CBCS SCHEME

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21EE51

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Transmission and Distribution

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. What are the advantages of high voltage transmission? Explain. **(07 Marks)**

b. The tower of height 30 m and 90 m respectively support a transmission line conductor at water crossing. The horizontal distance between the towers is 500 m. If the tension in the conductor is 1600 kg, find the minimum clearance of the conductor and water and clearance midway between the supports. Weight of conductor is 1.5 kg/m. Bases of the towers can be considered to be at water level. **(07 Marks)**

c. List the methods of improving string efficiency and explain any one method with a neat sketch. **(06 Marks)**

OR

2 a. With a neat diagram, explain feeders, distributors and service main of a distribution system. **(07 Marks)**

b. A 3-phase overhead transmission line is supported by 3 suspension type insulators. The potential across first and second insulators are 8 KV and 11 KV respectively. Calculate :
i. Ratio of self to shunt capacitance
ii. Line voltage
iii. String efficiency. **(07 Marks)**

c. Write short notes on vibration of conductors. **(06 Marks)**

Module-2

3 a. Derive an expression for the inductance of a conductor due to internal flux. **(05 Marks)**

b. The three conductors of a 3-phase transmission line are arranged in a horizontal plane and are 3 meters apart. The diameter of each conductor is 4 cm. determine the inductance per km of each phase. Assume balanced load and R, Y B phase sequence. **(07 Marks)**

c. The three conductors of a 3-phase line are arranged at the corners of a triangle of sides 2m, 2.5m and 4.5 m. Calculate the inductance per km of line when the conductors are regularly transposed. The diameter of each conductor is 1.24 cm. **(08 Marks)**

OR

4 a. Derive an expression for the line to neutral capacitance for a 3-phase over head transmission line when the conductors are unsymmetrizally speed. **(10 Marks)**

b. If the double circuit 3-phase line has conductors of diameter 2 cm and are separated with 2 m in hexagonal spacing arrangement. Calculate phase to neutral capacitance for 100 km line. **(05 Marks)**

c. A 3ϕ, 50 Hz, 66 kV overhead line conductors are placed in a horizontal plane as shown in Fig.Q4(c). The conductor diameter is 1.25cm. If the line length is 100 km. Calculate :
i. Capacitance per phase
ii. Charging current per phase
Assuming complete transposition of the line.
Given $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m. **(05 Marks)**

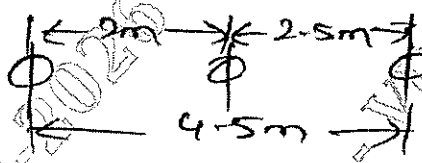

Fig.Q4(c)

Module-3

5 a. Explain the nominal π method for obtaining the performance calculations of medium transmission line. Draw the corresponding vector diagram. **(10 Marks)**

b. A 3-phase ,50 Hz overhead transmission line of 100 km has the following constants. Resistance per km per phase is 0.1 Ω, inductance reactance per km per phase is 0.2Ω, capacitance susceptance per km per phase is 0.4×10^{-14} ℧. Find i) Sending End Current ii) Sending End Voltage iii) Sending End p.f iv) Transmission efficiency. When supplying a balanced load of 10,000 kw at 66 kv with a lagging p.f of 0.8. Use nominal T – method. **(10 Marks)**

OR

6 a. Derive an expression for ABCD constants of a medium transmission line using nominal T – method. Show that AD - BC = 1. **(10 Marks)**

b. Derive an expression for sending end voltage and current for long transmission line using rigorous solution. **(10 Marks)**

Module-4

7 a. Derive an expression for critical disruptive voltage and visual critical voltage with reference to corona. **(10 Marks)**

b. A 132 KV line with 1.956 diameter conductor is built so that corona takes place if the line voltage exceeds 210 KV (rms). If the value of potential gradient at which ionization occurs can be taken as 30 KV per cm, find the spacing between the conductors. Assume 3 phase. **(05 Marks)**

c. Explain the factors affecting corona in brief. **(05 Marks)**

OR

8 a. What are the methods of grading of cables? Explain inter sheath grading of cable. **(10 Marks)**

b. A single cone cable of conductor diameter 2 cm and lead sheath of diameter 5.3 cm is to be used on a 66 KV, 3 – phase system. Two inter sheaths of diameter 3.1 cm and 4.2 cm are introduced between the cone and lead sheath. If the maximum stress in the layers is the same, find the voltages on the inter sheath. **(10 Marks)**

Module-5

9 a. Briefly explain radial and ring main distributors. **(10 Marks)**

b. The loading on a distributor is shown in Fig. Q9(b). The distributor is a 2 core cable for which the resistance and reactance are 0.35 Ω and 0.185 Ω per 1200 m of cable run respectively. What should be the voltage at point A to maintain 420V at point D if the power factor is referred to the far end voltage at D? **(10 Marks)**

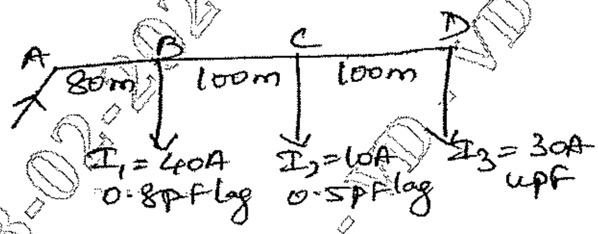

Fig. Q9(b)

OR

10 a. Write a note on power quality. **(05 Marks)**

b. Define: i) Reliability ii) Availability iii) Adequacy iv) Security v) Failure rate. **(10 Marks)**

c. Write a note on limitation of distribution system. **(05 Marks)**

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21EE52

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Write the comparison between open and closed Loop Control System with example. **(06 Marks)**

b. For the mechanical systems shown in fig. Q. 1 (b). Draw the electrical equivalent network based on torque – voltage analogy.

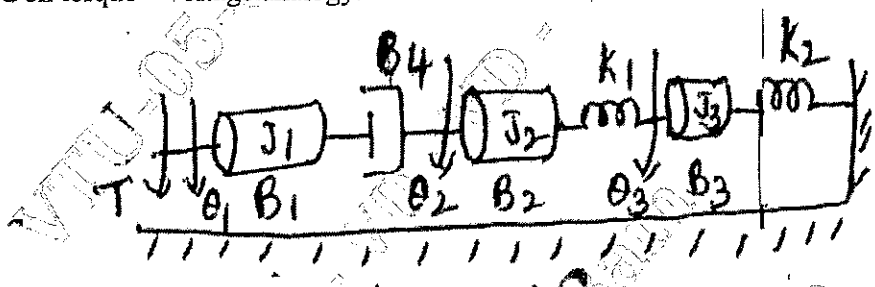


Fig. Q. 1(b) **(08 Marks)**

c. Define Transfer function. Also derive the transfer function relating displament and excitation voltage drop for the armature controlled DC motor. **(06 Marks)**

OR

2 a. For the mechanical system shown in fig. Q.2 (a), write the differential equation relating to the Force F (t). Also obtain the analogous electrical circuits based on : **(10 Marks)**
i) Force – current analogy
ii) Force – Voltage analogy.

