Bachelor of Science in Electrical and Electronic Engineering

EEE 400 (July 2022): Thesis

Title of Your Thesis We Tested a Very Very Long Title to See What Happens in This Case Then We Made it Longer and We Can Make It Even Longer Than Longer

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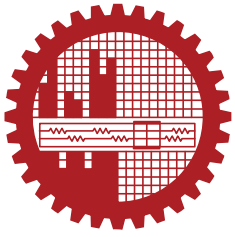

Department of Electrical and Electronic Engineering

Bangladesh University of Engineering and Technology

Dhaka, Bangladesh

May 2023

CANDIDATES' DECLARATION

This is to certify that the work presented in this thesis, titled, "Title of Your Thesis We Tested a Very Very Long Title to See What Happens in This Case Then We Made it Longer and We Can Make It Even Longer Than Longer", is the outcome of the investigation and research carried out by us under the supervision of Supervisor Name.

It is also declared that neither this thesis nor any part thereof has been submitted anywhere else for the award of any degree, diploma or other qualifications.

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CERTIFICATION

This thesis titled, **"Title of Your Thesis We Tested a Very Very Long Title to See What Happens in This Case Then We Made it Longer and We Can Make It Even Longer Than Longer"**, submitted by the group as mentioned below has been accepted as satisfactory in partial fulfillment of the requirements for EEE 400: Project/Thesis course, and as the requirements for the degree B.Sc. in Electrical and Electronic Engineering in May 2023.

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First Thesis Student Name

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ACKNOWLEDGEMENT

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Dhaka
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ABSTRACT

This sample abstract adheres to the guidelines set forth by the Department of Electrical and Electronic Engineering for undergraduate thesis submissions. It provides a concise overview of the research project, highlighting the objectives, methodology, findings, and implications. Please note that the content presented in this abstract does not represent an actual research study but is solely for illustrative purposes.

The abstract should follow the given rules:

Purpose: Clearly state the objective or problem the research aims to address within the field of electrical and electronic engineering. Provide a brief background to contextualize the research topic.

Methods: Briefly describe the research design, methodology, and techniques employed in the study. Highlight key components or aspects explored in the project.

Results: Summarize the major findings or outcomes of the research. Include quantitative or qualitative data, if applicable, to support the conclusions drawn.

Conclusion: Discuss the implications and significance of the research findings within the field of electrical and electronic engineering. Address any limitations encountered during the study and suggest potential areas for future research.

Sample Abstract:

This research project focuses on the design and analysis of power distribution systems for effective integration of renewable energy sources within microgrid environments. As the demand for clean and sustainable energy continues to grow, microgrids are emerging as promising solutions for local energy distribution and management. This study aims to develop robust and efficient power distribution systems that can accommodate renewable energy sources, such as solar panels and wind turbines, while ensuring reliable and stable operation.

The research employs a combination of simulation modeling and optimization techniques to assess different power distribution configurations and their performance under varying scenarios. Various factors, including power quality, system efficiency, and grid resilience, are considered during the analysis. The outcomes of the research provide valuable insights into the optimal design parameters, control strategies, and system architectures for microgrids integrating renewable energy sources.

The findings reveal that a carefully designed power distribution system, equipped with advanced control algorithms and energy storage solutions, can effectively handle the intermittency and variability of renewable energy sources. Through simulation experiments, it is demonstrated that optimized microgrid configurations result in improved overall system performance, enhanced power quality, and increased utilization of renewable energy resources.

However, the study acknowledges certain limitations, such as the assumptions made in the simulation models and the need for further validation through field tests. Future research could focus on real-time monitoring, advanced fault detection algorithms, and economic analysis of the proposed power distribution systems.

The research outcomes have significant implications for the field of electrical and electronic engineering, specifically in the domain of renewable energy integration and microgrid design. The findings contribute to the development of sustainable power distribution infrastructure, promoting the utilization of clean energy sources and reducing reliance on traditional fossil fuel-based grids.

Keywords: power distribution systems, renewable energy integration, microgrids, simulation modeling, optimization techniques, power quality, system resilience, clean energy.

Chapter 1

Introduction

This chapter is for your introduction.

