THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

MECHANICAL ENGINEERING

SECOND SEMESTER EXAMINATION - 2024

Mechatronics ME 421
October 21st 2024

MAXIMUM MARKS: 40

TIME ALLOWED: 2 HOURS

INSTRUCTIONS FOR CANDIDATES:

1. You have 10 minutes to read the paper. You must not begin writing during this time.
2. Answer all the **FOUR** questions. Marks or each part of the questions are indicated in the bracket.
3. Use only ink. Do not use pencil or writing except or drawing and sketches.
4. All answers must be written in the answer book provided. No other written material will be accepted.
5. Write your **name** and **ID number** clearly on the front page of the answer booklet provided. **Do it now!**
6. Use of Calculator in the exam room is permitted. Notes and textbooks are not allowed. Required property values are provided in the question paper.

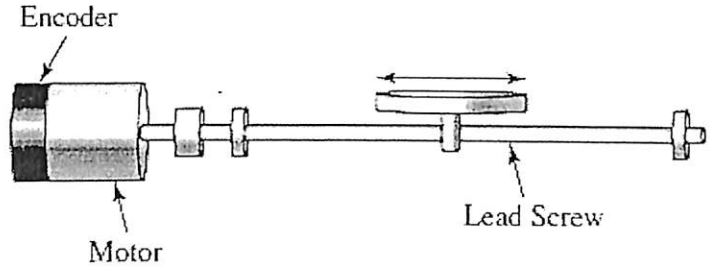
Question 1: Represent the decimal number 65 in binary form and represent the binary number 111011 in decimal form.

10 Marks

Question 2: Discuss Sensor Performance Terminology in Terms of Dynamic Characteristics Only.

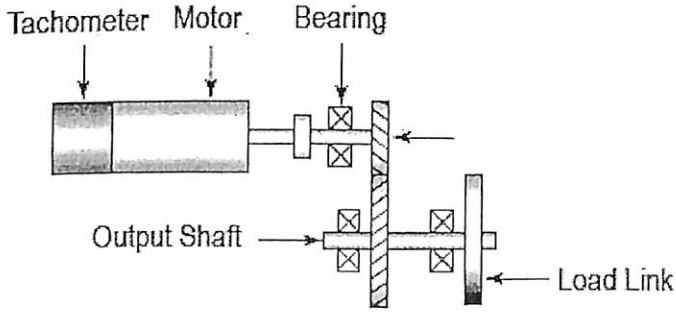
10 Marks

Question 3: A DC motor equipped with an incremental optical encoder is used to drive a lead-screw positioning table as shown below. The screw has a lead of 0.1 in/rev, the encoder disk has 1000 lines, and the encoder is operated in quadrature mode. Determine the measurement resolution of this encoder for the setup shown only.



10 Marks

Question 4: The drive system shown below has a gear ratio of *N*:1. Assume that the motor is a PM DC motor. Develop a dynamic model that relates the input voltage applied to the motor to the motor speed as measured by a tachometer mounted on the motor shaft. The tachometer has sensitivity $k_{\text{tachometer}} \times v / rpm$. Let the viscous damping coefficient at the input shaft be b_1 and at the output shaft be b_2. Assume that the shafts are rigid, and let I_1 represents the combined inertia of the motor shaft, input shaft, coupling, and the pinion, and I_2 represents the combined inertia of the gear, the output shaft, and the load link.



10 Marks