UNAM
UNIVERSITY OF NAMIBIA

FACULTY	ENGINEERING AND INFORMATION TECHNOLOGY		
DEPARTMENT	ELECTRICAL AND COMPUTER ENGINEERING		
SUBJECT	RENEWABLE ENERGY TECHNOLOGIES		
SUBJECT CODE	I3772ER/TECC3792		
DATE	OCTOBER/NOVEMBER 2024		
DURATION	3 HOURS	**MARKS**	100

Second Opportunity Examination

Examiner: AT NDAPUKA

Internal Moderator: DR. D. K. CHEMBE

External Moderator: PROF. J. TSADO

This question paper consists of **2** pages including this front page.

Instructions

1. This examination paper consists of FIVE questions.
2. Each question carries 20 marks, distributed as indicated.
3. Answer ALL questions.
4. Clearly show your working and sketch good label diagrams where required.

Question 1: [20 Marks]

1.1. Mention the FOUR (4) main CSP technologies and discuss their advantages and disadvantages with regard to the Namibian conditions. [20]

Question 2: [20 Marks]

Ohorongo Cement factory has decided to install a 5 MW_{AC} grid-connected solar PV system at its plant near Otavi Town. The system is equipped with a single-axis tracking and it operates at rated conditions for 8 hours a day. Assuming a 0.8 derate factor, answer the following questions.

2.1. Calculate the total energy delivered by this system in a year. [4]

2.2. Determine the DC power rating of the system. [2]

2.3. The plant employs string inverter system. Explain string inverter setup and its THREE (3) advantages. [4]

2.4. Discuss FIVE (5) possible benefits that this plant can provide to Ohorongo Cement factory. [10]

Question 3: [20 Marks]

Ruacana Hydropower Station is a run-off-the-river type with an average flow rate of 68 m^3/sec and 4 generator units. The penstocks have an elevation drop of 140 m from the intake to the turbine-generator shed and a diameter of 3.6 m. The total head losses in the penstock is estimated to be 5 m each. Each turbine-generator unit is expected to have a rated efficiency of 90%.

3.1. Discuss FIVE (5) advantages of hydropower. [10]

3.2. Calculate the rated power of the generator unit in kW. [5]

3.3. Calculate the expected annual energy output of the power station. Ignore seasonal fluctuations. [5]

Question 4: [20 Marks]

An in-stream tidal power system consisting of an underwater 11 m diameter, horizontal axis turbine delivers its rated power of 300 kW in 2.4 m/s currents.

4.1. List and explain three (3) methods used to harvest tidal energy [6]

4.2. What is the efficiency of this system at that current speed? [5]

4.3. In those currents what will be the blade rpm and the blade tip speed if it operates with a TSR = 5.0. [4]

4.4. Assume the system operated the whole year in waters with average power of 323 kW while the average efficiency of the system is 60% of its rated power. How much energy would the turbine deliver and what would be its capacity factor? [5]

Question 5: [20 Marks]

Explain the functional duties and the main features of the following components of the wind turbine.

5.1 Yaw Control [4]

5.2 Brake [4]

5.3 Gearbox [4]

5.4 Rotor blades [4]

5.5 Pitch Mechanism [4]

END.