Ref. No: Ex/PE/PE/B/T/421B/2023

B.E. POWER ENGINEERING FOURTH YEAR SECOND SEMESTER EXAMINATION - 2023

DESIGN OF HYBRID ENERGY SYSTEMS

Time: Three Hours **Full Marks: 100**

<table>
<tr><th>Question Number</th><th></th><th>Marks</th></tr>
<tr><td></td><td>Unit-I
(Answer any one; Marks: 30)</td><td></td></tr>
<tr><td>1.</td><td>a) i) Define the fuel consumption of diesel generator ii) Define LOLP.
b) Explain the power output variation for PV system with proper expression
c) Compare DC bus, AC bus and Hybrid bus systems.</td><td>5+5
10
10</td></tr>
<tr><td>2.</td><td>a) i) What is capacity factor? How does it affect the power output from wind turbine? ii) What are the advantages of optimal PMC?
b) Derive the expression for total net present cost of a system designed for 25 years?
c) Find total PV power and numbers of Series and parallel connected PV panels for a 24V DC bus PV system designed for 5000Wh/day energy requirement. Consider followings: η_{bat}=95%; η_{el}=90%; η_{dc}=80%; V_{oc}=43V, Energy produced (worst) =300Wh/day/Panel and P_{pv}=150W.</td><td>2+4+4
10
10</td></tr>
<tr><td></td><td>Unit-II
(Answer any one; Marks: 15)</td><td></td></tr>
<tr><td>3.</td><td>a) Write the significance of ocean energy systems in renewable energy systems.
b) Explain the operation of tidal energy system with proper schematic diagram.</td><td>5
10</td></tr>
<tr><td>4.</td><td>a) Define the following terms: i) Highest astronomical tide ii) Lowest astronomical tide and chart datum
b) Briefly explain the Operating cycle of a two-way barrage scheme with proper schematic.</td><td>5
10</td></tr>
<tr><td></td><td>Unit-III
(Answer any one; Marks: 30)</td><td></td></tr>
<tr><td>5.</td><td>a) Calculate the net present cost of a system designed for 30 years considering following data
<table>
<tr><th>Item</th><th>Price ( )</th><th>Replacement Cost ( )</th><th>OMC (%)</th><th>Scrap value (%)</th><th>Lifetime (Yrs.)</th></tr>
<tr><td>Wind Turbine (kW)</td><td>2500</td><td>1500</td><td>4</td><td>20</td><td>20</td></tr>
<tr><td>Civil work for wind (kW)</td><td>500</td><td>300</td><td>4</td><td>20</td><td>30</td></tr>
<tr><td>PV (kW)</td><td>1000</td><td>700</td><td>1</td><td>10</td><td>30</td></tr>
<tr><td>Civil work for PV (kW)</td><td>400</td><td>280</td><td>1</td><td>20</td><td>30</td></tr>
<tr><td>Converter(kW)</td><td>600</td><td>350</td><td>Nil</td><td>10</td><td>10</td></tr>
<tr><td>Battery (kWh)</td><td>200</td><td>120</td><td>3</td><td>20</td><td>5</td></tr>
</table>
b) Write down the flow chart for simulation program for lowest cost optimal designing of hybrid</td><td>15

15</td></tr>
</table>

[Turn over

	energy system considering minimized dummy load and maximized LOLP as other objective parameters	
6.	a) What are NPC, CRF, and COE?	5
	b) What do you mean by *objective function* in designing and optimization of hybrid energy system?	5
	c) What are the design constraints while designing a hybrid energy system consisting of PV, wind, battery, Diesel generator set and dummy load?	10
	d) Define the power management strategy while designing a hybrid energy system consisting of PV, wind, battery, Diesel generator set and dummy load.	10
	Unit-IV **(Answer any *one;* Marks: 25)**	
7.	a) What are different deterministic features of energy storage systems (ESS)?	5
	b) Compare the power and energy density of batteries, fuel cell and super capacitors? Briefly explain the application areas of each and state the reasons for such niche applications.	10
	c) What is Kinetic or Flywheel Electric Energy Storage (FEES)? State the principle and identify the application areas and briefly explain/demonstrate the operation with an example.	10
8.	a) What are technological challenges of ESS?	5
	b) What is Superconducting Magnetic Energy Storage (SMEs)? State the principle and briefly explain/demonstrate the operation of SMEs with an example.	10
	c) Explain the operation and utility of SCs/Battery hybrid storage in Wind Turbine system	10