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Question Paper Code : 11261

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fifth/Sixth/Seventh/Eighth Semester

Electrical and Electronics Engineering

EE3014 — POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the major environmental impacts of fossil fuel-based power generation?
2. Draw the effect of irradiance variation on PV characteristics.
3. What is the role of slip in induction generator operation?
4. Tabulate the differences between SCIG and DFIG, considering various important performance parameters.
5. What is the function of DC-DC converters in a solar PV system?
6. How is the output of a solar PV system synchronized with the grid?
7. Why are back-to-back power electronic converters used in WECS?
8. What are the advantages of using matrix converters in WECS?
9. Justify the statement that hybrid renewable energy systems offer better reliability than single-source systems.
10. State the need for MPPT in renewable energy systems.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explicate the need to develop the new energy technologies. (4)
(ii) With the help of a neat block diagram, explain the principle of operation and construction of a fuel cell, and write some of the recent developments of the same. (9)

Or

- (b) Describe the different system components of a wind energy conversion system and explain the functioning of any three major components.
12. (a) Draw the typical power circuit diagram of a Doubly Fed Induction Generator (DFIG) system and explain its operation under sub-synchronous, synchronous, and super-synchronous modes.

Or

- (b) With suitable justification, compare PMSG and SCIG used in wind energy conversion systems. Explain the power electronic requirements, control capabilities, and other performance advantages of PMSG over SCIG.
13. (a) Draw the typical grid-connected PMSG wind energy conversion system and discuss the following grid-related problems (4)
(i) Inrush current. (3)
(ii) Stability limit. (3)
(iii) Load transient. (3)

Or

- (b) Using an appropriate solar PV source/load scenario, explain the working principle and function of boost and buck—boost converters in a solar PV system.
14. (a) (i) Explain the role and function of grid-interactive inverters in renewable energy conversion systems. (6)
(ii) Describe the role of inverters in renewable energy systems. List different PWM control techniques and explain the selection criteria for choosing an appropriate technique for a given system. (7)

Or

- (b) Explain the working principle of a matrix converter employed in Wind Energy Conversion Systems (WECS) with a neat schematic diagram. Further, describe its operation under real power control and reactive power control modes.

15. (a) Describe the operation of a diesel-PV hybrid system for a suitable load profile. Support your answer with a neat block diagram and discuss the limitations of the system.

Or

- (b) Analyze the working of a PV renewable energy system with a complete schematic diagram. Explain how the Perturb and Observe (P&O) MPPT algorithm improves energy harvesting from the system.

PART C — (1 × 15 = 15 marks)

16. (a) Develop a complete design of a solar photovoltaic (PV) system by selecting and sizing the inverter, battery bank, and PV array. Perform detailed numerical calculations using assumed design parameters and critically justify the design choices for optimal system performance.

Or

- (b) Analyze the energy sharing mechanism in a hybrid renewable energy system comprising wind, solar PV, and battery storage. Considering a suitable load pattern, illustrate the coordination among these sources using appropriate control strategies and power circuit schematics.

