



SUMMER - 16 EXAMINATION

Subject Code: 17207

Model Answer

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		<p>Important Instructions to examiners:</p> <ol style="list-style-type: none">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.		



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1)		Attempt any NINE of the following:		18
	a)	Define the term i) Retardation ii) Velocity time graph Each definition i) Retardation:- Retardation means negative acceleration. OR If the velocity of body decreases with increase in time then corresponding acceleration is called retardation. ii) Velocity time graph:- Graphical representation of velocity with respect to time is called Velocity time graph.	1	2
	b)	Define one newton and one watt. Each definition One newton: It is the force required to accelerate a mass of one kilogram with one meter per second square . One watt:- When one joule of work is done in one second then the power is said to be one watt.	1	2
	c)	Define: i) Time of flight ii) Horizontal range Each definition i) Time of flight:- The total time in which projectile covers the entire trajectory is called as time of flight. ii) Horizontal range: Maximum horizontal distance covered by projectile is called horizontal range.	1	2
	d)	Define ultrasonic wave. Definition Ultrasonic wave: - The sound wave is having frequency greater than 20 KHz is called ultrasonic wave.	2	2



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	e)	<p>Name any four Non Destructive Testing method.</p> <p>Each method</p> <p>Non Destructive Testing methods:-</p> <ol style="list-style-type: none">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) <p>Note: Any other relevant factors can be considered.</p>	½	2
	f)	<p>Explain the term: i) Reverberation ii) Reverberation time.</p> <p>Each explanation</p> <p>i) Reverberation : It is the persistence of sound due to multiple reflections in a hall even after the source of sound is cut-off. Reverberation creates confusion & affects the quality of sound.</p> <p>ii) Reverberation time: The time for which sound persists in a hall even after the source of sound is cut off is called as reverberation time. Proper reverberation time can be adjusted by providing sound absorbing material in the hall.</p>	1	2
	g)	<p>Intensity of sound produced by thunder is 0.2Wm^{-2}. Calculate the level in decibel.</p> <p>Formula</p> <p>Answer with unit</p> <p>Given : Assume $I_0 = 10^{-12} \text{Wm}^{-2}$</p> <p>Required : I.L. in dB = ?</p> <p>Formula:</p> $I = 10 \log_{10}(I/I_0)$ $I = 10 \log_{10}(0.2/10^{-12})$ $I = 113 \text{ dB}$	1 1	2



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1)	h)	State the principle of photometry. Principle Principle of photometry:- 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 as below. $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$	2	2
	i)	Define threshold frequency and stopping potential. Each definition Threshold frequency: It is the minimum frequency of incident light at which emission just begins. Stopping potential:- It is the negative potential at which photoelectric current becomes zero.	1	2
	j)	State the range of wavelength of X-ray. Range Wavelength of X-ray :- 10^{-10} to 10^{-11} m.	2	2
	k)	State photoelectric effect. 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	2
	l)	State Newton's third law of motion with equation. Statement Equation Newton's third law of motion: For every action there is an equal reaction. $m_1v_1 = m_2v_2$	1 1	2



