Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

GENERATION, TRANSMISSION AND DISTRIBUTION [ELE 2224]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 07 MAY 2024** **Max. Marks: 50**

Instructions to Candidates:

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

1A Compare the key characteristics of nuclear, steam, solar, and wind power plants, highlighting their distinct features, advantages, and limitations. **4**

1B The available discharge and head of a proposed hydroelectric power plant are 350 m^3/s and 30 m respectively. The turbine efficiency is 80% and speed is 280 rpm. Determine the least number of machines required if you have to use Francis turbine having a specific speed of 300? **3**

1C A single-phase line is as shown in figure 1. Conductors a and a' in parallel form one conductor while conductors b and b' in parallel form the return path. Find the total inductance of the line per km assuming that current is equally shared by the two parallel conductors. Conductor diameter is 2 cm.

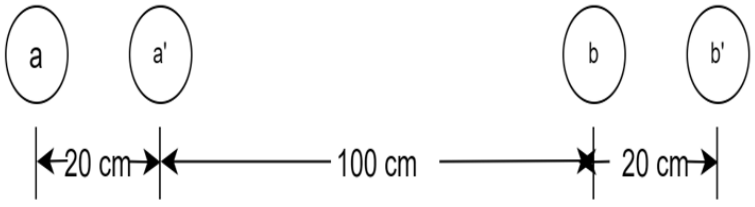

Figure 1: **3**

2A A 50 Hz, three-phase transmission line is 280 km long. It has a total series impedance of 35+ j140 ohms and a shunt admittance of $930 \times 10^{-6}\ siemens$. It delivers 40 MW at 220 kV with 90% power factor lagging. Determine the sending end voltage, voltage regulation, transmission efficiency and A, B, C, D constants by nominal T method. **4**

2B A 50 Hz, three-phase, 132 kV overhead line has conductors placed in a horizontal plane 4.56 m apart. Conductor diameter is 22.4 mm. If the line length is 100 km, find the charging current per phase assuming complete transposition.

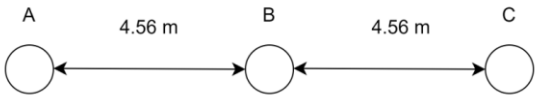

Figure 2: **3**

2C Explain the following: a) Ferranti Effect in electrical transmission systems, highlighting its cause of occurrence. b) Surge Impedance Loading (SIL) and its role in determining the maximum power transfer capability of transmission lines. **3**

3A An overhead transmission line is supported by two towers has the following data: conductor diameter = 4.41 cm; weight of conductor = 0.4 kg/m; tensile strength =1250 kg; safety factor =5; if span length is 200 m, find (i) Sag in the still air, (ii) Sag, if the conductor is covered with 0.5 cm thick ice (ice density of 915 kg/m^3); (iii) Sag (total & vertical), if the conductor is covered with ice of 0.5 cm thickness & a wind pressure of 10 kg/m^2 is acting on the projected area. **4**

3B A 3-phase, 220 kV, 50 Hz transmission line consists of 1·5 cm radius conductor spaced 2 metres apart in equilateral triangular formation. If the temperature is 40°C and atmospheric pressure is 76 cm, Evaluate the corona loss per km of the line. Take m_o = 0·85, g_o = 21·2 kV/cm (r.m.s.). **3**

3C A 200 km, 3-phase, 50 Hz transmission line has the following data: $A = D = 0.938\angle 1.2^\circ$, $B = 131.2\angle 72.3^\circ \, ohms/ph$, the sending end voltage is 230 kV. Determine (a) the receiving end voltage when the load is disconnected and (b) the maximum power that can be transmitted at a receiving end voltage of 220 kV and the corresponding load reactive power required at the receiving end. **3**

4A Each line of a 3-phase system is suspended by a string of 3 identical insulators of self-capacitance C farad. The shunt capacitance of connecting metal work of each insulator is 0·2C to earth and 0·1 C to line. Evaluate the string efficiency of the system if a guard ring increases the capacitance to the line of metal work of the lowest insulator to 0·3 C. **4**

4B Explain the need of overhead line insulators and their properties. Also discuss the methods to improve the string efficiency in a string of insulators. **3**

4C Find the most economical diameter of a single-core cable to be used on a 132 kV, 3-phase system. Find also the overall diameter of the insulation if the peak permissible stress is not to exceed 60 kV. **3**

5A A 3-phase, 66 kV, single core cable has a conductor diameter of 2.5 cm and a sheath of inside diameter 6 cm. It is desired to reduce the maximum stress by using two intersheaths. Determine the maximum stress with and without intersheath and the voltage on each intersheath. **3**

5B A 3-core, 3-phase metal sheath cable gave the following results on testing for cables: Capacitance between all conductors bounded and sheath = 0.90 μF; Capacitance between two conductors bounded with sheath and third conductor = 0.40 μF. Find the capacitance (a) between any two conductors (b) between any two bounded conductors and the third conductor (c) Calculate the capacitance to neutral and charging current taken by the cable when connected to 11 kV, 3-phase, 50 Hz system. **3**

5C Explain the concepts of radial and ring main distribution networks in electrical power systems. Provide a comparative analysis of their advantages and disadvantages. Support your explanation with a neat diagram illustrating both network configurations. **4**