1.1 Cross Referencing

We have incorporated the `\cref` or `\Cref` command from `cleveref` package in this system. This will automatically insert words like Figure, Table etc. in your text.

See these examples:

- Figure 1.1 is a sample figure.
- Table 1.1 is a table.
- Section 2.1 in Chapter 2 shows some examples of citations.
- Figure 1.3 is a vector figure drawn with Tikz.

1.2 How to Write a Section

This is for writing section.

1.3 How to Add Table and Figures

You should refer a figure as, "Figure 1.1 is a sample figure".

Then we applied same test cases to our modified algorithm i.e. the heuristic algorithm with our new operation *Block Reversal*. The performance is shown in Table 1.1.

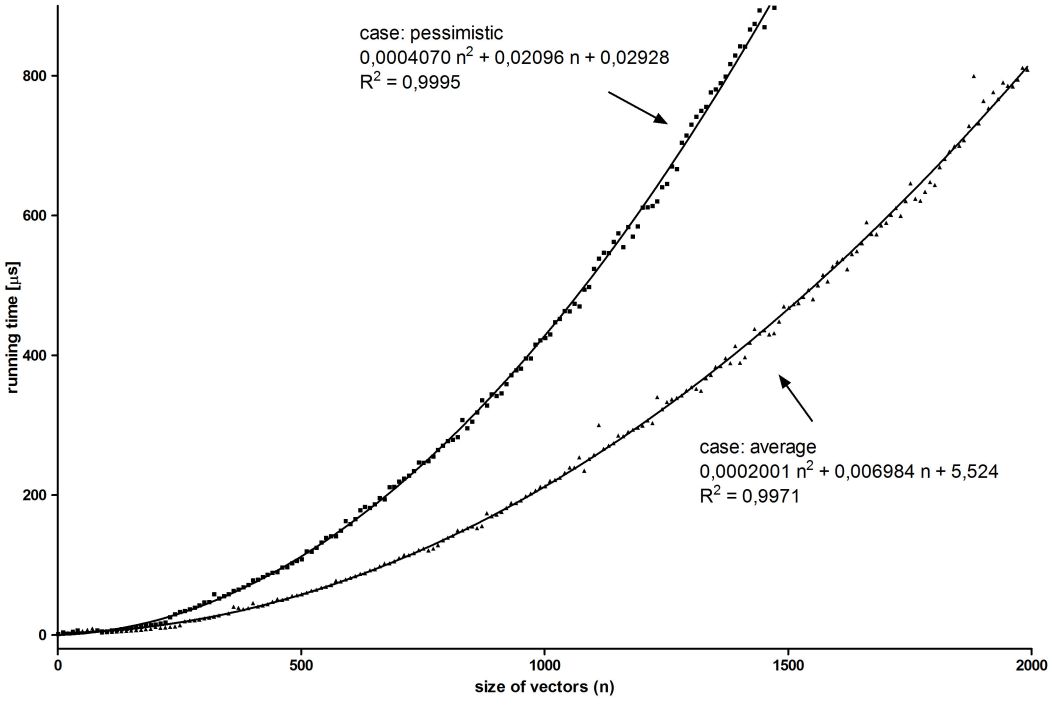

Figure 1.1: This is a sample figure.

Table 1.1: Performance table of *Block reversal* in a heuristic algorithm

α	αn	Test Cases											Average # of calculated operation
		1	2	3	4	5	6	7	8	9	10	11	
0.1	2	2	2	2	2	2	2	2	2	2	2	2	2
0.2	4	4	4	5	2	4	4	4	4	2	4	4	3.73
0.3	6	5	6	6	6	6	7	6	5	6	6	6	5.91
0.4	8	7	8	5	6	7	6	6	7	8	8	7	6.82
0.5	10	9	10	6	12	10	8	10	10	7	7	10	9
0.6	12	9	12	16	10	12	12	9	11	12	9	12	11.27
0.7	14	13	7	18	15	14	8	13	11	13	13	14	12.64
0.8	16	10	17	14	16	13	16	13	11	13	17	13	13.91
0.9	18	14	16	15	12	15	11	15	11	15	12	12	13.45
1	20	18	11	13	11	13	15	17	17	13	18	12	14.36

You can also use TikZ package to directly generate vector drawings. For example see Figure 1.3.

