**SUMMER – 2015 EXAMINATION**

Subject Code: 17207 **Model Answer Applied Science (Physics)** 

| Que. No. | Sub. Que. | Stepwise Solution | Marks | Total Marks |
|---|---|---|---|---|
| | | **Important Instructions to examiners:**<br><br>1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.<br>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.<br>3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).<br>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.<br>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.<br>6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.<br>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** | | 18 |
| | a) | **Define i) Uniform velocity ii) Retardation** | | |
| | | **Each Defination** | 1 | 2 |
| | | **i) Uniform velocity:-** If a body covers equal distance in equal interval of time in a particular direction, then it is said to be having uniform velocity. **OR** If a body covers equal displacement in equal interval of time, then it is said to be in uniform velocity. **OR** If a body is moving with constant speed in the same direction then it is said to in uniform velocity. | | |
| | | **ii) Retardation:-** Retardation means negative acccelration. **OR** If the acceleration of body is negative and uniform in magnitude and direction with respect to time then it is called uniform retardation. | | |
| | b) | **Why does the gun recoil, when a bullet is fired from a gun?** | | |
| | | **Reason** | 2 | 2 |
| | | According to Newtons third law of motion 'For every action there is always equal and opposite reaction.' So when the bullet is fired from gun it moves in forward direction (Action) and its reaction is gun moves in backward direction that is recoil of gun. | | |
| | c) | **State the range for infrasonic and ultrasonic waves.** | | |
| | | **For each range** | 1 | 2 |
| | | **Waves** / **Range**: Infrasonic – Less than 20 Hz; Ultrasonic – More than 20 kHz | | |
| | d) | **What is meant by NDT? Name two popular NDT methods used in mechanical industry.** | | |
| | | **Meaning** | 1 | |
| | | **Any two method** | 1 | 2 |
| | | NDT:- Non-Destrctive Testing Methods. | | |
| | | **NDT methods:** | | |
| | | 1) Liquid penetrant testing (LPT)<br>2) Ultrasonic testing (UT)<br>3) Magnetic particle testing (MT) | | |

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| 1) | d) | 4) Radiograph testing (RT)<br>5) Leak testing (LT)<br>6) Visual testing (VA)<br>7) Holographic testing (HT)<br>8) Thermal infra radiography (TR)<br>**Note: Any other relevant factors can be considered.** | | |
| | e) | **State the range of wavelength of X-rays. Write the formula for minimum wavelength of X-rays.**<br>**Range**<br>**Formula**<br>Range of wavelength of X-ray is $10^{-10}$ to $10^{-11}$ m.<br>Formula:- $\lambda_{min} = \frac{hc}{eV}$ | 1<br>1 | 2 |
| | f) | **Define the terms: i) Luminous intensity ii) Illuminance**<br>**Each Defination**<br>**i) Luminous intensity:-** It is defined as luminous flux per unit solid angle emitted in that direction.<br>**ii) Illuminance:-** The illuminance at point on a surface is defined as the luminous flux received on unit area of surface around the point. | 1 | 2 |
| | g) | **Define Photon. Write the formula for energy of a Photon.**<br>**Defination**<br>**Formula**<br>**Photon:-** The small energy packets or bundles are called Photon.<br>**OR**<br>Radiation of light energy in discrete packets called as photon.<br>**Formula:-** $E = h\upsilon$ | 1<br>1 | 2 |
| | h) | **Write any four properties of X-rays.**<br>**Any four property**<br>(1) X-rays are highly penetrating electromagnetic radiations of very short wavelength.<br>(2) X-rays are electrically neutral.<br>(3) X-rays travel with the speed of light.<br>(4) X-rays affects the photographic plate.<br>(5) X-rays are not deflected by electric or magnetic field. | 2 | 2 |

