

## Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



## SUBJECT: APPLICATION OF POWER ELECTRONICS IN POWER SYSTEMS [ELE540]

**REVISED CREDIT SYSTEM** 

02 JULY 2016

Time: 3 Hours

## Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- Missing data may be suitable assumed.
- 1A. Define FACTS controller. List any four benefits of FACTS controllers.

*03* 

*04* 

03

02

*04* 

02

MAX. MARKS: 50

- 1B. Derive the expressions for midpoint voltage, current and power of a symmetrical long line with a shunt capacitor connected at the midpoint of the line. A 500 kV, 50 Hz, 600 km long symmetrical line is operated at the rated voltage. Inductance of the line= 1 mH/km and capacitance=11 nF/km. Angular difference  $\delta$ =60°.
  - i) What is the maximum power carried by the line and the midpoint voltage corresponding to this condition?
  - ii) Compute the power transfer through the line when a shunt capacitor of reactance 350Ω is connected at midpoint of the line.07
- 2A. With a neat schematic diagram, explain the working of Thyristor controlled Reactor. Also show that the susceptance offered by TCR is a function of firing angle. *06*
- 2B. Starting from fundamentals, develop an equivalent circuit diagram of a static phase shifter.
- 3A. With relevant phasor diagrams, explain the operating modes of UPFC.
- 3B. Derive the expressions for midpoint voltage, current, power and condition for maximum power of a symmetrical long line with a STATCOM connected at the midpoint of the line. **05**
- 3C. What is the difference between voltage sag and undervoltage?
- 4A. A feeder is powering 100 computers. The total current can be represented by  $i(t) = 4 + 50 \sin(377t) + 30 \sin(1131t) + 10 \sin(1885t) + 5 \sin(2639t)$  A. Compute the THD of the feeder. If a linear load of 100 A is connected to the same feeder, what would be the new THD? 04
- 4B. With a neat block diagram, explain the function of each block in a shunt active filter.
- 4C. What is harmonic resonance? What are the effects of harmonic resonance?
- 5A. A motor has a maximum current of 20 A during starting when the source voltage is 120 V. The inductive reactance of the line is 2  $\Omega$ . Calculate the voltage sag across the motor terminals. **03**
- 5B. A 3<sup>rd</sup> harmonic voltage source is represented by  $v = 100 \sin (1131t) V$ . The voltage source is connected to a load of  $Z_L = (10+j0.1\omega) \Omega$  through a cable whose inductive reactance = j 0.01 $\omega$   $\Omega$ . The load is compensated by a 100  $\mu$ F capacitor bank connected in parallel to the load. Compute the voltage across the load, voltage across the cable and current through the capacitor.
  - 07 04

- 6A. With neat schematic diagrams, explain the different types of HVDC systems.
- 6B. A 3 phase 24 pulse bridge rectifier is fed from transformer with turns ratio 0.5 and primary voltage 250 kV. Determine i) output voltage of rectifier when firing angle is 20° and extinction angle 20°. ii) If the dc current is 2 kA, calculate the effective commutation resistance, fundamental component of line current, power factor, reactive power at primary side of the transformer.