These are some dummy text used as page fillers only.

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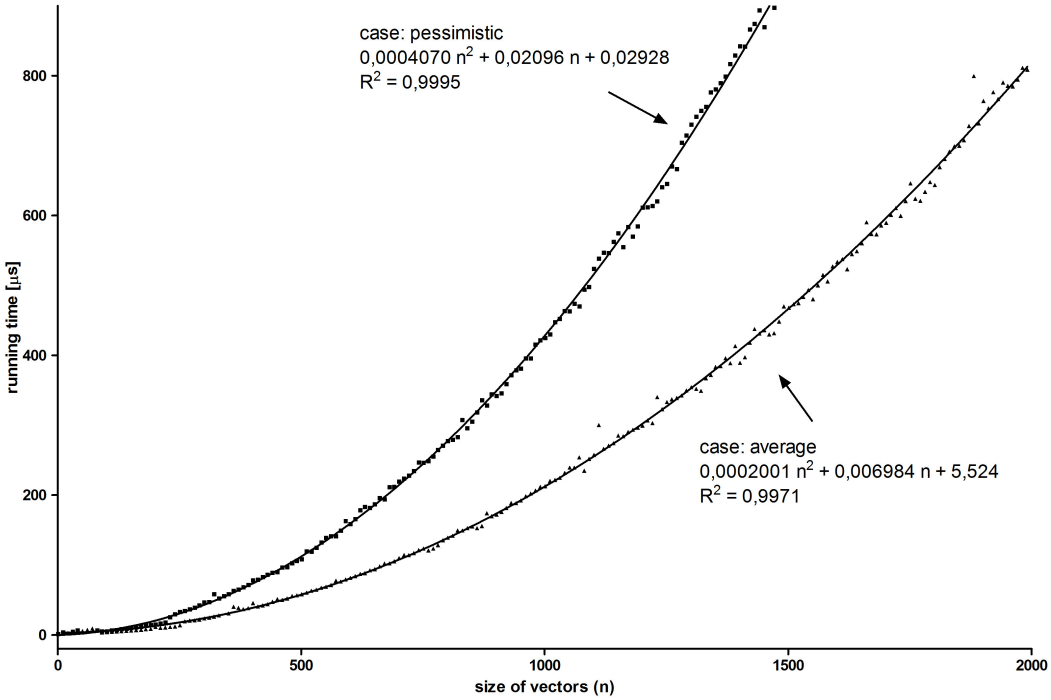

Figure 1.2: This is a sample figure.

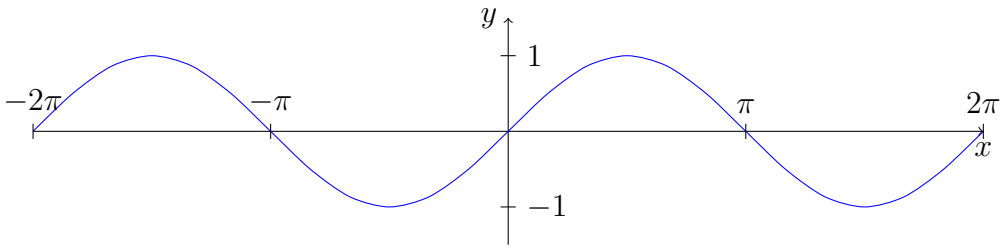

Figure 1.3: Sine Wave.

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Chapter 2

Literature Review

This chapter should be linked to PO(b), Identify, formulate, research literature, interpret data, and analyze complex electrical and electronic engineering problems using principles of mathematical, natural and engineering sciences.

In this chapter we show how we can cite the references.

