



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058



END SEMESTER EXAMINATION MAY 2026 / ~~RE-EXAM JULY 2026~~

Program: F. Y. M. Tech *CPEPS Sun II*

Course Code: PE-MTPX202

Course Name: Smart Grid Technologies

Notes: (1) Solve any 5 questions out of 7.

Duration: 3 Hour

Maximum Points: 100

Semester: II

(2) Draw suitable diagram wherever necessary.

26/5/26

Q.No.	Questions	Points	CO	BL	Module No.
Q. 1 (a)	Describe the present development of smart grid in India. Explain about different ongoing smart grid projects and smart cities in India. Also discuss various international policies in smart grid.	02+ 06+ 02	01	L-1	01
Q. 1 (b)	What is the need of smart grid implementation? Discuss the important functions and opportunities of smart grid. Hence, explain the barriers in implementation of smart grid in India.	01+ 05+ 04	01	L-1	01
Q. 2 (a)	What is Smart Meter and hence explain the different functions of Smart Meters. Also, discuss the significance of real time pricing in smart grid?	01+ 05+ 04	01	L-1	02
Q. 2 (b)	Draw the architecture of sensor node and explain the role of different blocks. Hence, explain the different tasks to be performed by home area network (HAN) in smart grid environment.	02+ 04+ 04	01	L-1	02
Q. 3 (a)	Explain the significance of smart storage system. Hence describe the pumped hydro compressed air energy storage system with diagram.	02+ : 06	02	L-1	03
Q. 3 (b)	Discuss accurate customer to electrical system model of modern Outage Management System to provide accurate predictions of outage locations with block diagram.	10+ 02	02	L-1	02
Q. 4 (a)	What is the need of substation automation and hence explain the concept of smart substation. Hence, elaborate the role of wide area monitoring system in smart grid?	02+ 04+ 04	02	L-1	03



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Q. 4 (b)	What is the need of microgrid and hence explain the basic concept of microgrid with its conceptual diagram and applications? Explain different issues of interconnection of distributed energy resources in microgrid.	01+ 03+ 02+ 04	02	L-1	04
Q. 5 (a)	Discuss the following by explaining working principle, diagram, advantages, disadvantages and application. (a) Thin film solar cells. (b) Variable speed wind generators. (c) Microturbines.	04+ 04+ 04	03	L-1	04
Q. 5 (b)	Why do you need to study/understand power quality and electromagnetic compatibility (EMC) in Smart Grid? Hence, what is power quality conditioner? State different power quality conditioners used in Smart Grid and explain any two of them.	01+ 01+ 03+ 03	03	L-1	05
Q. 6 (a)	Explain the following communication protocols/networks used in smart grid and do the comparison between them. (a) Bluetooth (b) Zig-bee (c) GPS network (d) Wi-Fi (e) Wi-Max	10	04	L-1	06
Q. 6 (b)	Explain advanced metering infrastructure (AMI) used for Smart Grid in detail. Hence, discuss Home area network (HAN), neighbourhood area network (NAN), wide area network (WAN).	04+ 06	04	L-1	06
Q. 7 (a)	What is cloud computing? Hence draw and explain the cloud computing architecture. Also, discuss the different security challenges related to cloud computing in smart grid system?	02+ 04+ 04	04	L-1	07
Q. 7 (b)	Explain the broadband over power line (BPL) communication system in detail. Hence draw the architecture of BPL.	08+ 02	04	L-1	07



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END SEMESTER EXAMINATION MAY 2026 / ~~RE-EXAM JULY 2026~~

Program: M. Tech. (Electrical-PEPS)

Sum I

Duration: 3 hrs.

