Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – SUMMER 2025

Subject Code: 3140914 Date:21-05-2025

Subject Name: Power System- I

Time: 10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define the following terms: (i) tariff (ii) diversity factor (iii) load curve	**03**
	(b)	An alternator supplies load of 100 kW at 0.8 lagging power factor at 11 kV. If the power factor of the load is raised to unity, how much more real power in kW can the alternator supply for the same kVA loading?	**04**
	(c)	Consider a string of suspension type insulators consisting of three identical insulator disc units. If *'C'* is the disc capacitance and *'C_1'* is the shunt capacitance between metal fitting pin of each disc and tower (earth), derive expressions for voltages across all the three discs and string efficiency in terms of ratio K of C_1 to C.	**07**
Q.2	**(a)**	A 220 kV line has the sag of 3 metre for equal support level of tower configuration and weight of each conductor of 1 kg per metre. If working tension of 1200 kg is to be kept, evaluate the length of the span. Consider span curve to be parabolic.	**03**
	(b)	Differentiate clearly constant speed SCIG and WRIG types of wind generation units from operational aspects with their schematic diagram.	**04**
	(c)	Construct schematic layout of conventional steam – turbine based thermal power station and compare it with hydroelectric power station from these aspects : (i) overall efficiency (ii) initial cost (iii) transmission and distribution cost.	**07**
		OR	
	(c)	Construct schematic diagram of grid connected solar PV system and standalone solar PV system. Compare these two systems by any three points from operational & application aspects.	**07**
Q.3	**(a)**	Clarify briefly function of the following in context with underground cables: (i) metallic sheath (ii) bedding (iii) armouring	**03**
	(b)	Applying concept of flux linkages computation, prove that inductance of three-phase transmission line having symmetrical spacing is given by $L = 2\times10^{-7} \ln\left(D/r'\right)$ henry per metre per phase, where notations used have their usual meaning.	**04**
	(c)	A three-phase 50 Hz, 132 kV transmission line has the flat horizontal spacing with 3 metre between the adjacent conductors. The conductors are seven-strand ACSR having outer diameter of 1	**07**

cm. Evaluate the capacitance to neutral in μF/km and the charging current in A/km.

OR

Q.3 **(a)** What is meant by grading of underground cables? Compare briefly capacitance grading and intersheath grading. **03**

(b) Applying concept of charge and potential difference, prove that capacitance to neutral for two – wire line (single-phase line) is given by **04**

$$C_n = \frac{2\pi\varepsilon_0}{\ln\left(D/r\right)} \text{ farad per metre per phase,}$$

where notations have their usual meaning.

(c) Consider fig.1 that shows the first section of a fully transposed double circuit three-phase line labeled with different distances. **07**

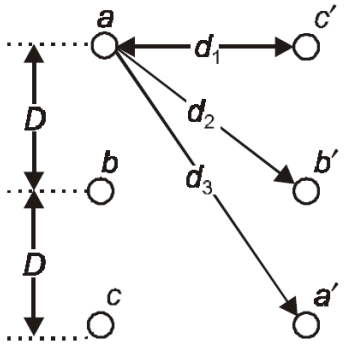

Fig.-1

If D=3 m and d_1=4 m, using GMD (Geometric Mean Distance) method evaluate (i) equivalent self GMD (ii) equivalent mutual GMD and (iii) the inductance of the line in mH/km/phase. Assume conductor radius to be 1 cm.

Q.4 **(a)** Compared to ungrounded neutral system, state three specific advantages of grounded neutral system when a single line to ground fault occurs on one of the three phases. **03**

(b) A single core underground cable has a conductor radius of 1 cm and internal sheath radius of 2 cm. If the relative permittivity of insulation used is 4, determine the capacitance for 1 km length of the cable. **04**

(c) Derive an expression with usual notations of capacitance to neutral for a three-phase transmission line having equilateral spacing. Apply phasor diagram method considering balanced condition for obtaining algebraic sum of line voltages (V_{ab}+V_{ac}) in terms of phase voltage (V_{an}). **07**

OR

Q.4 **(a)** State three specific disadvantages of ungrounded neutral system when a single line to ground fault occurs on one of the three phases. **03**

(b) Prove that insulation resistance of a single core underground cable is given by **04**

$$R = \frac{\rho}{2\pi l}\ln\left(\frac{r_2}{r_1}\right)\Omega$$

where r_1=conductor radius, r_2=internal sheath radius, l=length and ρ =insulation resistivity.

(c) Consider a single infinitely long conductor whose external inductance is to be computed using basic principles of electromagnetism. Show that its external inductance is given by **07**

$$L_{external} = 2\times10^{-7} \ln\left(D_2/D_1\right) \text{ henry per metre,}$$

where D_1 and D_2 are the distances from centre of the conductor to two external points P_1 & P_2 in the space. Note $D_2>D_1>$radius of the conductor.

