UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION PAPER

PROGRAMME: BSC IN LAND AND WATER MANAGEMENT YEAR 3

COURSE CODE: LUM 303

TITLE OF PAPER: FLUID AND SOIL MECHANICS

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS

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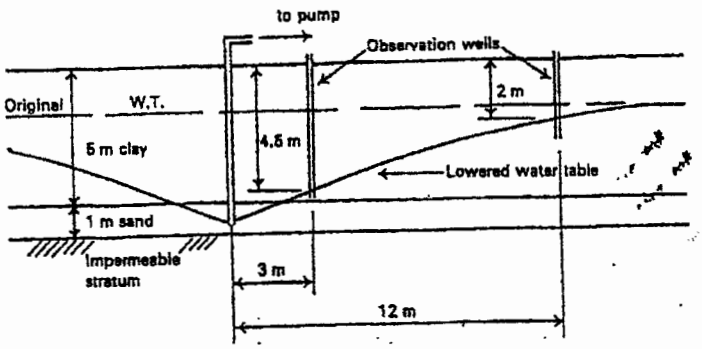
QUESTION 1

a) State the Darcy Law. **[5 marks]**

b) Briefly but clearly discuss each component of the Darcy equation i.e. flux, hydraulic conductivity and the hydraulic gradient. **[15 marks]**

c) Define permeability **[5 marks]**

d) A well-point lowering scheme is carried out on a site and after steady conditions have been obtained, the readings in observation wells are as shown in the figure below. If the rate of pumping is 100 L/min, estimate the coefficient of permeability of the sand stratum



[15 marks]

QUESTION 2

Write short notes on the following:

i) specific gravity
ii) viscosity
iii) pipe friction
iv) relative compaction
v) soil settlement
vi) laminar flow

[30 marks]

QUESTION 3

a) Explain how the following concepts are significant in solving problems in hydrodynamics:

- Discharge and continuity
- Conservation of energy
- Momentum **[15 marks]**

b) In a vertical pipe conveying water, pressure gauges are inserted at A and B where diameters are 150 and 75 mm respectively. The point B is 2.4m below point A and when the rate of flow down the pipe is 21 L/s, the pressure at B is 12 kN/m^2 less than at A. Assuming that the losses in the pipe between A and B can be expressed as $kv^2/2g$, where v is the velocity at A and k is a constant, find the value of k.

[15 marks]

QUESTION 4

a) Using a pitot tube, it is possible to calculate the mainstream velocity by creating a stagnation point and measuring p_1 and p_s where p_1 is the general pressure in pipe, and ps is the stagnation pressure. Elaborate on the concept, and show how the Bernoulli equation can be simplified to equation below which can then be easily used to determine the velocity of flow.

$$v_1 = \sqrt{2\left(\frac{p_s - p_1}{\rho}\right)}$$

[15 marks]

b) Discuss the physical/hydraulic differences between channels and pipes.

[15 marks]