Course Code: PC-MTPX 201

Maximum Points: 100

Course Name: Power system dynamics and control

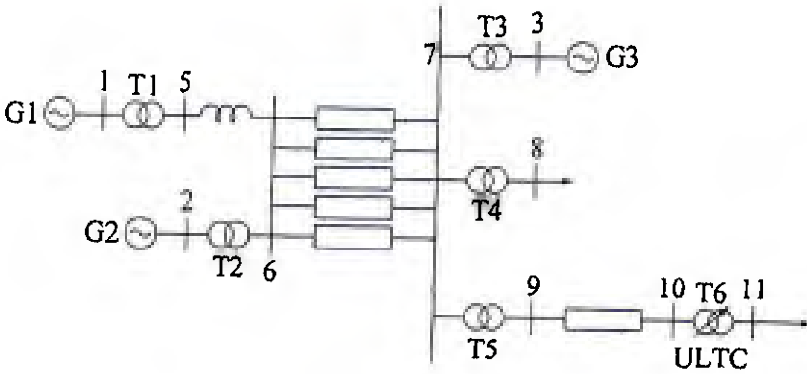
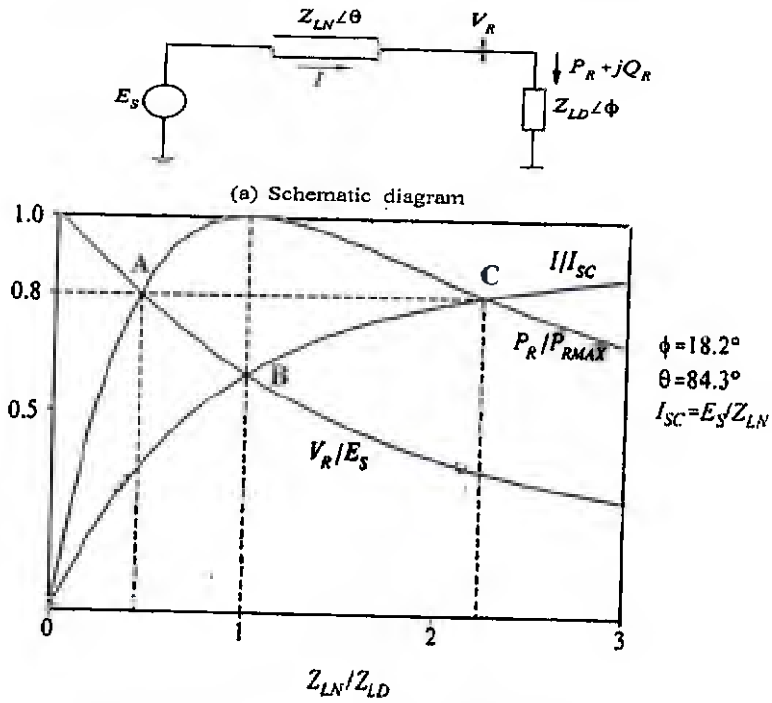
Semester: II

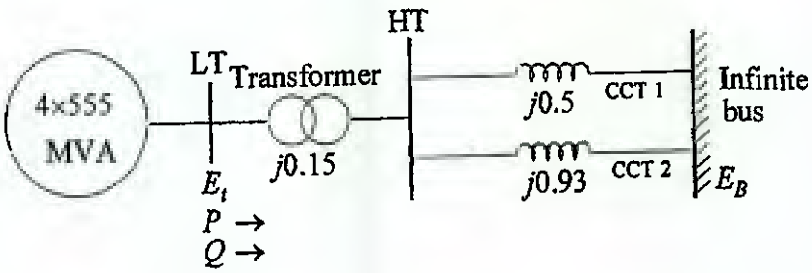
Notes:

19/5/26

1. Question number 1 compulsory.
2. Attempt any **four** questions out of remaining **six**.
3. Draw neat diagrams.
4. Assume suitable data if necessary.

Q. No.	Questions	Pts.	CO	BL	Mod. No.
1. (a)	Which are methods of transient stability enhancement? Explain in detail Steam turbine fast valving.	10	1	L2	7
1.(b)	Explain in detail working of power system stabilizer in transient stability enhancement.	10	1	L2	7
2.	Derive expression for small signal stability of a single machine infinite bus system with the help of following points 1. Classical model representation 2. State space representation 3. Block diagram representation 4. Expression of damping ratio (ζ) and natural frequency (ω_n)	20	1	L2	3
3. (a)	A generator operating at 50 Hz delivers 1 pu power to an infinite bus through a transmission circuit in which resistance is ignored. A fault takes place reducing the maximum power transferable to 0.5 pu whereas before the fault, this power was 2.0 pu and after the clearance of the fault, it is 1.5 pu. By use of equal area criterion, determine the critical clearing angle. (Consider initial mechanical input power 1.0 pu)	10	2	L3	4
3.(b)	Write short note on 1. V-Q Sensitivity analysis 2. Q-V model analysis	10	1	L2	6

