



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058



END SEMESTER December 2025 / RE-EXAM February 2026

Program: M. Tech (PEPS) (Dept. of EE)

Duration: 3 Hrs.

Course Code: PC-MTPX101

Maximum Points: 100

Course Name: Advance Power Electronics

Semester: 1st Mtech (PEPS)

Notes: Attempt all Questions; assume suitable data, if required. All questions are compulsory

29/12/2025

Q.No.	Questions	Points	CO	BL	Module No.
Q. No. 01	<p>Explain the power losses taking place in the power semiconductor devices. Derive their respective formulae from the fundamental principles</p> <p><i>A power MOSFET SiHB065N60E is being used as a switch for a full bridge DC-DC resonant converter with following specifications: $V_{dc} (max) = 400V$, $I_d(peak)=15A$, $R_{ds_on} = 57m\Omega$, Duty Cycle $d=0.5$, $f_s=100kHz$, rise time $t_r=92ns$, fall time $t_f=28ns$, $R_{thjc}=0.5\text{ }^\circ C/W$, $R_{thcs}=1.5\text{ }^\circ C/W$, $T_j(max) = 150\text{ }^\circ C$, $T(ambient)=30\text{ }^\circ C$, $Q_g max=74nC$. $V_{gs}=0$ to $15V$ Calculate: (1) The Conduction loss in each switch (2) Total Switching loss (3) The thermal resistance temperature coefficient of the heatsink to be used (R_{thsa}) to maintain the junction temperature below the maximum permissible temperature of $150\text{ }^\circ C$ (4) The gate driving power in Watts (5) The peak and average value of the gate current if $R_g=10\text{ }^\Omega$</i></p>	20	01	03	01
Q. 02	<p>(a) Draw a neat circuit diagram of a SEPIC DC-DC Converter. Derive the relationship for the transformation ratio in terms of the duty cycle for this converter.</p> <p>(a) Draw a neat circuit diagram of a Cuk's DC-DC Converter. Derive the relationship for the transformation ratio in terms of the duty cycle for this converter.</p> <p>(c) Compare the above two type of converters as referred in (a) and (b) above and state relative advantages of these topologies as compared to conventional non-isolated basic topology.</p> <p>(d) What is the best alternative isolated DC-DC Converter as a substitute for SMPS applications catered by SEPIC and Cuk's.</p>	20	02	02	02



END SEMESTER December 2025 / RE-EXAM February 2026

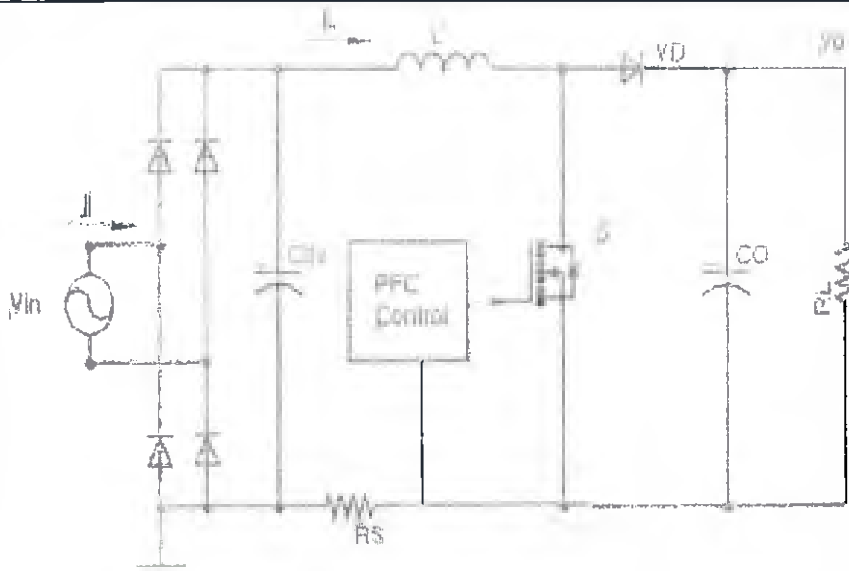


Fig. 2

A boost Converter based Active Power Factor Correction circuit as shown in Fig. 2 is required to be designed for following specifications:

