

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART 11 SUPPLEMENTARY EXAMINATIONS – OCTOBER 2009
WASTEWATER ENGINEERING – TCW 3104**

INSTRUCTIONS

Answer any four (4) questions. Illustrate your answers where necessary with clearly labeled sketches.

Time: 3 hours

Total marks 100

QUESTION 1

- (a) Waste stabilisation pond system is an appropriate technology for developing countries. Discuss **(14 marks)**
- (b) Assuming a mean velocity of 0.3 m/s determine the size of a spherical grit particle ($R_D = 2.65$) and spherical organic material ($R_D = 1.15$) which will remain in suspension in a grit channel for which $K = 0.05$ and $F = 0.03$. **(11 marks)**

QUESTION 2

- (a) A sample of wastewater has a 4 – day, 20°C BOD value of 75% of the final BOD. Find the rate constant (to base 10) per day at 20°. **(13 marks)**
- (b) With the aid of a neat sketch, describe the symbiotic relationship between bacteria and algae. **(12 marks)**

QUESTION 3

- Distinguish between aerobic and anaerobic process in the treatment of wastewater. **(12 marks)**
- (b) A bar screen is inclined at 60° angle with the horizontal. The circular bars have diameter of 20 mm and clear spacing of 25mm. Determine the head loss when the bars are clean and the velocity approaching the screen is 1.0m/s. Assume shape factor = 2.4 and the flow rate is 3m³/min. **(13 marks)**

QUESTION 4

- (a) What do you understand by a ‘trickling filter’? Explain with the help of a neat sketch, the biological process involved in the operation of a trickling filter. **(13 marks)**

- (b) For a wastewater sample, the 5 day BOD at 20⁰C is 200g/L and is 67% of the ultimate BOD. What will be the 4 – day BOD at 30⁰C. Assume $K_{20} = 0.23$ per day. **(12 marks)**

QUESTION 5

Differentiate clearly between attached growth processes and suspended growth processes. List the various treatment techniques falling under each such process. **(10 marks)**

- (b) The following information is given for the design of waste stabilization pond system.
- (i) Retention time in anaerobic ponds – 2.2 days
 - (ii) Detention tie in facultative ponds - 19 days
 - (iii) Temperature
 - (iv) Concentration of faecal coliforms in influent – $5 \times 10^7/100\text{ml}$.

Calculate the retention time in the maturation ponds y 3 ponds are placed in series in order to achieve a required faecal coliforum concentration of $10^3/100\text{ml}$ for the effluent. **(15 marks)**