FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

DIPLOMA IN ELECTRICAL ENGINEERING

EEE405 – ENGINEERING SCIENCE

SEMESTER 1, 2016

DAY/DATE: As timetabled DURATION : TWO hours

ROOM: As timetabled

INSTRUCTION TO STUDENTS

1. You are allowed 10 minutes extra reading time during which you are **NOT** to write.
2. Answer **ALL** questions in Section A and in Section B
3. **Begin the answer to each Question** on a fresh page and use both sides of the sheet.
4. Write clearly the number of the question attempted on the top of each sheet
5. Write your candidate number at the top of each sheet & attach them.
6. Insert all written foolscaps, graph paper etc. in their correct sequence and secure with a string.
7. All sheets of paper on which rough/draft work has been done, cross it through and attach all of them to your answer scripts.
8. Where ever possible, draw clear neat diagrams

Total number of pages - 5

Section A

Answer ALL Questions

A1. State the basic physical quantities. State the SI units of these physical quantities.

(5 marks)

A2. State three derived vector quantities. What are the SI units of these derived units

(3 marks)

A3. An average man's height and weight are 190.5 cm and 72500 gm. Express these quantities in Engineering prefixes and notations

(2 marks)

A4. Define what are scalar quantities and vector quantities. Give two examples of each of the two quantities.

(4 marks)

A5. Tension and frictional force are examples of "*contact forces*". Give one example of a "*field force*"

(2 marks)

A6. Explain what is meant by "*static frictional force*" and "*dynamic frictional force*". In a system μ_s and μ_k are the static frictional force coefficient and dynamic frictional force coefficients. State which of these coefficients is higher.

(3 marks)

A7. Explain what is meant by simple harmonic motion (SHM). Give an example of SHM.

(3 marks)

A8. Describe the two types of "*mechanical waves*". Give examples of these different types of waves.

(3 marks)

A9. For "*specular reflection*", state the law of reflection.

(2 marks)

A10. An object was placed at an object distance of 10 cm in front of a convex mirror of focal length 20 cm. Calculate the image distance and comment on the nature of the image.

(4 marks)

A11. State the Snell's law of refraction

(2 marks)

A12. What was Einstein's radical postulate to explain "*photo electric effect*"?

(2 marks)

A13. What are the three scales to measure temperature? Express the relationship between them.

(2 marks)

A14. State the different ways (modes) by which heat can be transferred between two points and state the different media in which each mode is dominant.

(3 marks)

Section B
Answer ALL Questions

B1. *a*) State the Newton's three laws of motion. (3 marks)

b) A rugby ball weighs 450 gm. A player kicks the ball vertically up, and the ball reaches a maximum height of 25 m. Assume the acceleration due to gravity as 10 m s^{-2}.

i) What is the velocity with which the ball was kicked?

ii) What is the momentum imparted on the ball by the player? (5 marks)

c) A car starts from rest, and accelerate for 10s when its speed reaches 6 ms^{-1}. Then the car moves with this speed for 20s. The driver then reduces the speed and comes to rest in another 12s. Draw a velocity – time graph to illustrate the motion of the car. Using the graph, calculate the acceleration, deceleration and the total distance travelled by the car. (5 marks)

d) Two force vectors with magnitude 20 N and 50 N acts on an object. If the angle between the force vectors is 120^0,

i) Calculate the magnitude of the resultant force vector R? Round your answer to first decimal (4 marks)

ii) Draw the parallelogram to verify this. (3 marks)

B2. *a*) A marble weighing 25 gm revolves on a horizontal circular rail of radius 3 m at a constant speed. The marble takes 2 s to complete one revolution. Calculate the centripetal force acting on the marble.

(5 marks)

b) An equation of a mechanical wave is: $y = 2.5 \sin (2x - 25\ t)$ meters..
What are the directions of oscillation of the particles and direction of movement of the wave?

(2 marks)

For this wave, write down the amplitude and the frequency of oscillation of the particles.

(3 marks)

c) An object is placed at a distance of 10 cm in front of a converging lens of focal length 5 cm.

i) By the method of ray tracing, obtain the position of the image. (You must draw the diagram to scale). (5 marks)

ii) Is the image real or virtual (2 marks)

iii) Verify your answer analytically (3 marks)

B3. *a*) A farmer decides to put an iron ring over the wheel of a cart made with wood. The radius of the wooden wheel is 1 m at room temperature. The farmer chooses an iron ring of radius 99.9 cm and decided to heat the ring so that the hot ring will just slip over the wooden wheel. Calculate the temperature difference the farmer should have to complete his task. The coefficient of linear expansion of iron is 12.1×10^{-6} /°C.

(7 marks)

b) A cylindrical copper rod of radius 0.5 cm of length 35 cm is completely covered by a good thermal insulator along its length. One end of the rod is immersed in boiling water at 98.5°C and the other end is kept in a glass of water at 30°C. Thermal conductivity of copper is 397 W m^{-1} $°C^{-1}$.

i) Calculate the rate of flow of heat.

(5 marks)

ii) Explain what will happen to the rate of flow of heat as time passes.

(3 marks)

c) *i*) State the three gas laws.

(3 marks)

ii) Starting with the gas law equations, indicate how the "*ideal gas equation*" can be obtained

(2 marks)

THE END