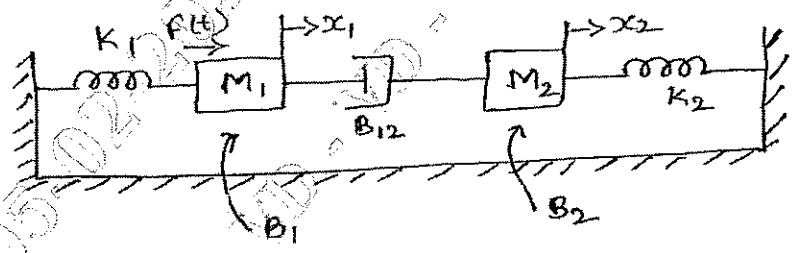
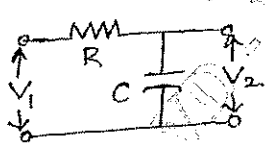
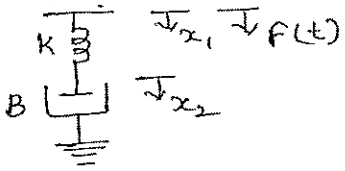


Fig. Q 2(a)

b. Define servomotor. Compare AC servomotor and DC servomotor. **(04 Marks)**

c. Show that the two systems in fig. Q 2 (c) are analogous by comparing the transfer function.





(06 Marks)

Fig. Q 2(c)

Module-2

3 a. Using block diagram reduction technique. Obtain transfer function $\frac{C(S)}{R(S)}$ whose block diagram shown in fig. Q. 3 (a). **(10 Marks)**

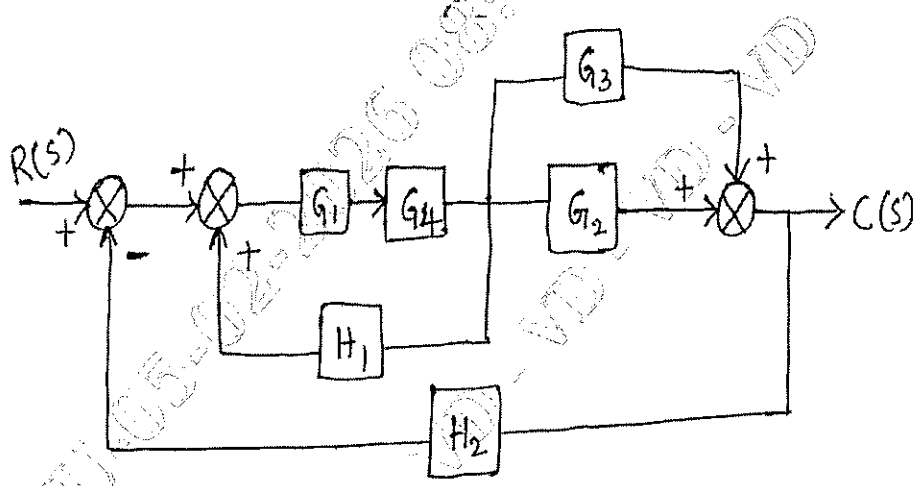


Fig. Q 3(a)

b. Draw a block diagram for the electric circuit shown in Fig. Q. 3(b) and hence evaluates transfer function, $\frac{E_o(S)}{E_i(S)}$ using block diagram reduction technique. **(10 Marks)**

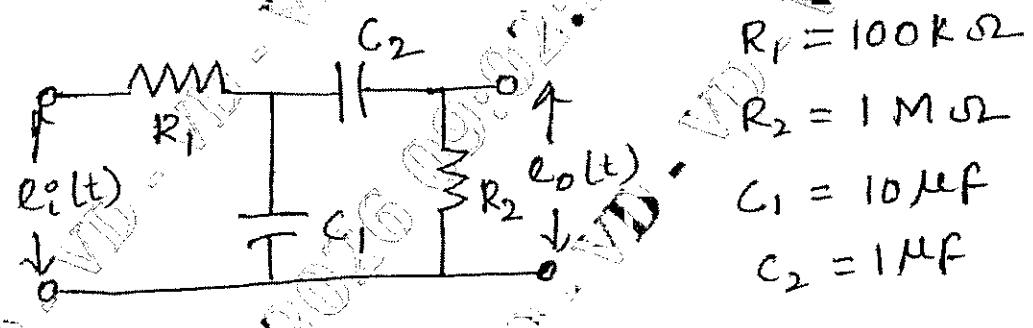


Fig. Q.3 (b)

OR

4 a. Define : i) Source and sink node ii) Loop and Loop gain iii) Forward path **(04 Marks)**

b. For the signal flow graph shown in Fig. Q 4(b). Determine the transfer function $\frac{C(S)}{R(S)}$ using Mason's gain formula. **(08 Marks)**

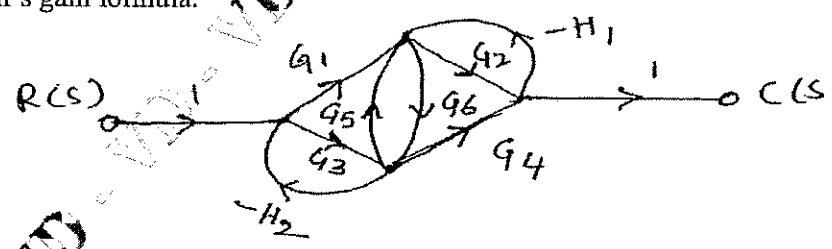


Fig. Q 4(b)

c. Determine the transfer function for the block diagram shown in fig. Q. 4 (c) by using Mason's gain formula. **(08 Marks)**

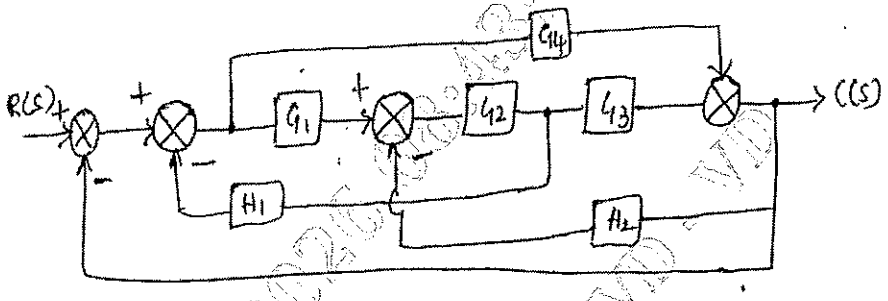


Fig.Q .4 (c)

