

## 1 UDL applied to an Exam

The outcomes of my course contain the preliminary understanding of each sub-fields of robotics; electronics, mechanics, and programming, and to apply this knowledge I plan to have a hands-on experience by making a robot and applying knowledge of each discipline to one common goal. As of for the Final Exam, I plan to have three sections to access them on each sub-fields of robotics. In this assessment, I originally planned for having one questions for each section but after UDL application, I am considering to have a choice in each section ensuring diverse question and a better success rate. My course outcomes are as follows and the final exam reflect that a student can successfully learn as directed in the outcomes.

### 1. Knowledge-Based Outcomes

- (a) Differentiating and understanding components that comprise of an electronic circuit
- (b) Understanding the way a machine works and processes
- (c) Writing a program to control computer and its hardware
- (d) Understanding of robotic designs and processes

### 2. Skill-Based Outcomes

- (a) Hands on expertise and training in all the parent fields
- (b) Design and Implement basic and intermediate electronic circuits
- (c) Write and compile code in Embedded C
- (d) Experience in system analysis and troubleshooting

## 2 UDLized Finals

I would like to offer two options for the final exam; written(2.1) or hands-on Exam(2.2). No matter what student choose, they will have to finish that particular form of exam in the designated time.

### 2.1 Final Written Exam

Page 3-16, contains my new version of Final Exam that has been changed as per UDL concepts. The traditional version of my exam contained QIb, QIIa, QIIIb, QIVc. The UDLized written Final Exam is covered in Section 3 and its rubrics in Section 4. This written exam will be an hour constrained.

Following are the details on how questions of the exam tie with my course outcomes.

Question Number	Outcome Targeted
Q1	1(a), 2(b)
Q2a	1(b)
Q3	1(c), 2(c), 2(d)
Q4	1(d)

The remaining objective, 2(a), along with other objectives are completed with the final project that students need to submit to obtain a final grade.

### 2.2 Final Hands-On Exam

As an option to the traditional written exam, the students can also choose to have a hands-on exam in which they will have to deal with piratical knowledge. The UDLized written Final Exam is covered in Section 5 and its rubrics in Section 6. This written exam will have a deadline of 24 hours.

### **3 Written Final Exam**

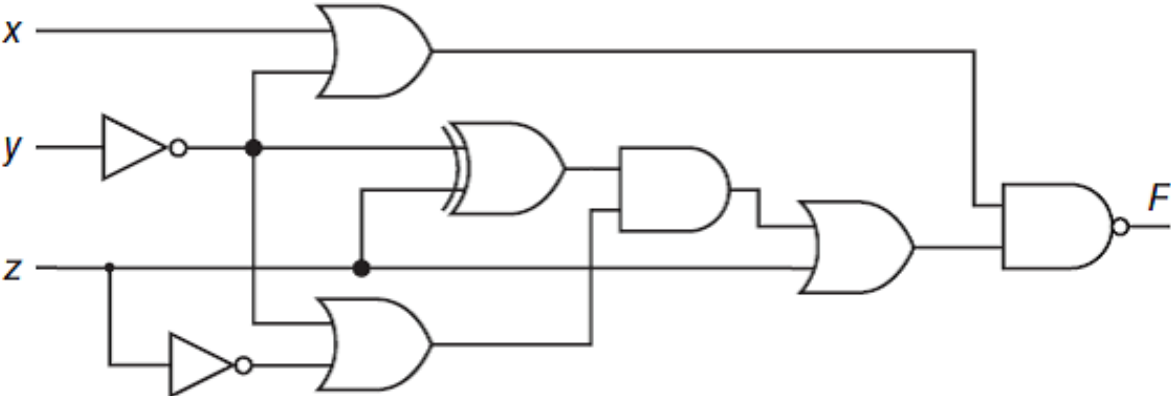
Note:- The written final exam is divided into four sections; electronics, mechanics, programming and robotics, and in each section you have a choice to complete either question to obtain full points in the section. If you submit both the questions of a section, the one with the better answer will be considered towards final points.