2.1 See the Citations

According to [1], a reconfigurable broadband metasurface was developed with switchable functionalities in the visible range. In a comprehensive review by [2], the authors discussed the concept of biomimicry in nanotechnology. The work of [3] presented an all-optical reflection modulator reaching 85% efficiency for the 2μm waveband. Roy et al. [4] developed a custom gold-patterned rewritable optical disc-based plasmonic sensor for blood hemoglobin detection. The refractive index sensor based on a T grating on a nano-cavity array was presented by [5]. In the field of virus detection, [6] provided a review on plasmonic nano-biosensors with a focus on coronavirus. The work of [7] introduced a structurally tunable gear-shaped plasmonic sensor. A comprehensive review on colors with plasmonic nanostructures was presented by [8]. The roadmap on metasurfaces was outlined by [9]. The sensitivity to ambient refractive index was enhanced using tunable few-layer graphene/hBN nanoribbons [10]. Jiang et al. [11] demonstrated phase modulation with metasurfaces using gated ultra-thin TiN films. The material platforms for optical metasurfaces were discussed in [12]. Hybrid plasmonic waveguides formed by metal coating of dielectric ridges were investigated by [13]. A Pancharatnam-Berry phase manipulating metasurface for visible color hologram based on low-loss silver thin film was presented by [14]. Kim et al. [15] controlled the polarization state of light with plasmonic metal oxide metasurfaces.

Chapter 3

Methodology

3.1 Theoretical Framework

Some text.

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And some more.

This is a Subsubsection

Yet some more.

3.2 Design

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3.3 Design Considerations

This section should be linked to PO(c) Design/development Solution: Design solutions to complex engineering problems and design systems, components, or processes that meet the needs relevant to electrical and electronic engineering with appropriate considerations to public health and safety, cultural, societal, and environmental considerations. (K5).

3.3.1 Public Health and Safety Considerations

Write here...

3.3.2 Cultural, Societal, and Environmental considerations

Write here...

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3.4 Simulation and/or Experimental Methods

Make sure to evaluate and analyse the limits of your simulation tools (eg. accuracy, domain size etc.)

Should be linked to PO(e) Modern tool usage: Use techniques, skills, and modern engineering tools to solve complex and practical engineering problems related to electrical and electronic engineering with understanding of the limitations. (K6).

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Chapter 4

Results and Discussion

Write details of design of experiment, analysis, data interpretation. Should be linked to PO(d) Investigation: Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. (K8).

4.1 BUET

Bangladesh University of Engineering and Technology, abbreviated as BUET, is one of the most prestigious institutions for higher studies in the country. About 5500 students are pursuing undergraduate and postgraduate studies in engineering, architecture, planning and science in this institution. At present, BUET has sixteen teaching departments under five faculties and it has three institutes. Every year the intake of undergraduate students is around 900, while the intake of graduate students in Master's and PhD programs is around 1000. A total of about five hundred teachers are teaching in these departments and institutes. There are additional teaching posts like Dr. Rashid Professor, Professor Emeritus and Supernumerary Professors.

4.2 Campus

The BUET campus is in the heart of Dhaka — the capital city of Bangladesh. It has a compact campus with halls of residence within walking distances of the academic buildings. The physical expansion of the University over the last three decades has been impressive with construction of new academic buildings, auditorium complex, halls of residence, etc.

4.3 History

BUET is the oldest institution for the study of Engineering and Architecture in Bangladesh. The history of this institution dates back to the days of Dhaka Survey School which was established at Nalgola, in Old Dhaka in 1876 to train Surveyors for the then Government of Bengal of British India. As the years passed, the Survey School became the Ahsanullah School of Engineering offering three-year diploma courses in Civil, Electrical and Mechanical Engineering. In recognition of the generous financial contribution from the then Nawab of Dhaka, it was named after his father Khawja Ahsanullah. It moved to its present premises in 1912. In 1947, the School was upgraded to Ahsanullah Engineering College as a Faculty of Engineering under the University of Dhaka, offering four-year bachelor's courses in Civil, Electrical, Mechanical, Chemical and Metallurgical Engineering. In order to create facilities for postgraduate studies and research, Ahsanullah Engineering College was upgraded to the status of a University in 1962 and was named East Pakistan University of Engineering and Technology. After the War of Liberation in 1971, Bangladesh became an independent state and the university was renamed as the Bangladesh University of Engineering and Technology.

4.4 Students

Till today, it has produced around 25,000 graduates in different branches of engineering and architecture, and has established a good reputation all over the world for the quality of its graduates, many of whom have excelled in their profession in different parts of the globe. It was able to attract students from countries like India, Nepal, Iran, Jordan, Malaysia, Sri Lanka, Pakistan and Palestine.