Module-3

5 a. Define time domain specifications of the second order system with diagram. **(05 Marks)**

b. A unity feedback control system is characterized by an open Loop transfer function $G(s)=\frac{k}{s(s+\alpha)}$, where k and α are positive constants. By what factor the amplifier gain 'K' should be reduced so that the peak overshoot of the unit step response of the system is reduced from 75% to 25%. **(08 Marks)**

c. A certain feedback control system is described by the following transfer function $G(s)=\frac{k}{s^2(s+20)(s+30)}$, $H(s)=1$ Determine order of system, type number, steady state error 8 unit due to input $r(t)=1+10t+30t^2$. **(07 Marks)**

OR

6 a. Explain Routh- Hurwitz criterion for determining the stability of the system and mention its limitations. **(04 Marks)**

b. Define and derive the expression for :
i) Rise time
ii) Peak overshoot of an under damped second order control system subjected to step input. **(08 Marks)**

c. A unity feedback control system is characterized by the open Loop transfer function.
$G(s)=\frac{k(s+13)}{s(s+3)(s+7)}$ using R. H criteria
i) Calculate the range of k for the system to be stable
ii) Determine the value of k which will cause sustained frequency of oscillations in the Closed Loop System. What are the corresponding oscillation frequencies ? **(08 Marks)**

Module-4

7 a. Draw the complete root locus plot for the system $G(s)H(s)=\frac{k}{s(s+2)(s+4)}$ Find the range of k, so that damping ratio of the Closed Loop System is 0.5. **(10 Marks)**

b. For a system having $G(s)H(s)=\frac{k}{s(s+6)(s^2+4s+13}$. Find the angle of departure. **(05 Marks)**

c. Explain : i) Angle of Asymptotes ii) Break away points **(05 Marks)**

OR

8 a. A unity feedback system with $G(s) = \frac{80}{s(s+2)(s+20)}$. Draw the bode plot. Determine GM, PM, wgc and wpc. Comment on the stability. **(14 Marks)**

b. Define the following as applied to bode plots:
i) Gain Margin
ii) Phase margin
iii) Gain crossover frequency **(06 Marks)**

Module-5

9 a. What is controller? Explain the effect of P, I, PI and PID controller of a second order system. **(10 Marks)**

b. Explain the step by step procedure of lag compensating network. **(10 Marks)**

OR

10 a. The open Loop transfer function of a control system is $G(s)\,H(s) = \frac{1}{s(s+2)(s+10)}$. Sketch the Nyquist plot and calculate the value of k. **(14 Marks)**

b. State and explain Nyquist Stability Criterion. **(06 Marks)**

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21EE53

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Power System Analysis – I

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. What is one line diagram? What is the need of single line diagram? Explain the procedure for finding the per unit reactance diagram by stating all the assumptions involved. **(10 Marks)**

b. The single line diagram of a power system is shown in Fig.Q1(b). Draw the per unit impedance diagram.

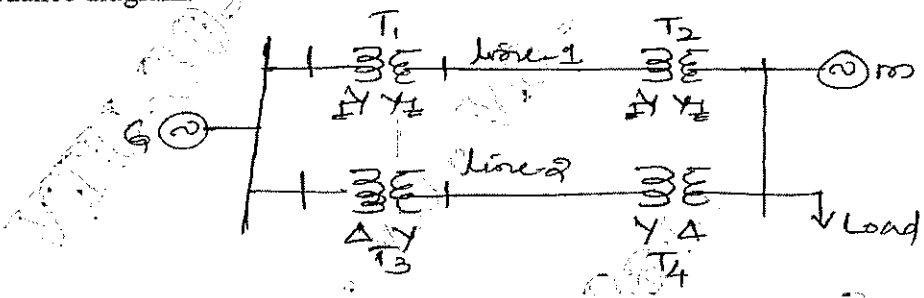

Fig.Q1(b)

G : 90 mVA. 11 KV X″ = 18% line 1 : Z = j80Ω
T_1 : 70 mVA. 11/110 KV X = 15% line 2 : Z = j120Ω
T_2 : 60 mVA. 110/11KV X = 10% m = 85 mVA, 11KV X″ = 13%
T_3 : Three 1ϕ units each rated at 10 mVA, 11/127 KV X = 9%
T_4 : Three 1ϕ units each rated at 16.67 mVA 127/11 KV X = 12%
The load Absorbs 74 mVA, 0.8 pf lagging at 6.5 KV. Select a common base of 100 mVA, 11 KV on the generator side. **(10 Marks)**

OR

2 a. Define the per unit system. The advantages of a per unit system. **(05 Marks)**

b. Prove that the per unit impedance of a two winding transformer on either of its side is equal **(05 Marks)**

c. A single line diagram of a power system is shown in Fig.Q2(c). Draw its impedance diagram. Choose a base of 100 mVA, 220 KV in 50 Ω line. The ratings of generator, motor and transformer are given below.

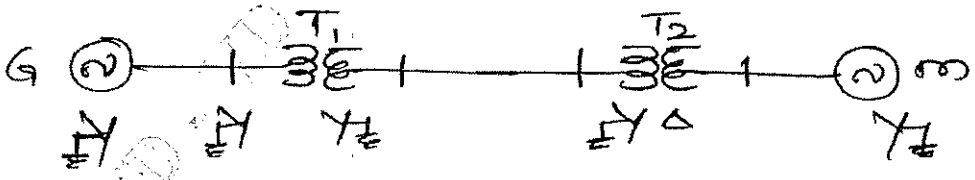

Fig.Q2(c)

G: 40 mVA, 25 KV X″ = 20% m = 50 mVA, 11 KV X″ = 30%
T_1 : 40 mVA, 33/220 KV X = 15%
T_2 : 30mVA, 220/11 KV X = 15%. **(10 Marks)**

Module-2

3 a. Draw the oscillogram of short circuit current, when an unloaded generator is subjected to symmetrical fault. Determine the steady state, transient and sub transient reactance's is from the oscillogram. **(10 Marks)**

b. A 100 mVA, 13.8 KV, 50 Hz Y–connected 3ϕ synchronous generator is connected to a 13.8/220 KV, 100 mVA Δ-Y transformer. The machine reactance on its own base are X_d = 1.1 pu, X_d' = 0.25 pu. The transformer reactance is 0.2 pu, A 3ϕ load of 100 mVA 0.8 pf lag is connected to transformer secondary. A 3ϕ short circuit occurs at the load terminals. Find the generator transient current, if before the fault, the load is operating at 220 KV, choose a base of 220 KV, 100 mVA on HT side of the transformer. **(10 Marks)**

OR

4 a. Describe the doubling effect on transmission line under 3ϕ short circuit with neat sketches. **(10 Marks)**

b. A 75 mVA, 6.6 KV generator connected through a 5 cycle breaker, having reactance of X_d'' = 9% X_d' = 15% and X_d = 100%. It operates on noload and at rated terminal voltage when short circuit occurs behind circuit breaker find :

i) Sustained short circuit current
ii) Initial symmetrical rms current
iii) Maximum possible decomponent of short circuit current after 5 cycle
iv) Interrupting mVA. **(10 Marks)**

Module-3

5 a. What is symmetrical components? How they are useful in the solution of power system? **(05 Marks)**

b. Show that the symmetrical component transformation is power invariant. **(05 Marks)**

c. The symmetrical component of phase currents are $I_{a1} = 100\angle 30°$ A, $I_{b2} = 40\angle 90°$ A and $I_{co} = 10\angle -30°$ A, evaluate the phase currents I_a, I_b and I_c. **(10 Marks)**

OR

6 a. Prove that set of balanced phasors have only positive sequence symmetrical component. **(06 Marks)**

b. Draw the zero sequence networks for the following 3-ϕ transformers.

i) Y_g–Y_g ii) Y_g–Y iii) Δ–Δ

iv) Y_g–Δ v) Y–Δ.

