Discipline of Electrical, Electronic and Computer Engineering
ENEL1ED Electrical Design 1

Main Examination 11 November 2025
Duration: 120 minutes Maximum Marks: 70

Internal Examiner: Dr SS Patel Independent Moderator: Mr B Naidoo

Instructions to Students

- This examination is **Open-Book**
  - Students may use any paper-based physical material (including notes, lecture slides, textbooks, research articles, etc.) as reference material when answering the questions.
  - No digital devices (tablets, smartphones, etc.) are permitted.
- All questions are compulsory.
  Questions may be answered in any order, however, sub-questions should be answered consecutively.
- Answers should be written using a pen with blue or black ink. The use of highlighters and other forms of stationery are permitted if necessary.
  - Answers written in pencil will not be considered with the exception of graphs, sketches or diagrams.
- The use of a non-programmable calculator is permitted.
- Students are advised to plan their time carefully.
- **State any assumptions clearly and justify why they were made.**
- **Answer Question 8 on your Question Paper.**
- **Answer Section A and Section B in separate booklets.**
  Hand in your Question Paper with the booklet in which you answered Section B.

Including this cover page, the examination question paper has 5 pages.

Students are advised to check that they have all pages of the question paper before commencing with the examination.

Student No.	
Seat No.	

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Section A – 32 Marks Total

Road accidents are a major health and safety concern globally. It has been identified that fatigue and tiredness in drivers, which results in impaired concentration, is one of the leading causes of fatal road accidents.

Currently, ongoing research is being done globally towards developing electronic systems that can detect drowsiness in drivers in real-time. Some systems have explored direct approaches, like monitoring the rate at which the driver blinks and yawns (more frequent blinking and yawning indicates higher drowsiness). Other systems have explored indirect approaches, like monitoring driving patterns (a driver's vehicle positioning within a lane and braking/acceleration patterns often change when fatigued).

Some of the parties interested in such systems include car insurance companies (fewer accidents means fewer claims for vehicle repairs), medical professionals (fewer accidents means less strain on the healthcare system) and logistics/trucking companies (fewer accidents means that the goods they are transporting are reaching their destination more reliably and timeously).

1 Discuss why the design and development of a real-time driver drowsiness detection system is a complex engineering problem. (5)

2 Identify two stakeholders for this system. (2)

3 Classify each of the following statements as either [A] a functional requirement, [B] a non-functional requirement, [C] a specification, [D] a constraint, or [E] irrelevant or unncessary to designing a solution to the complex engineering problem.

Assume that a computer-vision based solution is being implemented.

3.1 The system should determine the drowsiness of the driver with a minimum accuracy of 78%. (1)

3.2 The system should implement a computer vision solution that is compliant with the Protection of Personal Information Act. (1)

3.3 The system should have a power supply. (1)

3.4 The system should function in bright and moderate lighting conditions. (1)

3.5 The electromagnetic interference produced by the system should not interfere with the normal operations of a vehicle's electronics system. (1)

4 Personnel management is important in engineering projects. Discuss how changes to team allocations, and the delays that are introduced due to unfinalized project teams, can negatively impact engineering projects. Refer to your experiences in the AI project this semester. (4)

5 Describe two limitations of AI tools like LLM-based chatbots (e.g. ChatGPT). Discuss why it is important for engineers to know how to validate AI-generated output independently when working with these tools. (5)

6 Give a brief overview of the ECSA Graduate Attribute GA1, including both its knowledge and attitude profiles. How did content from Electrical Design contribute towards introducing and developing students towards achieving GA1? (5)

7 With reference to health, safety and hygiene considerations, discuss the following:

7.1 The reason that wearing closed shoes is essential in engineering laboratories. (4)

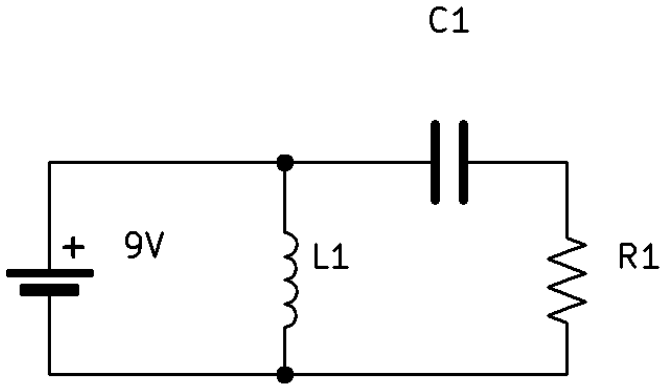
7.2 The reason that eating and drinking is not allowed in engineering laboratories. (2)