4.5 Departments

Both Undergraduate and Postgraduate studies and research are now among the primary functions of the University. Eleven departments under five faculties offer Bachelor Degrees, while most of the departments and institutes offer Master's Degrees and some of the departments have Ph.D. programs. In addition to its own research programs, the university undertakes research programs sponsored by outside organizations like European Union, UNO, Commonwealth, UGC, etc. The expertise of the University teachers and the laboratory facilities of the University are also utilized to solve problems and to provide up-to-date engineering and technological knowledge to the various organizations of the country.

Chapter 5

Evaluation

5.1 Assessment of Issues

In this section, Apply reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions particular to your thesis.

Should be linked to PO(f) The Engineer and Society: Apply reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7).

5.1.1 Societal Issues

5.1.2 Health and Safety Issues

5.1.3 Legal and Cultural Issues

5.2 Evaluation of Environment and Sustainability

In this section, evaluate the sustainability and impact of your thesis work in societal and environmental contexts.

Should be linked to PO(g) Environment and sustainability: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7).

5.3 Ethical Issues

In this section, clearly mention how ethical principles and commitment to professional ethics and responsibilities was upheld during your thesis work. Mention responsible conduct of research, plagirism etc.

Should be linked to PO(h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7).

5.4 Future Works

In this section, discuss possible future works for your particular thesis work.

Should be linked PO(l) Life-long Learning: Recognize the need for, and ability to engage in life-long learning and know contemporary aspects related to the field of electrical and electronic engineering.

References

[1] Karim, E. and Choudhury, S.M. "Reconfigurable broadband metasurface with switchable functionalities in the visible range." *Optical Materials Express*, volume 13, no. 5:pp. 1409–1423, 2023. Open Access

[2] Himel, M.H., Sikder, B., Ahmed, T. and Choudhury, S.M. "Biomimicry in nanotechnology: A comprehensive review." *NanoScale Advances*, volume 5:pp. 595–614, 2023. Open Access

[3] Bhuiyan, M.A.H., Mitu, S.A. and Choudhury, S.M. "TiN-GST-TiN All-Optical Reflection Modulator for 2μm Waveband Reaching 85% Efficiency." *Applied Optics*, volume 61, no. 31:pp. 9262–9270, 2022. ArXiv

[4] Roy, H., Karim, E., Mondal, S. and Choudhury, S.M. "Custom Gold-Patterned Rewritable Optical Disc based Plasmonic Sensor for Blood Hemoglobin Detection." *Optics Continuum*, volume 1, no. 10, 2022. Open Access

[5] Abed, Y.F., Bhuiyan, M.A.H. and Choudhury, S.M. "T Grating on Nano-Cavity Array based Refractive Index Sensor." *J. Opt. Soc. Am. B*, volume 39, no. 9, 2021. ArXiv

[6] Hassan, M.M., Sium, F.S., Islam, F. and Choudhury, S.M. "A Review on Plasmonic Nanobiosensors for Virus Detection with a Focus on Coronavirus." *Sensing and Biosensing Research*, volume 33:p. 100429, 2021. Open Access

[7] Sarker, A., Mitu, S.A., Das, P. and Choudhury, S.M. "Structurally Tunable Gear-Shaped Plasmonic Sensor." *Optics Express*, volume 28, no. 24:pp. 36070–36083, 2020. Open Access

[8] Song, M., Wang, D., Peana, S., Choudhury, S., Nyga, P., Kudyshev, Z.A., Yu, H., Boltasseva, A., Shalaev, V.M. and Kildishev, A.V. "Colors with plasmonic nanostructures: A full-spectrum review." *Applied Physics Reviews*, volume 6, no. 4:p. 041308, 2019. PDF

[9] Quevedo-Teruel, O., Chen, H., Díaz-Rubio, A., Gok, G., Grbic, A., Minatti, G., Martini, E., Maci, S., Eleftheriades, G.V., Chen, M., Zheludev, N.I., Papasimakis, N., Choudhury, S., Kudyshev, Z.A., Saha, S., Reddy, H., Boltasseva, A., Shalaev, V.M., Kildishev, A.V.,

