Name: **Enrolment No:**	

UPES

End Semester Examination, May 2023

Course: Smart and Microgrid **Semester: VIII**

Program: B.Tech Electrical Engineering **Time : 03 hrs.**

Course Code: EPEG 4021 **Max. Marks: 100**

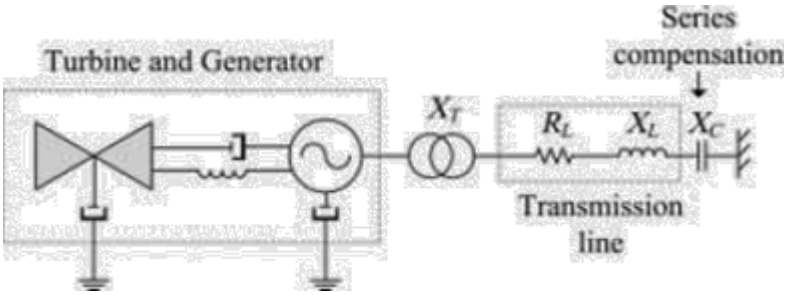
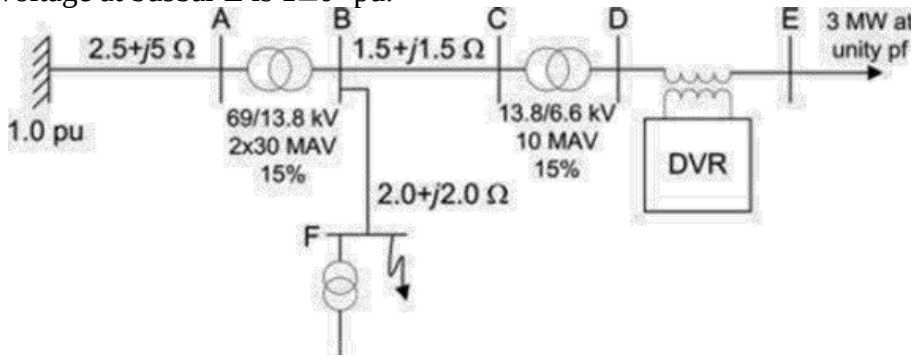
Instructions: Attempt all the questions. Assume any missing data. Use of calculator is allowed.

