



**COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)**

**SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING**

**TRADE DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING - Stage 1**

**EEE405- ENGINEERING SCIENCE**

**FINAL EXAMINATION – SEMESTER-1, 2017**

**Duration of Paper, 3hrs 10minutes**

**Total Marks---100**

**Day/Date: As per timetable Time: As per timetable(3Hrs) Room: As per timetable**

**INSTRUCTIONS TO STUDENTS**

1. *You are allowed 10 minutes Extra reading time during which you are NOT to write.*
2. *Begin each answer on a fresh page and use both sides of the sheet.*
3. *Write your candidate-number at the top of each attached sheet*
4. *Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with string*
5. *For all sheets of paper on which rough/draft work has been done, cross it though and you MUST ATTACH to your answer scripts.*
6. *Write clearly the number(s) of the question(s) attempted on the top of each sheet.*
7. **ANSWER ALL QUESTIONS.**
8. *Show all workings where necessary.*
9. *Do not use programmable calculators, especially the ones that does the conversions of number systems.*

1. Give the SI Units for length, mass, time, force, and acceleration. [2 Marks]
2. Differentiate between vector quantity and scalar quantity and give two examples of each. [2 Marks]
3. What is one condition that must be satisfied for kinematic equations to hold true? [1 Mark]
4. What are the four fundamental forces in nature and which force is the weakest? [2 Marks]
5. Define inertia. [2 Marks]
6. What is an inertial reference frame? [1 Mark]
7. What is one condition in which Newton's second law will not hold true? [2 Marks]
8. A person walks first at a constant speed of 8.00 m/s along a straight line from point A to point B and then back along the line from B to A at a constant speed of 5.00 m/s. What is (a) her average speed over the entire trip and (b) her average velocity over the entire trip? [4 Marks]
9. A car is approaching a hill at 40.0 m/s when its engine suddenly fails just at the bottom of the hill. The car moves with a constant acceleration of  $-4.00 \text{ m/s}^2$  while coasting up the hill. (a) Write equations for the position along the slope and for the velocity as functions of time, taking  $x = 0$  at the bottom of the hill, where  $v_i = 40.0 \text{ m/s}$ . (b) Determine the maximum distance the car rolls up the hill. [6 Marks]
10. If an object weighs 850 N on the Earth, what would it weigh on Alpha Centauri, the nearest star from our solar system, where the surface gravity is  $23442.29 \text{ m/s}^2$ ? [3 Marks]
11. Two people pull as hard as they can on ropes attached to a car that has a mass of 200 kg. If they pull in the same direction, the car has an acceleration of  $1.52 \text{ m/s}^2$  to the right. If they pull in opposite directions, the car has an acceleration of  $0.518 \text{ m/s}^2$  to the left. What is the force exerted by each person on the car? (Disregard any other forces on the car.) [5 Marks]

1. What are the two types of reflection and what is the difference between them, explain with the aid of diagrams. [2 Marks]
2. Briefly explain what you understand by the term superposition. [2 Marks]
3. What are the two main types of waves? [2 Marks]
4. A sinusoidal wave is traveling in the negative x direction which has amplitude of 20cm, a frequency of 100Hz and a speed of 4m/s. Determine the general expression for the given information [5 Marks]
5. A sinusoidal wave train is described by the equation

$$y = (2.4m)\sin(2x - 36t)$$

Where x and y are in meters and t is in seconds. Determine for this wave the (a) amplitude, (b) angular frequency, (c) angular wave number, (d) wavelength, (e) wave speed, and (f) direction of motion.

[6 Marks]

6. An athlete rotates a 1.00-kg discus along a circular path of radius 1.4 m. The maximum speed of the discus is 24.0 m/s. Determine the magnitude of the maximum radial acceleration of the discus. [3 Marks]
7. A tire 0.600 m in radius rotates at a constant rate of 120 rev/min. Find the speed and acceleration of a small stone lodged in the tread of the tire (on its outer edge). (Hint: In one revolution, the stone travels a distance equal to the circumference of its path,  $2\pi r$ .) [4 Marks]
8. An automobile whose speed is increasing at a rate of  $0.600 \text{ m/s}^2$  travels along a circular road of radius 20.0 m. When the instantaneous speed of the automobile is 4.00 m/s, find (a) the tangential acceleration component, (b) the radial acceleration component, and (c) the magnitude and direction of the total acceleration. [6 Marks]

**SECTION C****[40 MARKS]**

1. What are the three methods of heat transfer? [3 marks]
2. Explain two applications of radiation? [2 Marks]
3. A spherical convex mirror has a radius of curvature of 40.0 cm. Determine the position of the virtual image and the magnification (a) for an object distance of 30.0 cm and (b) for an object distances of 60.0 cm. (c) Are the images upright or inverted [6 Marks]
4. At an intersection of hospital hallways, a convex mirror is mounted high on a wall to help people avoid collisions. The mirror has a radius of curvature of 0.55m. Locate and describe the image of a patient 10.0 m from the mirror. Determine the magnification. [4 Marks]
5. A magnifying glass is a converging lens of focal length 15.0 cm. At what distance from a postage stamp should you hold this lens to get a magnification of + 2.00. [3 marks]
6. A glass fiber ( $n = 1.50$ ) is submerged in water ( $n = 1.33$ ). What is the critical angle for light to stay inside the optical fiber? [2 Marks]
7. Adamantium has a work function of 4.20eV. (a) Find the cutoff wavelength and cutoff frequency for the photoelectric effect. (b) Calculate the stopping potential if the incident light has a wavelength of 180nm. [6 Marks]
8. Three-fifths of the light from a 200cd source falls on a floor measuring 3m x 1.5m. What is the average illumination? [4 Marks]
9. At what height would a light source be mounted if its vertical luminous intensity was 5000cd and it was required to provide an illuminance of 100lx on the working plane? [4 Marks]
10. Copper, Aluminum, and Iron have work functions of 2.10eV, 3.90eV, and 4.50eV, respectively. If 350nm light is incident on each of these metals, determine (a) which metals exhibit the photoelectric effect and (b) the maximum kinetic energy for the photoelectrons in each case. [6 Marks]

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