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks										
2)	a)	<p>Attempt any FOUR of the following: State the equation of K.E. of body: i) at rest ii) when its velocity is doubled Equation of K.E.</p> $\text{K.E.} = \frac{1}{2} mv^2$ <p>i) at rest Velocity (v) = 0</p> $\text{K.E.} = \frac{1}{2} mv^2$ $\text{K.E.} = \frac{1}{2} m(0)^2$ <p>K.E. = 0</p> <p>ii) when its velocity is doubled Velocity (v) = doubled(2v)</p> $\text{K.E.} = \frac{1}{2} mv^2$ $\text{K.E.} = \frac{1}{2} m(2v)^2$ $\text{K.E.} = \frac{1}{2} m4v^2$ <p>K.E. = 2mv²</p>	1 1½ 1½	16 4										
	b)	<p>Distinguish between Centripetal force and centrifugal force. Each point</p> <table border="1"> <thead> <tr> <th>Centripetal force</th> <th>Centrifugal force</th> </tr> </thead> <tbody> <tr> <td>1) 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>1) 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>2) This is real force.</td> <td>2) This is pseudo (imaginary) force.</td> </tr> <tr> <td>3) This force acting towards the center.</td> <td>3) This force acting away from the center.</td> </tr> <tr> <td>4) Required to maintain U.C.M.</td> <td>4) This force is required and helps to obey Newton's laws of motion in accelerated frame of reference.</td> </tr> </tbody> </table>	Centripetal force	Centrifugal force	1) 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.	1) 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.	2) This is real force.	2) This is pseudo (imaginary) force.	3) This force acting towards the center.	3) This force acting away from the center.	4) Required to maintain U.C.M.	4) This force is required and helps to obey Newton's laws of motion in accelerated frame of reference.	1	4
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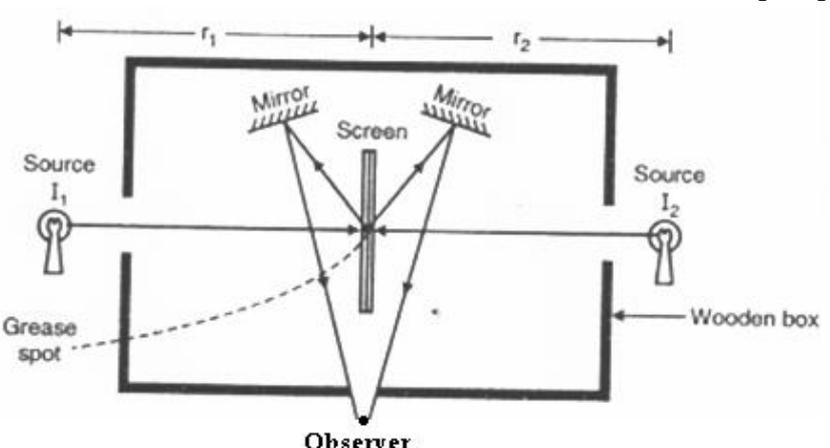
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	c)	<p>Describe piezoelectric method for their production. Diagram with label Principle Working</p>  <p>Principle: When the electric field is applied across the crystal its dimensions changes and when alternating PD is applied across crystal then the crystal sets into elastic vibrations.</p> <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 produces 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>	1 1 2	4
	d)	<p>A hall of volume 5000 m³ has reverberation time of 3 sec. The surface area of sound absorbing surface 3500 m². Calculate the average coefficient of absorption. Formula with substitution Answer with unit Given: V=5000 m³ t=3 sec Σ S = 3500 m² a=?</p> <p>Formula : $t = \frac{0.164 \times V}{\Sigma as}$</p> <p>$a = \frac{0.164 \times V}{t \Sigma s}$</p>	2 2	4

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	d)	$a = \frac{0.164 \times 5000}{3 \times 3500}$ <p>a= 0.0780 O.W.U.</p>		
	e)	<p>Explain the working of Bunsen’s photometer with help of a neat ray diagram.</p> <p>Principle Diagram Construction Working</p> <p>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</p> $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$  <p>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.</p>	1 1 1 1	4



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	e)	<p>Working:</p> <p>The two sources of intensity I_1 & I_2 are placed at a distance r_1 & r_2 from the screen respectively.</p> <p>Position of source are adjusted such that image of the grease spot seen in two mirrors is equally bright.</p> <p>Then the luminous intensities of 2 sources can be compared using relation</p> $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$ <p>The same procedure is repeated by changing the position of two sources.</p>		
	f)	<p>Find minimum wavelength and maximum frequency of X-ray production by an X-ray tube work on 50kV.</p> <p>[Given $h=6.62 \times 10^{-34}$Js, $e=1.6 \times 10^{-19}$C and $c=3 \times 10^8$ m/s)</p> <p>Each formula</p> <p>Each answer with unit</p> <p>Given</p> <p>$V=50\text{kV}=50 \times 10^3\text{V}$</p> <p>$h = 6.63 \times 10^{-34}\text{Js}$</p> <p>$e=1.6 \times 10^{-19}\text{C}$</p> <p>$c=3 \times 10^8$ m/s</p> <p>We have,</p> $\lambda_{\min} = \frac{hc}{eV}$ $\lambda_{\min} = \frac{(6.62 \times 10^{-34})(3 \times 10^8)}{(1.6 \times 10^{-19})(50 \times 10^3)}$ <p>$\lambda_{\min} = 0.248 \times 10^{-10}$ m.</p> <p>$\lambda_{\min} = 0.248 \text{ \AA}$</p> $f = \frac{c}{\lambda_{\min}}$ $f = \frac{(3 \times 10^8)}{(0.248 \times 10^{-10})}$ <p>$f = 120 \times 10^{17}$ Hz.</p>	1 1	4



