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Question Paper Code: U5515

M.E. DEGREE EXAMINATION, NOV 2025

Professional Elective

Power Electronics and Drives

21PPE515– SOLAR AND ENERGY STORAGE

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART - A (5 x 20 = 100 Marks)

1. (a) Explain the important aspects of solar cell design that affect efficiency and draw the cross-section of a typical commercial solar cell. CO1- U (20)

Or

(b) Demonstrate the formation of a PN junction and explain the characteristics. CO1- U (20)

2. (a) Compare various controller topologies adapted for photovoltaic systems. CO2 - Ana (20)

Or

(b) Analyze the different approaches of the design for the stand-alone photovoltaic system. CO2 - Ana (20)

3. (a) Design a buck-boost converter-based maximum power point tracking (MPPT) system for a grid-tied solar PV application. Include circuit diagrams, component specifications, and control algorithms. Justify your design choices. CO3 - C (20)

Or

(b) Design an active power filter (APF) system integrated with a grid-tied PV inverter to mitigate harmonic distortion and improve power quality. CO3 - C (20)

4. (a) Analyze the Lithium-ion battery based on its 3.0 to 4.2v per cell range to optimize performance, efficiency, and range use in solar cell. CO4 - Ana (20)

Or

(b) Analyze the chemical reactions occurring in a battery, and assess how these factors influence the battery's performance, efficiency, and suitability for use in solar cell. CO4 - Ana (20)

5. (a) Design the following for a solar car CO5- C (20)
(i) Drive (ii) PV array size (iii) Controller (iv) Battery
(v) Protection components

Or

(b) Model the potential of solar cars in becoming a common vehicle CO5- C (20)
considering the following: 1) Cost, 2) Safety, 3) Current status
and 4) Potential problems and obstacles.