4.	With the help of neat diagram explain in detail - Classical model representation of synchronous machine - Higher order model representation of synchronous machine.	20	1	L2	1,2
5.(a)	With the help of Fig.1 comment on voltage stability of each bus bar if the outage of one of the transmission line between bus bar no. 6 & 7 take place.  Fig. 1	10	3	L3	6
5.(b)	Explain in detail operating condition for point A, B and C using given graph. Also draw normal and abnormal operating region on graph (b).  (a) Schematic diagram (b) Receiving end voltage, current and power as a function of load demand	10	2	L3	6

6.	A 20 MVA, 50 Hz generator delivers 18 MW over a double circuit line to an infinite bus. The generator has kinetic energy of 2.52 MJ/MVA at rated speed. The generator transient reactance is $X'_d = 0.35$ pu. The first transmission circuit has $R = 0$ and a reactance of 0.2 pu and second transmission circuit has $R = 0$ and a reactance of 0.3 pu on a 20 MVA base. $E' = 1.1$ pu and infinite bus voltage $V = 1.0 \angle 0^\circ$. A three-phase short circuit occurs at the midpoint of second transmission line. Plot swing curves over the period of 0.5 second if the fault is sustained using point by point method.	20	2	L4	5
7.	Fig.2 shows the system representation applicable to thermal generating station consisting of four 555 MVA, 24 KV, 60 Hz units  Fig. 2 The network reactance shown in figure are in per unit on 2220 MVA, 24 KV base. Resistances are assumed to be negligible. Type of fault occur: Loss of circuit 1 (CCT 1) The post fault system condition in per unit on the 2220 MVA, 24 KV base is as follows: $P = 0.9$ $Q = 0.3$ (overexcited) $E_t = 1.0 \angle 36^\circ$ $E_B = 0.995 \angle 0^\circ$ The generators are modeled as a single equivalent generator represented by the classical model with the following parameters expressed in per unit on 2220 MVA, 24 KV base: $X'_d = 0.3$ $H = 3.5 \text{ MW.s/MVA}$ Write the linearized state equation of the system. Determine the Eigen values, Damped frequency of oscillation in Hz, damping ratio and undamped natural frequency for each of the following values of damping coefficient (in pu torque/ pu speed) : (i) $K_D = 0$ (ii) $K_D = -10.0$ (iii) $K_D = 10.0$	20	2	L4	3



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END SEM/~~RE-EXAM~~ EXAMINATION May/~~June~~ 2026

Program: M.Tech (PEPS) *Sum II*

Duration: 3 h

Course Code: PC MTPX 202

Maximum Points: 100

Course Name: Advance Control of Electric Drives ^{al}

Semester: II

Note:

- Attempt any five questions
- Group sub parts of questions together

21/5/26

Q.No.	Questions	Points	CO	BL	Module No.
Q1(a)	Describe the four-quadrant operation of a motor driving a hoist. Explain each quadrant with respect to direction of motion, torque, and power flow. Illustrate your answer with a neat diagram.	10	1	3	2
Q1(b)	A motor is driving two loads, one is coupled directly to its shaft and other is connected through transmission system converting rotational motion to linear. If J_0 in Kg m^2 and T_0 in Nm are inertia and load torques of the load directly coupled to motor. If the second load is of M (Kg) mass, v (m/s) is its velocity and F (N) force acting on it, with the help of a neat diagram shown the arrangement and also evaluate equivalent torque and inertia of the system.	10	2	3	2
Q2(a)	Discuss the various technical and economic factors that must be considered while selecting an electrical drive for a specific application.	8	1	2	1
Q2(b)	A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with $a=0.1$ and efficiency of 90%. The load has a moment of inertia of 10Kg m^2 and a torque of 10 Nm. Other load has translational motion and consists of 1000Kg weight to be lifted up at a uniform speed of 1.5 m/s. Coupling between this load and the motor has an efficiency of 85%. Motor has an inertia of 0.2 kg m^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred	6	1.2	3	2