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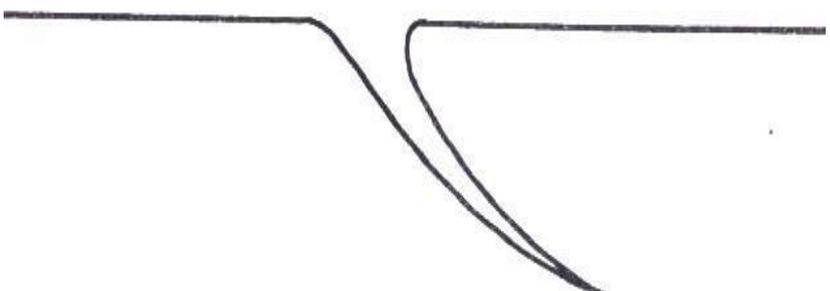
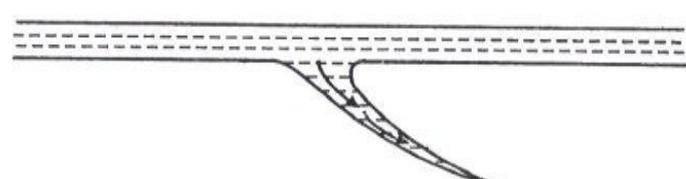
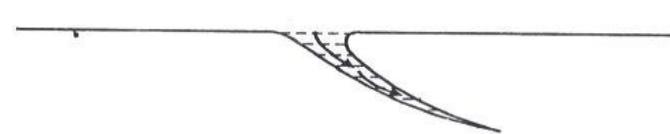
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	a)	<p>Attempt any FOUR of the following:</p> <p>A flywheel starting from rest is subjected to an acceleration of 150 rpm². Find its angular displacement during the 10th sec.</p> <p>Formula with substitution</p> <p>Answer with unit</p> <p>Given:</p> $w_0=0$ $\alpha=150 \text{ rpm}^2$ $=(150 \times 2\pi)/(60 \times 60)$ $=0.26 \text{ radians / sec}^2$ <p>n=10 sec</p> <p>Formula : $\theta_n = w_0 + (\alpha/2)(2n-1)$</p> $\theta_{10} = 0 + (0.26/2)(2 \times 10 - 1)$ $\theta_{10} = 2.48 \text{ radians.}$	2 2	4
	b)	<p>A train weighing 300 kN is moving with a velocity of 60 km/hr. the velocity is reduced to 40 km/hr in a second by applying the brakes, find the braking force assuming it is to be uniform.</p> <p>Formula with substitution</p> <p>Answer with unit</p> <p>Given: Initial velocity(u) =60 km/hr</p> $=60 \times 1000/3600$ $=16.6 \text{ m/s}$ <p>Final velocity(v)=40 km/hr</p> $=40 \times 1000/3600$ $=11.1 \text{ m/s}$ <p>Mass of train(m)=weight/g</p> $=300 \times 1000/9.81$ $=30581.039 \text{ kg.}$ <p>Train changes velocity in time (t)= 1 sec.</p> <p>Formula</p> $a = (v-u)/t$ $a = (11.111-16.666)/1$ $a = -5.5 \text{ m/s}^2$ <p>Let braking or retarding force =F</p> $F = m.a \quad (\text{In magnitude})$ $F = 30581.039 \times 5.555$ $F = 169877.6764 = 1.6 \times 10^5 \text{ N}$	2 2	4