- (i) Rated output power P_o : 2.5kW
- (ii) AC input voltage range: V_{in} : 85-270VAC, at 50Hz
- (iii) Output DC voltage U_o : 400V @ Max Pk-Pk ripple 4%, with minimum voltage value =360V
- (iv) Switch frequency f_{sw} : 120kHz
- (v) Expected Input Power Factor= 0.99 to 1.00

Assume the peak-to-peak ripple in the inductor current to be less than or equals to 20% of the peak input AC current at the maximum power. Calculate the following by assuming 100% efficiency with CCM mode:

- (a) RMS and peak Value of the input AC Current
- (b) The Voltage and Current rating of the Input side diode bridge with Minimum value of the input filter Capacitor C_{in}
- (c) Duty cycle when the inductor current goes to the maximum peak.
- (d) The minimum value of the boost inductor L
- (e) The minimum value of the Output filter Capacitor C_o
- (f) The MOSFET Switch : Voltage and Peak Current rating
- (g) The PIV and peak current and average current rating of the diodes
- (h) The value of the current sensing resistor R_s @ 5Watt

Q. 03		20	02,03	03,04	03 and 06
Q. 04	Write the importance of soft switching in the DC-DC Converter. Draw the accurate circuit diagram of both the half and Full bridge LLC converter. Draw the AC Side equivalent circuit of this	20	02 and 03	02 and 03	06 and 07

**END SEMESTER December 2025 / RE-EXAM February 2026**

	<p>converter and write the expression for AC primary resistance derived from the DC Output resistance using first harmonic approximation. Also, elaborate on the special design of the HF Transformer. Explain the Gain Vs Frequency Characteristics in LLC resonant converter for different Inductance ratios (L_m/L_r) with the help of suitable gain-curves. Also explain how the load appears in series and parallel with the resonant circuit at different loads and how the output voltage would be regulated by varying the switching frequency in these converters.</p> <p><i>A half bridge LLC resonant converter is required to be designed for $Q=0.42$ and $f_0=120\text{kHz}$, for variable input voltage ranges from 340V DC to 400VDC. The output should be regulated by frequency control to 54V @ $P_{out}=2000\text{W}$ to be used for charging a 48V battery system. Assume the inductance ratio to be used as $m=6$; where $m=(L_m+L_r)/L_r$. Calculate the following parameters</i></p> <p>(i) <i>The transformation ratio of the transformer</i> (ii) <i>The resonant inductor value</i> (iii) <i>The resonant capacitor value</i> (iv) <i>The magnetizing inductance of the transformer</i></p>				
Q. 05 (a)	<p>Sketch the circuit schematic of a three-phase bridge voltage source inverter with star connected load fed from a input DC split supply with capacitors. Designate the numbers to the six IGBT switches with appropriate numbering as per the gating sequence. Considering the Input voltage to be 100V DC. It is decided to use 180 degrees conduction mode for driving the inverter through six gating pulses G1-G6 (1) Draw the six equivalent circuits for six modes for each 60-degree interval from a complete fundamental cycle of 20ms (2) Compute three-phase phase-neutral and phase-phase output voltage values for each 60-degree step and show them for two fundamental cycle and show them in a tabular form also (3) Find the rms value of a resulting Phase-Neutral voltage using quarter wave symmetry (4) Find the rms value of a resulting Phase-Phase voltage using quarter wave symmetry</p>	10	02, 03	02, 03	04, 06

