WINTER– 18 EXAMINATION

Subject Name: Applied Physics **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 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)	**Define angular displacement. State its S.I. unit.** **Definition** **S.I.unit** **Angular displacement:-** Angular displacement is defined as the angle traced by radius vector . **OR** Angular displacement is defined as the angle subtended at the centre by path travelled. **S.I.unit** :- radian (rad)	**2** 1 1
	b)	**Define momentum. State its S.I. unit.** **Definition** **S.I.unit** Momentum:- The product of mass and velocity is called as momentum. **S.I.unit:-** Kg m/s **OR** N.s	**2** 1 1
	c)	**A body of mass 200 kg changes its velocity from 40 km/hr to 10 km/hr. Calculate the impulse acting on body.** **Formula** **Answer with unit** **Given:-** m = 200 kg u = 40 km/hr = (40 x 1000) / (60 x 60) = 11.11 m/s v = 10 km/hr = (10 x 1000) / (60 x 60) = 2.78 m/s we have, **Impulse** = Change in Momentum = mv – mu = (200 x 2.78) – (200 x 11.11) **Impulse = 1666 kg m/s or Ns**	**2** 1 1

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1.	d)	**Define angle of projection and range of projectile.** **Each definition** **Angle of projection:** - It is defined as angle made by the velocity of projection with the horizontal at the original point. **Range of projectile:** - The total horizontal distance covered by a projectile is called as range.	**2** 1
	e)	**State properties of ultrasonic waves.** **Any two Property** i) Frequency of these sound waves is more than 20kHz ii) 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) Travel with constant speed through a homogeneous medium. x) Posses certain vibrations which are used as good massage action in case of muscular pain.	**2** 2
	f)	**Define neutral temperature, inversion temperature.** **Each definition** **Neutral temperature:**- In thermocouple the temperature at which the emf is maximum is called neutral temperature. **Inversion Temperature: -** In thermocouple the temperature at which the emf becomes zero and changes its sign (becomes negative) is call inversion temperature.	**2** 1
	g)	**State Joules law. Give its mathematical equation.** **Statement** **Equation** **Joules law :** It state that the amount of heat generated (H) due to the flow of electric current through a resistance is directly proportional to 1) Square of the current (I^2) 2) Resistance (R) 3) Time for which current flows (t) $H = \left(\frac{1}{J}\right) I^2 Rt$	**2** 1 1

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1.	h)	**State Planck's Hypothesis.** **Statement** **Planck's Hypothesis:** Planck 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.	**2** 2
	i)	**An accelerated electron emits a quantum of radiation with frequency 8 x 10^{18} Hz. Calculate energy of electron. Given h= 6.625 x10^{-34}Js.** **Formula** **Answer with unit.** **Given:-** h= 6.625 x 10^{-34} Js , ν = 8x10^{18} Hz . To find : E= ? E = h ν = (6.625 x 10^{-34}) x (8 x10^{18}) **E = 53 x 10^{-16} J**	**2** 1 1
	j)	**State principle of production of X-rays.** **Principle** **Principle:** When fast moving electrons are suddenly stopped by a solid target then X- rays are produced.	**2** 2
	k)	**State any two medical applications of X-ray.** **Medical Application (Any two)** **Medical Application of X- Rays:** i) X – Rays are used in surgery to detect bone fractured. ii) X- Rays are used to cure skin diseases and destroy tumours. iii) X – Rays are used to cure diseases like cancer. iv) X – Rays are used to detect bullets position inside the body.	**2** 2
	l)	**Give full form of LASER.** **Full form** **LASER:** Light Amplification by Stimulated Emission of Radiation.	**2** 2

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.		Attempt **any four** of the following:	**16**
	a)	**i) Derive relation between angular velocity and linear velocity.**	**2**
		Derivation Consider a particle undergoing uniform circular motion. Let, s = Linear displacement θ = Angular displacement v = Linear velocity r = radius of a circle ω = Angular velocity $v = s / t = (r\theta) / t$ $(s = r\theta)$ $v = r \times (\theta / t)$ $(\theta / t = \omega)$ $\mathbf{v = r\,\omega}$	2
		ii) Calculate the angular velocity with which earth spin about its own axis. We have, $\omega = 2\pi n = 2\pi / T$ $(n = 1 / T)$ $\omega = (2 \times 3.14) / (24 \times 60 \times 60)$ $\mathbf{\omega = 7.27 \times 10^{-5}}$ **rad / sec**	**2**
	b)	**Distinguish between centripetal and centrifugal force.** **Any four points**	**4** 4

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

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

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

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.

	d)	**With neat labeled diagrams and procedural steps, explain LPT method.**	**4**
		Principle	1
		Diagram	2
		Procedure	1

Principle: It works on the principle of capillarity.

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.