(06 Marks)

c. The current flowing to a Δ connected load through line a is 10A with current on line a as reactances and assuming that line c is open find the symmetrical component of line currents. **(08 Marks)**

Module-4

7 a. Derive an expression for fault current, when double line to ground fault through impedance occurs on power system. **(10 Marks)**

b. A 3ϕ, 400V Y connected neutral grounded generator is subjected to various faults. Find positive negative and zero sequence impedances, also compute the fault current if LLG fault occurs. The current for : 3ϕ fault is 120A. LL fault is 160A, for LG fault it is 240 A. **(10 Marks)**

OR

8 a. Derive an expression for fault current for SLG fault, without fault impedance on an alternator. **(10 Marks)**

b. A 25 mVA, 13.2 KV alternator, with a solidly grounded neutral has a subtransient reactance of 0.25 pu. The negative and zero sequence reactance's are 0.35 and 0.1 pu respectively. Determine the fault current when the line to line fault current occurs at the terminals of the alternator. Neglect the resistance. **(10 Marks)**

Module-5

9 a. Derive an expression for power angle equation for salient pole synchronous machine connected to infinite bus. Also draw the power angle curve. **(10 Marks)**

b. A 50 Hz, 4-pole turbo generator rated 150 mVA, 11KV has an inertia constant of 9 mJ/mVA, find :

i) Stored energy at synchronous speed

ii) The rotor acceleration, if the input mechanical power is raised to 100 MW, when the electrical load is 75 MW

iii) The speed at the end of 10 cycles, if the acceleration is assumed constant at the initial value. **(10 Marks)**

OR

10 a. Derive an expression for swing equation of a generators when generator connected to infinite bus. **(10 Marks)**

b. 50 Hz, 4-pole turbo generator rated 100 mVA, 11 KV has an inertia constant of 8 mJ/mVA.

i) Find stored energy in rotor at synchronous speed

ii) If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW. Find rotor acceleration neglecting mechanical and electrical losses. **(10 Marks)**

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21EE54

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Power Electronics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain five different types of power electronic converter circuits with neat circuit diagram, input and output waveforms. **(10 Marks)**

b. With neat figure, explain the V-I characteristics of diode. **(05 Marks)**

c. Explain peripheral effects of power electronics equipments with block diagram. **(05 Marks)**

OR

2 a. With neat circuit diagram and waveforms explain single phase full wave rectifier with R load. And also derive the expression for average output voltage. **(10 Marks)**

b. Explain reverse recovery characteristics of a diode with waveforms. **(06 Marks)**

c. Explain the significance of free-wheeling diode. **(04 Marks)**

Module-2

3 a. Explain steady state and switching characteristics of BJT. **(10 Marks)**

b. Explain the switching limits of BJT. **(04 Marks)**

c. The bipolar transistor in Fig.Q.3(c) is specified to have β_F in the range of 8 to 40. The load resistance is $R_C = 11\Omega$. The dc supply voltage is $V_{co} = 200$ V and the input voltage to the base circuit is $V_B = 10$ V. If $V_{CE(sat)} = 1.0$ V and $V_{BE(sat)} = 1.5$ V. Find : i) The value of R_B that results in saturation with an ODF of 5 ; ii) The B_{forced} ; iii) The power loss P_T in the transistor.

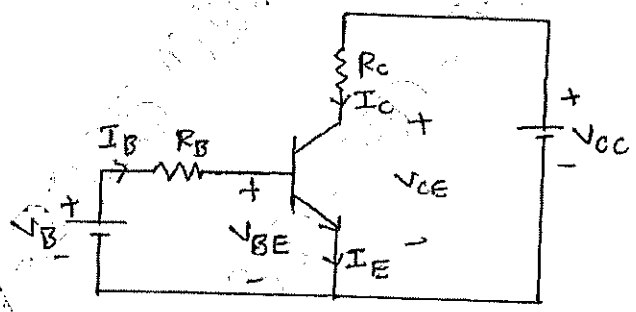

Fig.Q.3(c)

(06 Marks)

OR

4 a. With the help of neat figures, explain steady state and switching characteristics of MOSFET. **(10 Marks)**

b. With neat circuit diagram, explain pulse transformer and opto coupler. **(06 Marks)**

c. The maximum junction temperature of a transistor is $T_J = 150°C$ and the ambient temperature is $T_A = 25°C$. If the thermal impedances are $R_{JC} = 0.4°C/W$, $R_{CS} = 0.1°$ C/W and $R_{SA} = 0.5°$ C/W, calculate

i) The maximum power dissipation

ii) The case temperature. **(04 Marks)**

Module-3

5 a. Explain V – I characteristics of SCR. And also define i) Latching current ii) Holding current. **(12 Marks)**

b. Ten thyristors are used in a string to withstand a dc voltage of V_S = 15 kV. The maximum leakage current and recovery charge differences of thyristors are 10 mA and 150 μC, respectively. Each thyristor has voltage sharing difference of R = 56 KΩ and capacitance of C_1 = 0.5 μF. Determine : i) The maximum steady state voltage sharing ii) The steady-state voltage derating factor iii) The maximum transient voltage sharing $V_{DT(max)}$ iv) The transient voltage derating factor. **(08 Marks)**

OR

6 a. Explain with neat figure two-transistor model of thyristor and also write relevant equations. **(08 Marks)**

b. Explain briefly different thyristor turn-on methods. **(06 Marks)**

c. Explain $\frac{di}{dt}$ protection and $\frac{dv}{dt}$ protection. **(06 Marks)**

Module-4

7 a. With circuit diagram and waveforms explain single phase half wave controlled rectifier with R-L load. **(08 Marks)**

b. A single phase full converter bridge is connected to RLE load. The source voltage is 230 V, 50Hz. The average load current of 10 A is continuous over the working range. For R = 0.4Ω and L = 2 mH, compute i) Firing angle for E = 120 V ii) Firing angle for E = -120 V. **(06 Marks)**

c. With neat circuit diagram and waveforms explain J-ϕ dual converter. **(06 Marks)**

