Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

Course: Smart Grid and Hybrid Power Generation System **Semester : 2nd**

Program: M. Tech- Renewable Energy Engineering **Time : 03 hrs.**

Course Code: EPEC 7079 **Max. Marks: 100**

Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Highlight the benefits and challenges associated with the implementation of Smart Grids compared to conventional grids.	**4**	**CO1**
Q 2	Write the definition of hybrid power generation systems? Explain the concept and benefits of integrating Smart Grid technologies into hybrid power generation setups.	**4**	**CO1**
Q 3	Discuss the concept of Smart Substations and their significance in enhancing grid reliability and efficiency.	**4**	**CO2**
Q 4	Define an Energy Management System (EMS) and explain its role in modern power grids.	**4**	**CO**
Q 5	Explain Phase-Locked Loop (PLL) and its role in synchronizing the output of power converters with the grid voltage.	**4**	**CO2**
SECTION B **(4Qx10M= 40 Marks)**			
Q 6	Evaluate the opportunities offered by micro-grids in enhancing energy efficiency and promoting renewable energy integration. Discuss the challenges associated with the widespread deployment of micro-grids and potential solutions to overcome them.	**10**	**CO4**
Q 7	Explain Maximum Power Point Tracking (MPPT) techniques and their classifications. Discuss the principle of operation and advantages of MPPT in optimizing the performance of renewable energy systems, considering factors such as partial shading effects.	**10**	**CO2**
Q 8	Compare and contrast SCADA and Smart Grid technologies. Discuss their respective features, capabilities, and applications in power system operation and management.	**10**	**CO3**
Q 9	Discuss Load Frequency Control (LFC) and Voltage Control strategies in power systems. Evaluate different control techniques and their significance in maintaining system stability and reliability under varying operating conditions.	**10**	**CO2**

	Or, Discuss various modulation techniques such as Pulse Width Modulation (PWM) and Sinusoidal Pulse Width Modulation (SPWM) used in power electronics. Evaluate their advantages, limitations, and applications in controlling power converter outputs.		
SECTION-C (2Qx20M=40 Marks)			
Q 10	A large industrial facility is seeking to optimize its energy consumption and reduce operational costs through the implementation of an EMS. As a systems engineer, design and deploy an EMS tailored to the specific needs of the industrial facility. Evaluate the effectiveness of the EMS in optimizing energy usage, improving system efficiency, and reducing overall operational costs. **Questions:** a. Identify the key energy consumption patterns and operational requirements of the industrial facility. b. Design an EMS architecture tailored to the specific needs of the facility, including data acquisition, monitoring, control, and optimization components. c. Discuss the implementation process of the EMS, including hardware and software requirements, integration with existing systems, and deployment strategies. d. Evaluate the effectiveness of the EMS in optimizing energy usage, improving system efficiency, and reducing operational costs based on real-world data and performance metrics. e. Identify any challenges encountered during the implementation and operation of the EMS and propose strategies to address them.	**20**	**CO5**
Q 11	An electric utility is experiencing frequent voltage fluctuations in its distribution network due to increasing renewable energy integration. Design an EMS that utilizes advanced voltage control algorithms to maintain voltage within acceptable limits. Evaluate the performance of the EMS by simulating various scenarios with renewable energy penetration levels and analyzing voltage stability metrics. Or, "Analyze the integration of Energy Management Systems (EMS) in smart grid environments, particularly in the context of hybrid power generation systems. Utilizing case studies, examine how EMS technologies optimize the operation and control of hybrid power plants, including combinations of renewable and conventional energy sources. Evaluate the effectiveness of EMS in enhancing grid stability, maximizing renewable energy utilization, and minimizing operational	**20**	**CO5**

	costs. Discuss key challenges and potential solutions in implementing EMS for hybrid power generation within smart grid frameworks."		