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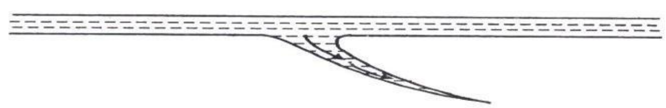
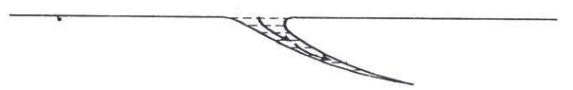
2. d)

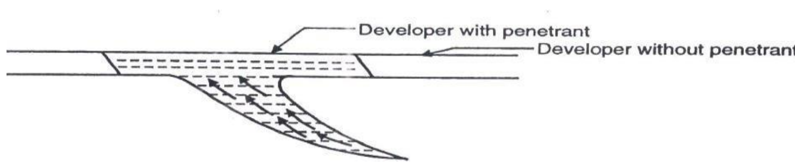
2. Application of Dye penetrant: Suitable fluorescent dye is mixed in penetrant so that its viscosity remains low. This dye penetrant is applied evenly on specimen. Due to capillary action the penetrant goes into the surface open discontinuities. It takes some time. In general case this 'dwell time' is 20-30 minutes.



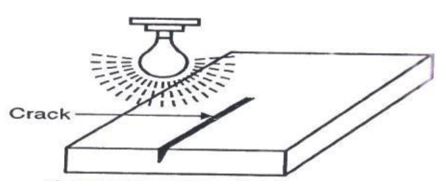
3. Excess penetrant removal: After dwell time is over, the excess penetrant is removed from the surface carefully



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.



5.Inspection & evalution of defects: Surface of the specimen is seen under white light or ultraviolet or laser light. The crack can be visualized under light.



(Inspection under light)

6. Post cleaning: After inspection the surface of the specimen is cleaned & the specimen can be used for its intended purpose.

e) **State advantages of NDT**. **4**

Any four advantages 4

The advantages of non-destructive testing

1. 100 % examination of material or production is possible.
2. NDT methods can be automated to lower their costs.

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	e)	3. Testing is possible on shop, floor because of portable equipments; this controls the quality of further production. 4. Permanent record of testing can be made during the testing process. 5. The destructed parts can be separated in the early stages of manufacturing. This saves the time & production cost. 6. Higher accuracy, reliability & repeatability in the test result can be obtained. 7. Rapid inspection of each & every component is possible. **Any other relevant advantage.**	
	f)	**A body is allowed to fall from the terrace of a building 200 m high. After what time will it reach the ground, What will be its velocity at that time?** **Two formulae with substitution** **Two answers with units**	**4** 2 2
		Given : **Required :** u= 0 t=? s= 200 m v=? a= g = 9.8 m/s^2 i) $v^2 = u^2 + 2as$ $v^2 = 0 + 2 \times 9.8 \times 200$ $v^2 = 3920$ **v = 62.61 m/s** ii) a = v – u / t t = v – u / a = 62.60 – 0 / 9.8 **t = 6.38 s**	
3.		Attempt **any four** of the following:	**16**
	a)	**Distinguish between Seebeck effect and Peltier effect .** **Any Four points**	**4** 4

Seebeck 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 heat generated depends on pair of metals and temperature difference.	Amount of heat generated depends on pair of metals and current through it.

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	b)	**Define thermo emf. State the factor on which it depends.** **Definition** **Three factors** **Thermo emf:** When two dissimilar metals are joined to form two different junctions and if temperature difference is maintained between them the electromotive force (e.m.f) developed between them is called thermo emf. **Factors** 1) Metals used 2) Length of the metal wires 3) Temperature difference between two junctions.	**4** 1 3
	c)	**The energy of photon is 5.28 x 10^{-19} J. Calculate frequency and wavelength. (Given h = 6.625 x 10^{-34} J-s, C = 3 x 10^{8} m/s)** **Two formulae with substitution** **Two answers with units** **Given:-** $E = 5.28 \times 10^{-19}$ J, $h = 6.625 \times 10^{-34}$ J-s, $C = 3 \times 10^{8}$ m/s $\upsilon = ?$ $\lambda = ?$ We have, $E = h\upsilon$ $\upsilon = E / h = 5.28 \times 10^{-19} / 6.625 \times 10^{-34}$ $\boldsymbol{\upsilon = 0.797 \times 10^{15}}$ **Hz** and $E = hc / \lambda$ $\lambda = hc / E = (6.625 \times 10^{-34}) \times (3 \times 10^{8}) / (5.28 \times 10^{-19})$ $\lambda = 3764 \times 10^{-10}$ m $\boldsymbol{\lambda = 3764}$ **A^0**	**4** 2 2
	d)	**State any four properties of X-ray.** **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 kills some form of animal cell.	**4** 4

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	e)	**State properties of LASER.** **Any four properties** **Properties** 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.	**4** 4
	f)	**A body starting from rest is moving with uniform acceleration. If it gains a velocity of 72 km/hr in 10seconds. Find it's acceleration, total distance covered in 10 second and distance covered in 6^{th} second.** **Each formula** **Substitution** **Each answer with unit** **Given:-** $u = 0$ $v = 72$ km/hr $= 72 \times 1000/(60 \times 60) = 20$ m/s $t = 10$ sec. $a = ?$ $s = ?$ $s^{6th} = ?$ we have, $v = u + at$ $a = (v - u) / t = (20 - 0) / 10$ $\mathbf{a = 2\ m/s^2}$ and also , $s = ut + 1/2\ at^2$ $s = (0 \times 10) + (1/2)(2 \times 100)$ **s = 100 m.** $s^{nth} = u + a/2\ (2n - 1)$ $s^{6th} = 0 + (2/2)\ (2 \times 6 - 1)$ $\mathbf{s^{6th} = 11\ m}$	**4** ½ 1 ½