UNIVERSITY OF KWAZULU-NATAL
HOWARD COLLEGE CAMPUS
SCHOOL OF ENGINEERING

SELECTED TOPICS IN ELECTRICAL ENGINEERING 1 (ENEL 4SA H1)

MAIN EXAMINATION

DATE: 8 JUNE 2026 **TIME: 2 HOURS** **FULL MARKS: 100**

STUDENTS ARE ADVISED TO FOLLOW THE INSTRUCTIONS BELOW:

- **BULLET-POINT ANSWERS ARE NOT ACCEPTABLE FOR DISCUSSIONS OR EXPLANATIONS**
- **USE BLACK BALL PEN ONLY**
- **ANSWER THE QUESTION(S) ON YOUR TOPIC AND THE QUESTION(S) ON ANY FOUR TOPIC(S) FROM THE REMAINING AND INDICATE THAT ON ANSWER BOOK COVER-PAGE**
- **ALLOCATED MARKS ARE INDICATED IN 'SQUARE BRACKETS' NEXT TO EACH QUESTION**
- **NO FORMULA SHEET WILL BE SUPPLIED**
- **STUDENTS CAN USE SCIENTIFIC CALCULATOR WITH A CLEARED MEMORY**

Question 1: A review on smart energy systems for smart cities **[20]**

(a) Discuss on how energy systems can achieve smartness to provide services to the smart cities. **[10]**
(b) Review on economic impact and future outlooks of smart energy systems for smart cities. **[10]**

Question 2: A review on energy management for smart cities **[20]**

(a) Discuss on energy management in smart cities and the challenges facing in this regard. **[10]**
(b) Analyse the aspects of energy management in smart cities. **[10]**

Question 3: A review on smart metering for smart cities **[20]**

(a) Discuss on smart meter hardware architecture and working principle. **[10]**
(b) Deliberate on smart meter data management systems. **[10]**

Question 4: A review on electric transportation system planning for smart cities **[20]**

(a) Analyse on the electric transportation technologies that could play significant role on electric transportation system planning for smart cities. **[10]**
(b) Present a debate on smart cities implementing electric transportation system. **[10]**

Question 5: A review on electric power scenario in South Africa **[20]**

(a) Discuss on structure of the electric supply industry in South Africa. **[10]**
(b) Review on grid integration challenges in regard electric power system in South Africa. **[10]**

Question 6: A review on applications of renewable energy systems in South Africa **[20]**

(a) Discuss on solar energy in connection with application of renewable energy systems in South Africa. **[10]**
(b) Analyse the benefits of application of renewable energy systems in South Africa. **[10]**

Question 7: A review on battery energy storage systems in South Africa **[20]**

(a) Analyse the importance of battery energy storage systems in connection with power systems in South Africa. **[10]**
(b) Discuss on architecture of battery energy storage systems. **[10]**

Question 8: A review on electricity market in South Africa **[20]**

(a) Analyse the emerging South African wholesale electricity market and decentralised solution in such connections. **[10]**
(b) Considering the electricity market in South Africa, discuss on the decentralised solutions. **[10]**

Question 9: A review on energy poverty in Africa **[20]**

(a) Analyse the impact of energy poverty households and industries in Africa. **[10]**
(b) Present a debate on the technical causes shaping the energy landscape in Africa. **[10]**

Question 10: A review on electric vehicle charging infrastructure in South Africa **[20]**

(a) Analyse the current state of electric vehicle charging infrastructure in South Africa considering generic electric vehicle infrastructure and architecture. **[10]**
(b) Make an argument on the challenges in regard to electric vehicle charging infrastructure in South Africa. **[10]**

Question 11: A review on energy efficient smart buildings **[20]**

(a) Discuss on the significance of energy efficient smart building concept and important considerations in such architectures. **[10]**
(b) Analyse the usage of smart materials in connection with energy efficient smart buildings. **[10]**

Question 12: A review on transformer condition monitoring **[20]**

(a) Provide an analysis on the transformer condition monitoring using breather monitoring. **[10]**
(b) Make an argument on the transformer condition monitoring using temperature as a parameter. **[10]**

Question 13: A review on transmission line insulator pollution **[20]**

(a) Analyse the sources of pollution of overhead transmission line insulator pollution. **[10]**
(b) Analyse the mitigation strategies of overhead transmission line insulator pollution. **[10]**

Question 14: A review on application of robots in electrical power systems **[20]**

(a) Review on the applications of the transmission line inspection robots and unmanned aerial vehicles in electrical power systems. **[10]**
(b) Analyse the usage of enabling technologies in connection with application of robots in electrical power systems. **[10]**

Question 15: A review on bio-inspired techniques in power systems **[20]**

(a) Analyse the scope and objectives of bio-inspired techniques used in power systems. **[10]**
(b) Present a debate on the application of genetic algorithm as one of the core bio-inspired techniques used in power systems. **[10]**

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