Reg. No.																

Question Paper Code	14566

M.E. / M.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Second Semester

M.E. - Power Electronics and Drives

24PPEEL216 - WIND ENERGY CONVERSION SYSTEMS

Regulations - 2024

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Power obtained from wind depends on: a) Wind speed b) Rotor swept area c) Air density d) All of the above	1	K3	CO1
2.	WECS stands for: a) Wind Energy Control System b) Wind Electric Circuit System c) Wind Energy Conversion System d) Water Energy Conversion System	1	K1	CO1
3.	The maximum theoretical efficiency of a wind turbine is a) 40% b) 50% c) 59.3% d) 75%	1	K2	CO1
4.	The ratio of the speed of the tips of the wind turbine blades to the speed of the actual wind is known as: a) Power Coefficient b) Tip Speed Ratio c) Solidity d) Aspect Ratio	1	K3	CO2
5.	Which type of control involves rotating the blades around their long axis to change the angle of attack? a) Yaw Control b) Stall Control c) Pitch Control d) Brake Control	1	K1	CO2
6.	Which of the following blade profiles is most commonly used in modern wind turbine rotors to maximize lift-to-drag ratio? a) Flat plate profile b) Aerofoil (Airfoil) profile c) Circular profile d) Square profile	1	K2	CO2
7.	In a Fixed Speed Wind Turbine system, which generator is most commonly used due to its ruggedness and low cost? a) Doubly Fed Induction Generator (DFIG) b) Permanent Magnet Synchronous Generator (PMSG) c) Squirrel Cage Induction Generator (SCIG) d) Shunt DC Generator	1	K2	CO3
8.	Which component of the wind turbine model accounts for the rotating masses and the stiffness of the shafts? a) Pitch model b) Drive Train model c) Generator model d) Wind Speed model	1	K1	CO3
9.	A "Constant Speed Constant Frequency" (CSCF) system is characterized by: a) A power converter that adjusts frequency b) The turbine speed varying with wind velocity c) The rotor being directly connected to the grid via a transformer d) Minimal mechanical stress on the drive train	1	K3	CO3

10.	PMSG based WECS often eliminates the need for a) Rotor blades b) Gearbox c) Transformer d) Tower	*1*	*K3*	*CO4*
11.	What is the primary advantage of a Permanent Magnet Synchronous Generator (PMSG) in variable speed systems? a) It requires a large gearbox b) It is the cheapest generator available c) It eliminates the need for external DC excitation and often the gearbox (Direct Drive) d) It can only operate at one specific wind speed	*1*	*K2*	*CO4*
12.	Variable speed wind turbines use power electronic converters primarily to: a) Increase the mechanical weight of the nacelle b) Decrease the total energy yield c) Decouple the generator frequency from the grid frequency d) Eliminate the need for a yaw system	*1*	*K1*	*CO4*
13.	What does the term "Low-Voltage Ride Through" (LVRT) signify in wind energy systems? a) The ability of the turbine to shut down instantly during a voltage dip. b) The process of increasing the voltage output to compensate for grid loss. c) The ability of the turbine to remain connected to the grid during short d) Operating the turbine only when the grid voltage is at its peak.	*1*	*K3*	*CO5*
14.	Ramp rate limitations are imposed on wind farms primarily to: a) Increase the mechanical wear and tear of the blades. b) Prevent sudden fluctuations in power output that could destabilize the grid frequency. c) Ensure the wind turbine reaches maximum speed as fast as possible d) Stop the turbine during high wind speeds.	*1*	*K2*	*CO5*
15.	Which of the following is considered an "Ancillary Service" a) Blade cleaning and maintenance. b) Marketing the energy to residential users. c) Reactive power support for voltage control. d) Tower structural analysis.	*1*	*K1*	*CO5*
16.	Which of the following describes the "Synthetic Inertia" provided by modern variable-speed wind turbines? a) The use of heavy mechanical flywheels installed at the base of the tower. b)The process of shutting down the turbine when the grid frequency exceeds 50Hz. c) A control strategy that temporarily increases active power output by extracting kinetic energy from the rotating blades during a grid frequency drop. d) A method of increasing the physical weight of the turbine blades to match traditional steam turbines	*1*	*K3*	*CO5*

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)

Answer ALL Questions

17.	A wind turbine rotor has diameter 30 m operating at wind speed 11 m/**s**. Examine the maximum extractable power using Betz limit**.**	*3*	*K3*	*CO1*
18.	Apply the aerodynamic principle of a wind turbine to get maximum power output.	*3*	*K3*	*CO1*
19.	Identify the various control strategies of WECS and explain the "Yaw Control".	*3*	*K3*	*CO2*
20.	Classify the various wind turbines and compare HAWT and VAWT.	*3*	*K4*	*CO2*
21.	Compare synchronous generator and induction generator used in wind turbines.	*3*	*K4*	*CO3*

22.	How will you make use of ancillary services for frequency and voltage control in WECS?		*3*	*K3*	*CO4*
23.	Analyze the operating characteristics of variable-speed wind energy systems employing DFIG and PMSG.		*3*	*K4*	*CO4*
24.	Illustrate current industry practices in wind farm grid integration.		*3*	*K3*	*CO5*

PART - B (Descriptive Answer Questions)

(5 × 12 = 60 Marks)

Answer ALL Questions

25.	a)	Apply the concept of wind energy conversion system to derive the equation for power obtained from wind.	*12*	*K3*	*CO1*
		OR			
	b)	Make use of simple momentum theory to determine the maximum power that can be extracted from wind flowing through a turbine with a known wind speed and rotor area.	*12*	*K3*	*CO1*
26.	a)	Derive the expression for the power developed by a wind turbine and explain the concept of Betz's Limit.	*12*	*K3*	*CO2*
		OR			
	b)	Apply the concept of maximum power extraction schemes to explain how wind turbines achieve optimal energy conversion.	*12*	*K3*	*CO2*
27.	a)	Demonstrate the configuration and operation of a Squirrel Cage Induction Generator (SCIG) in Fixed Speed Wind Systems. Include its advantages and limitations.	*12*	*K3*	*CO3*
		OR			
	b)	Identify the impact of wind speed characteristics on fixed speed system operation.	*12*	*K3*	*CO3*
28.	a)	Analyze why a synchronous generator is employed in variable speed wind energy conversion scheme and mention the advantages.	*12*	*K4*	*CO4*
		OR			
	b)	Examine variable speed constant frequency and variable speed variable frequency schemes.	*12*	*K4*	*CO4*
29.	a)	Examine the challenges associated with grid integration of wind energy systems.	*12*	*K4*	*CO5*
		OR			
	b)	Analyze the importance of ancillary services for maintaining power quality in WECS.	*12*	*K4*	*CO5*