OR

8 a. With circuit diagram and waveforms explain phase control in ac voltage controller and also derive expression for RMS output voltage. **(08 Marks)**

b. An ac voltage controller has a resistive load of R = 10Ω and rms input voltage is V_s = 120 V, 60 Hz. The thyristor switch is on for n = 25 cycles and is off for m = 75 cycles. Find : i) rms output voltage Vo ii) The input power factor iii) The average and rms current of thyristors. **(06 Marks)**

c. With circuit diagram and waveform explain single phase bidirectional controllers with resistive loads. **(06 Marks)**

Module-5

9 a. Explain the principle operation of step down converter with RL load and also draw the waveforms. **(10 Marks)**

b. For the stepdown chopper consisting of a resistive load of R = 10Ω and the input voltage is V_S = 220 V. When the converter switch remains on, its voltage drop is V_{ch} = 2 V and chopping frequency is f = 1 kHz. If the duty cycle is 50%, determine: i) average output voltage V_a ii) rms output voltage V_o iii) The converter efficiency iv) effective input resistance R_i of the converter v) rms value of the fundamental component of output harmonic voltage. **(10 Marks)**

OR

10 a. Explain :

i) Single pulse – width modulation

ii) Multiple – pulse – width modulation techniques used for voltage control of single phase inverters. **(10 Marks)**

b. Describe 180 – degree conduction operation of three phase bridge inverter with circuit diagram and waveforms of line voltages and phase voltages. **(10 Marks)**

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21EE54

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Power Electronics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With neat circuit diagram, input and output waveforms, explain the different types of power electronic converters. **(10 Marks)**

b. Explain reverse recovery characteristics of a diode with wave form. **(05 Marks)**

c. What are the peripheral effects in a power electronic equipment? How to minimize peripheral effects. **(05 Marks)**

OR

2 a. Explain different types of power diode and its applications. **(06 Marks)**

b. With neat circuit diagram and waveform, explain working of single phase full wave abridge rectifier with R load. **(08 Marks)**

c. Explain significance of freewheeling diode. **(06 Marks)**

Module-2

3 a. Explain switching characteristics of BJT with waveform. **(06 Marks)**

b. Sketch the structure of n-channel enhancement MOSFET, explain its working and steady state characteristics. **(10 Marks)**

c. Give a comparison between BJT and MOSFET. **(04 Marks)**

OR

4 a. Discuss the need of base drive control in a power transistor. Explain proportional and antisaturation base drive control methods. **(10 Marks)**

b. With neat circuit diagram, explain pulse transformer and optocoupler. **(05 Marks)**

c. A MOSFET is operated as a chopper switch at a frequency of f_s = 50 KHz. The circuit arrangement is shown in Fig.Q4(c). The DC input voltage of the chopper is Vs = 30 V and load current is I_C = 40 A. The switching times are t_r = 60 nS and t_f = 25 n S. Determine :
i) L_s ii) C_s iii) R_s for critically damped condition.

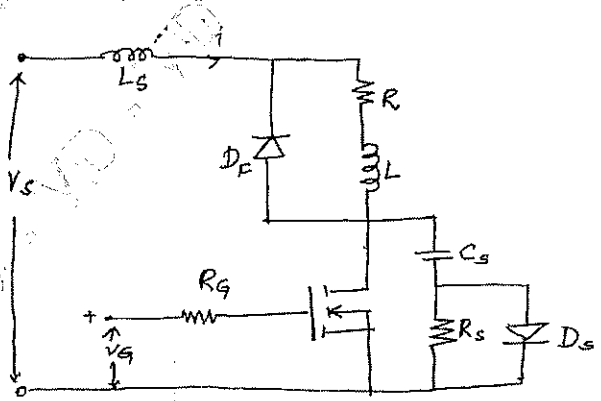

Fig.Q4(c) **(05 Marks)**

Module-3

5 a. With relevant circuit, derive an expression for the anode current of thyristor with the help of two transistor analogy. **(10 Marks)**

b. With the help of neat sketch, explain V–I characteristics of an SCR. Define latching and holding current. **(10 Marks)**

OR

6 a. Explain different types of Turn-ON used for thyristors. **(06 Marks)**

b. Explain the working of UJT triggering technique of SCR with neat waveform. **(07 Marks)**

c. A UJT is used to trigger the thyristor whose minimum gate triggering voltage is 6.2V. The UJT ratings are : $\eta = 0.66$, $I_p = 0.5$ mA, $I_v = 3$ mA, $R_{B1} + R_{B2} = 5$ KΩ
Leakage current : 3.2 mA, $V_p = 14$ V and $V_v = 1$ V.
Oscillator frequency is 2 KHz and capacitor C = 0.04 μF. Design the complete circuit. **(07 Marks)**

Module-4

7 a. Draw a single phase dual converter, explain the operation with waveform. **(10 Marks)**

b. A single phase half wave controlled rectifier is used to supply power to 10 Ω load from 230 V, 50 Hz supply at a firing angle of 30°. Calculate :
i. Average output voltage
ii. Effective output voltage
iii. Average and current. **(10 Marks)**

OR

8 a. With neat circuit and waveform, explain working of single phase bio-directional controller with resistive load (phase control). Derive expression for output voltage (V_{orms}). **(10 Marks)**

b. An AC voltage controller has a resistive load of 10 Ω and RMS input voltage of 230 V, 50 Hz. The thyristor is 'ON' for 25 cycles and 'OFF' for 75 cycles. Determine :
i. The RMS output voltage
ii. Input power factor
iii. RMS value of thyristor current I_{av}. **(10 Marks)**

Module-5

9 a. Classify the different types of choppers with the help of circuit and quadrant diagram and explain. **(08 Marks)**

b. Explain step-up chopper with circuit and waveform. Derive an expression for average output voltage. **(06 Marks)**

c. A step down chopper has a resistive load of 10 Ω and input voltage $V_s = 200$ V. When the chopper switch is ON, its voltage drop is 2V and the chopping frequency is 1 KHz. If the duty cycle is 50% determine :
i. Average output voltage
ii. RMS output voltage
iii. Chopper efficiency. **(06 Marks)**

OR

10 a. With circuit diagram, explain the operation of single phase full bridge inverter. **(10 Marks)**

b. With neat circuit diagram and waveforms explain the operation of transistorised current source inverter. **(10 Marks)**

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21EE62

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Power Systems Analysis – II

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define subgraph, tree, Co-tree as applied to graph theory. Give examples for each. **(06 Marks)**

b. What is primitive network? Obtain primitive Impedance – and admittance form of primitive net work. **(06 Marks)**

c. For the power shown in fig. 1.(c), choosing bus -1 as reference bus, obtain Incidence matrices B, C and K. Hence, verify the identity $B^tC = 0$.