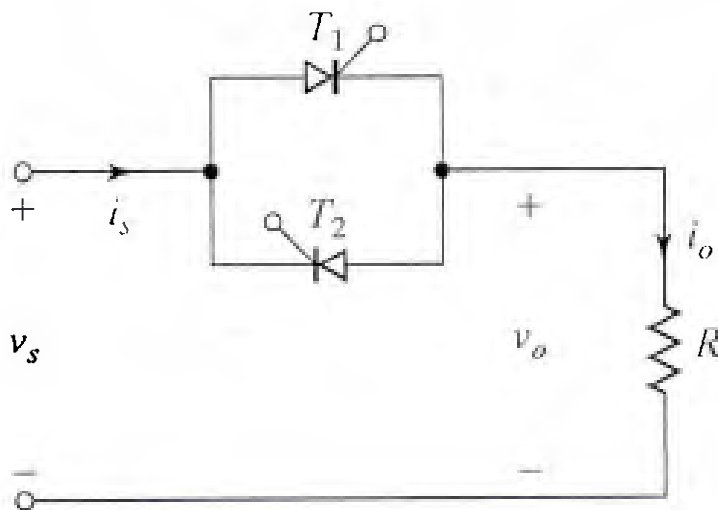


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A single-phase full-wave ac voltage controller in Figure has a resistive load of $R = 10$ and the input voltage is $V_s = 120$ V (rms), 60 Hz. The delay angles of thyristors T_1 and T_2 are equal AND $= 90^\circ$. Determine (a) the rms output voltage V_o , (b) the input PF, (c) the average current of thyristors I_A , and (d) the rms current of thyristors I_R .

Q. No
05(b)

10

02,
03

02,
03

03, 05,
06

END OF THE PAPER

**Re- END SEMESTER EXAM: ~~DEC 2025~~ Feb 2026**Program: **M. Tech (PEPS) (Dept. of EE)**

Duration: 3 Hrs.

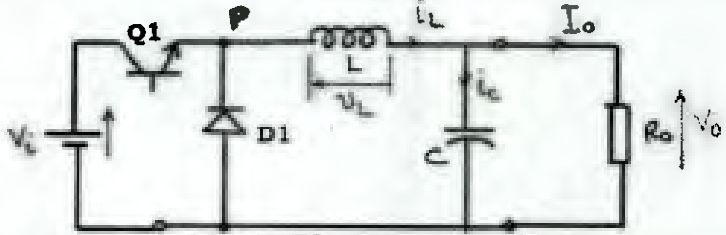
Course Code: **PC-MTPX101**

Maximum Points: 100

Course Name: **Advance Power Electronics**Semester: **1st Mtech (PEPS)**

Notes: Attempt all Questions; assume suitable data, if required. All questions are compulsory

09/02/26

Q.No.	Questions	Points	CO	BL	Module No.
	 <p>In a typical Buck Converter Circuit as shown in the Fig. 1 above, the input voltage varies from 200V to 380V dc. The switching frequency is kept at 100kHz and the output voltage is regulated at 120V DC @ 4% Pk-Pk Max ripple and @ Max Power of 4500Watt. The inductor should be so designed for a permissible max. pk-pk current ripple at 20%.</p> <ol style="list-style-type: none"> Calculate the duty cycle range for input voltage variation and operating at Maximum Power. Calculate the maximum value of the peak and average inductor current flowing in the circuit Calculate the value of minimum value of the inductor L Calculate the value of minimum value of the Capacitor C Obtain the Maximum peak voltage and current that the switch Q and the Diode D may come across Calculate the maximum value of the total switching power loss at the switch Q if it is selected as IPW60R045CPA of Infineon, having: Max $R_{dson}=45$ milliOhm, Turn- on delay time =30ns; Rise time = 20ns; Turn-off delay time=100ns; and Fall time=10ns. Calculate the total switching power loss in the diode D having forward voltage of 0.8V, the Reverse recovery time=600ns and Reverse recovery charge=17 Micro- Coulomb 				
Q. No. 01		20	01, 02	02.03	01, 02

