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ANNUAL RESEARCH REPORT

FACULTY OF ELECTRICAL ENGINEERING

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FACULTY OF ELECTRICAL ENGINEERING

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Deputy Dean Office (Research, Innovation and Development)
Faculty of Electrical Engineering

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PREFACE

This Annual Research Report 2023 aimed to share with the readers the research activities and short courses that were held throughout the year involving the members of Faculty of Electrical Engineering (FKE), Universiti Teknologi Malaysia. The differences in backgrounds and expertise of the faculty members have nourished versatility and diversity in the research conducted in FKE.

The first part of this report was comprised of research activities conducted by the faculty members under the FKE Centre of Excellence (CoE), Research Centre (RC) and Research Groups (RGs). It is hoped that the provided information will give a better view to the readers on the nature of the research and provide a platform for more potential collaborations with research institutions, industries, and communities within and outside of Malaysia. The second part of this report highlighted the short courses offered by the faculty members, which emphasize life long learning and personal skills enhancement.

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FOREWORD FROM DEAN

PROFESSOR DR. JAFRI DIN
Dean,
Faculty of Electrical Engineering,
Universiti Teknologi Malaysia,
Johor Bahru.

Assalamualaikum and Greetings,

I am honored to present the Annual Research Report 2023 for the Faculty of Electrical Engineering (FKE) at Universiti Teknologi Malaysia. This comprehensive report is a testament to the groundbreaking research and scholarly excellence that our faculty members have demonstrated over the past year. It provides a detailed overview of the exceptional academic work, dynamic activities, and notable achievements of all research groups affiliated with our faculty.

UTM has consistently raised the standard of excellence each year, guided by the ambitious Envision2025 framework. This strategic plan not only aims to empower the UTM community to thrive amidst contemporary challenges but also equips us to navigate and shape the future with resilience and innovation. The FKE research working committee has been at the forefront of this endeavor, meticulously organizing a variety of initiatives to align with the strategic goals of Envision2025. Their efforts have been instrumental in enhancing our research capabilities and outcomes.

The collaborative spirit and unwavering support of all our research groups have significantly amplified the impact of our research activities. Their active participation in faculty-led programs has directly contributed to a notable increase in the quality and quantity of our research outputs. This collective dedication has culminated in an outstanding performance in the Envision2025 assessment conducted by the Office of the Deputy Vice Chancellor (Research & Innovation).

A special acknowledgment must be given to our faculty members, whose contributions have been pivotal in numerous areas. Their work has led to high-impact publications, an increase in the number of principal investigators, and significant strides in consultation and training, industrial engagement and sponsorship, as well as product commercialization. This report encapsulates all these efforts, showcasing the dedication and expertise of the FKE staff throughout 2023.

As we look forward, I am filled with anticipation for the future achievements of our staff and students. Their innovation, commitment, and perseverance continue to drive us towards new horizons of success. I extend my deepest gratitude and appreciation to every member of the FKE staff and student body whose hard work and dedication have been integral to FKE's success in 2023. Your efforts have not only shaped the present landscape of our faculty but have also laid a solid foundation for our future endeavors.

FOREWORD FROM DEPUTY DEAN

PROFESSOR DR. SYED ABDUL RAHMAN SYED ABU BAKAR
Deputy Dean (Research, Innovation & Development),
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Universiti Teknologi Malaysia,
Johor Bahru.

Assalamualaikum, Salam Sejahtera, and Salam UTM Sanjungan Bangsa.

It is my great honour to welcome everyone with this year 2023 Faculty of Electrical Engineering, Universiti Teknologi Malaysia Annual Research Report.