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END SEM/RE-EXAM EXAMINATION May/June 2026

	to the motor shaft and power developed by the motor.				
Q2(c)	A drive has the following parameters $J=1 \text{ Kg m}^2$, $T=15-0.01N \text{ (Nm)}$ and passive load torque $T_L=0.005N \text{ (Nm)}$, where N is the speed in rpm. Initially the drive is operating in steady state. Now it is to be reversed. For this motor characteristic is altered such that $T=-15-0.01N \text{ (Nm)}$ for positive as well as for negative values of N . Calculate the time of reversal.	6	2	3	2
Q3(c)	Explain with the help of a neat diagram how the following speed transitions are carried out (i) Increase in the speed in the same direction. (ii) Decrease in the speed (iii) Reversal of speed (iv)	10	2	2	3
Q3(b)	Explain with the help of a neat diagram the operation of a closed loop speed control of multi motor drive with a common drive shaft used in electric locomotives.	10	1,2	3	3
Q4(a)	Analyze how a motor of smaller rating can be employed to supply higher power for short-time duty operation.	10	1,2	3	3
Q4(b)	Develop the thermal model of an electrical motor for both heating and cooling conditions by answering the following: (i) State the assumptions made in thermal modelling. (ii) Derive the differential equation governing the heating of the motor. (iii) Obtain the expression for temperature rise as a function of time during heating. (iv) Derive the equation for cooling of the motor after supply is switched off.	10	1,2	3	4
Q5(a)	Explain with the help of a neat schematic diagram how the speed of the DC separately excited motor can be controlled from zero to base speed using Armature control method. Sketch and explain the following characteristics: (i) Speed–torque characteristic (ii) Speed–power characteristic	10	3	3	5



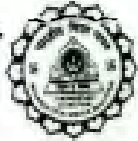
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Q5(b)	A DC separately excited motor is controlled using a Class D chopper drive. (i) Explain the circuit operation with appropriate switching sequence. (ii) Sketch the voltage and current waveforms and explain their nature in I and IV quadrants. (iii) Derive the equation of speed of the motor.	10	3	2,3	5
Q6(a)	Explain the closed loop operation of simultaneous dual converter with the help of a neat diagram.	10	3	3	5
Q6(b)	A slip-ring induction motor is controlled using closed-loop static rotor resistance control. (i) Explain the control scheme with a suitable block diagram. (ii) Derive the equation of the effective resistance of the rotor circuit. (iii) Discuss the speed torque characteristics and efficiency of the system.	10	3	3	6
Q7(a)	Explain the construction and working of a BLDC motor drive. Describe electronic commutation and compare it with conventional DC motor operation.	10	3	3	7
Q7(b)	What is a slip power recovery scheme in induction motor drives? Explain the working of the Kramer drive with a neat schematic diagram.	10	3	2,3	6



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END SEMESTER EXAMINATION MAY 2026 / RE-EXAM JULY 2026

Program: M. Tech. Electrical (PEPS) *Sum II*
Course Code: PE-MTPX206
Course Name: Renewable Energy Sources and Grid Integration

Duration: 3 Hrs.
Maximum Points: 100
Semester: II

Notes:

1. Question number 1 compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams.
4. Assume suitable data if necessary.

Q. No.	Questions	Points	CO	BL	Mod. No.																														
1.	A residential solar PV system is to be designed to power the following electrical loads: <table><tr><th>Sr. No.</th><th>Load Name</th><th>Power on Load (W)</th><th>No. of Load</th><th>Operating Hrs</th></tr><tr><td>1</td><td>LED Light</td><td>9</td><td>6</td><td>6</td></tr><tr><td>2</td><td>Ceiling Fan</td><td>75</td><td>3</td><td>8</td></tr><tr><td>3</td><td>TV</td><td>100</td><td>1</td><td>4</td></tr><tr><td>4</td><td>Refrigerator</td><td>180</td><td>1</td><td>24</td></tr><tr><td>5</td><td>Miscellaneous</td><td>200</td><td>1</td><td>2</td></tr></table> Consider following data 1. The refrigerator operates with a duty cycle of 0.5 2. Efficiency of battery : 90 % 3. Efficiency of Inverter : 95 % 4. Efficiency of charge controller and cables : 90 % 5. Safety factor of inverter : 1.25 6. Assume suitable rating of PV panels and battery Find out 1. PV Array Sizing 2. Battery Bank Sizing 3. Inverter Sizing 4. Charge Controller Sizing	Sr. No.	Load Name	Power on Load (W)	No. of Load	Operating Hrs	1	LED Light	9	6	6	2	Ceiling Fan	75	3	8	3	TV	100	1	4	4	Refrigerator	180	1	24	5	Miscellaneous	200	1	2	20	2.5	4	03
Sr. No.	Load Name	Power on Load (W)	No. of Load	Operating Hrs																															
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END SEMESTER EXAMINATION MAY 2026 / RE - EXAM JULY 2026