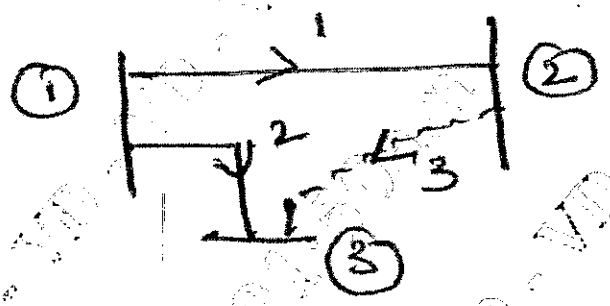

Fig. Q.1(c) **(08 Marks)**

OR

2 a. With usual notations, derive Y_{bus} by singular transformation. **(06 Marks)**

b. Obtain Y_{BUS} by singular transformation method for the power system network having the following data : Take bus – 4 as reference bus.

Element No.	1	2	3	4	5
Bus code (p – q)	1 – 2	2 – 3	3 – 4	1 – 4	2 – 4
Admittance (pu)	2	1.5	3	2.5	4

(06 Marks)

c. For the power system shown in Fig. Q2 (c), obtain Y_{BUS} by singular transformation.

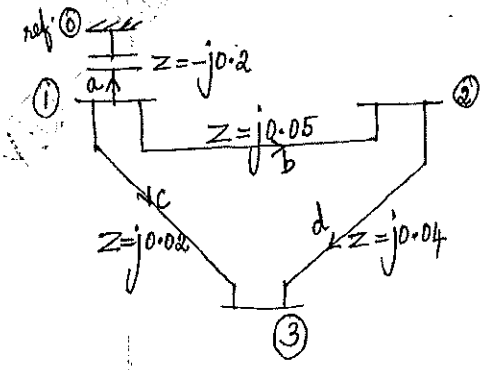

Fig. Q2 (c) **(08 Marks)**

Module-2

3 a. Derive the expressions for power flow-equations used in load flow analysis. **(08 Marks)**

b. What are different types of buses, considered during load fowl analysis? Explain briefly. **(06 Marks)**

c. Why load flow analysis in power system in necessary? Explain. **(06 Marks)**

OR

4 a. What is load flow analysis? Explain how the buses are classified to carryout the load flow analysis in power systems. **(08 Marks)**

b. For the 3 – bus system shown in fig. 4(b) use G – S – method and determine the voltage at bus – 2 and bus – 3 at the end of first Iteration. Give impedence marked on the diagram in PU. The information relating to bus data is given in table Q4 (b)

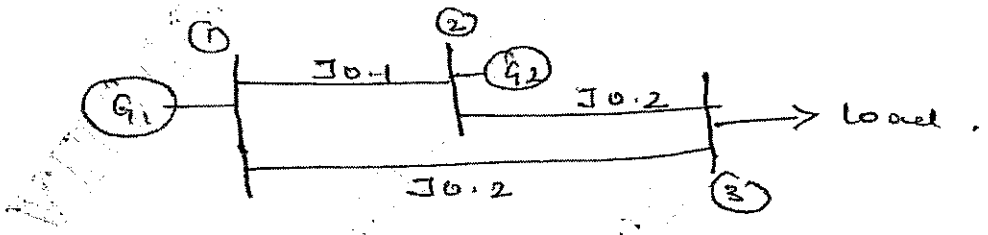

Fig. Q. 4 (b)

Bus No.	Type	Generation		Load		V	Reactive Power	
		P	Q	P	Q		Q_{min}	Q_{max}
1	Slack	-	-	-	-	1.0	-	-
2	PV	5.32	-	-	-	1.1	0	5.32
3	PQ	-	-	3.64	0.53	-	-	-

Table Q4 (b)

(12 Marks)

Module-3

5 a. Discuss the algorithm procedure for load flow analysis using N.R. Method. In polar co-ordinates. **(10 Marks)**

b. Derive the general expression for Jacobian elements in polar form with usual notations in NR – Method to obtain load flow solution. **(10 Marks)**

OR

6 a. Stating all assumptions, deduce FDLF model. Explain the step by step procedure for load flow solution using FDLF method. **(06 Marks)**

b. Compare G.S & N.R. Method. **(06 Marks)**

c. Draw the flow chart of FDLF analysis. **(08 Marks)**

Module-4

7 a. Define penalty factor. Derive on expression for optimal loading of an n – plant system considering transmission losses. **(08 Marks)**

b. The incremental fuel cost in Rs/Mwhr for a plant consisting of 2 – units are,
$IC_1 = 0.25P_1 + 40$, $IC_2 = 0.3P_2 + 30$.
Assume that all units are operating at all times and total load various from 40 mw to 300 mw. The minimum and maximum loads on each unit are 25 mw and 150mw.
Determine :
i) The most economical division of load between the generators for a load 250 mw.
ii) The saving in Rs. / day. Obtained compared to equal load sharing between the two units. **(12 Marks)**

OR

8 a. Explain unit commitment using Dynamic Programming Method. **(08 Marks)**

b. What are B – Co-efficient? Obtain the general loss – co – efficient formula with usual notation. **(12 Marks)**

Module-5

9 a. Explain the Z_{bus} – algorithm for a link addition to the partial network with no mutual coupling. **(10 Marks)**

b. Explain solution of swing equation by Range Kutta order – u – method. **(10 Marks)**

OR

10 a. Form Z_{bus} using building algorithm of a power system show in fig. 10 (a) self impedance of the element are given in the table 10 (a). Take element -3 as link and bus – 1 as reference bus.

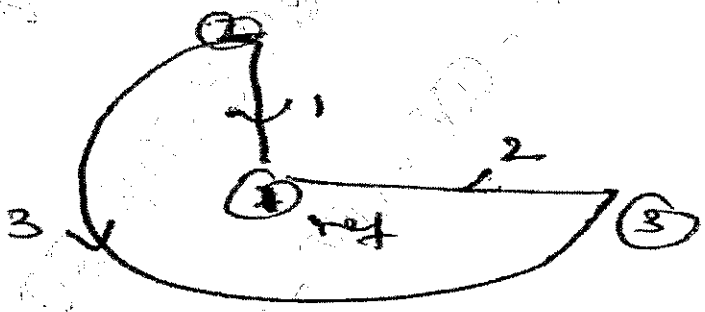

Fig. Q. 10 (a)

Element No :	1	2	3
Zbus	J0.5	J0.25	J0.3

(10 Marks)

b. Explain the algorithm for short – Circuit studies of an n – bus system. **(10 Marks)**

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21EE63

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Signals and Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define a Signal. With help of neat diagrams differentiate the different types of signals. **(06 Marks)**

b. Determine whether the continuous time signal $x(t) = x_1(t) + x_2(t) + x_3(t)$ is periodic, where $x_1(t)$, $x_2(t)$ and $x_3(t)$ have periods 1.08, 3.6 and 2.025 sec. respectively. Find the total energy of the signal shown in Fig.Q.1(b).

