UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : CIVIL*
SUBJECT	:	**WATER & SEWERAGE RETICULATION 3A**
CODE	:	**CEW3A21**
DATE	:	SUPPLEMENTARY EXAMINATION 00 JANUARY, 2020
DURATION	:	(SESSION X) 08:00 - 10:00
WEIGHT	:	40 : 60
TOTAL MARKS	:	90

ASSESSOR	:	MR. L F SHIRLEY
MODERATOR	:	DR. A M CASSA
NUMBER OF PAGES	:	3 PAGES, 1 FORMULA SHEET AND 5 ANNEXURES.

INSTRUCTIONS	:	THIS IS AN OPEN BOOK EXAMINATION. MEYER ONLY
REQUIREMENTS	:	NONE

INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

Tank A is connected to Tank B by means of a 75mm inside diameter galvanised iron horizontal pipe 10m long. Both the inlet and outlet of the connecting pipe are sharp and below water level and the difference in water level between the two tanks is 5,0m, the water level in Tank A being the higher. Fitted halfway along the connecting pipe is a 75mm diameter gate valve which is $^1/_2$ open.

1.1 Calculate the flow rate from Tank A to Tank B accurate to 1ℓ/s taking both friction and shock losses into account. Use the d'Arcy-Weisbach formula to quantify friction losses and the Moody diagram for determining the friction factor f. See Annexure 1 for an enlarged copy of the Moody diagram. Take the dynamic viscosity of water as 1×10^{-3} kg/m.s.

[20]

QUESTION 2

It is foreseen that a residential/light industrial development will consists of the following types of development by the year 2030:

a) 200 upper income group residential stands;
b) 500 middle income group residential stands;
c) An abattoir having a slaughtering capacity of 50 large cattle per day;
d) A milk powder factory having a production capacity of 10 tonnes per day;
e) A pasteurised milk dairy with a daily production of 50 000ℓ of milk;
f) A wool dyeing industry with a daily dyeing capacity of 1 000kg of wool;
g) A day school with 800 pupils;
h) A developed park of 7,50ha;
i) A sportsground of 1,75ha.

2.1 Using **average** water demand figures as per Annexures 2, 3 and 4, calculate the *daily water demand* of the development by the year 2030 in m^3/d;

[20]

QUESTION 3

A 200mm outside diameter (OD) class 12 uPVC pipeline is 2,50km long. Water flows in the pipe at a velocity of 1,20m/s. Calculate the pressure increase in the pipe in metres water if a valve is closed in 10 seconds. See Annexure 5 for available pipe sizes.

Take Young's modulus of elasticity E for uPVC as 3,0GPa;
Take k = 0,90;
Take the diameter of the pipe as the average of the outside and inside diameters.

[15]

QUESTION 4

Reservoir A supplies water to reservoir B through a 150 mm inside diameter pipeline 1200 m long with friction factor f = 0,0045. The TWL (top water level) of reservoir A is 1620 m and that of reservoir B 1600 m. Due to an increase in demand the flow from reservoir A to reservoir B has to be increased to 40 ℓ/s.

4.1 What do you recommend is to be done? Substantiate your recommendation by doing some calculations using the d'Arcy-Weisbach formula.

[15]

QUESTION 5

Reservoir A is connected to reservoir B by means of a pipeline. The difference in water level between the two reservoirs is 20m. The pipeline consists of a 200mm diameter pipe 4km long, followed by a 150mm diameter pipe 3km long, followed by a 100mm diameter pipe 2km long. The pipes all have the same friction factor f = 0,00350.

5.1 Calculate the flow rate from reservoir A to reservoir B.

[10]

QUESTION 6

The depth of flow in a 600 mm inside diameter semi-circular outfall drain open to the atmosphere and sloping at 1 in 1000 is 300 mm. Regarding the drain as an open channel, calculate the discharge in ℓ/s using Manning's formula taking n = 0,0150.

[10]

[TOTAL = 90]

Formulae

$$R_e = \frac{\rho v d}{\mu} = \frac{vd}{\nu}$$

$$h_f = \frac{4fL}{d}\frac{v^2}{2g}$$

$$h_f = \frac{fLQ^2}{3{,}03d^5}$$

$$h_f = \frac{10{,}67LQ^{1,85}}{C_H^{\,1,85}d^{4,87}}$$

$$v = \frac{1}{n}m^{\frac{2}{3}}i^{\frac{1}{2}}$$

$$m = \frac{A}{P}$$

$$\Theta = \cos^{-1}\frac{r-h}{r}$$

$$P = 2r\Theta$$

$$A = \frac{1}{2}r^2\left(2\Theta - \sin 2\Theta\right)$$

$$Q = av$$

$$p = \rho gh = \gamma h$$

$$H_{sys} = H_{stat} + H_f + H_v$$

$$P = \frac{\gamma QH}{Efficiency}$$

$$L_e = \frac{d_e^5}{f_e}\left(\frac{f_1 L_1}{d_1^5} + \frac{f_2 L_2}{d_2^5} + \frac{f_3 L_3}{d_3^5}\right)$$

$$\left(\frac{d_e^5}{f_e L_e}\right)^{.5} = \left(\frac{d_1^5}{f_1 L_1}\right)^{.5} + \left(\frac{d_2^5}{f_2 L_2}\right)^{.5} + \left(\frac{d_3^5}{f_3 L_3}\right)^{.5}$$