UNIVERSITY OF JOHANNESBURG

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| **PROGRAM** | NATIONAL DIPLOMA<br>*CHEMICAL ENGINEERING* |
| **SUBJECT** | **CHEMICAL PLANT 3B** |
| **CODE** | **ACPB 321** |
| **DATE** | : SUMMER EXAMINATION 2016<br>22 NOVEMBER 2016 |
| **DURATION** | : (SESSION 2) 12:30 - 15:30 |
| **TOTAL MARKS** | 120 |
| **FULL MARKS** | 100 |
| **EXAMINER** | PROFESSOR PETER OLUBAMBI |
| **MODERATOR** | Dr H. RUTTO |
| **NUMBER OF PAGES** | 3 |
| **INSTRUCTIONS** | NON-PROGRAMMABLE CALCULATORS PERMITTED (ONLY ONE PER CANDIDATE)<br>SHOW ALL UNITS IN CALCULATIONS!!!<br>ANSWER ALL THE QUESTIONS. |

## CHEMICAL PLANT 3B (ACPB 321)

### QUESTION ONE

a. Using typical Diagrams, explain the major difference between external and internal gears pumps (14)
b. Describe the operation principles of the two types of gear pumps (10)
c. List three major applications of the pumps (06)

**[20]**

### QUESTION TWO

a. List the measurements methods for assessing cooling tower performance. (08)
b. A plant has two travel grade boilers of rated capacity 38 TPH each and pressure 45 kg/cm2. The design steam temperature from the boilers is 420 ± 5°C. assuming an installed turbo feed water pump to boiler is Q = 135 m3/h, H = 650m, input pump power = 292 kW with 0.93 efficiency of motor feed water temperature at pump inlet is 105°C. What will be the design efficiency of pump? (Assume suitable specific weight correction) (12)

**[20]**

### QUESTION THREE

A series of cooling towers are employed to cool down water from a thermal power plant from 42°C to 35.3 °C. The wet-bulb air temperature is 27.1 °C and the dry-bulb temperature is 38.8 °C. The number of cells in operation is 43 of a total of 46. The cooling tower water flow was measured at 68413$m^3$/h and the cooling fan flow at 947521$m^3$/h. The design inlet temperature, outlet temperature, and wet-bulb temperature of the air are 41, 31, 25.2 respectively. The density of air is taken to be 1.08kg/$m^3$, and the TDS is 2.6.

- Calculate the cooling tower effectiveness, rated percentage cooling tower effectiveness and percentage evaporation losses (17
- Analyze the performance of the cooling tower. (03)

**[20]**

### QUESTION FOUR

a. List the main characteristics of a good fuel (07)
b. Calculate the minimum volume of air required to burn 1 Kg of coal having the following composition by weight, C = 72.4%, H2 = 5.3%, N2 = 1.8%, O2 = 8.5%, $H_20$ = 7.2% and S = 0.9%. Given that density of air at NTP is 1.29kg/$m^3$ (13)

**[20]**

### QUESTION FIVE

a. Describe the working principles and applications of the axial and radial impellers for liquids mixing (08)
b. Using typical diagrams, describe the nature of flow generated by axial and radial impellers. (12)

**[20]**

## QUESTION SIX

a. Discuss the causes of scaling and carryover in water boilers (06)

b. For a vessel containing 5000 gal of liquid with specific gravity of 0.9and viscosity of lOOcP. The dimensions of the liquid content are 9.5ft high by 9.5 ft diameter and the agitation speed to be 84 rpm. Determine the volumetric flowrate of the fluid in the agitator and the blending time. (14)

**[20]**

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