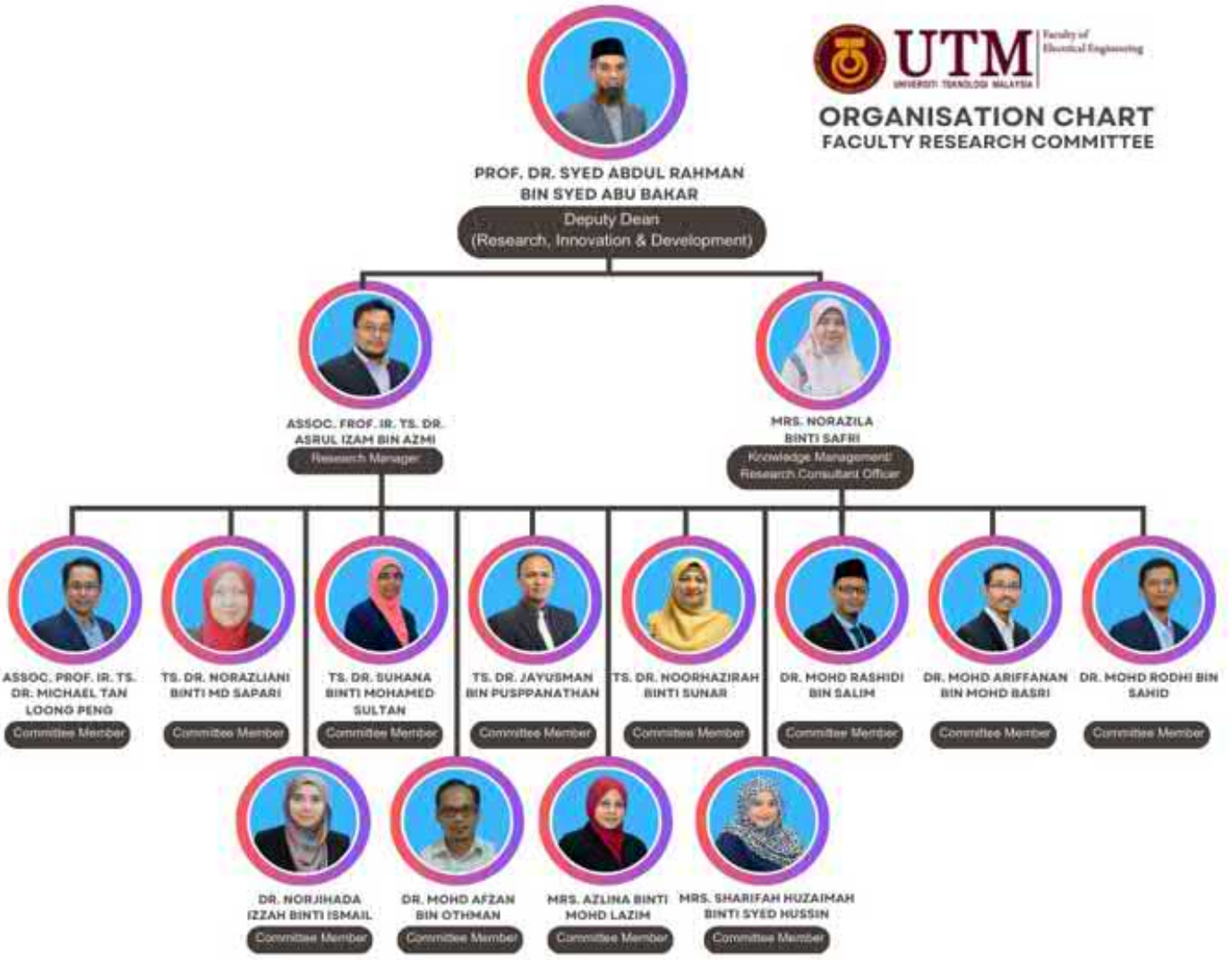
Being one of the national research universities, inevitably, research has been an important core business. It has been one of the key performance indices (KPI) for every staff to be engaged in research activities, and this includes indeed staff in the Faculty of Electrical Engineering or simply FKE. Hence, this annual research report is the consequence of achievements in research works conducted in 2023 by the staff of FKE.

Slightly different from the previous year, in this report, not only successfully completed research projects are highlighted, but also informative and valuable training courses conducted by FKE researchers are reported. Specifically, in this report, we have included 117 completed research projects, a significant increase by twofold compared to last year's annual research report. In addition, we have also reported 24 professional trainings and short courses that our researchers have carried out internally within the university as well as externally for industries, companies, and other communities.

Maintaining the same format as in the previous year, each completed project, training, and short course is limited to one page only consisting of both a summary and captivating pictures. Likewise, to ease the reader, this report has been arranged in accordance with the five core disciplines encompassing the FKE i.e. Communication Engineering, Control and Mechatronics Engineering, Electronics and Computer Engineering, Power Engineering, and Biomedical Engineering disciplines. Under these disciplines, the staff are positioned in either research centers or research groups based on their respective expertise and research areas.

It is hoped that with this report, research institutes, industries, government agencies, and communities at large will be able to benefit from our researchers by engaging and collaborating with them in solving real-world problems corresponding to our current tagline *Innovating Solutions*. Subsequently, accomplishing our slogan *In the Name of God for Mankind*. Hence, this report serves as a bridge between FKE and other entities in establishing engagement with these experts.