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| 1) | h) | (6) X-rays are invisible.<br>(7) They can ionize gases.<br>(8) They cannot be reflected by ordinary mirrors, lenses or by prism. They can be reflected, refracted, detracted by crystals under certain conditions.<br>(9) They show interference and polarization like light.<br>(10) They produce fluorescence effect.<br>(11) X-ray kills some animal cells. | | |
| | i) | **State Newton's second law of motion. Give one example.**<br>**Law**<br>**Example**<br>**Newton's second law of motion:**<br>The rate of change of momentum of a body is proportional to the applied force and takes place in the direction of the force.<br>Example:-<br>1) To lift a heavy body is difficult than to lift the lighter one.<br>2)To pull a table is easy than to pull a baby.<br>**OR any relevant example.** | 1<br>1 | 2 |
| | j) | **A lamp of 300 candela is at a distance of 10 m from wall. Find illuminance of the wall.**<br>**Formula**<br>**Answer with unit**<br>**Given:-**<br>P = 300 candela<br>r = 10 m<br>I = ?<br>We have, $I = \frac{P}{r^2} = \frac{300}{(10)^2} = \frac{300}{100}$<br>I = 3 Lumen/$m^2$ or Lux | 1<br>1 | 2 |
| | k) | **Write any two uses of Photoelectric effect**.<br>**Two uses**<br>1) Photoelectric cell is used in lux-meter to measure the intensity of light.<br>2) It is used to switch on and off automatically the street lights.<br>3) It is used for automatic control of traffic signals.<br>4) It is used in recording and reproduction of sound during shooting of a film.<br>5) Photoelectric cells are used in television sets,fire alarms.<br>6) It is used in detecting flaws in metals.<br>7) Photoelectric cell is used in Burglar alarm.<br>**OR any relevant application.** | 2 | 2 |

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| 1) | l) | **Define centrifugal force. Give one example.**<br>**Definition**<br>**Example**<br>**Centrifugal force –** It is defined as the force acting on a particle performing uniform circular motion which is directed away from centre and along the radius of the circular path**.** **OR**<br>A particle performing uniform circular motion experiences force which is along the radius and away from the centre is called Centrifugal force.<br>**Example**<br>i) Person sitting in merry go round or giant wheel,experience outward pool<br>ii) Motor cyclist driving in a artificial death well in a circus experiences outward pull because of his high speed. | 1<br>1 | 2 |
| 2) | a) | **Attempt any FOUR of the following:**<br>**A projectile is fired with a velocity of 60 m/s making an angle of $30^0$ with the horizontal plane. Find its time of flight, Range and Maximum Height.**<br>**Each formula**<br>**Answer with unit**<br>**Given**<br>V = 60 m/s<br>$\theta = 30^0$<br>T = ?<br>R = ?<br>H = ?<br>We have,<br>$T = \frac{2v\sin\theta}{g} = \frac{2\times 60\times \sin 30^0}{9.8} = 6.122$ sec.<br>$R = \frac{v^2 \sin 2\theta}{g} = \frac{(60)^2 \sin 2(30^0)}{9.8} = 318.12$ m.<br>$H = \frac{(v\sin\theta)^2}{2g} = \frac{(60\sin 30^0)^2}{2\times 9.8} = 45.9$ m | 1<br>1 | 4 |
| | b) | **A water tank of capacity 18000 liter is to be filled in 20 min. 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.** | | |

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| 2) | b) | **Formula and substitution**<br>**Answer with unit**<br>**Given:-**<br>18000 liter = 18000 kg of water.<br>t = 20 min. = 20 x 60 = 1200 sec.<br>h = 12 m.<br>Efficiency = 70% = $\frac{70}{100}$ = 0.7<br>Power = ?<br>We have,<br>Work = mgh = 18000 x 9.8 x 12<br>Work = 2116800 J<br>Power = $\frac{Work}{time} = \frac{2116800}{1200}$<br>**Power = 1764 Watt.**<br>Efficiency = output power / input power<br>Input power = power of pump = output power / efficiency<br>**Input power = power of pump = $\frac{1764}{0.7}$ = 2520 Watt.** | 2<br>2 | 4 |
| | c) | **With neat labeled diagram explain piezo-electric method to produce ultrasonic waves.**<br>**Diagram with label**<br>**Principle**<br>**Working**<br>  <br><br>**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.<br>**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.<br>Then the crystal sets into resonance vibration and ultrasonic waves are produced. | 1<br>1<br>2 | 4 |