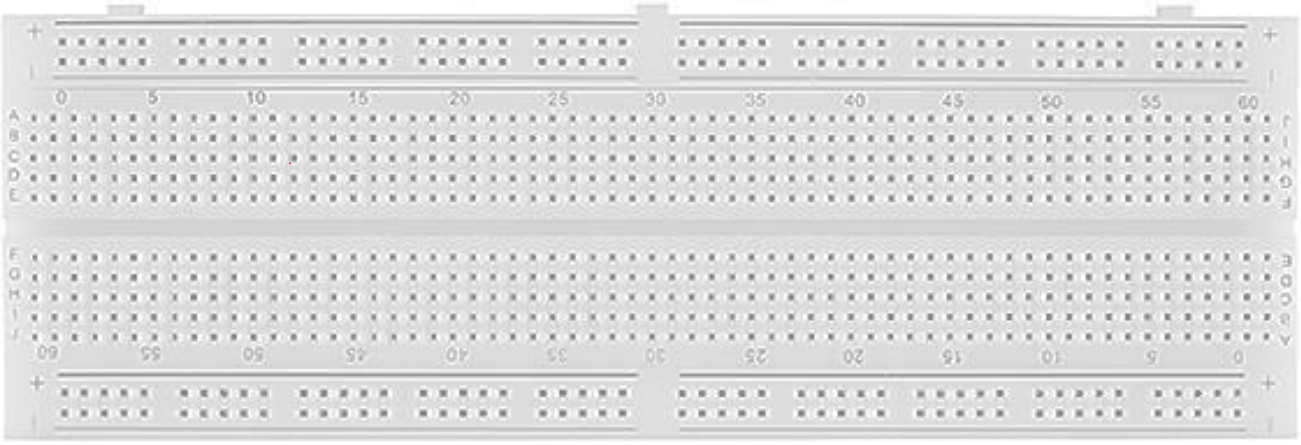
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Section B – 38 Marks Total

8 Sketch the following circuit diagram on the breadboard layout provided below: (8)





9 The resistor R1 has four bands: yellow, blue, red, silver. Determine the minimum, maximum and typical values of the resistor. (3)

10 Give two practical methods to differentiate between the anode and cathode of a typical through-hole LED. (4)

11 In typical high-efficiency power supplies, high-frequency switching techniques are used to convert voltages between different levels. The continuous switching creates high-frequency noise on the output of the power supply. What lab instrument would be most useful to measure and observe the noise at the output of such a power supply? Motivate your answer. (3)

12 Which of the following lines of MATLAB code implements the following equation? (4)

$$V = V_0 e^{-(\alpha+\beta \mathrm{i})}$$

Assume that MATLAB variables for each of the mathematical variables have been defined. **Select 2 of the options**.

A. `V = V0e(-alpha -beta i);`
B. `V0*e(-alpha-beta*i) = V;`
C. `V = V0*e(-alpha-beta*i);`
D. `V = V0*exp(-alpha-beta*i);`
E. `V = V0* exp(-alpha)*exp(-beta*i);`

13 The MATLAB variables `a` and `b` have been defined below:

```
a = [1, 4, 3; 1, -1, 0];
b = [2, 0, 5; 2, -1, -1];
```

Determine the values (showing all working out) of the variable `ans` for each of the following expressions. If an error occurs, explain why there is an error.

13.1 `a.*b` (3)

13.2 `a*b` (3)

13.3 `a*b'` (3)

14 You are designing an Arduino-based temperature sensor system using the LM35 temperature sensor. You want your system to send users a notification when there is a sudden change in the temperature. (7)

When a new temperature reading T_n is received, it is stored in variable `t1`.
The old temperature reading T_{n-1} should be moved to another variable `t0`.
A notification should be generated when the absolute temperature difference between readings is more than 1 degree Celsius, i.e. $|T_1 - T_0| > 1°\mathrm{C}$.

Sketch a flowchart showing the algorithm to be implemented for this system.