Ref No. Ex/PE/T/315/2019

B. POWER ENGINEERING EXAMINATION -2019

(3^{rd} Year – 1^{st} Semester)

SUBJECT – Power Transfer Systems

Time: Three hours Full Marks: 100

Answer any ***five*** questions

Assume suitable values for missing data, if any

Clearly define the variables introduced/used, if any

All parts of a question to be answered at one place

No. of Question		Marks
Q. 1. (a)	Define and explain the following with suitable examples: (i) Load factor (ii) Demand factor	3+3
(b)	A generating station has a maximum demand of 100 MW, load factor 65%, plant capacity factor 50% and plant use factor 75%. Determine (i) daily energy produced (ii) the reserve capacity of the plant (iii) the maximum energy that can be produced if the plants are running all the time.	6
(c)	What are the main causes of electrical failure of line insulators? Hence explain the terms puncture and flashover in line insulators.	4
(d)	What are XLPE cables? What are their advantages?	4
2. (a)	Explain Kelvin's economy law. What are the limitations of Kelvin's economy law and hence discuss Modified Kelvin's law. Illustrate them with the help of graphical representation.	10
(b)	A 3 phase 4 wire system is used for street lighting. Compare the amount of copper required with that required for 2 wire DC system with the same lamp voltage assuming same losses and balanced load. The neutral is one half the cross section of one of the respective outers.	10
3. (a)	Describe the methods of the measurements of capacitances in a three-core belted cable.	10
(b)	The capacitance of the 3-core belted cable are measured and found	

	to be as follows: (i) between 3-core bunched together and the sheath; 10 μF (ii) between conductor and the other two connected together to the sheath; 6 μF Calculate the capacitance to neutral and the total charging kVA when the cable is connected to a 11kV, 50 Hz 3-phase supply.	10
4. (a)	Explain why voltage across the insulators of a simple insulator string is not equal. Also, describe practical methods to improve voltage distribution.	10
(b)	Calculate the string efficiency of a 3-unit suspension insulator. The capacitance of the link pins to earth and the line are 25% and 10% of self capacitance C of each unit respectively. What should be the values of link pins to line capacitance for 100% efficiency?	10
5. (a)	Derive an expression for the inductance of a symmetrical 3-phase line. What is meant by the term equivalent spacing? State its significance.	10
(b)	A 3-phase 50 Hz overhead line has regularly overhead transposed conductors and are horizontally spaced 4.0 m apart. The capacitance (line to neutral) of such line is 0.01μF. Find the radius of each conductor and hence recalculate the capacitance per km to neutral when conductors are placed equilaterally spaced 4.0 m apart and are regularly transposed.	10
6. (a)	Draw and explain the phasor diagram for a medium transmission line assuming that half the line capacitance is concentrated at each end of the line.	10
(b)	Determine the voltage current and power factor at the sending end of 3-phase, 50 Hz overhead transmission line 160 km long delivering a balanced load of 100 MVA at 0.8 p.f. lagging at 132 kV. Resistance, inductance and capacitance per km per conductor are 0.16 Ω, 1.2 mH and 0.00082 μF. Use nominal π method	10
7. (a)	A single phase two winding transformer is rated 25 kVA, 1100/440 V, 50 Hz. The equivalent leakage impedance of the transformer referred to the low voltage side is $0.06\angle 78°$ ohm. Using transformer rating as the base values, determine the per unit leakage impedance referred to both low voltage wingding and high voltage winding.	8

(b)	A three phase transmission line operating at 33 KV and having a resistance and reactance of 5 ohm and 20 ohm respectively is connected to a generating station busbar through a 15 MVA step up transformer which has a reactance of 0.06 p.u. Two generators of 10 MVA and 5 MVA having 0.10 p.u and 0.075 p.u. reactance respectively are connected to the busbar. Calculate the short circuit MVA and fault current when a three phase short circuit occurs at (i) the high voltage end of the transformer and (ii) at the load end of the transmission line.	12
8.	Write technical notes on (i) Converter station of HVDC transmission systems (ii) Ferranti effect (iii)Synchronous condenser as reactive power compensator (iv)Three part tariff	4x5