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| 2) | d) | **A car is moving with a velocity of 80 km/hr. the diameter of wheel is 525 mm. find angular velocity of the wheel also find the Angular retardation if the car which comes to rest over a distance of 700 m under constant retardation.** | | |
| | | **Formula and substitution** | 2 | |
| | | **Answer with unit** | 2 | 4 |
| | | **Given** u = 80 km/hr = $\frac{80\times1000}{60\times60}$ = 22.22 m/sec<br>Diameter = 525 mm<br>Radius( r ) = d/2 = 262.5 x$10^{-3}$ m<br>ω=?<br>Formula v = r ω<br>ω = v/r = $\frac{22.22}{262.5\times10^{-3}}$ = 0.0846 x$10^{3}$ rad/sec.<br>For Angular acceleration(α)<br>$v^2 = u^2 + 2as$<br>a = $\frac{v^2-u^2}{2s}$ = $\frac{(0)^2-(22.22)^2}{2\times700}$ = -0.352 m/sec$^2$<br>We have a = r α<br>α = a/r = $\frac{-0.352}{262.5\times10^{-3}}$<br>α = -1.34 rad/sec$^2$. | | |
| | e) | **What is ultrasonic testing?State two advantages and two industrial application of ultrasonic testing.** | | |
| | | **Definition** | 1 | |
| | | **Advantages** | 1 ½ | 4 |
| | | **Application** | 1 ½ | |
| | | 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.<br>Advantages<br>i)High penetrating power, which allows the detection of flaws deep in the part.<br>ii)High sensitivity, permitting the detection of extremely small flaws.<br>iii) Only two nonparallel surfaces need to be accessible.<br>iv)Greater accuracy than other nondestructive methods in determining the depth of internal flaws and the thickness of parts with parallel surfaces<br>v) Capable of portable or highly automated operation.<br>**Any relevant advantages to be considered** | | |

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| 2) | e) | **Industrial application of ultrasonic testing**<br>i)To detect flaw: flaws in metal, rubber, tyre, concrete,wood composites, plastics components<br>ii) Rail inspection: Rail tracks are tested on the spot which avoids service failure in track<br>iii) Air-craft inspection: To detect crack<br>iv) Tunnel inspection: To detect crack<br>v) Bridge inspection<br>vi) To detect subsurface discontinuities<br>vii)To test plant component<br>viii)Testing: It is used to test casting, forging, welding, fabrication, rolling, heat treatment<br>ix) Monitoring: Monitoring of thermal and atomic power plant, equipment pipe lines and structures<br>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.**<br>**Necessity of testing methods**<br>**Criteria for selection**<br>**Necessity of testing methods:-**<br>Testing of material for its performance is the necessary part of quality control.<br>i)To detect crack or flaw porosity in the material.<br>ii)To determine breaking stress,Ultimate stress and strength of material<br>iii)To determine microstructure, texture, physical and chemical properties.<br>iv)To check suitability of component.<br>**Criteria for selection:-**<br>i)Codes or standard requirement<br>ii)Specification of material to be tested, for example, nature of material, its size and shape<br>iii)Type of disorders to be detected, also depend on nature of disorders.<br>iv)Testing also depends on manufacturing process of material to be tested<br>v)It is also depending on the equipments available for testing<br>vi)Total cost required to test the material. | 2<br>2 | 4 |

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| 3) | | **Attempt any four of the following** | | 16 |
| | a) | **State the factors affecting acoustical planning of building. Explain how they are to be adjusted for good acoustics.** | | |
| | | **Factors affecting** | 2 | 4 |
| | | **Explation** | 2 | |
| | | Factor affecting acoustical planning:<br>**i)Echo:** The echo is defined as the same sound heard again after an interval of $1/10^{th}$ 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<br>**ii) 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. Proper reverberation time can be adjusted by providing sound absorbing material in the hall.<br>**iii) 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.<br>**iv) Creep:** Creep occurs because of reflections of sound along a curved surface (dome shape surface). If the source of sound is close to the dome then energy of sound moves along the ceiling without absorption & can be heard distinctly at the other side<br>**v) External noise:** The outside noise can mix up with the sound of speech or music in the hall and create confusion for the audience. This can be decreased by making the hall sound proof and constructing small sound proof cabins for machinery and type-writers etc.<br>**vi) Audience & Upholstered seats:** The sound can be better heard in a hall full of audience than in an empty hall. The human body and clothes, also the foam, cushions (upholstery) affects the acoustics of the hall.<br>**vii) Echelon effect:** Repeated echo occurs when sound is reflected from structures like equidistant staircase; this effect is known as echelon effect.This creates confusion in the sound produced. This effect can be controlled by covering such staircases by sound absorbing materials<br>**viii) Focusing of sound due to dome shaped ceilings:** If auditorium has dome shaped ceilings then sound may concentrate at the centre of the hall. To avoid this, such ceilings are covered by sound absorbing material. | | |