2.	With a suitable diagram, explain the complete control architecture of a grid-connected solar PV system. Elaborate the role of: 1. MPPT for maximum energy extraction 2. DC-DC converter for voltage regulation 3. VSC for grid interfacing 4. PLL for synchronization with the grid 5. Current controller and PWM for inverter switching	20	3,4	3	07
3.(a)	Describe how a typical hydropower plant generates electricity, including the diagram of the plant and the roles of the dam, reservoir, penstock, turbine, and generator. Also prove that Actual output power = $\eta \times \rho \times Q \times g \times h$	15	1,2	2	05
3.(b)	A wind turbine system has the following data: Blade Length = 52m Wind Speed = 12 m/s Air density = 1.23 Kg/m ³ Power coefficient = 0.4 Calculate power converted from wind into rotational Energy.	05	1,2	2	05
4.(a)	A 2.5 MW, 6-pole Doubly Fed Induction Generator (DFIG) is connected to a 50 Hz grid. The wind turbine drives the generator at a speed of 920 rpm. The stator delivers 2 MW power to the grid. Calculate 1. Calculate the synchronous speed, slip, and rotor current frequency of the generator. 2. Identify the mode of operation (sub-synchronous or super-synchronous). Justify your answer. 3. Calculate the power handled by the rotor-side converter. Also state the direction of power flow in the rotor circuit.	10	3	2,3	02
4.(b)	The Central Electricity Authority (CEA) has established specific grid codes for the integration of renewable energy sources with the electricity grid to ensure stability and reliability. Discuss the key requirements outlined by the CEA for renewable energy generators regarding grid connectivity.	10	2,3	2,3	04



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5.(a)	Draw the layout of a flash type geothermal power plant and explain the process of how geothermal energy is harnessed and converted into electricity	10	1	1,2	06
5.(b)	What is an MPPT system in a solar PV system? With the help of a flowchart, explain the working principle of the Perturb and Observe (P&O) method and discuss its key advantages and limitations.	10	2,3	3	03
6.(a)	How to calculate hosting capacity for the transmission and distribution system for connecting distributed renewable energy sources?	10	3	3	07
6.(b)	Explain in detail the principles of different renewable energy resources (RES) with emphasis on global and Indian statistics. Include relevant graphs to support your explanation.	10	1	1,2	01
7.(a)	With the help of neat diagram Explain the different types of tidal energy systems and their working principles.	10	1	1,2	06
7.(b)	A wind turbine has a rotor radius of 40 m and operates at a wind speed of 10 m/s. The air density is 1.225 kg/m^3 . The power coefficient $C_p = 0.42$ and thrust coefficient $C_T = 0.75$ 1. Calculate the actual power extracted by the turbine. 2. Determine the thrust force acting on the turbine. 3. If the rotor speed is 50 rpm, calculate the tip speed ratio (λ).	10	3	3	02



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~~END SEMESTER EXAMINATION MAY 2026 / RE - EXAM JULY 2026~~

Program: M. Tech. Electrical (PEPS) *Seni*

Duration: 3 Hrs.

Course Code: PE-MTPX206

Maximum Points: 100

Course Name: Renewable Energy Sources and Grid Integration

Semester: II

Notes:

1. Question number 1 compulsory.
2. Attempt any **four** questions out of remaining **six**.
3. Draw neat diagrams.
4. Assume suitable data if necessary.