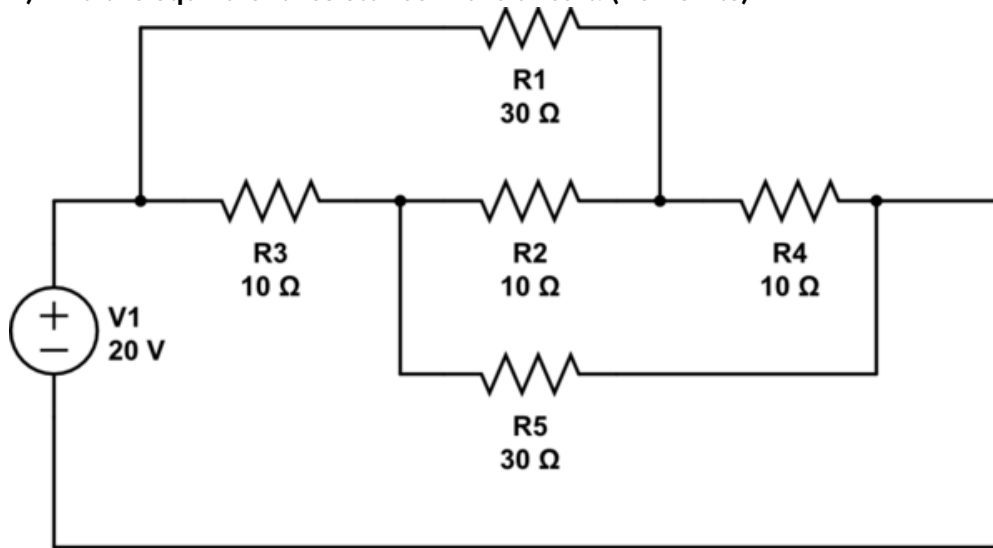
#### **3.1 ELECTRONICS - 25 Points**

**Problem Ia - Logical Gates.**

**1) Provide the truth table of a NAND Gate with 3 inputs. (10 Points)**

2) Find the truth table of the circuit. (15 Points)



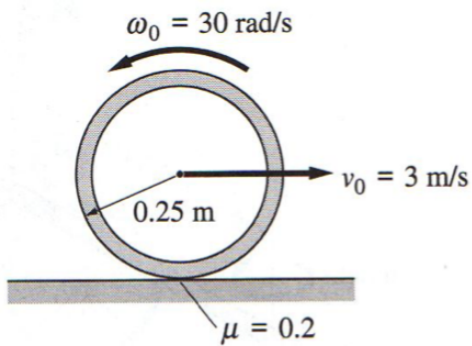
**Problem 1b - Resistance and Current in a circuit.****1) Find the equivalent resistance in the circuit. (10 Points)**

**2) Find the current flowing through each resistor. (15 Points)**

### 3.2 MECHANICS - 25 Points

#### Problem IIa - Wheel Design.

The uniform hoop of mass  $m$  has a central radius of gyration of 220 mm. The hoop is launched on a horizontal surface with 3 m/s forward speed and 30 rad/s backspin. The kinetic coefficient of friction between the hoop and the surface is 0.2. Determine the final speed of the hoop and the time when the final speed is reached using the principle of impulse and momentum. (25 Points)



**Problem IIb - Resistance and Current in a circuit.**

Two spheres of mass  $m_s$  and radius  $r_s$  are rigidly attached to a slender rod at the left-hand end (point A) and the right-hand end (point B). The mass of the rod is  $m_r$  and the length of the rod is  $L_r$ . The system pivots about the left-hand end at A. The system is released from rest in a horizontal position and swings freely. Determine the angular velocity of the rod as it passes through a vertical position using the conservation of energy principle. (25 Points)





### 3.3 Programming - 25 Points

#### Problem IIIa - Wheel Design.

1) The volume of a sphere with radius  $r$  is  $\frac{4}{3}\pi r^3$ . Complete the program below so that it prompts the user to enter the radius of a sphere and prints out the volume of that sphere, to two decimal places. (15 Points)

```
#include <stdio.h>
```

```
#define PI 3.14159265
```

```
int main() {
```

```
return 0; }
```

**2) What is the output of the following code segment? Briefly explain why the code does what it does. (10 Points)**

```
int x = 3, y = 5;  
if (x > y);  
printf("A");  
if (x = 4)  
printf("%d", x+y);
```

**Problem IIIb - Code Troubleshooting.****Find the error in all of the following piece of code. (25 Points)****1) Code Sample 1:**

```
#include<stdio.h>
int main(void)
{
while(.)
{
printf("hello");
}
return 0;
}
```

**2) Code Sample 2:**

```
#include<stdio.h>
void main()
{
int x = 10;
int y = 15;
printf("%d", (x, y))
}
```

**3) Code Sample 3:**

```
#include<stdio.h>
```

```
int main()
```

```
{
```

```
int a = 0;
```

```
printf("Enter value for a:");
```

```
scanf("%d", &a);
```

```
printf("Enter value for b:");
```

```
scanf("%d", &b);
```

```
sumfunction(a);
```

```
return 0;
```

```
}
```

```
void sumfunction(int a, int b)
```

```
{
```

```
int c = a + b;
```

```
printf("Value for c: %d", c);
```

```
}
```

### **3.4 ROBOTICS - 25 Points**

#### **Problem IVa - Robot Circuit.**

**Design the electronic circuit for a line following robot. to get full points report your reasoning for the design. (25 Points)**