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| 3) | b) | **State and explain the factors affecting the indoor lighting scheme.** | | |
| | | **Statement of factors** | 2 | 4 |
| | | **Explanation** | 2 | |
| | | **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)Maintance 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 ration between spacing of lamp and their height of working plane should be inbetween 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. | | |
| | c) | **If the light of wavelength 4000 $A^0$ is incident on metal surface of work function 5 eV, will the electrons be ejected or not?** | | |
| | | **h =6.63 x$10^{-34}$Js ,C= 3 x $10^8$ m/s** | | |
| | | **Formula** | 1 | |
| | | **Answer with unit** | 2 | 4 |
| | | **Conclusion** | 1 | |
| | | **Given** $\lambda = 4000\ A^0 = 4000 \times 10^{-10}$ m<br>$W_0 = 5eV = 5 \times (1.6 \times 10^{-19}) = 8 \times 10^{-19}$ J<br>$h = 6.63 \times 10^{-34}$Js<br>$C = 3 \times 10^8$ m/s | | |
| | | We have $\upsilon = \frac{c}{\lambda} = \frac{3\times10^8}{4000\times10^{-10}} = 0.75 \times 10^{15}$ Hz | | |
| | | And $\upsilon_0 = \frac{W_0}{h} = \frac{8\times10^{-19}}{6.63\times10^{-34}} = 1.206 \times 10^{15}$ Hz | | |
| | | **Since $\upsilon < \upsilon_0$ electrons will not be ejected.** | | |
| | | **OR** | | |
| | | $\lambda = 4000\ A^0$ | | |
| | | We have $\lambda_0 = \frac{hc}{W_0} = \frac{6.63\times10^{-34}}{8\times10^{-19}} = 2486\ A^0$ | | |
| | | **Since $\lambda > \lambda_0$ electrons will not be ejected.** | | |

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| 3) | d) | **State any two engineering and two medical applications of X-rays.** | | |
| | | **Engineering Application (Any two)** | 2 | |
| | | **Medical Application (Any two)** | 2 | 4 |
| | | **Engineering Application of X- Rays**<br>i)X- rays are used to detect the cracks in the body of aero plane or motor car<br>ii)X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control<br>iii)X – rays are used to detect flaws or cracks in metal jobs.<br>iv)X- rays are used to distinguish real diamond from duplicate one<br>v)X- rays are used to detect smuggling gold at airport and docks (ship) yard.<br>vi)X-rays are used to detect cracks in the wall<br>vii)X- ray radiography is used to check the quality of welded joints.<br>**Medical Application of X- Rays:**<br>i)X – rays are used in surgery to detect bone fractured.<br>ii)X- rays are used to cure skin diseases and destroy tumours.<br>iii)X – rays are used to cure diseases like cancer<br>iv)X – rays are used to detect bullets position inside the body. | | |
| | e) | **Define reverberation of sound.Write sabines formula for reverberation time. State the factors on which reverberation time depends.** | | |
| | | **Definition** | 1 | |
| | | **Formula** | 2 | |
| | | **Factors** | 1 | 4 |
| | | **Reverberation:** It is the persistence of sound due to multiple reflections in a hall even after the source of sound is cut-off.<br>**Sabine's Formula :**<br>$t = \frac{0.164V}{A}$<br>$t = \frac{0.164V}{\Sigma aS}$<br>**Factors on which reverberation time depends**-It depends upon the types of sound produced e.g-Human speech,Musical Sound Noise. | | |

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| 3) | f) | **The speed of train is reduced from 110 kmph to 55 kmph over a distance of 350 m.find uniform retardation and distance further travelled before coming to rest.** | | |
| | | **Each Formula with substitution** | 1 | |
| | | **Each Answer with unit** | 1 | 4 |
| | | **Given** u = 110 kmph = $\frac{110\times1000}{3600}$ = 30.55 m/sec | | |
| | | v = 55 kmph = $\frac{55\times1000}{3600}$ = 15.27 m/sec | | |
| | | For uniform retardation | | |
| | | $v^2 = u^2+2as$ | | |
| | | $a = \frac{v^2-u^2}{2s} = \frac{(15.27)^2-(30.55)^2}{2\times350}$ | | |
| | | **a = -1.0018 m/sec$^2$** | | |
| | | Negative sign indicates retardation takes place when speed changes from 110 kmph to 55 kmph. | | |
| | | **Distance travelled before coming to rest** | | |
| | | $v^2 = u^2+2as$ | | |
| | | **s =** $\frac{v^2-u^2}{2a} = \frac{(0)^2-(30.55)^2}{-2\times1.0018}$ | | |
| | | **s = 465.81 m** | | |