15/7/26

Q. No.	Questions	Points	CO	BL	Mod. No.
1.(a)	How to calculate hosting capacity for the transmission and distribution system for connecting distributed renewable energy sources?	10	3	3	07
1.(b)	A wind turbine has a rotor radius of 40 m and operates at a wind speed of 10 m/s. The air density is 1.225 kg/m ³ . The power coefficient $C_p = 0.45$ and thrust coefficient $C_T = 0.8$ 1. Calculate the actual power extracted by the turbine. 2. Determine the thrust force acting on the turbine. 3. If the rotor speed is 15 rpm, calculate the tip speed ratio (λ).	10	2,3	2,3	02
2.	With the help of neat diagram explain the complete control strategy of a grid-connected solar PV system. Describe the role of: 1. MPPT 2. DC-DC converter 3. Voltage Source Converter (VSC) 4. PLL 5. Current regulator and PWM Illustrate how power flows from PV array to grid.	20	3,4	3	7
3.(a)	With the help of neat diagram Explain the different types of tidal energy systems and their working principles.	10	1	1,2	06



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3.(b)	Draw the layout of a flash type geothermal power plant and explain the process of how geothermal energy is harnessed and converted into electricity	10	1	1,2	06																														
4.	A residential solar PV system is to be designed to power the following electrical loads: <table><tr><th>Sr. No.</th><th>Load Name</th><th>Power on Load (W)</th><th>No. of Load</th><th>Operating Hrs.</th></tr><tr><td>1</td><td>LED Light</td><td>9</td><td>6</td><td>6</td></tr><tr><td>2</td><td>Ceiling Fan</td><td>75</td><td>3</td><td>8</td></tr><tr><td>3</td><td>TV</td><td>100</td><td>1</td><td>4</td></tr><tr><td>4</td><td>Refrigerator</td><td>180</td><td>1</td><td>24</td></tr><tr><td>5</td><td>Miscellaneous</td><td>100</td><td>1</td><td>2</td></tr></table> Consider following data 1. The refrigerator operates with a duty cycle of 0.5 2. Efficiency of battery : 90 % 3. Efficiency of Inverter : 95 % 4. Efficiency of charge controller and cables : 85 % 5. Safety factor of charge controller : 1.25 6. Surge factor of inverter : 2 7. Assume suitable rating of PV panels and battery Find out 1. PV Array Sizing 2. Battery Bank Sizing 3. Inverter Sizing 4. Charge Controller Sizing	Sr. No.	Load Name	Power on Load (W)	No. of Load	Operating Hrs.	1	LED Light	9	6	6	2	Ceiling Fan	75	3	8	3	TV	100	1	4	4	Refrigerator	180	1	24	5	Miscellaneous	100	1	2	20	2,5	4	03
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5.(a)	Explain in detail the principles of different renewable energy resources (RES) with emphasis on global and Indian statistics. Include relevant graphs to support your explanation.	10	1	1,2	01																														
5.(b)	The Central Electricity Authority (CEA) has established specific grid codes for the integration of renewable energy sources with the electricity grid to ensure stability and reliability. Discuss the key requirements outlined by the CEA for renewable energy generators regarding grid connectivity.	10	2,3	2,3	04																														



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6.(a)	With the help of following points describe how a typical hydropower plant generates electricity. 1. Schematic diagram of hydro power plant 2. Role of the dam 3. Role of reservoir 4. Role of penstock 5. Role of turbine and generator.	10	1,2	2	05
6.(b)	Consider a wind turbine with 2 m diameter rotor speed of the rotor at 10 m/s, wind velocity is 90 rev./min. and power coefficient at this point is 0.35. Calculate tip speed ratio and torque coefficient of the turbine. What will be the torque available at the rotor shaft? Assume the density of the air to be 1.225 kg/m^3 .	05	2	2	02
6.(c)	Describe the different types of hydropower plants and discuss major advantage and disadvantage of each type. (Don't draw diagram)	05	1,2	2	05
7.(a)	What is an MPPT system in a solar PV system? With the help of a flowchart, explain the working principle of the Perturb and Observe (P&O) method and discuss its key advantages and limitations.	10	2,3	3	03
7.(b)	A photo voltaic cell has an open circuit voltage of 0.6V and a short circuit current of 350 A/m^2 at a cell temperature of 40°C . Calculate the voltage and current density that maximizes the power of the cell. What would be the corresponding maximum power output per unit cell area? What is fill factor of the cell?	10	2,3	2,3	03

**END SEMESTER EXAMINATION MAY 2026 / RE - EXAM JULY 2026**Program: M. Tech. (Electrical-PEPS) *Seen*

Duration: 3 hrs.

