WINTER– 16 EXAMINATION
Model Answer **Subject Code:** 17202

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 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.*

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.		**Attempt any NINE of the Following:**	**18**
	a)	**A car moving with an initial speed of 54 km/hr decelerates to 25 km/hr in 9 seconds Calculate the SOL deceleration.**	**2**
		Formula.	1
		Answer with unit.	1
		Given: u = 54 km/hr = 54 x 1000/60 x 60 =15 m/s , v = 25 km/hr = 25 x 1000/60 x 60 =6.94 m/s, t=9 sec, a =? We have, v = u + a t a = v – u / t a = 6.94 – 15 / 9 **a = -0.8955 m/s^2**	
	b)	**State work energy principle.** **Statement :**The work done by a system of forces acting on a body between any two points is equal to the change in kinetic energy of a body between the same two points	**2**

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1.	c)	**State any two application of centrifugal force.** **Each application** **Application of centrifugal force:** 1) Banking of curved road. 2) Centrifuge machine. 3) Drive in a washing machine. 4) Centrifugal governor. 5) Centrifugal pump. 6) Centrifugal Blower.	**2** 1
	d)	**State any two properties of ultrasonic waves.** **Each Property.** 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 possess certain vibrations which are used as good massage action in case of muscular pain.	**2** 1
	e)	**State any two limitations of NDT methods.** **Each limitation.** **Limitations of NDT** 1) Qualitative testing is possible; however, quantitative testing is difficult. 2) Cost of equipment is high and testing charges are more as compared to destructive testing. 3) Trained and certified persons are authorized to conduct the test (level I,II and III) as per American Society for Non-destructive testing(ANST) 4) NDT interpretation are relative .one should know the standard results first. 5) Minimum two methods for complete examination of the material are required. with only One method, testing for all parameters of materials is not possible.	**2** 1

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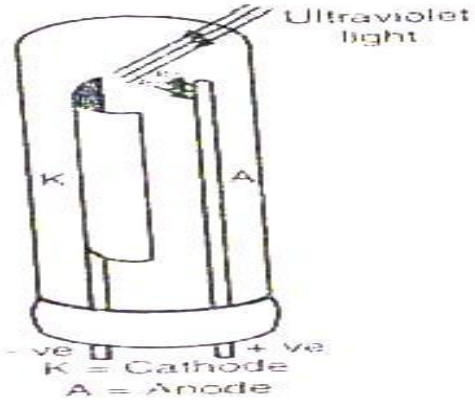
1.	f)	**State any two characteristics of thermocouple.**	**2**
		Each characteristic.	1
		1) Measurement of thermoelectric e.m.f 2) The temperature difference between the two junctions. 3) Pair of metal used in thermocouple. 4) It is selected as per the requirement of the system whose temperature is to be determined.	
	g)	**Define:(i) Neutral temperature (ii) Inversion temperature**	**2**
		Each definition.	1
		(i) **Neutral temperature :** The temperature at which the e.m.f is maximum is called neutral temperature. (ii) **Inversion temperature:** The temperature at which the e.m.f becomes zero is called inversion temperature	
	h)	**The energy of photoelectron is 2.8 eV.Calculate its wavelength (planks constant, h = 6.625x 10^{-34} J-sec; speed of light ,c = 3 x 10^{8} m/s)**	**2**
		Formula and conversion.	1
		Answer with unit.	1
		Given : h = 6.625x 10^{-34} J-sec, c = 3 x 10^{8} m/s, E =2.8 eV =2.8 x 1.6 x 10^{-19}= 4.48 x 10^{-19} J E = h υ But, υ = c / λ E = h c / λ λ = h c / E λ = 6.625x 10^{-34} x 3 x 10^{8} / 4.48 x 10^{-19} λ = 4.436 x 10^{-7} **λ = 4436 x 10^{-10} m** **OR** **λ = 4436 A^{0}**	

