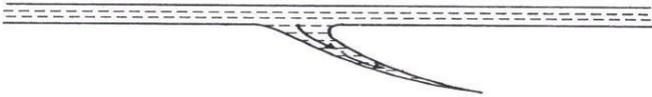
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2.	d)	<p>Explain the liquid penetration testing method for the detection of surface discontinuities with the help of principle ,diagram and experimental procedure.</p> <p>Principle Diagram Procedure</p> <p>Principle: It works on the principle of capillarity. Experimental Procedure:</p> <p>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.</p>  <p>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.</p>  <p>3. Excess penetrant removal: After dwell time is over, the excess penetrant is removed from the surface carefully</p>  <p>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.</p>	4 1 2 1

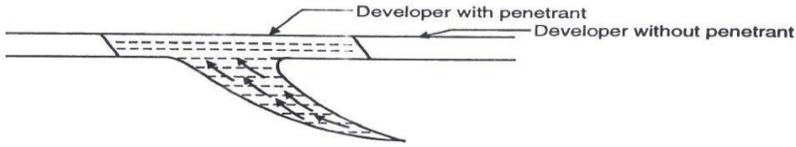
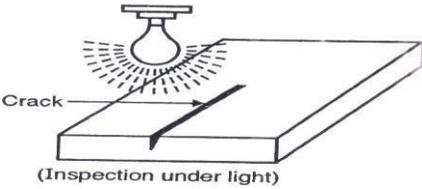
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2.	d)	 <p>5. Inspection & evaluation of defects: Surface of the specimen is seen under white light or ultraviolet or laser light. The crack can be visualized under light.</p>  <p>6. Post cleaning: After inspection the surface of the specimen is cleaned & the specimen can be used for its intended purpose</p>	
	e)	<p>State any four advantages of non destructive testing of material.</p> <p>Four advantages</p> <p>Advantages :</p> <ol style="list-style-type: none"> 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. 8. Any other relevant advantage 	<p>4</p> <p>4</p>

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2.	f)	<p>Explain the 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</p> <div style="text-align: center; margin: 10px 0;">  <p style="margin: 0;">Electric oscillator circuit Chip of piezoelectric (Quartzcrystal)</p> </div> <p>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.</p>	<p>4 2 1 1</p>

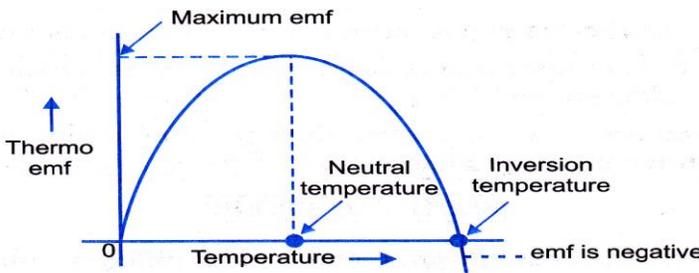
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3.	a)	<p>Attempt any four.</p> <p>Define thermo emf. State any three factors on which thermo emf is dependent.</p> <p>Definition</p> <p>Three factors</p> <p>Thermo emf: When two dissimilar metals are joined together so that two junctions are formed and if one junction is heated and the other is cooled then the emf is generated across the junction is called thermo emf.</p> <p>Three factors:</p> <p>i) The e.m.f generated depends on the nature two metals used.</p> <p>ii) The e.m.f generated depends on the temperature difference between two junctions.</p> <p>iii) The e.m.f generated depends on the position of metals in Seebeck's thermoelectric series .</p> <p>Any other relevant</p>	<p>16</p> <p>4</p> <p>1</p> <p>3</p>
	b)	<p>Explain graphically variation of thermo emf with temperature and hence define neutral temperature and inversion temperature.</p> <p>Diagram</p> <p>Explanation</p> <p>Definitions</p> <div style="text-align: center;">  </div> <p>The temperature of one junction is placed at 0°C and temperature of other junction is increased by providing heat. The emf generated is measured with the help of millivoltmeter. Number of e_1, e_2, e_3, \dots for different temperatures t_1, t_2, t_3, \dots are recorded and the graph is plotted.</p>	<p>4</p> <p>1</p> <p>1</p> <p>2</p>