Re - END SEMESTER EXAM: ~~DEC 2025~~ Feb 2026

Q. 02	A 1.2 kW PV system consists of 4 series-connected arrays, each of which has the rated voltage of 55 V and the rated current of 6.0 A at the maximum power point, at the maximum expected insolation. The output of the series-connected arrays is boosted to 400 V (dc) with 2% permissible ripple by a Boost converter, as an input to an inverter that feeds power into the single-phase utility grid. Assuming that the switching frequency in the Boost converter is selected to be 200 kHz and the peak-to-peak ripple in the input current to this converter is to be less than 10% of the rated current at the maximum power, calculate the following by assuming ideal components and CCM mode: Devise a suitable and power and control scheme for this application and : (a) The value of the inductance in this converter. (b) The value of the filter Capacitor at the output (c) The switch voltage and current rating (d) The diode PIV and peak current rating	20	02, 03	03, 04	02, 06
Q. 03	(a) Draw a neat circuit diagram of a SEPIC DC-DC Converter. Derive the relationship for the transformation ratio in terms of the duty cycle for this converter. (a) Draw a neat circuit diagram of a Cuk's DC-DC Converter. Derive the relationship for the transformation ratio in terms of the duty cycle for this converter. (c) Compare the two type of converters as referred in (a) and (b) above and state relative advantages of these topologies as compared to conventional non-isolated basic topology. (d) What is the best alternative isolated DC-DC Converter as a substitute for SMPS applications catered by SEPIC and Cuk's.	20	02, 03	02	02
Q. 4 (a)	A flyback converter is required to be designed for obtaining a output of DC 15V @ 1% ripple voltage at 10 Watts. The input DC Voltage varies from 110V to 380V DC. Assume switching frequency of 50kHz. Find the following assuming 20% inductor current ripple. (1) Transformer turns ratio (2) The magnetizing inductance of the transformer (3) The Output Capacitor value (4) The MOSFET switch voltage and current rating (5) The Output diode voltage and current rating	10	02, 03	02, 03	02, 03
Q. 4(b)	A full-bridge LLC resonant converter is required to be designed for $Q=0.3$ and $f_0=100\text{kHz}$, for a fixed input voltage = 400VDC. The output should be regulated by frequency control to 150V @ $P_{out}=1000W$ to be used for charging a 400V battery system. Assume the inductance ratio to be used as $m=6$; where $m=(L_m+L_r)/L_r$. Calculate the following parameters (i) The transformation ratio of the transformer (ii) The resonant inductor value (iii) The resonant capacitor value	10	02, 03	03,04	06, 07



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Re - END SEMESTER EXAM: DEC 2025 ~~Feb~~ Feb 2026

	(iv) The magnetizing inductance of the transformer				
Q. 5 (a)	<p>What is the difference between Unipolar and Bipolar Sinusoidal PWM Voltage Source Single-Phase Inverter? How do they differ in terms of sinusoidal output and harmonic patterns? What is synchronous PWM and its effect on resulting voltage harmonics? Explain with suitable sketch of harmonic spectrum.</p> <p>Explain with neat sketches the 2D- Space Vector Modulation for a three Phase VSC citing all the relevant modes of operations. Discuss advantages of SPVM over SVM.</p>	10	02 03	02	04
Q. 5(b)	<p>A single-phase, direct AC-AC, Buck-Boost Matrix Converter is required to be designed for AC Voltage Stabilization Application.</p> <p>(a) Draw the four switch converter topology power schematic (b) Draw the gating pulse Waveforms for each individual switch (c) Design a suitable control strategy and explain with block diagram</p> <p>If $V_{in}=120VAC$, 50Hz to 270V AC and $V_{out}=230V$ AC. P_{out} (resistive)=1000 Watt, $f_s = 100kHz$.</p> <p>(i) Compute the switching losses for each device. (2) Design the AC inductor (3) Design the AC filter Capacitor for both the input and Output side.</p>	10	02, 03	03, 04	05, 06
	THE PAER ENDS HERE				



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End Semester Examinations / ~~Re-Examinations~~ - December 2025 / ~~January 2026~~

Program: PEPS, M.Tech First year - Sem-I Duration: 3 h

Course Code: PC-MTPX102

Maximum Points: 100

Course Name: Computer Aided Power System Analysis

Semester: I

- Attempt five questions .
- Make suitable assumptions wherever necessary.
- Answer should have four digits after decimal.

31/12/2025

Q.No	Questions	Points	Module	BL	CO
Q1.(a)	Critically compare the Newton-Raphson methods and Fast decoupled method with respect to convergence, accuracy, and computational efficiency in load flow studies.	10	1,2	3	1,2
Q1.(b)	Describe the Modified Euler method for solving the swing equation. Explain the predictor and corrector steps with relevant equations.	10	1,4	2	1,2
Q2.(a)	<p>A three phase fault occurs at the point F as shown in the figure given below is cleared by isolating the faulted circuit simultaneously from both ends. Generator is delivering 0.8 pu power at 0.8 pf lagging. The fault is cleared in 0.1s. Obtain the numerical solution of the swing equation upto 0.15s using Runge Kutta fourth order method with step size of 0.05s. $H=5\text{MJ/MVA}$.</p>	20	1,4	4	1,2
Q3.(a)	A three bus power system is shown below. The relevant pu line reactances on 100 MVA base are indicated on the diagram and bus data is given in table below.	15	2	4	1,2