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	i)	**Draw a neat labelled diagram of photocell.**  	**2**
	j)	**Define spontaneous and stimulated emission.** **Each definition** 1) **Spontaneous emission :** When the electron jumps from higher energy state to lower energy state on its own accord the emission is called as spontaneous emission. 2) **Stimulated emission : :** When the electron jumps from higher energy state to lower energy state by triggering(supplying external energy) the emission is called as stimulated emission.	**2** 1
	k)	**State any two application of LDR.** **Each application.** **Application of LDR** 1) It is used in camera exposure control. 2) It is used in photocopy (Xerox) machine to control density of toner. 3) It is used in security alarm. 4) It is used as flame, smoke and burglar detectors. 5) It is used as automatic lighting control for street light. 6) It is used in colorimetric test equipment. 7) It is used as automatic rear view mirror.	**2** 1
	l)	**State Joules effect. Write its mathematical form along with meaning of all symbols involved.** **Statement** **Mathematical form and meaning**	**2** 1 1

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	l)	**Statement:** The amount of heat generated due to the flow of electric current through a resistance is directly proportional to square of the current, the resistance and the time for which current flows. **Mathematical form :** $H = \text{constant} \times I^2 R t$ $H = (1 / J) \times I^2 R t$ Where, H =Heat generated, J = Joules constant or mechanical equivalent of heat, I = Flow of electric current, R = Resistance, t = time for which current flow.	
2		**Attempt any <u>FOUR</u> of the following:**	**16**
	a)	**A train crosses a tunnel in 20 sec. At the entry of tunnel, velocity is 50 km/hr and at the exit of tunnel, velocity becomes 100 km/hr. find length of the tunnel.**	4
		Formula and conversion	2
		Answer with unit	2
		Given, t = 20 sec. u = 50 km/hr = 50 x 1000 /3600 u = 13.88 m/s. v = 100 km/hr.= 100 x 1000 / 3600 v = 27.77 m/s Length of tunnel = Distance covered = s =? We have, $a = v - u / t = 27.77 - 13.88 / 20$ $a = 0.69\ m/s^2$ Now, $v^2 = u^2 + 2as$ $s = v^2 - u^2 / 2a = (27.77)^2 - (13.88)^2 / 2 \times 0.69 = (771.17-192.65)/1.38$ **s = 419.21 m.** **Length of tunnel = s = 419.21 m**	
	b)	**A bullet of mass 100 gm is fired with a velocity of 500 m/s from a gun of mass 10 kg. Calculate recoil velocity of gun.**	**4**
		Formula with substitution.	2
		Answer with unit.	2
		Given : **Gun** — $m_1 = 10$ kg; $u_1 = ?$ **Bullet** — $m_2 = 100$ gm $= 100 \times 10^{-3}$ kg; $u_2 = 500$ m/s	

Q. No.	Sub Q.N.	Answer	Marking Scheme
2.	b)	According to law of conservation of momentum. $m_1u_1 = m_2u_2$ $u_1 = m_2u_2 / m_1$ $u_1 = 100x10^{-3} \times 500 / 10$ **u_1 = 5 m/s**	
	c)	**Define the terms:** **i) Projectile ii) Trajectory** **iii) Angle of projection iv) Time of flight** **Each definatition.** **i) Projectile: -** The object which moves in air by making an angle θ (less than 90^0) with the horizontal. **ii) Trajectory: -** The path along which projectile moves is called trajectory. **OR** It is also defined as the path traced by an object in projectile motion. **iii) Angle of projection: -** It is defined as angle made by the velocity of projection with the horizontal at the original point. **iv) Time of flight: -** The total time in which projectile covers the entire trajectory is called as time of flight.	**4** 1
	d)	**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  	**4** 2 1 1