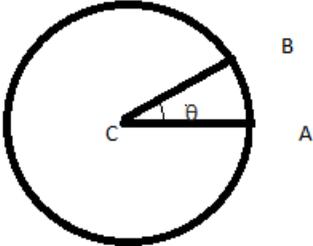
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3.	b)	<p>Neutral temperature – In thermocouple the temperature at which the emf is maximum is called inversion temperature</p> <p>Inversion Temperature: In thermocouple the temperature at which the emf becomes zero and changes its sign (becomes negative) is call inversion temperature.</p>	
	c)	<p>i) Define the terms: 1) angular velocity 2) angular acceleration</p> <p>Each definition</p> <p>Angular velocity: The rate of change of angular displacement with respect to time is called angular velocity.</p> <p>Angular acceleration: The rate of change of angular velocity with respect to time is called angular acceleration.</p> <p>ii) Derive the relation between linear velocity and angular velocity of a body.</p> <p>Diagram</p> <p>Derivation</p>  <p>Consider the particle undergoing uniform circular motion . It moves from point A to point B in time t. Let s= linear displacement , θ / t = angular displacement , v = linear velocity, r =radius of the circle , ω = angular velocity.</p> $v = s/t = r \theta / t \quad \text{as } s = r \theta$ $v = r \times \theta / t = r \times \omega \quad \text{as } \theta / t = \omega$ $\mathbf{v = r \times \omega}$ <p>Thus, linear velocity is radius times the angular velocity.</p>	<p>2</p> <p>2</p> <p>2</p> <p>1</p> <p>1</p>



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3.	d)	<p>The photo electric work function of a photo sensitive material is 3 eV. Calculate its threshold frequency and threshold wavelength. Plank's const, $h = 6.63 \times 10^{-34}$ J-s.</p> <p>Each Formula with calculation Each Answer with unit Given, $W_0 = 3 \text{ eV} = 3 \times 1.6 \times 10^{-19} \text{ J}$ $h = 6.63 \times 10^{-34} \text{ Js}$ We have, $\nu_0 = \frac{W_0}{h}$ $\nu_0 = 3 \times 1.6 \text{ eV} / h = 3 \times 10^8 / 6.63 \times 10^{-34}$ $\nu_0 = 7.23 \times 10^{14} \text{ Hz.}$ $\lambda_0 = c / \nu_0 = 3 \times 10^8 / 7.23 \times 10^{14}$ $\lambda_0 = 4.149 \times 10^{-7} \text{ m} = 4149 \text{ \AA}$</p>	<p>4</p> <p>1</p> <p>1</p>
	e)	<p>Find minimum wavelength and maximum frequency of X rays produced by X ray tube working at 50 KV. ($h = 6.63 \times 10^{-34}$ J-s, velocity of light, $c = 3 \times 10^8$ m/s and $e = 1.6 \times 10^{-19}$ C)</p> <p>Each Formula Each Answer with unit Given : $V = 50 \text{ KV} = 50 \times 10^3 \text{ V}$ $C = 3 \times 10^8 \text{ m/s}$</p> <p>Required: $\lambda_{\min} = ?$ $\nu_{\max} = ?$</p> <p> $\lambda_{\min} = hc/eV = 12400 \times 10^{-10} / V$ $\lambda_{\min} = 12400 \times 10^{-10} / 50 \times 10^3$ $\lambda_{\min} = 0.248 \times 10^{-10} \text{ m}$ $\lambda_{\min} = 0.248 \text{ \AA}$ $c = \nu_{\max} \times \lambda_{\min}$ $\nu_{\max} = c / \lambda_{\min}$ $\nu_{\max} = 3 \times 10^8 / 0.248 \times 10^{-10}$ $\nu_{\max} = 1.20 \times 10^{19} \text{ Hz}$</p>	<p>4</p> <p>1</p> <p>1</p>



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3.	f)	<p>State any four properties of LASER.</p> <p>Any four properties</p> <p>Properties</p> <p>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</p>	<p>4</p> <p>4</p>