ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination   Winter Semester: 2021 - 2022
Course Number: MCE 4461   **Full Marks: 150**
Course Title: Mechanical Technology II   **Time: 3 Hours**

There are **six** questions. Answer **all the** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. **Assume reasonable value of missing data.**

1. a. Draw sketches to illustrate the dynamic characteristics of the following: (12+8+5=25)
      i.   **Zero-order instrument**   CO1
      ii. **First -order instrument**   PO1,PO2
      iii. **Second-order instrument**

   In the case of a **second-order instrument**, indicate the effect of different degrees of damping on the time response.

   b. Draw the block diagram of **flow rate, speed measurement, temperature measurement and weight measurement** system and indicate different measuring elements in the block diagram.

   c. Describe how a measurement system can be used in an **automatic feedback** system?

2. a. How can you measure **linear and angular displacement** by **resistive sensor**?   (10+8+7=25)
      State the characteristics of resistive sensors?   CO2
                                                                                           PO1,PO2,
   b. What is a capacitive sensor? What are the different parameters that can change   PO10
      the capacitance value? In order to monitor the **water level**, how can this sensor
      be used?

   c. Explain Photo-emissive transducers with necessary diagram. How a photo
      transistor can be used to count the cans in a conveyer belt?

3. a. A **proportional controller** is used to control the height of water in a tank   (18+7=25)
      where the water level can vary from 0 to 4.0 m. The required height of the   CO4
      water is 3.5 m, and the controller is to **close** a valve fully when the water rises   PO1,PO10
      to 3.9 m and **open** it fully when the water falls to 3.1 m.
      i.   Explain the controlling action with a schematic and flow diagram.

      ii.   Do you think that Time Proportional Control is needed for the above case? Justify your comment with a proper diagram.

      iii.   What will be the effect of Proportional Band on this process performance?

b. What are the limitations of two-step (on/off) control, and in what situation such a control system is commonly used?

4   **a.** State the advantages and application areas of fluid power and explain them briefly.   (5+10+10=25)
                                                                                                            CO3
                                                                                                        PO1,PO2

b. Draw a schematic diagram of **Vane Pump** and mention its nomenclature. Deduce the equation of **maximum possible eccentricity** and **maximum volumetric displacement** and establish a relationship between e_{max} and $V_{D\,max}$.

c.   i.   A vane pump is to have a volumetric displacement of $100\ in^3$. It has a rotor diameter of 20 inch, a cam ring diameter of 30 inch, and a vane width of 5 inch. What must be the eccentricity?

      ii.   A vane pump has a rotor diameter of 2000 mm, a cam ring diameter of 7500 mm, and a vane width of 550 mm. If the eccentricity is 28 mm, determine the volumetric displacement.

5   **a.** Explain the working principle of **single acting and double acting cylinder** with appropriate diagram and state the equations for **extending stroke** and **retracting stroke**.   (10+7.5+7.5=25)
                                                                                                                                             CO3
                                                                                                                   PO1,PO2

b. A pump supplies oil at 20 gpm to a 2-in-diameter double-acting hydraulic cylinder. If the load is 1000 lb. (extending and retracting) and the rod diameter is 1 in, determine.
      i.   The hydraulic pressure during the extending stroke
      ii.   The piston velocity during the extending stroke
      iii.   The cylinder horsepower during the extending stroke
      iv.   The hydraulic pressure during the retraction stroke
      v.   The piston velocity during the retraction stroke
      vi.   The cylinder horsepower during the retraction stroke

c. A hydraulic motor has a displacement of $10\ in^3$ and operates with a pressure of 1000 psi and a speed of 2000 rpm. If the actual flow rate consumed by the motor is 95 gpm and the actual torque delivered by the motor is 1500 in·lb., find
      i. η_u
      ii. η_m
      iii. η_o
      iv.   The actual horsepower delivered by the motor

6   a.   Illustrate the schematic diagram of 3-way, 2 Position valve, Normally closed,   (5+8+12=25)
spring Return, Push Button operated DCV.   CO5
                                                                                         PO3

     b.   Explain the **control of a double-acting hydraulic cylinder** by drawing the
schematic diagram using proper ANSI symbols.

     c.   1.   Explain the working principle of the regenerative hydraulic circuit of
                Fig 1.
             2.   A double-acting cylinder is hooked up in the regenerative circuit of
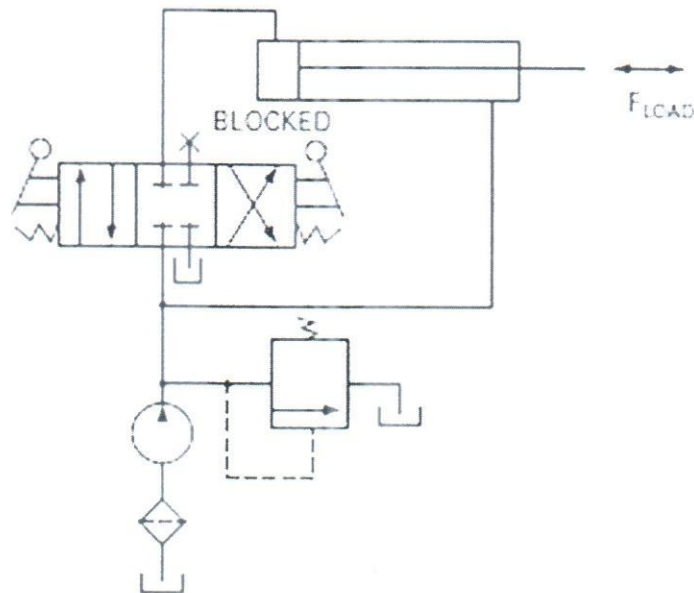   **Fig 1.**

Fig: 1

The cracking pressure for the relief valve is 1000 psi. The piston area is 25 in^2
and the rod area is 7 in^2. The pump flow is 20 gpm. Find the cylinder speed,
load-carrying capacity, and power delivered to the load (assuming the load
equals the cylinder load-carrying capacity) during the
    i.   Extending stroke
    ii.   Retracting stroke

....END..