



This is a closed book exam. The exam consists of one page. Attempt all questions

**Question # 1: Complete the following sentences (20 points)**

- 1) 9.9 kV is usually not the generating voltage
- 2) Transmission efficiency increases as voltage increases but power factor decreases.
- 3) In overhead transmission lines the effect of capacitance can be neglected when the length of line is less than 80 km.
- 4) Supercapacitor is the type of storage system uses mechanical energy to store energy.
- 5) Compressed air is an energy storage system which is usually built in abandoned mines.
- 6) Energy resources that are nonrenewable cannot be used up.
- 7) Thermal energy caused by the heating of Earth's crust. This energy can be converted into electrical energy at power plants.
- 8) Nonrenewable resources cannot be replaced or are replaced much more slowly than they are used.
- 9) In wind energy, the kinetic energy of wind can turn the blades of a wind turbine.
- 10) Renewable resources naturally replaced more quickly than they used.
- 11) Electric generators convert chemical energy in fossil fuels.
- 12) The energy of position is known as kinetic energy.
- 13) Overhead and underground are systems of electrical power transmission.
- 14) The underground system cannot be operated above 33 kV
- 15) Short transmission line according to line length 80: 240 Km
- 16) Step down transformers are used to step down the voltage from 11 kV to 400 V.
- 17) Gravitational potential depends on the position of height in a gravitational field.
- 18) Energy storage devices are absorbing energy when they charged.
- 19) Energy storage based on lithium-ion battery provides reliable and fast frequency response.
- 20) Medium transmission lines are modeled with lumped shunt admittance.

**Question # 2: (10 points)**

A (medium) single phase transmission line 100 km long delivering 15,000 kW at 0.8 power factor lagging has the following constant:

Resistance/Km=  $0.25 \Omega$

Reactance/Km=  $0.8 \Omega$

Susceptances/Km=  $14 \cdot 10^{-6}$  Siemen

receiving end line voltage= 66,000 V

If the total capacitance of the line is localized at the receiving end alone, determine:

- a) The sending end current.
- b) The sending end voltage.
- c) Regulation.
- d) Supply power factor.
- e) Draw the phasor diagram to illustrate your calculation.