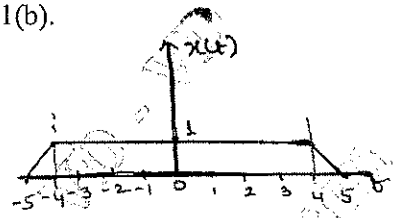

Fig.Q.1(b) **(06 Marks)**

c. With the help of neat diagram, find the linear convolution $y(t) = e^{-t}u(t) * (e^{-3t}(u(t) - u(t-2))$. **(08 Marks)**

OR

2 a. Define a System. Explain the properties of CT system. For the system $T\{x(n)\} = g(n)\,x(n)$, determine whether system is linear and time invariant. **(06 Marks)**

b. Find the output of an LTI system, whose impulse response h(n) is shown in Fig.Q.2(b), for the input signal $x(n) = u(n) - u(n-3)$.

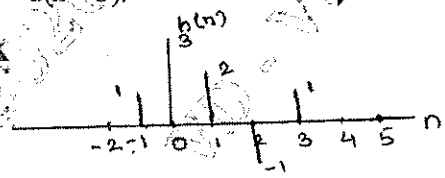

Fig.Q.2(b) **(06 Marks)**

c. Evaluate the discrete time convolution sum $y(n) = \beta^n u(n) * u(n-3)$ $|B| < 1$. **(08 Marks)**

Module-2

3 a. Determine the 8-point DFT of the sequence $x(n) = \{1, 1, 1, 1, 1, 1\}$. Sketch its magnitude and phase spectra. **(10 Marks)**

b. Let x(n) be the sequence, $x(n) = \delta(n) + 2\delta(n-2) + \delta(n-3)$

i) Find the 4-point DFT of x(n)

ii) If y(n) is the 4 point circular convolution of x(n) with itself, find y(n). **(06 Marks)**

c. Let x(n) be a finite length sequence with $X(k) = (0, 1 + j, 1, 1 - j)$. Using the properties of DFT find DFTs of the following sequence:

i) $x_1(n) = e^{j\frac{\pi}{2}n}\,x(n)$ ii) $x_2(n) = x((n-1))_4$ **(04 Marks)**

OR

4 a. Find the IDFT of X(k) = {255, 48.63 + j166.05, -51 + j102, -78.63 + j46.05, -85, -78.63 – j46.05, -51 – j102, 48.63 – j166.05}. Prove the Parseval's theorem of DFT. **(10 Marks)**

b. Find the output y(n) of a filter whose impulse response is h(n) = {1, 1, 1} and the input signal x(n)={3, -1, 0, 1, 3, 2, 0, 1, 2, 1} using overlap save method assuming length of block be 8. **(06 Marks)**

c. Given x(n) = {1, 2, 3, 4} and h(n) = {1, 2, 2}. Compute linear convolution using circular convolution. **(04 Marks)**

Module-3

5 a. Derive the 8 point Radix-2 DIT-FFT algorithm and draw its signal flow graph. Discuss about Inplace computation and Butterfly computation. **(10 Marks)**

b. Find 4 point circular convolution of x(n) and h(n) using radix – 2 DIF-FFT algorithm for x(n) = (1, 1, 1, 1) and h(n) = (1, 0, 1, 0). **(10 Marks)**

OR

6 a. Using DIF-FFT algorithm compute DFT of x(n) = (1, 2, -1, 2, 4, 2, -1, 2). If $x_2(n) = x_1(-n)$ without performing FFT find $x_2(k)$ using $x_1(k)$. **(10 Marks)**

b. First five points of 8 point DFT of a real valued sequence is given by x(0) = 36, x(1) = -4 + j9.7, x(2) = -4 + j4, x(3) = -4 + j1.7 and x(4) = -4. Determine the remaining points and find the original sequence x(n) using DIF FFT algorithm. **(10 Marks)**

Module-4

7 a. Explain how the pole in s plane is mapped to pole in z-plane in impulse invariant transformation with the same technique obtain H(z) for given analog filter :

$$H_a(s) = \frac{1}{(s+0.5)(s^2+0.5s+2)}$$ **(10 Marks)**

b. Determine H(z) for a lowest order Butterworth filter satisfying following constraints:

$\sqrt{0.5} \le |H(e^{jw})| \le 1 \quad 0 \le |w| \le \pi/2$

$|H(e^{jw})| \le 0.2 \quad 3\pi/4 \le w \le \pi$

with T = 1s. Apply impulse invariant transformation. **(10 Marks)**

OR

8 a. Design a analog Bandpass filter to meet the following frequency domain specifications:

i) -3.01 dB at upper and lower cut off frequency of 50 Hz and 20 kHz.

ii) Stopband attenuation of atleast 20 dB at 20 Hz and 45 kHz.

iii) A monotonic response. **(10 Marks)**

b. Design a Chebyshev filter for the following specifications using Bilinear transformation:

$0.8 \le |H(e^{jw})| \le 1 \quad 0 \le w \le 0.2\pi$

$|H(e^{jw})| \le 0.2 \quad 0.6\pi \le w \le \pi$ **(10 Marks)**

Module-5

9 a. What is the significance of window sequence in FIR filter design? Discuss about the different window functions used in the design of linear phase FIR filter. **(05 Marks)**

b. Obtain the DF-II and cascade realization for the system function

$$H(z)=\frac{(1+z^{-1})}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}$$ **(05 Marks)**

c. Design a bandpass FIR filter using Hanning window with M = 7. Given:
Lower cut off frequency $w_{c_1} = 2\text{rad/sec}$
Upper cut off frequency $w_{c_2} = 3\text{rad/sec}$ **(10 Marks)**

OR

10 a. Derive the frequency response of linear phase FIR filter for symmetric impulse response for an odd order. **(05 Marks)**

b. Realize the following system function in:
i) Direct form
ii) Linear phase form by giving necessary equations

$$h(n)=\delta(n)+\frac{1}{2}\delta(n-1)-\frac{1}{4}\delta(n-2)+\delta(n-4)+\frac{1}{2}\delta(n-3)$$ **(05 Marks)**

c. Design a linear phase FIR filter of length M = 15 which has symmetric unit response and the frequency response that satisfies the condition:

$$H\left(\frac{2\pi k}{15}\right)=1 \quad K=0,1,2,3$$
$$=0.4 \quad K=4$$
$$=0 \quad K=5,6,7$$ **(10 Marks)**

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21EE71

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
High Voltage and Power System Protection

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Write any four advantages, limitations and applications of high voltage engineering. **(08 Marks)**

b. Define town sends first ionization co-efficient and derive an expression for the current in the air gap that in $I = I_0 e^{\alpha d}$. **(06 Marks)**

c. In an experiment in a certain gas it was found that the steady state current in 5.5×10^{-8} A at 8 KV at a distance of 0.4 cm between the plane electrodes keeping the field constant and reducing the distance to 0.1 cm results in a current of 5.5×10^{-9}A. Calculate town sends primary ionization coefficient α. **(06 Marks)**