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End Semester Examinations / ~~Re-Examinations~~ - December 2025/ January 2026

	<table border="1" data-bbox="319 873 1109 1088"> <thead> <tr> <th rowspan="2">Bus Number</th> <th rowspan="2">Type</th> <th colspan="2">Generation</th> <th colspan="2">Load</th> <th rowspan="2">Bus Voltage</th> </tr> <tr> <th>P_G (MW)</th> <th>Q_G (MVAR)</th> <th>P_L (MW)</th> <th>Q_L (MVAR)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>slack</td> <td>?</td> <td>?</td> <td>0</td> <td>0</td> <td>$1.02 \angle 0$</td> </tr> <tr> <td>2</td> <td>PQ</td> <td>25</td> <td>15</td> <td>50</td> <td>25</td> <td>?</td> </tr> <tr> <td>3</td> <td>PQ</td> <td>0</td> <td>0</td> <td>60</td> <td>30</td> <td>?</td> </tr> </tbody> </table> <p>Form Y_{bus} and find voltages at bus 2 and 3 after second iteration using Gauss Siedel method. Take acceleration factor 1.6.</p>	Bus Number	Type	Generation		Load		Bus Voltage	P_G (MW)	Q_G (MVAR)	P_L (MW)	Q_L (MVAR)	1	slack	?	?	0	0	$1.02 \angle 0$	2	PQ	25	15	50	25	?	3	PQ	0	0	60	30	?				
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1	slack	?	?	0	0	$1.02 \angle 0$																															
2	PQ	25	15	50	25	?																															
3	PQ	0	0	60	30	?																															
Q.3(b)	<p>Explain why buses in a power system are classified for load flow studies. Describe the different types of buses with justification.</p>	5	2	4	2																																
Q4.(a)	<p>Two synchronous machines are connected through three phase transformer to the transmission line. The rating and reactances of the machine and transformers are:</p> <table border="1" data-bbox="319 1417 1133 1542"> <tbody> <tr> <td>Machine 1&2</td> <td>100MVA, 20KV, $X''_d = X_1 = X_2 = 20\%$; $X_o = 4\%$ and $X_n = 5\%$</td> </tr> <tr> <td>Transformer 1&2</td> <td>100 MVA, 20 Δ/345 Y KV; $X = 8\%$</td> </tr> </tbody> </table> <p>On the choice of 100MVA, 345 KV in the transmission line current the line reactance are $X_1 = X_2 = 15\%$ and $X_o = 5\%$. Find the subtransient condition when LLG fault with $Z_f = 0$ occurs at the terminal of machine 2.</p>	Machine 1&2	100MVA, 20KV, $X''_d = X_1 = X_2 = 20\%$; $X_o = 4\%$ and $X_n = 5\%$	Transformer 1&2	100 MVA, 20 Δ /345 Y KV; $X = 8\%$	12	3	4	3																												
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Q4.(b)	<p>Three 6.6 KV generators A, B and C; each of 10% leakage reactance and MVA ratings 40, 50 and 25 respectively are interconnected electrically as shown below by a tie bar through current limiting reactors each 12% reactance based upon the rating of the machine to which it is connected. A 3-ϕ feeder is supplied from the busbar of generator A at a line voltage of</p>	8	3	4	3																																



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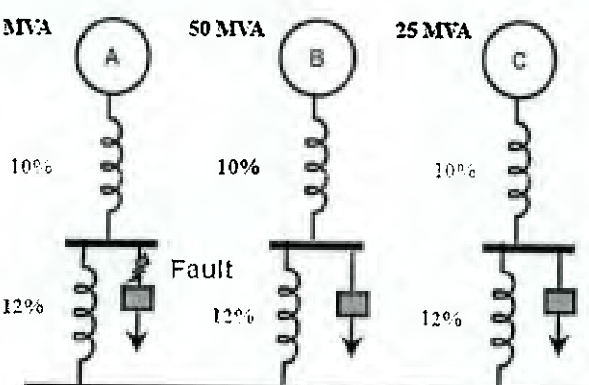

