

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech. Summer 2021 - 22 Examination

Semester: 8
Subject Code: 203106481
Subject Name: Wind and Solar Energy Systems

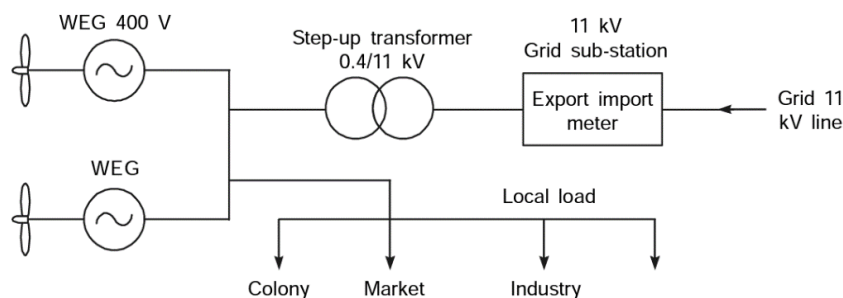
Date: 30/03/2022
Time: 10:30 AM to 1:00 PM
Total Marks: 60

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

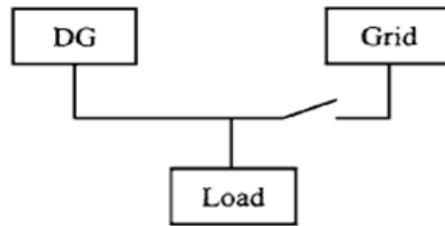
Q.1 Objective Type Questions**(15)**

1. Wind at one standard atmospheric pressure with air density 1.226 kg/m^3 and 15°C has a speed of 10 m/s . A 10 m diameter wind turbine is operating at 5 rpm with maximum efficiency of 40% . The axial thrust on turbine structure is _____ N.
 - a) 4018.50
 - b) 4277.40
 - c) 4618.20
 - d) 4824.90
2. An approach that employs small-scale technologies to produce electricity close to the end users of power is known as _____.
 - a) Distributed Generation
 - b) On-Site Generation
 - c) Distributed Energy Resources
 - d) All of these
3. For _____ type of relay, operating time depends on magnitude of operating current.
 - a) Definite - time overcurrent relay
 - b) Inverse time overcurrent relay
 - c) Instantaneous overcurrent relay
 - d) None of these
4. _____ is a vertical angle between the direction of the sun's rays (passing through the point) and its projection on the horizontal plane.
 - a) Altitude Angle (α)
 - b) Hour Angle (ω)
 - c) Zenith Angle (θ_z)
 - d) Surface Azimuth Angle (γ)
5. You have 5 solar panels, 4 of which have a 6 V , 2 A output and 1 with a 12 V , 1 A output. What will be the output voltage, current and power?
 - a) 12 V , 10 A , 60 W
 - b) 12 V , 10 A , 40 W
 - c) 12 V , 5 A , 60 W
 - d) 12 V , 15 A , 40 W
6. Wind Power Generation System shown in figure below is working in _____ mode.



7. The wind speed at which wind turbine starts to operate is known as _____.
8. Device number for inverse time overcurrent relay according to IEEE Standard for Electrical Power System Device Function Numbers, Acronyms and Contact Designations is _____.
9. The radiation received on a terrestrial surface (scattered by aerosols and dust) from all parts of the sky dome, is known as _____ radiation.

10. Figure shown below is _____ type of DG connection / operation with electrical system.



11. Group of several PV modules electrically connected in a series-parallel combination to generate the required current and voltage is called as _____.

12. _____ is a small-scale power grid that can operate independently or collaboratively with other small power grids.

13. In power system, allowable variation of frequency is _____.

14. _____ type of inverter used in solar PV system match phase with a utility-supplied sine wave and are designed to shut down automatically upon loss of utility supply, for safety reasons.

15. _____ islanding detection is based on monitoring of grid variables, such as frequency, voltage, phase angle, or particular harmonic by a dedicated algorithm residing in the control of DG or outside in a dedicated device, such as relay.

Q.2 Answer the following questions. (Attempt any three) (15)

- A) Define distributed generation. How it is classified?
- B) Derive theoretical maximum efficiency of wind energy conversion system is 59%.
- C) What are the advantages and disadvantages of using Solar PV System for Power Generation?
- D) Explain in detail about Yaw Control used in wind turbine.

Q.3 A) What are the different Power Electronics Interfaces available for interconnecting Wind and Solar Energy Sources with Distribution System? Explain along with concept of Point of Common Coupling (PCC). (07)

B) What is the function of Maximum Power Point Tracker in Solar PV System? Explain in detail along with its features. (08)

OR

B) Design a Wind turbine for an industry having annual energy requirement of 20000 kWh with following assumptions: (08)

- Annual energy requirement: 20000 kWh
- Propeller type wind machine is used
- Coefficient of performance: 0.40
- Wind speed at 15 meter height is 5 meter/sec
- Density of air: 1 kg/m³
- Capacity factor: 0.30 (i.e., 30% of the time, wind machine is producing energy is rated power)
- Number of hours in a year: 8760 hours

Q.4 A) How it is advantageous to use DFIG with Rotor Converter technology in Wind Power Generation System? Explain about DFIG with Rotor Converter technology in detail. (07)

OR

A) The current rating of an over current relay is 5 A. The relay has a plug setting of 150 % and time multiplier setting of 0.4. The CT ratio is 400/5. Determine the operating time of the relay for a fault current of 6000 A. At TMS=1, operating time at various PSM are given in following table: (07)

| | | | | | | |
|---------------------------|----|---|---|---|-----|-----|
| PSM | 2 | 4 | 5 | 8 | 10 | 20 |
| Operating time in Seconds | 10 | 5 | 4 | 3 | 2.8 | 2.4 |

B) What are the protection issues which may occur because of introducing Wind and Solar Energy Systems in Distribution System? Explain each in detail. (08)