FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING - Stage 1

EED500- ENGINEERING SCIENCE

FINAL EXAMINATION – SEMESTER-1, 2019

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.

SECTION A [30 MARKS]

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. 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]

4. 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 $-4.00\ m/s^2$ 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 $v_i = 40.0$ m/s. (b) Determine the maximum distance the car rolls up the hill. [6 Marks]

5. A particle is moving with a velocity of 58.0 m/s in the positive x direction at $t = 0$. Between t=0 and t=17.0 s, the velocity decreases uniformly to zero. What was the acceleration during this 17.0-s interval? What is the significance of the sign of your answer? [2 Marks]

6. What is one condition that must be satisfied for kinematic equations to hold true? [1 Mark]

7. What are the four fundamental forces in nature and which force is the weakest? [2 Marks]

8. Define inertia. [2 Marks]

9. If an object weighs 950 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 m/s2? [2 Marks]

10. 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 m/s2 to the right. If they pull in opposite directions, the car has an acceleration of 0.518 m/s2 to the left. What is the force exerted by each person on the car? (Disregard any other forces on the car.) [5 Marks]

11. What is an inertial reference frame? [1 Mark]

12. What is one condition in which Newton's second law will not hold true? [1 Mark]

SECTION B [30 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 30cm, 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

   $Y = 3.6\text{Sin}(4x - 42t)$

   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 0.700 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, 2π r.)

   [4 Marks]

8. An automobile whose speed is increasing at a rate of 0.700 m/s2 travels along a circular road of radius 30.0 m. When the instantaneous speed of the automobile is 5.00 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 concave spherical mirror has a radius of curvature of 20.0 cm. Find the location of the image for object distances of (a) 40.0 cm, (b) 20.0 cm, and (c) 10.0 cm. For each case, state whether the image is real or virtual and upright or inverted, and find the magnification. [6 Marks]

4. A narrow beam of sodium yellow light, with wavelength 589nm in vacuum, is incident from air onto a smooth water surface at an angle $\theta_1 = 35.0^0$. Determine the angle of refraction θ_2 and the wavelength of light in water. [4 Marks]

5. A light ray initially in water enters a transparent substance at an angle of incidence of 37.0^0, and the transmitted ray is refracted at an angle of 25.0^0. Calculate the speed of light in the transparent substance. [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 185nm. [6 Marks]

8. Copper, Aluminum, and Iron have work functions of 2.10eV, 3.90eV, and 4.50eV, respectively. If 450nm 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]

9. A flashlight projects a sphere of light that is 0.8m in diameter on a wall 10 meters away, calculate the solid angle subtended at the flashlight by the rectangle. If the intensity of the light is 50cd calculate the luminous flux. [4 Marks}

10. Find the rate at which heat is dissipated by radiation alone from a heat sink of area 100cm2 and the emissivity of 0.90. The temperature of heat sink is 28^0C and the surrounding temperature is 20^0C. [4 Marks]

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