BITS, PILANI K K BIRLA GOA-CAMPUS

SEMESTER-I, 2022-2023

COURSE: EEE_INSTR F473 WIND ELECTRICAL SYSTEMS; ME F483 WIND ENERGY

DATE: 22/12/2022; TIME: 10 A.M. TO 1.00 P.M.; REG, OB/CB, WT 35%; MM: 70

COMPREHENSIVE EXAMINATION {PART_A & PART-B}

Instructions:

1. **Question Paper is presented in two parts- PART-A {OB, 2 HRS, 4 Questions, 10 Marks each} and PART-B {CB, 1 HR, 3 Questions, 10 Marks each}. PART-B can be answered ONLY after submitting Answer Book for PART-A.**
2. **In Each Part, the questions are categorized thematically as indicated by "#..." line. Write answers to sub-questions so as to be relevant to the given '#...' theme.**
3. **While attempting PART-A (OB), access to printed material ONLY is permitted, including the prescribed Text Book(s) and Reference book(s), SSR and hand-written class-notes.**
4. **Write complete answers to questions in the order these are presented category wise. Identify your answer with correct question number (main & sub-question number). Avoid writing statement of the Question. In the case when you decide not to answer a question (main or sub-question) write "NA" (for Not Attempted) against the Question (main or sub-question).**
5. **Only complete and conclusive answers, relevant to the given theme, will be considered for award of marks as indicated. Irrelevant and/or invalid answers may be awarded equivalent negative marks.**

PART-A {OPEN BOOK, 2 Hrs, 4 Qs, 10 Marks each}

#1 In the interest of a potential wind power developer in India, describe your response to each of the following challenges:

a) Describe achievements in wind power generation in India, giving current facts and figures in support of your response.
b) Identify potential sites for installing WPP of Type-A, Type-B, Type-C or Type-D.
c) Describe technical specifications such as Make or Manufacturer's name, generation capacity, aerodynamic and power control strategies, for different types of WPP to be installed.
d) Estimate land area (acres or hectares) required for setting up a grid-integrated wind farm with minimum 20 MW generation capacity.
e) State essential requirements of a wind farm operator for entering into a power purchase agreement with the local utility.

#2 In the interest of a wind farm operator at a given site, state factors to be considered, in each of the below-mentioned cases:

a) Requirements of the wind farm operator to be fulfilled by the grid-operator for continuing power generation in grid-integrated mode.
b) Requirements of the grid operator to be fulfilled by the wind farm operator for continuing power generation in grid-integrated mode.
c) Requirements of operational conditions which must be maintained for stable grid-connection and minimizing system-wide impacts.
d) Requirements of operating the wind farm in an islanding mode.
e) Requirements of the fault-ride through capability to be fulfilled by a wind power plant.

#3. State a rule of thumb useful for performance analysis of a grid-integrated wind farm, in each of the below-mentioned cases:

a) Range of acceptable specific rating for a large turbine, representing the best compromise among the energy capture, wind loading of the components and the costs involved.
b) Range of acceptable braking torque for a Type-C WPP having 2.5 MW rating, and the aerodynamic torque rating of 240,000 Nm.
c) Range of acceptable pitch angle in active stall controlled rotor blade.
d) Range of acceptable rotor's speed (RPM) for a Type B WPP which has a three-bladed rotor and a gearbox which provides 2% speed regulation for gear ratio 1:1500.
e) Range of estimated land requirement for setting up wind farm of 20 MW capacity, consisting of four WPPs of diameter 90 m, each**.**

#4. State names of technologies employed for wind power generation, in each of the following cases:

a) Wind power plants employing (i) scalar control technique and, (ii) vector control technique.
a) Minimizing reactive power requirement, cooling requirement for gear-box, enhancement of fault ride through capability and minimizing generation of harmonics under normal operating conditions.
b) Wind power plant operating under either of the two following conditions: (i) the generator operates with a positive slip as per standard convention, (ii) the generator operates with a negative slip, as per standard convention.
c) Wind power plant implementing feed-forward as well as feed-back control strategies for maximizing wind energy capture and electric power generation.
d) Economic scheduling of power generation in grid-integrated mode.

----------END OF PART-A----------

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PART-B {CLOSED BOOK, 1 Hr, 3 Questions, 10 Marks each}

#1. In the interest of promoting wind power for sustainable development in India, state recommendations in each of the below-mentioned cases:

a) Innovative financial mechanisms for increasing wind power generation capacity.
b) India's leadership role in promoting power generation from renewable energy sources and commitment to international community.
c) Penetration of wind power generation for displacing non-renewable energy based power generation capacity.
d) Tapping potential social-economic benefits of wind power generation to community.
e) Enhancement of Government's role and support to wind power developers.

#2 Options for wind turbine design development.

a) State options for selecting a gear-box for a wind power plant.
b) State options for selecting strategies for aerodynamic regulation techniques.
c) State significance of center point of an aero-foil section in selection of rotor blade profile.
d) State range of options for selecting a topology for Type-D wind power plant.
e) State names of unique materials used for wind turbine rotor blade and permanent magnets in permanent magnet synchronous generator.

#3 Decision making in wind power generation.

a) State reasons for not using squirrel cage induction generator or wound rotor induction generator in Type-D wind power generation.
b) State reasons for operating a non-ideal Type C WPP in a particular region of operation, bounded by practical wind speeds, to capture maximum energy in the wind.
c) State reasons for higher preference to a semi-geared hydrodynamic hybrid Type-D WPP, in a given case, over a Direct Drive Type-D WPP.
d) State reasons for operating a doubly fed induction generator coupled to a grid, in (i). a sub-synchronous generating mode and, (ii). A sub-synchronous motoring mode.
e) State reasons for operating a given wind power plant in a narrow range of tip-speed ratio for the wind power plant, to generate maximize wind energy capture at a given site.

----------END OF PART-B----------