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End Semester Examinations / ~~Re-Examinations~~ – December 2025/ January-2026

	<p>6.6KV. The feeder has a reactance of $0.06 \Omega/\text{phase}$ and an inductive reactance of $0.12 \Omega/\text{phase}$. Estimate the maximum MVA that can be fed into symmetrical short circuit at the far end of the feeder.</p> 				
<p>Q5.(a)</p>	<p>In the two bus system, bus 1 is a slack bus with $V_1=1.0 \angle 0^\circ$. A load of 150 MW and 50 MW is taken from bus 2. The line admittance is $Y_{12}=10 \angle -73.74^\circ \text{ pu}$ on the base of 100 MVA. The expression for the real and reactive power at bus 2 is given by</p> $P_2=10 V_2 V_1 \cos(106.26^\circ - \delta_2 + \delta_1) + 10 V_2 ^2 \cos(-73.74^\circ)$ $Q_2=-10 V_2 V_1 \sin(106.26^\circ - \delta_2 + \delta_1) - 10 V_2 ^2 \sin(-73.73^\circ)$ <p>Using Newton Raphson obtain the voltage magnitude and phase angle at bus 2. Start with an initial estimate of $V_2 =1 \text{ pu}$ and $\delta_2 = 0$. Perform one iteration.</p> 	<p>12</p>	<p>2</p>	<p>4</p>	<p>1,2</p>
<p>Q5.(b)</p>	<p>What is load forecasting and why is it important in power system planning and operation? List the different types of load forecasting based on time horizon. What factors influence electrical load forecasting?</p>	<p>8</p>	<p>5</p>	<p>2</p>	<p>5</p>
<p>Q6.(a)</p>	<p>Explain the application of state estimation in power system operation. Explain, with the help of a neat diagram, the information flow between various functions performed by the computer system in a power system control centre.</p>	<p>10</p>	<p>6</p>	<p>3</p>	<p>4</p>
<p>Q6.(b)</p>	<p>Explain the various operating states of a power system with neat diagrams. Explain the transition of a power system from one</p>	<p>10</p>	<p>7</p>	<p>3</p>	<p>4,5</p>



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End Semester Examinations / ~~Re-Examinations~~ – December 2025/ January 2026

	operating state to another.				
Q7.(a)	Use Least square method to estimate two random variables x_1 and x_2 by using the data for a three dimensional vector y . Take $H = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$	10	6	4	5,6
Q7.(b)	Explain the two major system security functions—security assessment and security control—performed in an operations control centre.	10	7	3	5,6

**END SEM/PE-EXAMINATION JANUARY 2026**Program: F.Y. M. Tech PEPS

Duration: 03 Hour

Course Code: PE-MTPX 101

Maximum Points: 100

Course Name: Distributed Generation and Micro Grid

Semester: I

Instructions:

1. Attempt any FIVE questions.
2. Draw neat diagrams wherever possible.

05/01/2026

Q.No.	Questions	Points	CO	BL	Module No.
Q. 1(a)	What security issues are associated with the implementation of distributed generation and how can it be mitigated? Hence, discuss the parameters need to be considered while selecting the distributed energy resources.	05+ 05	01	L-1	01
Q. 1(b)	What roles do batteries and ultra-capacitors play in energy storage and how do they enhance distributed generation system. How do Ultra capacitors compared to batteries in terms of energy density and life cycle.	06+ 04	01	L-1	01
Q. 2 (a)	What are the limits on operational parameters such as voltage, frequency, and Total Harmonic Distortion (THD) for integrating Non-Conventional Energy (NCE) sources into the grid? Hence, how should renewable energy systems respond to abnormal grid operating conditions such as voltage sags, frequency deviations, and faults?	04+ 06	01	L-1	02
Q. 2 (b)	What is the concept of islanding in grid-connected renewable energy systems, and what are the challenges associated with its detection and prevention?	04+ 06	02	L-1	02
Q. 3 (a)	What role do power electronic interface play in the integration of renewable energy sources. How do power electronics help to maintain the power quality in micro grid?	05+ 05	02	L-1	03



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END SEM/RE-EXAMINATION JANUARY 2026