OR

2 a. Explain Bubbles theory and suspended particles theory and break down in liquid dielectrics. **(10 Marks)**

b. Explain the following breakdown mechanism in solid dielectrics :
i. Thermal breakdown
ii. Electromechanical breakdown. **(10 Marks)**

Module-2

3 a. Write a neat sketch explain the working of 4 stage Cockcraft Walton DC generator. **(10 Marks)**

b. With the help of neat sketch explain the construction and working principle of generating voltmeter. **(10 Marks)**

OR

4 a. With a neat sketch explain the marx circuit arrangement for multistage impulse generator. **(10 Marks)**

b. Explain in brief the method of discharge detection using straight detector. **(10 Marks)**

Module-3

5 a. Discuss the essential qualities of a protective relay. **(08 Marks)**

b. Explain various methods of back up protection. **(06 Marks)**

c. Write a note on protection of parallel feeder. **(06 Marks)**

OR

6 a. Draw the schematic diagram of a numerical relay and briefly describe the functions of its various components. **(08 Marks)**

b. Write the merits and demerits of static relay. **(06 Marks)**

c. Differentiate between earth fault and an over current relay. **(06 Marks)**

Module-4

7 a. What in an impedance relay? Explain its operating principle, torque equation and operating characteristics of impedance relay. **(10 Marks)**

b. Define the term pilot with reference to power line protection. List the different types of wire pilot protection scheme and explain circulating current protection. **(10 Marks)**

OR

8 a. Explain balanced (opposed) voltage differential protection. **(06 Marks)**

b. With a neat sketch explain the working of frame leakage protection used for Bus-Zone protection. **(06 Marks)**

c. With a neat diagram, explain construction and operation of Buchholz relay. **(08 Marks)**

Module-5

9 a. With a neat sketch, explain the construction and working of non-puffer type SF_6 circuit breaker. **(08 Marks)**

b. With a neat sketch, explain the phenomenon of lighting. **(06 Marks)**

c. Explain the phenomenon of current chopping with neat waveform. **(06 Marks)**

OR

10 a. With a neat sketch, explain the synthetic testing of circuit breaker. **(08 Marks)**

b. With a neat diagram, explain the construction and working of Klydonograph. **(06 Marks)**

c. What are the causes of over voltages arising on a power system? (Any 6). **(06 Marks)**

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CBCS SCHEME

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21EE72

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Power System Operation and Control

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the operating states of Power System with a neat diagram. **(07 Marks)**

b. Explain the key concepts for reliable operation of Power System. **(07 Marks)**

c. Explain the major components of energy management center. **(06 Marks)**

OR

2 a. State and explain the major components of a SCADA system. **(10 Marks)**

b. List out the purpose of RTU's used for SCADA in Power Systems. Also explain in detail the Major Components of RTU's and its functions. **(10 Marks)**

Module-2

3 a. Explain the modeling of Speed Governor System. Also explain the functions of the various components with a neat diagram. **(12 Marks)**

b. Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 600 MW be shared between them? What will be the system frequency at this load? Assume free governor operation. **(08 Marks)**

OR

4 a. State the basic Control loops equipped in a generator in power plant and explain them in detail with a neat functional block diagram. **(10 Marks)**

b. With a neat diagram, explain the proportional Plus Integral Controller. Also show the steady state error is zero. **(10 Marks)**

Module-3

5 a. Derive a Mathematical Model of a Tieline interconnecting two control areas 1 and 2. Then draw the block diagram representation of a two area interconnected system with primary control loops. **(10 Marks)**

b. Explain the frequency bias tie line control of a two area system stating various tie line control actions. Also draw the block diagram of AGC for a two area system. **(10 Marks)**

OR

6 a. Explain state space model of two area system. **(08 Marks)**

b. Explain the load frequency control with Generation Rate Constraints (GRCs). With a neat diagram. **(06 Marks)**

c. Describe the effect of Speed Governor dead band on AGC. **(06 Marks)**

Module-4

7 a. Explain Generation and Absorption of reactive power in electrical power system. **(06 Marks)**

b. Derive the equations to get the relation between voltage, power and reactive power at a Node. **(06 Marks)**

c. Briefly explain the different methods of Reactive power injection in Power System. **(08 Marks)**

OR

8 a. Describe in detail, the following Voltage Control Methods using transformers. :
i) Tap- Changing Transformers
ii) Booster Transformers **(10 Marks)**

b. Three generating stations are connected to a common bus bar X as shown in Fig. Q. 8 (b). For a particular system load, the line voltage at the bus bar falls by 2 KV. Calculate the reactive power injection required to bring back the voltage to the original valve. All pu values are on a 500 MVA base.

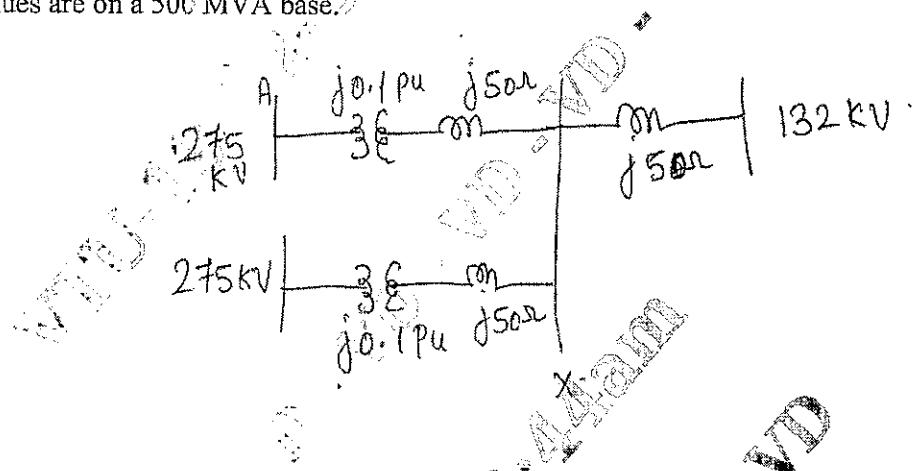

Fig. Q. 8 (b)

(10 Marks)

Module-5

9 a. List out the major function of Power System Security and explain them in detail. **(08 Marks)**

b. With the help of flow chart, explain the AC Power flow security analysis with Contingency case selection. **(08 Marks)**

c. Explain the factors affecting Power System Security. **(04 Marks)**

OR

10 a. Define the following terms :
i) Generation shift sensitivity factor
ii) Line outage distribution fator **(04 Marks)**

b. Explain the contingency analysis procedure for the following outages in a Power System with flow charts:
i) Generator outages
ii) Line outages. **(16 Marks)**

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