Q.5 **(a)** Enlist three advantages with reason or expression of using high voltage for transmission system. **03**

(b) Draw layout and schematic connection diagram of a pole-mounted distribution sub-station and briefly mention how it functions. **04**

(c) Consider an AC distributor AB with concentrated loads at C and B as shown in fig.-2. **07**

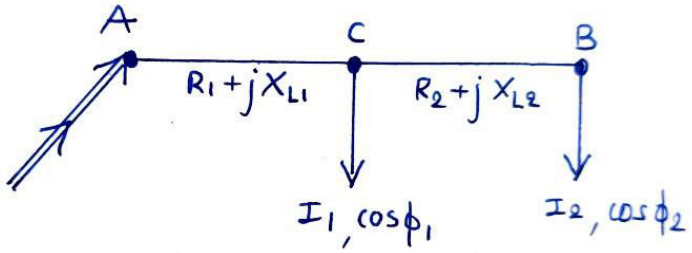

Fig.-2

The power factors of the loads are referred to respective load voltages. Analyze system for computation of V_A, V_B, V_C and voltage drops in the distributor with the help of phasor diagram.

OR

Q.5 **(a)** Classify various AC supply systems in terms of number of phases and number of wires. **03**

(b) Calculate the inductance and inductive reactance of Peterson coil to be deployed for neutral grounding for 132 kV, 50 Hz, 3-phase transmission line having 10 μF capacitance to ground of each phase conductor. **04**

(c) Sketch duplicate busbar system and analyze its operation under fault condition. **07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3140914 Date:05-07-2024

Subject Name: Power System- I

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Define: (i) Load factor (ii) Demand factor and (iii) Diversity factor	**03**
	(b)	Discuss the components of nuclear reactor with their functions.	**04**
	(c)	Explain steam power plant with schematic arrangement. Also discuss the functions of main components of steam power plant.	**07**
Q.2	**(a)**	Give the classification of wind turbine power plant.	**03**
	(b)	Discuss the comparison of different types of solar collectors.	**04**
	(c)	What are the types of variable speed electric generator for wind power generation? Explain any one in detail.	**07**
		OR	
	(c)	Explain Solar Photovoltaic system. Also draw and explain V-I characteristics of solar cell.	**07**
Q.3	**(a)**	Explain power supply scheme with necessary line diagram.	**03**
	(b)	Define power factor. Discuss the causes of low power factor.	**04**
	(c)	Explain the classification of distribution systems considering different ways with diagrams.	**07**
		OR	
Q.3	**(a)**	Compare feeder, distributor and service mains.	**03**
	(b)	What are the types of insulators? Explain any one in details.	**04**
	(c)	Discuss the methods for power factor improvement with their advantages and disadvantages.	**07**
Q.4	**(a)**	Give the classification of Cables according to construction.	**03**
	(b)	What is the grading of Cables? Discuss the methods of grading of cables.	**04**
	(c)	Define substation. Explain the classification of substation in details with considering different parameters.	**07**
		OR	
Q.4	**(a)**	Differentiate neutral earthing and general earthing. Write the different grounding methods.	**03**
	(b)	Derive the relation of inductance of single phase two wire line.	**04**
	(c)	A single phase 20 Km line is 6 m above the ground with 1 cm radius of each conductor separately by a distance of 4 m horizontally. Calculate: (i)Capacitance between the conductors with effect of ground (ii) Capacitance between phase and neutral taking the presence of ground into account and (iii) Capacitance between conductors neglecting the presence of ground	**07**
Q.5	**(a)**	What is Bundled Conductor? Discuss the advantages of Bundled Conductors.	**03**
	(b)	List out equipments which are used in transformer substation with their function.	**04**

	(c)	A factory load consists of (i) an induction motor of 50 H.P (37.3 kW) with 0.8 power factor and efficiency 0.85. (ii) a synchronous motor of 25 H.P. (18.65 kW) with 0.90 power factor leading and efficiency 0.90 and (iii) lighting load at 10 kW at unity power factor. Find the annual electrical charges if the tariff is Rs. 60 per kVA of maximum demand per annum plus 5 paise per kWh. Assume the load to be steady for 2000 hours in a year.	**07**

OR

Q.5	**(a)**	Write the advantages of high transmission voltage.	**03**
	(b)	What is string efficiency? What are methods of improving string efficiency.	**04**
	(c)	Discuss the comparison between horizontal axis wind turbine and vertical axis wind turbine. Also compare fixed speed turbine with variable speed wind turbine.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3140914 Date:21-07-2023

