UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACCALAUREUS TECHNOLOGIAE *CHEMICAL ENGINEERING*
SUBJECT	:	**CHEMICAL ENGINEERING TECHNOLOGY 4 (HEAT AND MASS)**
CODE	:	**WARC432**
DATE	:	WINTER EXAMINATION 2 JUNE 2016
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	95

EXAMINER	:	DR R. HUBERTS	080207003
MODERATOR	:	PROF M.S. ONYANGO	2242
NUMBER OF PAGES	:	2	

INSTRUCTIONS	:	WORK ACCURATELY AND ANSWER ALL QUESTIONS. NON-PROGRAMMABLE CALCULATORS PERMITTED (ONLY ONE PER CANDIDATE). ENTER THE ANSWERS ON BLACKBOARD (Bb) AS REQUIRED

QUESTION 1

$0.01m^3s^{-1}$ mercury flows into a heated pipe with internal and external diameter of 0.085m and 0.090m respectively, and length given on Bb.

1.1. If the mercury needs to be heated from 13.7°C to 40.0°C, to what temperature should the surface of the pipe be heated? Neglect heat transfer resistance in the pipe wall and let 0°C=273.15K. (31)

1.2. What would you use to maintain a constant surface temperature? Explain why. (3)

[34]

QUESTION 2

2.1. Use the mass diffusion equation for steady state one-dimensional diffusion in the radial direction of a cylindrical stationary medium to derive the concentration profile for no generation in your script. Then answer the question on Bb. (5)

$0.002mols^{-1}$ of Carbon Dioxide gas is transported at 25°C through a long rubber pipe of 0.0050m and 0.008m internal and external diameter respectively. The absolute pressure in the pipe, given on Bb, is maintained by intermittent pumping, and the outside pressure of the fresh air is 101325Pa.

2.2. What is the rate of diffusion of the CO_2 through the pipe wall in $mols^{-1}m^{-1}$? Neglect the mass diffusion resistances of the gas film next to the internal and external surfaces of the pipe, and the CO_2 concentration in the air. (17)

2.3. Analyze your answer. Is this rate significant? Explain... (5)

[27]

QUESTION 3

3.1. Draw a diagram of the Boundary layer for film condensation on a vertical surface according to Nusselt's analysis and then answer the question on Bb. (4)

Consider a vertical flat plate having a uniform surface temperature (T_S) of 83.7°C with steam condensing on it at a pressure of 1atm. Dimensions are given on Bb. Let 0°C=273.15K and the gravitational constant = $9.81ms^{-2}$.

3.2. Calculate the height of the vertical flat plate in m if a condensation rate of $0.1kgs^{-1}$ is required. (26)

[30]

QUESTION 4

A kaolin brick, at 1600K, is exposed to black surroundings at 800K. What is the initial net radiation heat transfer flux from the brick to the surroundings in Wm^{-2}? (4)

[4]

TOTAL MARKS =95

FULL MARKS =95