# UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2019

**COURSE NO**: RN 262

**COURSE NAME**: COMPUTER APPLICATIONS

**CLASS**: RN II **TIME:** 3 HOURS

Name**:** _____Index Number: _____

***Carefully read each instruction under the three sections before answering. Adherence to these instructions is important. The files for each section must be named as RN_Index no. and save in the folder RN located on the desktop.***

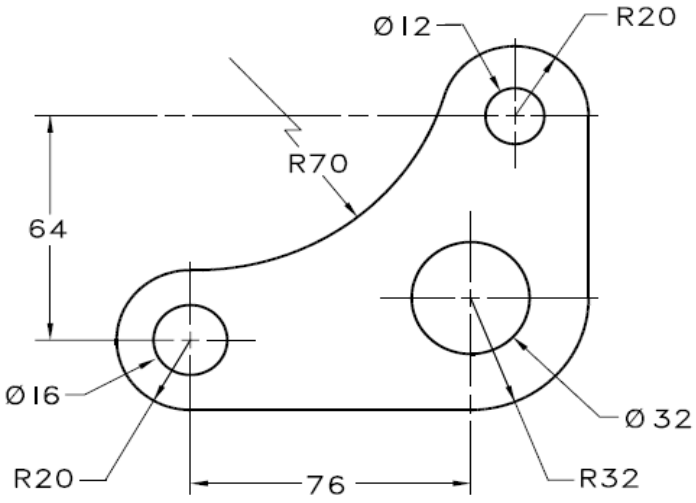
## ***SECTION A***

***Instructions***

- All center line should be in colour blue and have a lineweight of 0.3 mm.
- All dimensions should be in colour green.

***Question one*** ***[20 marks]***

Construct the lever crank using AutoCAD's drawing tools.




**Dimensions in mm**

## ***SECTION B***

***Instructions***

- Answer all the questions in this section in one script file.
- Begin the script file with commands to clear the command window and workspace.
- Do not suppress the final answer in each question.

***Question One*** ***[7.5 marks]***

Using the zeros, ones, and eye commands create the following arrays by typing one command:

a) $\begin{bmatrix} 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$ c) $\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

***Question Two*** ***[7.5 marks]***

Create the following matrix by typing one command. Do not type individual elements explicitly.

a) $\begin{bmatrix} 0 & 0 & 0 & 0 & 8 \\ 0 & 0 & 0 & 0 & 7 \\ 0 & 0 & 0 & 0 & 6 \end{bmatrix}$ b) $\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 4 & 3 \\ 0 & 0 & 2 & 1 & 0 \end{bmatrix}$ c) $\begin{bmatrix} 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 10 & 20 \\ 0 & 0 & 2 & 8 & 26 \\ 0 & 0 & 3 & 6 & 32 \end{bmatrix}$

***Question three*** ***[15 marks]***

Plot the function $f(x) = sin^2(x)\cos(2x)$ and its derivative $f'(x) = 2\sin(x)\cos(x)\cos(2x) - 2sin^2(x)\sin(2x)$, both on the same plot, for $0 \leq x \leq 2\pi$. Plot the function with a black solid line, and the derivative with a magenta dashed line. Add a legend and label the axes.

## ***SECTION C***

***Instructions***

- All parameters in the software should remained unchanged unless indicated in the question.

***Question 1*** ***[30 marks]***

a) Use the information in **Table 1-3** and sample load data in HOMER to design a standalone energy solution for Adiembra, an unelectrified rural community in the Ashanti region. The energy options that should be considered are diesel generator, solar PV, Wind energy and a battery bank. Ensure that at least solar PV and wind energy contributes 62 % and 38 % respectively of the renewable energy components to meet the overall energy demand. Based on the simulation results;

i. Rank the optimal design systems from the best to the worst.
ii. Can the optimal energy design system be refined, if yes indicate how?
iii. Undertake sensitivity analyses using the data presented in **Table 4** and indicate the optimal design.

**Table 1:** Resource data

| | **Solar Irradiation ($kW/m^2/d$)** | **Wind speed (m/s)** |
|---|---|---|
| January | 5.000 | 4.794 |
| February | 5.400 | 5.702 |
| March | 5.500 | 3.338 |
| April | 5.600 | 4.121 |
| May | 5.500 | 4.062 |
| June | 4.800 | 2.664 |
| July | 4.600 | 3.572 |
| August | 4.400 | 3.630 |
| September | 4.700 | 3.594 |
| October | 5.400 | 4.823 |
| November | 5.400 | 6.587 |
| December | 5.000 | 7.195 |

**Table 2:** Cost components

| | **Size (kW)** | **Capital ($)** | **Replacement ($)** | **O&M ($/yr)** |
|---|---|---|---|---|
| PV | 1 | 1000 | 900 | 20 |
| Generic 10 kW wind turbine | 1 | 35000 | 30000 | 700 |
| Surette 4KS25P | 1 | 400 | 400 | 20 |
| Converter | 1 | 1000 | 1000 | 100 |
| Generator | 1 | 3000 | 2500 | 0.070 |

Note. Cost of diesel for the base case scenario is 0.6 $/L

**Table 3:** Parameters for optimization

| PV array (kW) | Generic 10kW wind turbine | Generator | Surette 4KS25P | Converter |
|---|---|---|---|---|
| 1.000 | 0 | 16.00 | 0 | 0.00 |
| 2.000 | 1 | | 3 | 6.00 |
| 3.000 | | | 4 | 12.00 |
| | | | 5 | |
| | | | 6 | |

**Table 4:** Parameters to consider in the sensitivity analysis

| Solar (kWh/m$^2$/d) | Wind (m/s) | Diesel ($/L) |
|---|---|---|
| 5.110 | 4.500 | 0.600 |
| 5.200 | 4.000 | 0.700 |
| 5.400 | 5.000 | 0.800 |
| 5.600 | 5.500 | 0.900 |
| 5.800 | 6.000 | |
| 6.000 | 6.500 | |

***Examiner: D. Yellezuome/ I. Osei***