**Problem IVb - Robot Design.**

**Design the mechanical design for a line following robot. to get full points report your reasoning for the design. (25 Points)**

**Problem IVc - Robot Programming.**

**Write the programming logic for a line following robot. to get full points report your reasoning for the design. (25 Points)**



## 4 Rubrics for Written Final Exam

Question Number	Points				
	25-20	20-15	15-10	10-5	5-0
Q1a	Final answer matches the solution of both sub questions	either sub question is completely correct	both the questions are partially correct	correct approach but incorrect answer	everything is incorrect
Q2a	Final answer matches the solution	all steps are correct except for the numerical error	correct method of solution but incorrect steps	incorrect method chosen for solving the answer	everything is incorrect
Q3a	Final answer matches the solution	all steps are correct except there is a compilation error	both the outputs are incorrect	code has an error and incorrect output	everything is incorrect
Q3b	all sub questions are correct	2 sub questions are correct	1 sub question is correct	1 error found	everything is incorrect answers
Q4a	idea and implementation is correct	idea is correct but implementation is incorrect	idea is correct and implementation is missing or lack primary details	only idea is provided	even idea/concept is incorrect

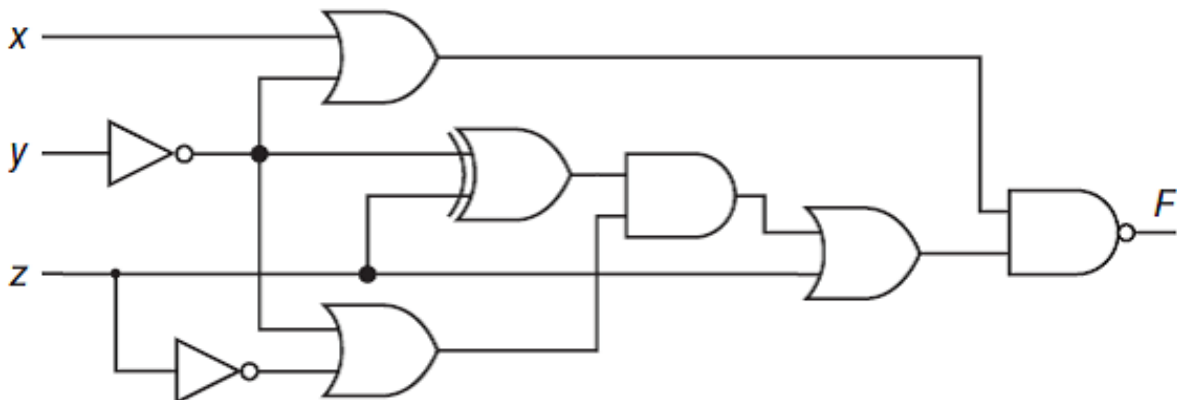
My Rubrics would stay the same for the traditional exam just the choices of questions are less thus affecting the grade of the students and reducing their chances of getting higher points on the final exam.

## 5 Hands-on Final Exam

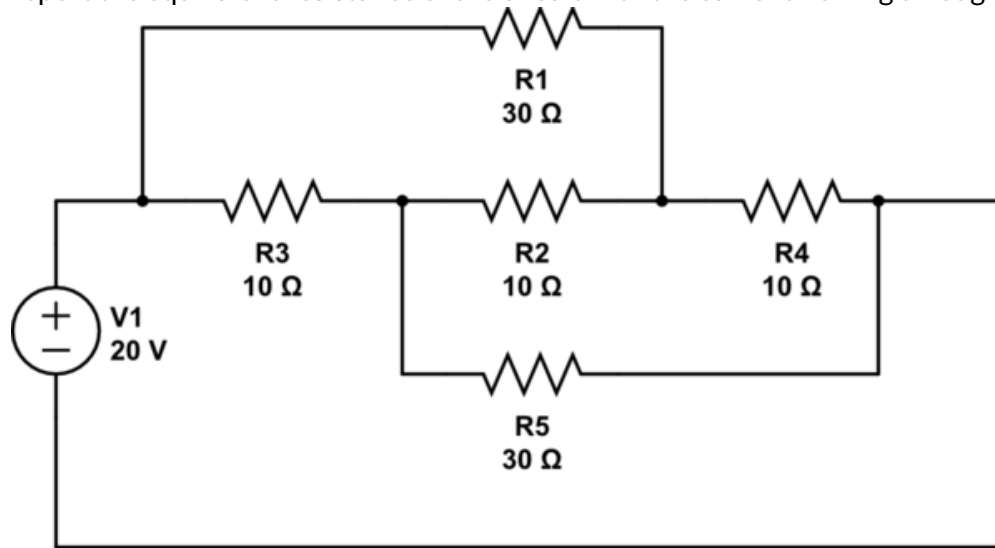
Note:- The written final exam is divided into four sections; electronics, mechanics, programming and robotics, and in each section you have a choice to complete either question to obtain full points in the section. If you submit both the questions of a section, the one with the better answer will be considered towards final points. You will have to submit a soft copy of the exam that includes videos and images for each task/question. You should also write a short description on the design and implementation for each section. You can use all lab equipment for getting the results.

