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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2024

ELECTRICAL AND ELECTRONICS ENGINEERING
Seventh Semester
EE5009 Power Electronics for Renewable Energy Systems
(Regulation2019)

Time:3hrs Max.Marks: 100

CO1	To study the principle of generation of different renewable energy sources.
CO2	To model the electrical machines used for renewable energy conversion systems.
CO3	To analyse the power converters used for renewable energy systems.
CO4	To analyse the operation of standalone and grid integrated renewable energy systems.
CO5	To study the hybrid operation of wind and PV systems and features of MPPT tracking.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10 x 2 = 20 Marks)

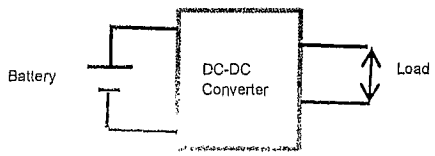
Q.No.	Questions	Marks	CO	BL
1	List any four primary Green House Gases and ways to reduce these gas emissions.	2	CO1	L4
2	What are the sources of biomass energy?	2	CO1	L1
3	Draw the stator-referred steady state T-form circuit model of Induction machine.	2	CO2	L4
4	State the advantages of analyzing the electrical machines using dynamic d-q model.	2	CO2	L4
5	Define DOD and SOC in relevance with battery.	2	CO3	L1
6	Differentiate the passive and active stall control in wind turbine.	2	CO3	L4
7	Specify the drawbacks of fixed speed WEC system.	2	CO4	L2
8	Mention the problems faced in connecting a renewable energy system to the grid.	2	CO4	L4
9	Give the principle involved in extraction of maximum power from solar PV system.	2	CO5	L4
10	What is the range of hybrid system?	2	CO5	L1

PART- B (5 x 13 = 65 Marks)

Q.No.	Questions	Marks	CO	BL
11 (a)	Explain in detail, the ways of obtaining electrical energy from ocean energy.	8	CO1	L2
	Discuss in detail, the impact of ocean energy generation on environment?	5	CO1	L2
	OR			
11 (b) (i)	Explain the process of electric energy generation from solar cells with equivalent circuit. What are the impacts of its generation on the environment?	8	CO1	L2
(ii)	Discuss the output characteristics of PV module for different insolation and temperature levels.	5	CO1	L2
12 (a) (i)	Derive the DQ model of Permanent magnet Synchronous Generator.	8	CO2	L4
(ii)	Consider a surface PM pole rotor PMSG with R_s = 10Ω, $L_s = L_d = L_q$ =0.05H, ψ_{PM1}=0.8 Wb, and p_1= 2 pole pairs that have to deliver	5	CO2	L3

	power into a three-phase resistance of R_L= 10 Ω/phase at the speed n_1=2000 rpm. Calculate the phase voltage, current and power delivered to the load resistance, also the voltage and current power angles δ_v, δ_I.			
	OR			
12 (b)	Derive the expression for active and reactive power of induction machine under balanced conditions using d-q transformation.	13	CO2	L4
13 (a) (i)	A three-phase diode bridge is supplied by a synchronous generator whose excitation emf is 1.06 p.u. and synchronous reactance is 0.25 p.u. Assuming continuous load current of 0.8 p.u., determine the percentage of the DC output voltage of its no-load voltage and the total rating of the rectifier. Neglect diode drops.	5	CO3	L3
(ii)	Explain the operation of a diode rectifier with L, C load and mention the drawbacks of it while interfacing a wind generator with a three-phase utility source?	8	CO3	L4
	OR			
13 (b)	Explain with waveforms, the principle of hysteresis band current control in a three phase PWM inverter.	13	CO3	L4
14 (a)	With relevant expressions, discuss the bidirectional flow of power achieved in DFIG using an AC/DC/AC converter.	13	CO4	L4
	OR			
14 (b) (i)	Explain the process of self-excitation in variable voltage variable frequency generation.	5	CO4	L4
(ii)	Derive the stator referred circuit model of a self-exited induction generator normalized to the base frequency.	8	CO4	L4
15 (a) (i)	Why do we need hybrid systems when stand-alone and grid connected systems are available?	3	CO5	L2
(ii)	With a neat block diagram, explain the operation of PV-Diesel hybrid system with and without battery backup. State the relative advantages and disadvantages of the configurations.	10	CO5	L2
	OR			
15 (b)	With flowchart and algorithm, explain the following MPPT Techniques	6	CO5	L2
(i)	Perturb and Observe Method for solar PV system.			
(ii)	Fuzzy logic Controller for Wind Electrical Conversion system	7	CO5	L2

PART- C (1 x 15 = 15 Marks)

Q.No.	Questions	Marks	CO	BL
16.(i)	For a DC-DC converter as shown in Figure, a battery of 25V is connected and the input current is 4A. At the output side, a voltmeter shows 50V across the load and the output current is 1.8A. Find a) power input and output of the converter b) efficiency of the converter. 	8	CO3	L5
(ii)	Find the required diameter of a wind turbine to generate 4kW at a wind speed of 7m/s and a rotor speed of 120rpm. Assume power coefficient of 0.4.	7	CO4	L5