Ref. No: Ex/PE/PE/B/T/421B/2025

B.E. POWER ENGINEERING FOURTH YEAR SECOND SEMESTER EXAMINATION 2025

DESIGN OF HYBRID ENERGY SYSTEMS

Time: 3 Hrs. **Full Marks: 100**

Question Number		Marks
	Unit-I **(Answer any *two*; Marks: 20) (Q1-Q3 must be answered consecutively)**	
1.	a) Define hybrid energy system. Compare DC bus, AC bus and Hybrid bus systems. b) Define LOLP	2+5 3
2.	a) Explain the wind speed variation with height. b) What is capacity factor? How does it affect the power output from wind turbine?	4 2+4
3.	a) Write down the flow chart for P&O based MPPT algorithm. b) Briefly describe the Inverter Hysteresis Current Control with neat schematic.	5 5
	Unit-II (Answer any *two*; Marks: 20) (Q4-Q6 must be answered consecutively)	
4.	Define the following terms: i) Highest astronomical tide ii) Lowest astronomical tide and chart datum	5+5
5.	Explain the operation of tidal energy system with proper schematic diagram.	10
6.	Derive the expression of power in waves.	10
	Unit-III (Answer any *two*; Marks: 40) (Q7-Q9 must be answered consecutively)	
7.	a) A solar PV has an initial capital cost of $15,000, a replacement cost of $7,000, a lifetime of 10 years, and an operation and maintenance (O&M) cost of $50/yr. What is its annualized cost over a 25year project lifetime at an annual real interest rate of 5%?	20
8.	a) A wind turbine has a capital cost of $40,000 a replacement cost of $35,000, and a lifetime of 20 years. At the end of a 30-year project lifetime, what is its salvage value? b) Find total PV power and numbers of Series and parallel connected PV panels for a 12V DC bus PV system designed for 5000Wh/day energy requirement. Consider followings: η_{bat}=95%; η_{el}=90%; η_{dc}=80%; V_{oc}=18V, Energy produced (worst) =300Wh/day/Panel and P_{pv}=150W.	5 15
9.	a) What are the design constraints while designing a hybrid energy system consisting of PV, wind, battery, Diesel generator set and dummy load? b) Define the power management strategy while designing a hybrid energy system consisting of PV, wind, battery, Diesel generator set and dummy load.	10 10
	Unit-IV (Answer any *two;* Marks: 20) (Q10-Q12 must be answered consecutively)	
10.	a) What are technological challenges of ESS? b) What is Superconducting Magnetic Energy Storage (SMEs)?	5 5
11.	State the principle and briefly explain/demonstrate the operation of SMEs with an example.	10
12.	Explain the operation and utility of SCs/Battery hybrid storage in Wind Turbine system	10