UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMMES : BSC AGRICULTURAL AND BIOSYSTEMS
ENGINNERING YEAR III

COURSE CODE : ABE 303

TITLE OF PAPER: SOIL AND FLUID MECHANICS

TIME ALLOWED : TWO (2) HOURS

INSTRUCTIONS : ANSWER QUESTIONS ONE AND ANY TWO
OTHER QUESTIONS.

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GRANTED BY THE CHIEF INVIGILATOR.

FLUID HYDRAULICS

FINAL EXAMINATION

Question 1: Compulsory

(a) The figure below shows that the pipes 1 and 2 all deliver into pipe 3. The discharge in pipe 2 is 6.0 m⅗ and the discharge in pipe 1 is 20% of the discharge in 3. Velocities in all pipes is maintained at 1.5 m/s and the friction loss factor for all the pipes is 0.009.
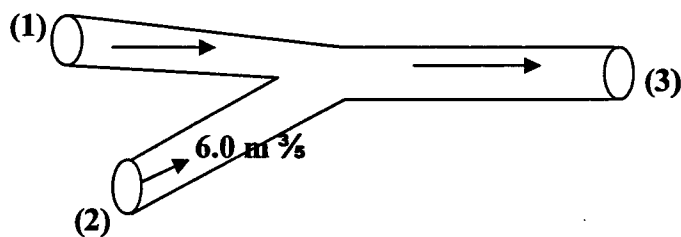
Calculate

    (i)   The flows in pipe 2 and 3.   **[10 marks]**

    (ii)   Calculate the sizes of pipe 1, 2 & 3   **[15 marks]**

Please show your workings.

(b) Differentiate between;

    Uniform, Turbulent, steady flows as used in fluids hydraulic   **[15 marks]**

Question 2

You are given a 100 ha field to irrigate. The field is supposed to be irrigated by sprinklers, and there are 250 sprinklers needed for irrigating the field. Each sprinkler discharges 0.36 litres per second. You are required to pump water to the last sprinkler at the top of the field which is at an elevation of 40 metres from the pump. Sprinkler pressure is 35.0 metres sprinkler riser is 3.0 metres, minor losses along the pipes are 2.0 metres, dragline losses are 0.13 m. Lateral length is 300 m and the main line is 500 m. Friction factor the pipes used in the laterals and mainline is 0.02.

Calculate

(a) Total discharge in the system.   **[10 Marks]**

(b) Total head required by the pump.   **[10 Marks]**

(c) Power requirement for pump that will be directly coupled to an
    electric motor and efficiency is 85 %   **[10 Marks]**

Question 3

Describe briefly with an aid of a diagram the following scenarios, and the situation in which they could be used.

(a) Pipes in series (description only).   **[4 Marks]**

(b) Pipes in parallels (description and where it could be used).   **[6 Marks]**

(c) Describe the difference between Absolute Pressure and Gauge Pressure.   **[10 Marks]**

(d) A pump discharge 100 litres per second and the crops need 80 litres per
    second to sustain their needs. Calculate the pump efficiency.   **[10 Marks]**

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Question 4

(a) Write the following expressions or equations for determining the following;

    (i)   Density   **[5 Marks]**

    (ii)   Specific Weight   **[5 Marks]**

    (iii)   Specific Gravity   **[5 Marks]**

(b) A sample of soil weighing 30.6 kg, had a volume of 0.0183 m³. When dried out in·an oven its weight was reduced to 27.2 kg. The specific gravity of the solids was found to be 2.65. Determine;

    (i)   Percentage moisture content   **[5 Marks]**

    (ii)   Percentage voids   **[5 Marks]**

    (iii)   Degree of Saturation   **[5 Marks]**