Sievenpiper, D., Caloz, C., Alù, A., He, Q., Zhou, L., Valerio, G., Rajo-Iglesias, E., Sipus, Z., Mesa, F., Rodríguez-Berral, R., Medina, F., Asadchy, V., Tretyakov, S. and Craeye, C. "Roadmap on metasurfaces." *Journal of Optics*, volume 21, no. 7:p. 073002, 2019. Open Access

[10] Jiang, H., Choudhury, S., Kudyshev, Z.A., Wang, D., Jiang, Y. and Kildishev, A.V. "Enhancing sensitivity to ambient refractive index with tunable few-layer graphene/hBN nanoribbons." *Photonics Research*, volume 7, no. 7:pp. 815–822, 2019. Open Access

[11] Jiang, H., Reddy, H., Shah, D., Kudyshev, Z.A., Choudhury, S., Wang, D., Jiang, Y. and Kildishev, A.V. "Modulating Phase by Metasurfaces with Gated Ultra-thin TiN Films." *Nanoscale*, volume 11:pp. 11167–11172, 2019. PDF

[12] Choudhury, S.M., Wang, D., Chaudhuri, K., DeVault, C., Kildishev, A.V., Boltasseva, A. and Shalaev, V.M. "Material platforms for optical metasurfaces." *Nanophotonics*, volume 7, no. 6:pp. 959–987, 2018. Open Access

[13] Zenin, V.A., Choudhury, S., Saha, S., Shalaev, V.M., Boltasseva, A. and Bozhevolnyi, S.I. "Hybrid plasmonic waveguides formed by metal coating of dielectric ridges." *Optics Express*, volume 25, no. 11:pp. 12295–12302, 2017. Open Access

[14] Choudhury, S., Guler, U., Shaltout, A., Shalaev, V.M., Kildishev, A.V. and Boltasseva, A. "Pancharatnam–Berry Phase Manipulating Metasurface for Visible Color Hologram Based on Low Loss Silver Thin Film." *Advanced Optical Materials*, volume 5, no. 13:p. 1700196, 2017. Open Access

[15] Kim, J., Choudhury, S., DeVault, C., Zhao, Y., Kildishev, A.V., Shalaev, V.M., Alù, A. and Boltasseva, A. "Controlling the Polarization State of Light with Plasmonic Metal Oxide Metasurface." *ACS Nano*, volume 10, no. 10:pp. 9326–9333, 2016. PDF

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Appendix A

Codes

A.1 Sample Code

We use this Matlab code to find out the transfer function of a third order nonlinear system.. . .

```
syms s x u

% Define the system dynamics (example equation)
f = u^3 + u^2*x + u*x^2 + x^3;

% Define the input and output variables
U = laplace(u);
X = laplace(x);

% Calculate the transfer function
TF = simplify(X/U);

% Display the transfer function
pretty(TF)
```

A.2 Another Sample Code

We use this Python code to plot the IV characteristics of a Photovoltaic cell.. . .

```
import numpy as np
import matplotlib.pyplot as plt

# Define the constants
Is = 1e-9  # Reverse saturation current (A)
n = 1.5  # Ideality factor
Vt = 0.025  # Thermal voltage (V)
Rs = 0  # Series resistance (ohms)
Rsh = 100  # Shunt resistance (ohms)
Iph = 0.1  # Photocurrent (A)

# Define the voltage range
```

```
V = np.linspace(0, 1, 100)

# Calculate the current using the Shockley diode equation
I = Iph - Is * (np.exp(V / (n * Vt)) - 1) - V / Rs

# Calculate the maximum power point (MPP)
P = I * V
mpp_index = np.argmax(P)
V_mpp = V[mpp_index]
I_mpp = I[mpp_index]

# Plot the I-V curve
plt.plot(V, I)
plt.scatter(V_mpp, I_mpp, color='red', label='MPP')
plt.axhline(0, color='black', linewidth=0.5)
plt.axvline(0, color='black', linewidth=0.5)
plt.xlabel('Voltage (V)')
plt.ylabel('Current (A)')
plt.title('I-V Characteristics of a Single Junction Solar Cell')
plt.legend()
plt.grid(True)
plt.show()
```

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