Subject Name:Power System- I

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define: Load factor, Demand factor and Diversity factor.	**03**
	(b)	Compare steam power plant, hydro power plant and nuclear power plant.	**04**
	(c)	Explain the steam power station with neat schematic diagram. Also discuss advantages and disadvantages of steam power station. Also write the points, which are considered during the site selection of steam power plant.	**07**
Q.2	**(a)**	What are the properties of insulating material for cables? Name some insulating materials used in cables.	**03**
	(b)	Discuss the comparison of overhead transmission system with underground transmission system.	**04**
	(c)	A synchronous motor improves the power factor of a load of 200 kW from 0.8 lagging to 0.9 lagging. Simultaneously the motor carries a load of 80 kW. Find (i) the leading kVAR supplied by the motor (ii) kVA rating of the motor and (iii) power factor at which the motor operates.	**07**
		OR	
	(c)	A 50 Hz overhead transmission line consisting of 3 conductors each of diameter 1.24 cm and spaced 2 m apart. Calculate the inductance per phase per km for the following arrangement between conductors: (1) Equilateral spacing (2) Horizontal spacing	**07**
Q.3	**(a)**	Compare indoor substation with outdoor substation.	**03**
	(b)	What do you understand by grading of underground cables? List the methods of grading and explain any one of them in detail.	**04**
	(c)	Calculate the capacitance of a 100 km long 3-phase, 50 Hz overhead transmission line consisting of 3 conductors, each of diameter 2 cm and spaced 2.5 m at the corners of an equivalent triangle.	**07**
		OR	
Q.3	**(a)**	Compare AC and DC supply system.	**03**
	(b)	What is neutral grounding? List the advantages of Neutral grounding.	**04**
	(c)	Explain methods of distribution systems with necessary diagrams.	**07**
Q.4	**(a)**	Enlist various equipment's used in substation.	**03**
	(b)	Differentiate between horizontal and vertical axis wind turbine.	**04**
	(c)	Explain Photovoltaic cell for electrical power generation. Write applications of solar energy.	**07**

OR

Q.4	**(a)**	Explain the advantages of high transmission line.	**03**
	(b)	Derive an expression for the capacitance of a single phase overhead transmission line.	**04**
	(c)	What is string efficiency? Explain methods of improving string efficiency.	**07**
Q.5	**(a)**	List out the main components of overhead lines. Also write the types of insulators.	**03**
	(b)	Explain the disadvantages of low power factor.	**04**
	(c)	Define the sag in overhead line. Derive the equation of sag in case of when supports are at equal and unequal level.	**07**

OR

Q.5	**(a)**	Define and explain string efficiency. Can its value be equal to 100%? Justify your answer.	**03**
	(b)	Define substation. Explain the classification of substation considering different ways.	**04**
	(c)	Draw block diagram of nuclear power station and explain working of nuclear station including chain reaction.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3140914 Date:06-07-2022

Subject Name:Power System- I

Time:10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Enlist various equipments used in substation.	**03**
	(b)	Explain pole mounted substation with suitable figure.	**04**
	(c)	Give comparison of steam power station and hydro power station.	**07**
Q.2	**(a)**	Explain with neat sketch the construction of cables.	**03**
	(b)	What are the properties of insulating material for cables? name some insulating materials used in cables	**04**
	(c)	Enlist different types of nuclear reactors. Explain working of pressurized water nuclear reactor with suitable diagram.	**07**
		OR	
	(c)	A 3-phase transmission line being supported by three-disc insulators. The potential across top unit and middle unit are 8 kV and 11kV respectively. Calculated (i) the ratio of capacitance between pin and earth to the self-capacitance of each unit (ii) the line voltage and (iii) string efficiency.	**07**
Q.3	**(a)**	Why starting motor is used in gas turbine power station? What is the main difference between open cycle and combine cycle gas power plant?	**03**
	(b)	Drawblock diagram of nuclear power station and explain working of nuclear station including chain reaction.	**04**
	(c)	What is string efficiency? Derive its equation in case of 3-disc string.Explain methods of improving string efficiency	**07**
		OR	
Q-3	**(a)**	Compare AC and DC supply systems.	**03**
	(b)	What are the different methods of neutral grounding? Explain solid grounding. State its advantage and disadvantages.	**04**
	(c)	With equation find out the volume of conductor in case of 3-phase 3-wire system and 3-phase 4-wire system in overhead power transmission.	**07**
Q-4	**(a)**	What is tariff? Discuss three part tariff.	**03**
	(b)	What are the factors that affect the sag in the transmission line?	**04**
	(c)	Derive condition for most economic size of conductor in an underground cable.	**07**

OR

Q-4	**(a)**	Explain the disadvantages of low power factor.	**03**
	(b)	Differentiate between Horizontal and Vertical Axis Wind Turbine.	**04**
	(c)	What is solar photovoltaic system? Discus its major components. Also state its applications.	**07**
Q-5	**(a)**	Enlist the power factor improvement methods and describe any one method.	**03**
	(b)	Explain the advantages of high voltage transmission line.	**04**
	(c)	Define the sag in overhead line. Derive the equation of sag in case of When supports are at equal and unequal level. Also find the sag during effect of wind and ice loading	**07**

OR

Q-5	**(a)**	What do you mean by transposition of line? What is itseffect on the performance of the line?	**03**
	(b)	Explain the effect of earth on capacitance.	**04**
	(c)	Explain the inductance of three phase transmission line.	**07**

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