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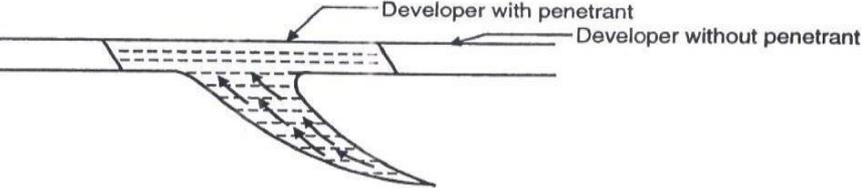
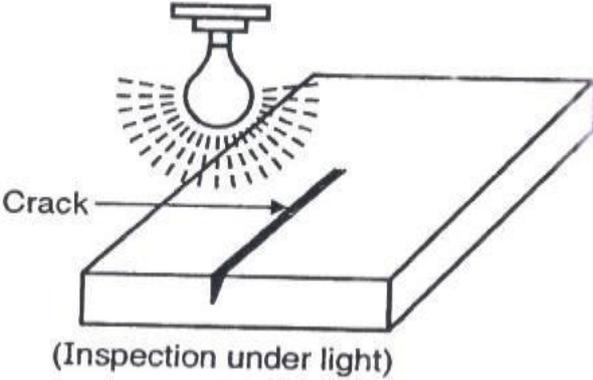
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	c)	<p>State principle of LPT and explain its experimental procedure.</p> <p>Principle Diagram Procedure</p> <p>Principle: It works on the principle of capillarity.</p> <p>Experimental Procedure: 1.Surface Preparation: Initially the surface of 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.</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> 	1 1 2	4

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	c)	<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>  <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>		
	d)	<p>A lamp of 300 candela is at a distance of 10 m from a wall. Find the illuminance of the wall. Formula with substitution Answer with unit Given $P = 300$ candela $r = 10$ m $I = ?$ We have $I = P / r^2$ $= 300 / (10)^2$ $I = 3 \text{ Cd/m}^2$</p>	2 2	4



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	e)	<p>Derive Einstein photoelectric equation. Einstein's Photoelectric Equation</p> <p>When radiations of suitable frequency is allowed to incident on surface of the metal plate , electrons are emmited from the surface atoms.</p> <p>The amount of energy of incident radiations (E) is used in 2 ways</p> <p>1.To knock out the electron from the surface atom or make it free = (W_0)</p> <p>2.Remaining part of energy of incident photon is given to electron as K.E.</p> $E = W_0 + K.E.$ <p>But $E = hv$</p> $W_0 = hv_0$ $K.E. = (1/2)mv^2$ $hv = hv_0 + (1/2)mv^2$ $(1/2)mv^2 = hv - hv_0$ $(1/2)mv^2 = h(v - v_0)$	4	4
	f)	<p>Explain the production of X-rays using Coolidge tube with a neat labeled diagram.</p> <p>Diagram</p> <p>Explanation</p> <p>Principle: When fast moving electrons are suddenly stopped then X- rays are produced.</p>	2 2	4

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	f)	<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 45%;"> </div> <div style="width: 45%;"> <p>T - Target F - Metal filament S - Cylinder A - Ammeter B - Battery Rh - Rheostat P₁ P₂ - Primary of transformer S₁, S₂ - Secondary of transformer</p> </div> </div> <p>Working: When the cathode is heated by electric current it produced electron due to thermionic emissions. The beam of electron is then focused on the anode (target). The electrons from cathode are accelerated by applying of high voltage between cathode & anode using step up transformer. When these fast moving electrons are suddenly stopped by tungsten anode, they lose their kinetic energy and x rays are produced from the target. Some amount of Kinetic energy is converted to large amount of heat. By controlling the filament current, the thermionic emission of electron hence intensity of X- rays can be controlled.</p>		