



MCE \$14 Fluid Power Systems Test.



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

**COURSE: MCE 414: FLUID POWER SYSTEM ENGINEERS**

**TIME ALLOWED: 2 HOURS**

**CREDIT UNIT: 2**

**LEVEL: 500**

**Instruction: Answer Four Questions in all, Atleast Two Questions from Each Section**

**SECTION A ( 30 Marks )**

**QUESTION 1**

- a). The pump in Figure 1 is used by an agricultural drone for spraying chemicals in a rice farm. The differences between the pump inlet and outlet pipe diameter is 15cm. Using the parameter given in the Figure calculate the power in kilowatts, if the pump is delivering the chemical in for the given conditions. Neglect all losses. **15 Marks**

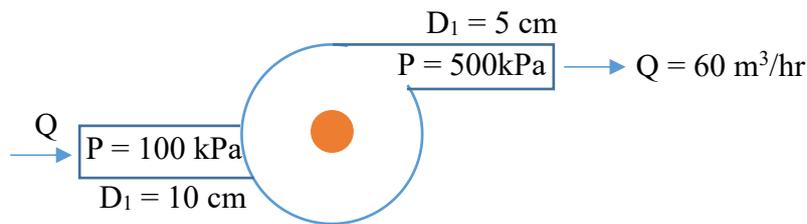


Figure 1:

**Question 2:**

Consider a Liquid Level system shown in Figure 2 having a steady state in flow  $Q_i = \bar{Q}$ , the out flow  $Q_o = \bar{Q}$  and the head  $H = \bar{H}$ . Assume that the flow is turbulent derive the mathematical model and its transfer function. **15 Marks**

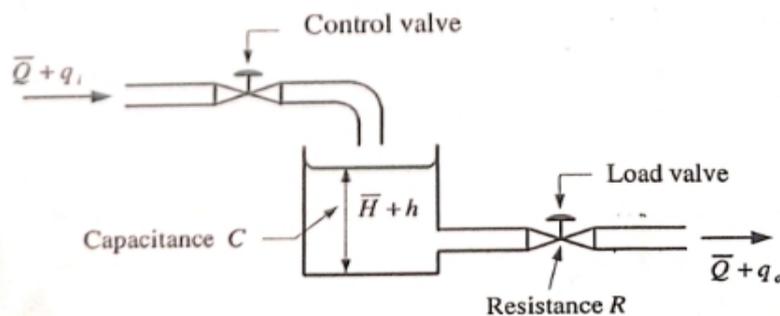


Figure 2:

**Question 3:**

- a. Sketch the standard symbols for the following fluid power components: i. pump ii. Filter iii. Reservoir iv. Heater v. Single acting actuator. **10 Marks**
- b. A gear pump has 75mm outside diameter, 50mm inside diameter and 25mm width. If the volumetric efficiency is 90% at rated pressure and pump speed 1000rpm, what is the actual flow rate. **10 Marks**

## **SECTION B (30 Marks )**

### **QUESTION 4**

- a. Sketch and label the working parts of a hydraulic press. [5 Marks]
- b. (i) Calculate the force required to move a load of 16kN at the exerting piston of radius 60cm, if its own piston at the input end is 40cm  
(ii) What force would be necessary to move an additional load of 4kN given same piston parameters [5 Marks]
- c. List five industries where hydraulic press is necessary in its operations. [5 Marks]

### **QUESTION 5**

- (a) Sketch a well labelled diagram to show the essential components of an hydraulic system [7 Marks]  
(b) What does the term 'hydraulic' connote in either mechanical or mechatronic system? [4 Marks]
- (c) Outline the elements of an hydraulic pump. [4 Marks]

### **QUESTION 6**

- a. Draw and label an axial-piston pump, show associated cross-sectional view, if any [8 Marks]
- b. What drives the pistons in these category of pumps [2 Marks]
- c. Given 'D' value peculiar to a case study axial-piston pump, determine the axial-displacement corresponding to  $\beta$  values of  $30^\circ$  and  $45^\circ$  respectively [5 Marks]