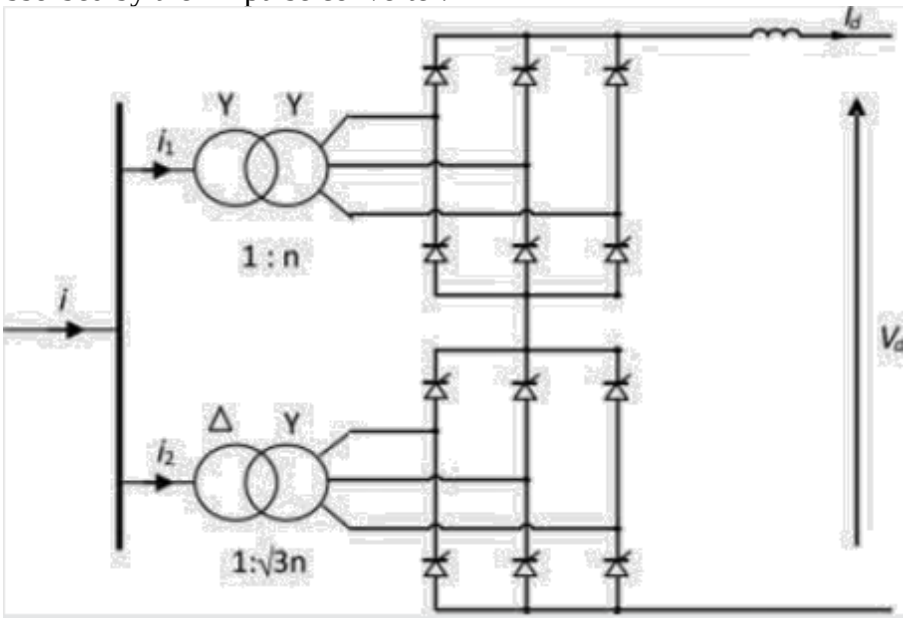
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Classify the types of transmission line based on the operating voltage.	**4**	**CO1**
Q 2	Briefly explain the working a dc-dc boost converter along with the output voltage and current waveforms.	**4**	**CO2**
Q 3	Explain the holding and latching current of thyristor.	**4**	**CO3**
Q 4	Highlight the major differences between a normal power grid and a smart grid.	**4**	**CO1**
Q 5	What are the performance parameters of a rectifier. Explain any four along with their mathematical expressions.	**4**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A 500 MW VSC is connected to a 400 kV network through a 600 MVA, 400/250 kV transformer having a leakage reactance of 20 per cent. The reactance of the phase reactor on 500 MVA, 250 kV base is 0.2 pu. Find the voltage that should be generated by the VSC to deliver 300 MW to the grid at unity power factor. If the DC link voltage is 500 kV, what should be the value of the modulation index? **Data:** For the VSC operating on sinusoidal PWM $V_{LL} = 0.612 \times m_a \times V_{DC}$ where V_{LL} is the line-to-line voltage at D-STATCOM terminals, m_a is the modulation index and V_{DC} is the DC capacitor voltage.	**10**	**CO5**
Q 7	For the single-phase, full-wave, uncontrolled rectifier, the supply voltage is 110V, 50Hz, the load resistor is 25Ω. Calculate: (a) The average value of the output voltage and current. (b) The rms value of the output voltage and current. (c) The dc power consumed by the load (P_{dc}) and the average value of the power delivered to the load (P_{ac}). Sketch the appropriate voltage and current waveforms	**10**	**CO4**

Q 8	Explain the working of single-phase full wave-controlled rectifier connected to a resistive load along with the input and output voltage and current waveforms.	**10**	**CO3**
Q 9	Explain the various turn-on methods of a SCR. **OR** Explain the static I-V characteristics of a thyristor.	**10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	A series compensated transmission line is shown in Fig. 1. On 100 MVA, 400 kV base X_g = 0.1 pu, X_T = 0.02 pu, R_L = 0.0015 pu, and X_L = 0.04 pu. Calculate the value of the series capacitor and electrical resonance frequency for 30 per cent and 60 per cent compensation. Generator resistance can be ignored. **Data:** percentage compensation is defined as: $K = (X_C)/(X_g + X_T + X_L) \times 100$  Fig. 1 **OR** Part of a distribution network is shown in Fig. 2. The load connected to busbar E is a sensitive load and therefore the voltage magnitude at that bus should be maintained at 1 ± 0.1 pu. Calculate the voltage at the load bus when a fault occurs on bus F. Using a phasor diagram, calculate the magnitude of the DVR voltage that should be injected to maintain the voltage at the sensitive load within its limits. Assume before the fault, voltage at busbar E is $1\angle 0^0$ pu.  Fig. 2	**20**	**CO5**
Q 11	(a) A 12-pulse rectifier is shown in Fig. 3. The effective turns ratio, n, of the transformer is 0.4. When the primary voltage is 220 kV, the firing angle delay is 15^0, the DC current delivered by the rectifier is 1000 A.	**10**	**CO4**

	Calculate (1) DC link voltage; (2) rms current; and (3) reactive power absorbed by the 12-pulse converter.  Fig. 3 (b) A HVDC link delivers 1000 MW. Its DC voltage is 500 kV. The DC line resistance is 2Ω/line and each 6-pulse converter has an equivalent commutating resistance of 2Ω. The DC link is operating with the rectifier on CC mode with $\alpha = 15^0$ and the inverter on CV mode with $\beta = 20^0$. Calculate the following: 1. RMS value of the line-to-line voltage. 2. Reactive power absorbed by the inverter.	**10**	