



**FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA**  
**SCHOOL OF ELECTRICAL ENGINEERING AND TECHNOLOGY**  
**DEPARTMENT OF MECHATRONICS ENGINEERING**  
**FIRST SEMESTER 2019/2020 ACADEMIC SESSION**

**COURSE: MCE 516: ROBOTIC HARDWARE SYSTEMS**

**TIME ALLOWED: 2 HOURS**

**CREDIT UNIT: 2**

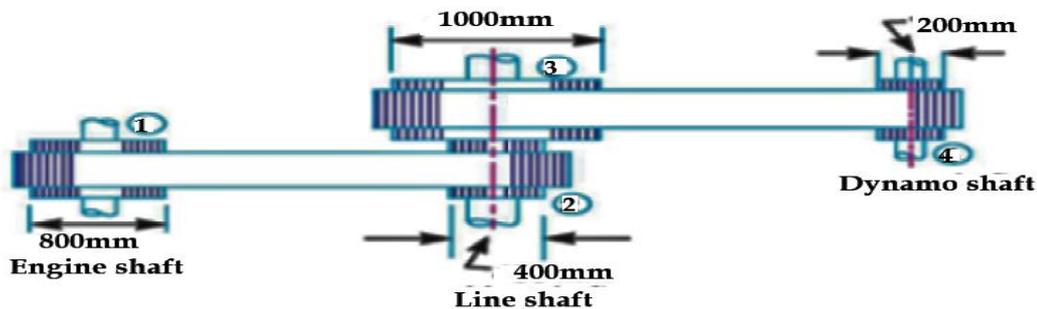
**LEVEL: 500**

**Instruction: Answer Four Questions.**

All questions carry equal mark.

**QUESTION ONE (15 marks)**

- a. Federal University of Technology Minna, bottling company is face with series of problem on how to convey it beverages during production, as an engineer you are asked to design a system that will transport this beverages. What are the factor that must be consider in selecting a belt drive. State the power transfer device that can be used in the design and why? [4 marks]
- b. Explain, with the help of neat sketches, the types of various flat belt drives.[5 marks]
- c. An engine running at 150 r.p.m drives a line shaft by means of a belt. The engine pulley is 800mm diameter and the pulley on the line shaft being 400mm. A 1000mm diameter pulley on the line shaft drives a 200mm diameter pulley keyed to a dynamo shaft. Find the speed of the dynamo shaft. When i). There is no slip ii). There is a ship of 3% at each drive. [6 marks]



**QUESTION TWO (15 Marks)**

- a. A pulley is driven by a flat belt running at a speed of 600m/min. The coefficient of friction between the pulley and the belt is 0.3 and the angle of lap is  $160^\circ$ . If the maximum tension in the belt is 700N. Find the power transmitted by a belt.[4 marks]
- b. State the advantages and disadvantages of the chains drive over belt drive or rope drive.[3marks]
- c. What are gears, and how are they classified? Illustrate with neat sketch the working drawing of a spur gears, defining its terminology.[8 marks]

### **QUESTION THREE (15 Marks)**

- a. What is coupling, and why do we need couplings?[2 marks]
- b. What are the requirements of a good shaft coupling?[3 marks]
- c. The power transmitted from a pulley 1mm diameter running at 200 r.p.m to a pulley 2.25m diameter by means of a belt. Find the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack side of the belt is 14MPa and 0.5MPa respectively. The young's modulus for the materials of the belt is 100MPa.[5 marks]
- d. Define the following terms used in spur gearing.[5 marks]
  - i. Line of action.
  - ii. Path of action.
  - iii. Surface of action.
  - iv. Plane of action.
  - v. Point of contact.

### **QUESTION FOUR (15 Marks)**

- a. Mention three main subsystems of robots and mention two components each of these subsystems.[6 marks]
- b. Classify robots based on coordinate system and programming method , by control method citing only two examples. [3 marks]
- c. List and discuss on the 3 types of actuators you know briefly mentioning one important feature of each . [6 marks]

### **QUESTION FIVE (15 Marks)**

- a. As a student of Mechatronics engineering who is familiar with robot manipulators, list the types of robotics arm geometry known to you and explain each briefly? [8marks]
- b. Describe end effectors comparing them to the human hand mentioning the two categories of end effectors you know and their functions? [3 marks]
- c. According to construction and working principles, mention 4 types of grippers familiar to you. [4 marks]