Course Code: PC-MTPX 201

Maximum Points: 100

Course Name: Power system dynamics and control

Semester: II

Notes:

1. Question number 1 compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams.
4. Assume suitable data if necessary.

13/7/26

Q. No.	Questions	Pts.	CO	BL	Mod. No.
1.	A 20 MVA, 50 Hz generator delivers 18 MW over a double circuit line to an infinite bus. The generator has kinetic energy of 2.52 MJ/MVA at rated speed. The generator transient reactance is $X'_d = 0.35$ pu. Each transmission circuit has $R = 0$ and a reactance of 0.2 pu on a 20 MVA base. $ E' = 1.1$ pu and infinite bus voltage $V = 1.0 \angle 0^\circ$. A three-phase short circuit occurs at the midpoint of one of the transmission lines. Plot swing curves with fault cleared by simultaneous opening of breakers at both ends of the line at 2.5 cycles using point by point method.	20	2	L4	5
2.	With the help of neat diagram explain in detail 1. Classical model representation of synchronous machine 2. Higher order model representation of synchronous machine.	20	1	L2	1,2
3.	Fig.1 shows the system representation applicable to thermal generating station consisting of four 555 MVA, 24 KV, 60 Hz units Fig. 1 The network reactance shown in figure are in per unit on 2220 MVA, 24 KV	20	2	L4	3

	base. Resistances are assumed to be negligible. Type of fault occur: Loss of circuit 1 (CCT 1) The post fault system condition in per unit on the 2220 MVA, 24 KV base is as follows: $P = 0.9$ $Q = 0.3$ (overexcited) $E_t = 1.0 \angle 36^\circ$ $E_B = 0.995 \angle 0^\circ$ The generators are modeled as a single equivalent generator represented by the classical model with the following parameters expressed in per unit on 2220 MVA, 24 KV base: $X'_d = 0.3$ $H = 3.5 \text{ MW.s/MVA}$ Write the linearized state equation of the system. Determine the eigen values, Damped frequency of oscillation in Hz, damping ratio and undamped natural frequency for each of the following values of damping coefficient (in pu torque/ pu speed) : (i) $K_D = 0$ (ii) $K_D = -10.0$ (iii) $K_D = 10.0$				
4. (a)	A generator operating at 50 Hz delivers 1 pu power to an infinite bus through a transmission circuit in which resistance is ignored. A fault takes place reducing the maximum power transferable to 0.5 pu whereas before the fault, this power was 2.0 pu and after the clearance of the fault, it is 1.5 pu. By use of equal area criterion, determine the critical clearing angle. (Consider initial mechanical input power 1.0 pu)	10	2	L3	4
(b)	Explain in detail working of power system stabilizer in transient stability enhancement.	10	1	L2	7
5.	Derive expression for small signal stability of a single machine infinite bus system with the help of following points 1. Classical model representation 2. State space representation 3. Block diagram representation 4. Expression of damping ratio (ζ) and natural frequency (ω_n)	20	1	L2	3
6.(a)	Write short note on 1. P-V Curve 2. Q-V Curve 3. P-Q Curve	10	1	L2	6

(b)	Explain in detail operating condition for point A, B and C using given graph. Also draw normal and abnormal operating region on graph (b).	10	2	L3	6
	(a) Schematic diagram (b) Receiving end voltage, current and power as a function of load demand	10	2	L3	6
7.(a)	Which are methods of transient stability enhancement? Explain in detail Steam turbine fast valving.	10	1	L2	7
(b)	Write short note on 1. V-Q Sensitivity analysis 2. Q-V model analysis	10	1	L2	6



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END SEM/RE-EXAM EXAMINATION *July* ~~May/June~~ 2026

Program: M.Tech (PEPS) *2am 11*

Duration: 3 h

Course Code: PC MTPX 202

Maximum Points: 100

Course Name: Advance Control of ^{at} Electric Drives

Semester: II

Note:

- Attempt any five questions
- Group sub parts of questions together
- Note paper is 3 pages long

