FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

DIPLOMA IN ELECTRONIC ENGINEERING - Stage 1

EED500- ENGINEERING SCIENCE

FINAL EXAMINATION – SEMESTER-1, 2018

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. What are the SI units of Force, mass, Torque and angular acceleration [2 Marks]

2. Differentiate between vector quantity and scalar quantity and give two examples of each. [2 Marks]

3. State the term 'forces in equilibrium' [2 Marks]

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

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

6. A stone is thrown from the top of a building is given an initial velocity of 90km/hr straight up. The height of the building is 1/20 of a kilometer and the stone just misses the top of the building and is on its way down. Using the initial time as 0s when the stone leaves the throwers hand. Determine,
   a. The time at which the stone reaches its maximum height [1 Mark]
   b. The maximum height reached (excluding the building height) [2 Marks]
   c. Velocity of the stone at t=5sec [2 Marks]
   d. Velocity of the stone just before it reaches the ground [2 Marks]

7. The position of a motor car was observed and the results was taken as shown below:

x(m)	0	2.3	9.2	20.7	36.8	57.5
t(s)	0	1	2	3	4	5

   Given the data above,
   a) Find the average velocity of the car at 3 sec. [2 Marks]
   b) Plot a velocity time graph [2 Marks]

8. A string in motion takes 0.167sec to complete one cycle. The amplitude of the motion is 30cm and the wave speed is $25ms^{-1}$. Determine the angular frequency and the angular wave number for this wave, and write an expression for the wave function. [4 Marks]

9. In a wind turbine, a gearbox connects the low-speed shaft (the one connected to the rotor) to the high-speed shaft (the one connected to the generator). Typically, the gearbox has a ratio of 50:1 and rotates at 1200rpm. The turbine has a rotor diameter of 144ft.
   a. What is the angular velocity of the high speed shaft? [1 Mark]
   b. At what angular velocity will the low-speed shaft spin? How fast will the tips of the blades be moving? [3 Marks]
   c. Most generators have an upper limit on their rotational speed, to prevent damage. If your generator's limit is 1500 rpm, what is the maximum velocity of the tips of your rotor blades? [3 Marks]

SECTION B [30 MARKS]

1. State two main types of waves? [1 Mark]

2. What is the difference between transverse and longitudinal waves? [2 Marks]

3. What are the two types of reflection and what is the difference between them, explain with the aid of diagrams. [2 Marks]

4. Briefly explain what you understand by the term superposition. [2 Marks]

5. A sinusoidal wave is traveling in the negative x direction which has amplitude of 20cm, a frequency of 200Hz and a speed of 4m/s. Determine the general expression for the given information [3 Marks]

6. A sinusoidal wave train is described by the equation

$$y = (3m)\sin(2x - 36t)$$

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]

7. An astronaut orbiting Mars is preparing to dock with Voyager 1 satellite. The satellite is in a circular orbit 600 km above Mars's surface, where the free-fall acceleration is 14.26 m/s2. The radius of Mars is 6 400 km. Determine the speed of the satellite and the time required to complete one orbit around Mars. [2 Marks]

8. An athlete rotates a 2.00-kg discus along a circular path of radius 1.8 m. The maximum speed of the discus is 24.0 m/s. Determine the magnitude of the maximum radial acceleration of the discus.

[2 Marks]

9. 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, 2π r.)
[4 Marks]

10. An automobile whose speed is increasing at a rate of 0.600 m/s2 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. Explain two applications of radiation? [2 Marks]

2. What are the three methods of heat transfer? [3 marks]

3. Adamantium has a work function of 4.60eV. (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. [4 Marks]

4. Three-fifths of the light from a 250cd source falls on a floor measuring 3m x 1.5m. What is the average illumination? [2 Marks]

5. At what height would a light source be mounted if its vertical luminous intensity was 4000cd and it was required to provide an illuminance of 100lx on the working plane?
[1 Mark]

6. Copper, Aluminum, and Iron have work functions of 2.10eV, 3.90eV, and 4.50eV, respectively. If 360nm 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. [5 Marks]

7. 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.
[2 Marks]

8. 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? [2 Marks]

9. 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.

[2 Marks]

10. A thin lens has a focal length of 25.0 cm. Locate and describes the image when the object is placed (a) 26.0 cm and (b) 24.0 cm in front of the lens.

[4 Marks]

11. 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? [1 Mark]

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