**FACULTY OF ENGINEERING**

**END OF SEMESTER EXAMINATIONS - APRIL 2025**

**PROGRAMME: DIPLOMA IN ELECTRICAL AND CONTROL ENGINEERING**

**YEAR/SEM: YEAR 1/SEMESTER 2**

**COURSE CODE: DEE1207**

**NAME: ELECTRICAL AND ELECTRONIC INSTRUMENT I**

**DATE: 2025-04-17**

**TIME: 2:00-5:00PM**

**INSTRUCTIONS TO CANDIDATES:**

1. Read the instructions very carefully

2. The time allowed for this examination is STRICTLY three hours

3. Read each question carefully before you attempt and allocate your time equally between all the Sections

4. Write clearly and legibly. Illegible handwriting cannot be marked

5. Number the questions you have attempted

6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks

7. Any examination malpractice detected will lead to automatic disqualification.

**DO NOT WRITE ANYTHING ON THE QUESTION PAPER**

# Section A Answer any TWO questions from this section

### Question 1:

a)  What is meant by a unit of measurement? **(5 Marks)**

b)  Explain the purposes of Dimensional Analysis? **(8 Marks)**

c)  Give examples of the 7 basic units and include their unit symbols. **(7 Marks)**

d)  The price of milk in the UK is about 1.65 pounds every 6 pints. That in Chine is 33 RMB every 6 litre. Assume that 1 pound = 15 RMB.
     i.    Which is cheaper? (2 Marks)
     ii.   There is a 50% price rise in China recently. Which is cheaper? **(3 Marks)**

### Question 2:

a)  What is Measurement? **(2 Marks)**

b)  With help of a block diagram explain the measurement process. ( 15 Marks)

c)  Differentiate between a category scale and interval scale. (8 Marks)

### Question 3:

a)  What are the two types of Standards used in measurement? **(4 Marks)**

b)  Suppose that we are trying to develop a model which will predict the period t of a swinging pendulum, the list of factors are the length l, the mass m, the angle $\theta$ and acceleration g due to gravity. Assume that the period $[t] = [kl^a m^b g^c \theta^d]$ ,find a,b,c,d and k the unknown real numbers. **(12 Mark)**

c)  The pressure p at a depth h below the surface of a fluid of density $\rho$ is given by $p = \rho gh$, where g is the acceleration due to gravity. Check the dimensions. **(9 Marks)**

### Question 4:

a)  What are the dimensions of the following common physical quantities? Give two different units for each quantity. **(10 MARKS)**
     (i)    Velocity â?? $v$          (iii)  Force â?? F       (v) Mass Density - Ï•
     (ii)   Acceleration â?? a      (iv)  Pressure â?? P

b)  What are the dimensions of the variable K in the following equations? (Where q is charge, t is time, r is distance, En is energy, f is frequency). **(10 MARKS)**
     (i)    F=KL                       (iii)  E =
     (ii)   En=Kf                      (iv)  P = KÏ•|a|
     (iii)  Express capacitance in terms of dimensions of fundamental quantities i.e. Mass (M), Length (L), Time(T) and Ampere (A). **(5 MARKS)**

# Section B Answer any TWO questions from this section

**Question 1:**

a) A quantity X is defined as $X = \frac{M^a L^b T^c}{I^d}$, where I is electric current. If X represents resistance, known to have units of ohms ($\Omega = kg \cdot m^2/s^2 \cdot A^2$ find the values of a,b,,c, and d.

b) **Part B: (15 Marks)**

The formula for wave speed is:

$$v = \sqrt{\frac{T}{\mu}}$$

where:

- $v$ is wave speed,
- $T$ is tension (force),
- $\mu$ is mass per unit length.

Show whether this equation is dimensionally correct.

**Question 2:**

a) Express capacitance in terms of dimensions of fundamental quantities i.e. Mass (M), Length (L), Time(T) and Ampere (A). **(5 MARKS)**

b) The Centripetal force (F) acting on a particle (moving uniformly in a circle) depends on the mass (m) of the particle, its velocity (v) and radius (r) of the circle. Derive dimensionally formula for force (F). **(10 MARKS)**

c) A students while doing an experiment finds that the velocity of an object varies with time and it can be expressed as equation

$$V = Xt^2 + Yt + Z$$

If units of v and t are expressed in terms of SI units, determine the units of constants X,Y and Z in the given equation. **(10 MARKS)**

**Question 3:**

## Part a: (10 Marks)

The equation for force is given by:

$$F = ma + bv$$

where:

- $F$ is force,
- $m$ is mass,
- $a$ is acceleration,
- $v$ is velocity,
- $b$ is a constant with unknown dimensions.

Determine the dimensions of $b$ if the equation is to be dimensionally correct.

## Part b: Verify whether the following equations are **dimensionally consistent**. Show your working. (15 Mark)

The equation for velocity after time $t$ under uniform acceleration is:

$$v = u + at$$

where:

- $v$ is final velocity,
- $u$ is initial velocity,
- $a$ is acceleration,
- $t$ is time.

## Question 4:

a) The equation for the period of a simple pendulum is assumed to be $T=k.l^a g^b$, where lll is the length of the pendulum, g is acceleration due to gravity, and k is a dimensionless constant. Determine the values of a and b using dimensional analysis. **(13 Marks)**

b) The drag force on an object moving through a fluid is given by $F=kv^n$, where k is a constant and v is velocity. If k has dimensions $[M^a L^b T^c]$, determine the values of a, b, and c such that the equation is dimensionally consistent. **(12 Marks)**