<table>
<tr><th>Q. No.</th><th>Sub Q.N.</th><th>Answer</th><th>Marking Scheme</th></tr>
<tr><td>2.</td><td>d)</td><td>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.</td><td></td></tr>
<tr><td></td><td>e)</td><td>State the necessary criteria for selection of NDT method in practice. (Any four points).
Each 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 equipments available for testing.
vi) Total cost required to test the material.</td><td>4
1</td></tr>
<tr><td></td><td>f)</td><td>Differentiate between Seebeck’s effect and peltier effect.(any four points).
Each point.
<table>
<tr><th>Seebeck’s effect</th><th>Peltier effect</th></tr>
<tr><td>1) 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>1) 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>2) e.m.f is developed across the two junction.</td><td>2) One junction gets heated and other get cooled.</td></tr>
<tr><td>3) e.m.f generated is small in mV.</td><td>3) Heat generated or absorbed is small.</td></tr>
<tr><td>4) Amount of e.m.f. generated depends on pair of metals and temperature difference.</td><td>4) Amount of heat generated depends on pair of metals and current through it.</td></tr>
<tr><td>5) This effect is reversible.</td><td>6) This effect is reversible.</td></tr>
</table></td><td>4
1</td></tr>
</table>

Q. No.	Sub Q.N.	Answer	Marking Scheme
3.		**Attempt any <u>FOUR</u> of the following:**	**16**
	a)	**State any four properties of X-rays.** **Any four 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	**4**
	b)	**Threshold wavelength for silver is 3600 A^0. Calculate the energy of photoelectrons emitted in eV when it is exposed U.V. light of wavelength 2500 A^0.** **Formula with substitution** **Answer with unit** Given : $\lambda_0 = 3600\ A^0 = 3600 \times 10^{-10}$ m $\lambda = 2500\ A^0 = 2500 \times 10^{-10}$ m $h = 6.63 \times 10^{-34}$ Js $c = 3 \times 10^8$ m/s $E = h\,c\,(1/\lambda - 1/\lambda_0)$ $E = 6.63 \times 10^{-34} \times 3 \times 10^8\,(1/2500 \times 10^{-10} - 1/3600 \times 10^{-10})$ $E = 2.431 \times 10^{-19}$ J **E = 1.51 eV**	**4** 2 2

Q. No.	Sub Q.N.	Answer	Marking Scheme
3.	c)	**State any two engineering applications and two medical applications of LASER.**	**4**
		Each Application.	1
		Engineering applications : i. Lasers are used for engraving and embossing of printing plates. For example- number plate, name plate etc., ii. Lasers are used in cutting, drilling and welding metals. iii. Lasers are used in holography iv. Lasers are used in computer printers v. Lasers are used for 3D, Laser scanners vi. Lasers are used in controlled heat treatment vii. Lasers are used for data transfer through optical fiber from one computer to other viii. Lasers are used to find flaws or defect in material. **Medical applications:** i.Surgeryless eye treatment. ii. Surgeryless treatments of different body parts. iii. Scanning of different body parts. **Note: Any other related application can be considered.**	
	d)	**Find the minimum wavelength and maximum frequency of X-rays produced by an X-ray tube working of 50 kV.**	**4**
		Each Formula with substitution	1
		Each Answer with unit	2
		Given : V= 50 kV = 50 x 10^3 V **Find:** λ_{min} =? υ_{max}=? λ_{min} = 12400 x 10^{-10}/V λ_{min} = 12400 x 10^{-10}/ 50 x 10^3 λ_{min} = 2.48 x 10^{-11} m =0.248 x 10^{-10}m **λ_{min} = 0.2480A^0**	

Q. No.	Sub Q.N.	Answer	Marking Scheme
3.		$\upsilon_{max} = c / \lambda_{min}$ $\upsilon_{max} = 3 \times 10^{8} / 0.248 \times 10^{-10}$ **$\upsilon_{max} = 1.2 \times 10^{19}$ Hz**	
	e)	**State three equations of motion of a body performing angular motion – along with the meaning of all symbols involved.** **Three equations.** **Symbols.** i) $\omega_1 = \omega_0 + \alpha t$ ii) $\theta = \omega_0 t + \frac{1}{2}(\alpha t^2)$ iii) $\omega_1^2 = \omega_0^2 + 2\alpha\theta$ ω_0 = initial angular velocity. ω_1= final angular velocity. α = angular acceleration. θ =angular displacement. t = time	**4** 3 1
	f)	**State any 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**