### 5.1 ELECTRONICS - 25 Points

Problem 1a - Logical Gates Construct a circuit as per the diagram. Treat x,y and z as the inputs and replace them with push buttons, while F will be connected to a LED. Using this circuit record images for each state of the truth table and report in the report.



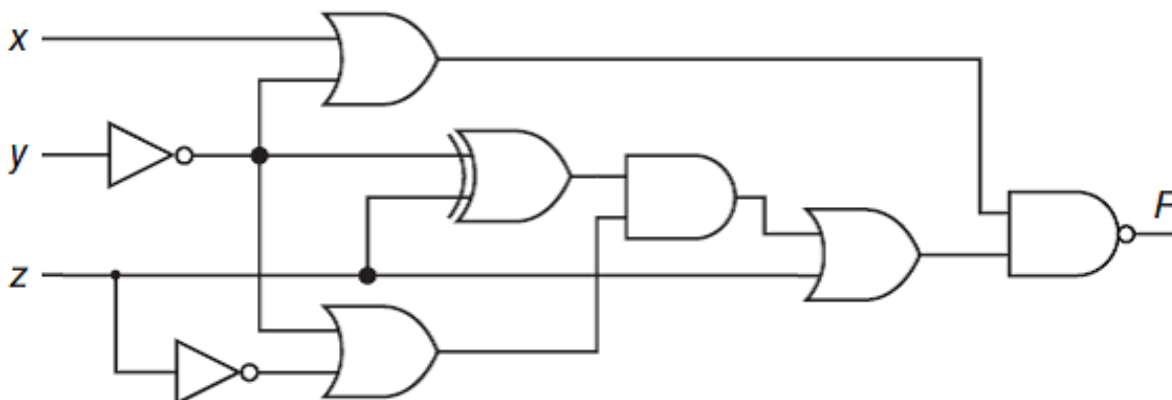
Problem Ib - Resistance and Circuit in a circuit Construct a circuit as per the diagram. You have to report the equivalent resistance of the circuit with the current flowing through each circuit.



## 5.2 MECHANICS - 25 Points

Problem IIa - Wheel Assembly Using two motors, wheels and a castor, construct a base for the robot. You can connect the motor wires to the battery and record a video of the assembly running on a flat surface. After this measure the friction between wheel and surface.

Problem IIb - Wheel response to Logic circuit. Construct a circuit as per the diagram. Treat  $x, y$  and  $z$  as the inputs and replace them with IR sensors, while  $F$  will be connected to a motor. Using this circuit record images for each state of the truth table and report in the report. Also, state the response seen for each entry to truth table.



### **5.3 PROGRAMMING - 25 Points**

Problem III - For your choice of Experiment in Mechanics/Electronics section, program a micro-controller to get results. Record a video of the task and submit it along with the code you wrote.

### **5.4 ROBOTICS - 25 Points**

Problem IV - For your choice of Experiment in Programming section, attach remaining components to make the system more robot like. Record a video of the task and submit a write-up on the implementation for the experiment. You can also submit a video for explaining the write-up.

## 6 Rubrics for Hands-on Final Exam

Question Number	Points				
	25-20	20-15	15-10	10-5	5-0
Q1	Both, video and documentation is submitted	Either one submitted video or documentation	partially correct or incomplete	Effort is seen but the outcome is not	everything is incorrect
Q2	Both, video and documentation is submitted	Either one submitted video or documentation	partially correct or incomplete	Effort is seen but the outcome is not	everything is incorrect
Q3	Both, video and documentation is submitted	Either one submitted video or documentation	partially correct or incomplete	Effort is seen but the outcome is not	everything is incorrect
Q4	Both, video and documentation is submitted	Either one submitted video or documentation	partially correct or incomplete	Effort is seen but the outcome is not	everything is incorrect

## 7 Final Exam Evaluation Form

Please fill the following questionnaire to give me feed-backs on the final exam.

### Exam Questionnaire

very much →

← not at all

How mentally demanding was the exam? .....

How hurried or rushed was the pace of the exam? (Time Taking) .....

How successful were you in accomplishing what you were asked to do?

How hard did you have to work to accomplish your level of performance?

How insecure, discouraged, irritated, stressed, and annoyed were you?

### General Remarks and Ideas

► Please share any other remarks or ideas for the final exam:

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Note:- This questionnaire is inspired from NASA TLX form on a Likert Scale.