Finally, my special thanks to the committee members for their dedication in collecting, organizing, reformatting, and editing the materials to ensure the publication of this report in a timely manner. Thank you all and see you again in next year's edition of the FKE Annual Research Report.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UTM

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PROTOM

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BSP
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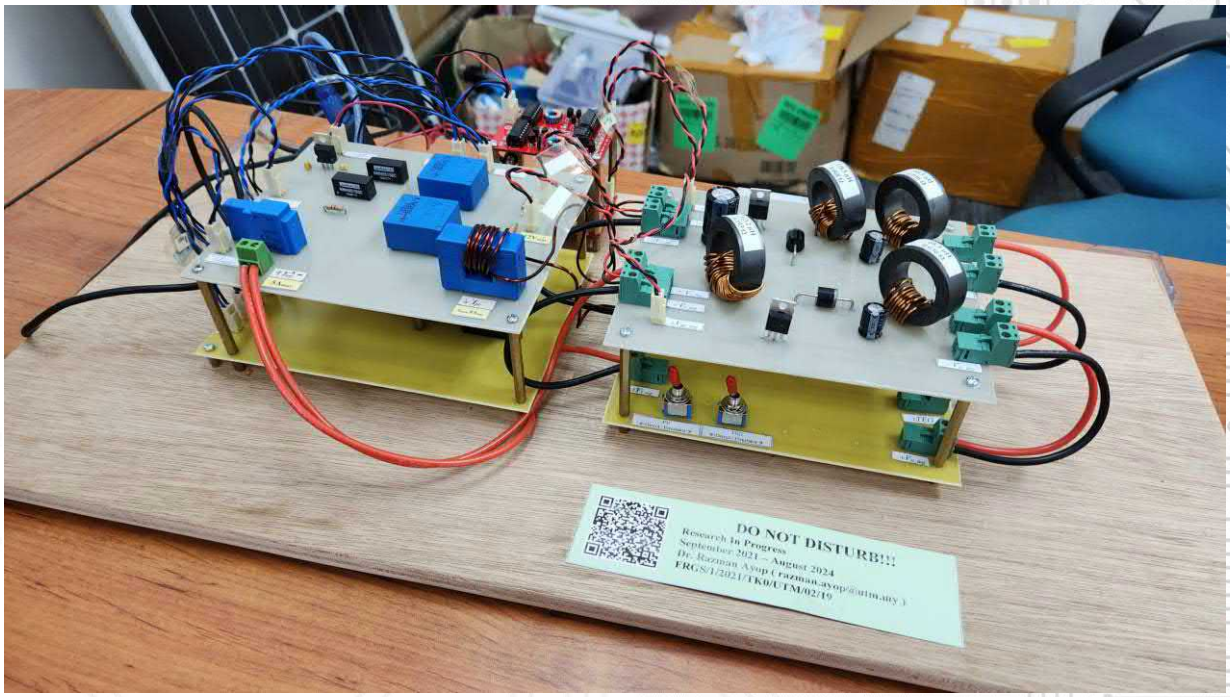
Medical Devices & Imaging, Biosensor, Medical Sciences, Rehabilitation & Clinical Decision Support System

DIAGNOSTIC

RESEARCH ACTIVITIES

Photovoltaic (PV) – Theromolectric Generator (TEG) Cogeneration System



PV generates heat when converting solar energy into electrical energy, which reduce the efficiency of the PV. TEG able to absorb the heat energy from the PV and produce electrical energy. The reduction of heat at PV increases its efficiency and the TEG produce additional energy. Power electronic converter research is done so that the energy produces by these PV-TEG cogeneration system (vary voltage and current) can be used by conventional load (required specific and fixed voltage).

This research will focus on the electrical part of this system, which specified more towards the effective sizing of passive components and effective maximum power point tracking (MPPT) of PV-TEG cogeneration system. The objective is to use an optimization algorithm called Ant-Lion Optimization (ALO) to solve MPPT problems faced by this system. The results from the PV-TEG cogeneration system are then compared with the conventional PV generation system.

To achieve these objectives, the PV-TEG modules need to be implemented. Their characteristics will be analysed and an accurate model will be simulated. The model is then used in simulation and hardware implementation of the ALO MPPT converter.

The outcome of this research is expected to show an increase in energy production for the PV-TEG cogeneration system compared to the PV-generation system. If the expected results are achieved, the use of ALO in PV-TEG MPPT and sizing can improve the current and future PV-generation system in Malaysia and the rest of the world.

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