Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M. TECH (EVT/PED)

MAKEUP EXAMINATIONS JUNE-2024

SUBJECT: POWER QUALITY ISSUES & MITIGATION [ELE 5411]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 24 June 2024** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. How are power quality problems classified? ***(03)***

1B. What are the different types of passive shunt compensators used in the distribution network based on supply/load systems? ***(02)***

1C. Derive the expressions for the susceptances of the passive shunt compensator for load balancing and p.f. correction (UPF) of a single-phase load. ***(05)***

2A. How are passive power filters classified based on the connection used with neat sketches? ***(02)***

2B. How are DSTATCOMs classified based on types of converters used and which type is generally preferred and why? ***(02)***

2C. Explain with a neat block diagram of synchronous reference frame theory-based control algorithm for a three-phase four-wire VSC based UPQC for the operation of the DSTATCOM and DVR. ***(06)***

3A. For a trapezoidal wave of voltage with 90° flat portion with an amplitude of 10V, compute the crest factor and total harmonic distortion. ***(05)***

3B. Explain with a neat block diagram of unit template-based control algorithm of three-leg VSC based three-phase 3-wire DSTATCOM for UPF mode of operation. ***(05)***

4A. What is power quality monitoring? Mention different types of instruments used for PQ monitoring. ***(03)***

4B. What are the effects of power quality problems on users? ***(03)***

4C. A three-phase three-wire 415 V, 50 Hz AC supply feeds power to three-phase delta connected induction motor. If a PWM based 25kVA (safety factor of 0.1), 415V, DSTATCOM is used to provide reactive power compensation for UPF operation of motor, design the values of (i) DC bus voltage (ii) DSTATCOM current and (iii) The value of interfacing inductance if the switching frequency is 2.5kHz and ripple current is 10%. ***(04)***

5A. Determine percentage current unbalance in a 3-phase 3-wire system with three phase unbalanced load currents I_a=(0.9+j0) pu, I_b=(-0.55-j0.9526) pu and I_c=(-0.475+j0.8227) pu. ***(03)***

5B. Explain with a neat block diagram of right shunt and left shunt UPQC used for mitigating multiple PQ problems of voltages and currents. ***(03)***

5C. With the relevant phasor diagram, explain the operation of three phase three wire capacitor supported DVR to protect the sensitive loads from voltage sag. ***(04)***