14/7/26

Q.No.	Questions	Points	CO	BL	Module No.
Q1(a)	Analyze how the steady-state stability of an electric drive is governed by the relative torque-speed characteristics of the motor and the load. Derive the criterion for stability and support your answer with suitable diagrams.	10	2	4	2
Q1(b)	A rolling mill driven by thyristor converter fed dc motor operates on a speed reversing duty cycle. Motor field current is maintained constant at the rated value. Moment of inertia referred to motor shaft is 10,000 Kg m ² . Duty cycle consists of the following intervals: (i) Rolling at full speed (200 rpm) and at constant torque of 25,000 Nm for 10s. (ii) No load operation for 1 s at full speed. (iii) Speed reversal from 200 to -200 rpm in 5 s. (iv) No load operation for 1 s at full speed. (v) Rolling at full speed (200 rpm) and at constant torque of 20,000 Nm for 15s. (vi) Speed reversal from 200 to -200 rpm in 5 s. (vii) No load operation at full speed for 1 s.	10	1,2	3	3
Q2(a)	List and explain the advantages of electric drives over other types of drives.	8	1	3	1



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Q2(b)	Classify components of load torques based on the relationship with the angular speed. Draw and explain the torque speed characteristic of the (i) high speed hoist (ii) traction load.	6	2	3	2
Q2(c)	A motor is used to drive a hoist. Motor characteristic are given by Quadrant I and IV: $T=200-0.2N$, Nm Quadrant II and IV: $T=-200-0.2N$, Nm; where N is speed in rpm. When hoist is loaded, the net torque $T_f=-80$ Nm. Obtain the equilibrium speeds for operation in all four quadrants.	6	1,2	3	2
Q3(c)	Describe the four-quadrant operation of a motor driving a hoist. Explain each quadrant with respect to direction of motion, torque, and power flow. Illustrate your answer with a neat diagram.	10	1,2	3	2
Q3(b)	Explain the operation of a closed loop speed control scheme with inner current loop. What are various functions of inner current control loop?	10	2	2	4
Q4(a)	The motor rating is to be selected from a class of motors with heating and cooling time constant of 60 and 90 minutes respectively. Calculate the motor rating for the following duty cycles: (i) Short time periodic duty cycle consisting of 100KW load for 10 minutes followed by no load period long enough for the motor to cool down. (ii) Intermittent periodic duty cycle consisting of 100KW load period of 10 min and no-load period of 10 min. (iii)	10	2	3	3
Q4(b)	Develop the thermal model of an electrical motor for both heating and cooling conditions by answering the following: (i) State the assumptions made in thermal modelling. (ii) Derive the differential equation governing the heating of the motor. (iii) Obtain the expression for temperature rise as a function of time during heating. (iv) Derive the equation for cooling of the motor after supply is switched off.	10	1,2	3	4



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Q5(a)	Explain with the help of a neat schematic diagram how the speed of the DC separately excited motor can be controlled from zero to above base speed using Ward Leonard method. Sketch and explain the following characteristics: (i) Speed–torque characteristic (ii) Speed–power characteristic	12	3	3	5
Q5(b)	Sketch and explain voltage and current waveform of a single-phase rectifier-controlled DC separately excited motor for different modes of operation (continuous and discontinuous modes) when the motor is braking .	8	3	3	5
Q6(a)	A three-phase induction motor undergoes AC dynamic braking through a two-lead connection. (i) Explain the braking mechanism and current distribution in the stator windings. (ii) Derive the expressions for positive and negative sequence currents using symmetrical component theory. (iii) Derive (and sketch) how the corresponding torques are developed and obtain the net braking torque. (iv) Draw the equivalent circuit used for analysis.	10	3	4,3	6
Q6(b)	A three-phase induction motor is controlled using open-loop V/f control. (i) Explain the working of the control scheme with a suitable diagram. (ii) Justify why the V/f ratio is kept constant. (iii) Analyse the performance of the motor at low and high frequencies.	10	3	3,2	6
Q7(a)	Describe with the help of a neat diagram how slip power is recovered and fed back to the supply in the Scherbius drive. If $n:1$ is stator to rotor turn ratio, supply voltage is V per phase obtain the turn ratio of the transformer connected on inverter side for optimal slip power recovery ensuring motor operates in stable region of speed torque characteristic.	10	3	3	6
Q7(b)	Explain the construction and working of a BLDC motor drive. Describe electronic commutation and compare it with conventional DC motor operation.	10	2	3	7



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