Q. 3 (b)	Draw and explain the typical structure/configuration of AC-DC Hybrid micro-grid. Hence discuss the benefits of hybrid micro-grid over the independent AC and DC micro-grids.	06+ 04	02	L-1	03
Q. 4 (a)	How does active and reactive power control maintain the balance between generation and demand in a micro grid? Describe a method commonly used for active power control in micro grid?	05+ 05	03	L-1	04
Q. 4 (b)	How does the protection system in a micro grid differentiate between faults in grid-connected and islanded modes? What strategies are used to ensure reliable protection?	05+ 05	03	L-1	04
Q. 5 (a)	Identify and describe the main types of power quality issues caused by distributed generation? Hence, discuss the challenges of maintaining power quality in islanded microgrid operation, especially under varying load and generation conditions?	06+ 06	03	L-1	05
Q. 5 (b)	Explain the positive and negative impacts of distributed energy resources on power system.	04+ 04	03	L-1	05
Q. 6 (a)	Explain the working and role of Phase Locked Loops (PLLs) in grid synchronization of DG inverters with diagram.	10	04	L-1	06
Q. 6 (b)	Describe the current control method used in DG inverters. How does it ensure system stability during transient events?	10	04	L-1	06
Q. 7 (a)	What factors affect the cost of energy in Distributed Generation systems?	05	04	L-1	07
Q. 7 (b)	A university plans to install a grid-connected solar PV system to reduce its electricity bills. The system has the following specifications: Rated Capacity: 60 kW; Capital Cost: ₹40,00,000; Operating Hours per Year: 1,500 hours; O&M Cost: ₹25,000 per year; System Life: 25 years; Electricity Tariff (Saving): ₹8 per kWh; Discount Rate: 6%; Residual Value at End of Life: ₹3,00,000. Calculate annual energy generation, annual gross savings; net annual savings; present value of net annual savings; present value of residual value; net present value (NPV); the payback period; LCOE and interpret the financial viability.	15	04	L-1	07



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END SEMESTER December 2025 / RE - EXAM February 2026

Program: PEPS M Tech First year

Duration:

Course Code: PE-MTPX107

Sem-I

Maximum Points:100

Course Name: EVSD

Semester: I, M. Tech

Electric vehicle System Design

Notes: Attempt any 5 out of 7 questions. Each question carries 10 marks.

09/01/2026

New Copy

Q.No.	Questions	Points	CO	BL	Module No.
1. a	Define a drive cycle for an electric vehicle. Explain its importance in evaluating vehicle performance and energy consumption.	10	3	2	1
1.b	List the common EMI/EMC standards applicable to automotive ECUs.	10	5	2	4
2 a	Describe the sequence of charging stages in an AC EV charger. Elaborate on the charging protocol and communication signals used between the EV and the AC charger.	10	4	4	5
2b.	Explain the design considerations of DC fast chargers, including vehicle interface and charging protocol.	10	4	4	6
3.a	An electric passenger vehicle is traveling at 60 km/h on a city road. The driver releases the accelerator pedal and applies the brake lightly to slow down as a traffic signal turns red. During this deceleration phase, the vehicle activates regenerative braking to recover energy while maintaining vehicle stability and safety. I. Identify the ECUs involved in the processes. II. Explain the sequence of communication among the ECUs involved during deceleration and regenerative braking.	10	5	5	3
3.b.	List the possible sources of EMI in the EV. Explain the EMI/EMC measurement techniques used for automotive ECUs.	10	5	3	4
4.a	Explain the functional safety requirements of automotive electronics as per ISO 26262.	10	3	2	7
4.b	An electric passenger car is to be designed for urban and highway operation. The vehicle has a total mass of 1600 kg, a rolling resistance coefficient of 0.015, an aerodynamic drag coefficient of 0.29, and a frontal area of 2.2 m ² . It is required to operate at a maximum speed of 100 km/h on a road gradient of 10%, with a drivetrain efficiency of 90% and a wheel radius of 0.3 m. Calculate the tractive force acting on the vehicle and determine the required	10	1	4	1



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END SEMESTER December 2025 / RE - EXAM February 2026

	motor power rating. Suggest a suitable type of electric motor for this application.				
5.a	Analyze the maximum acceleration limit, traction limit, and maximum grade limit of an electric vehicle.	10	1	4	1
5.b	Explain the selection and sizing of battery packs for 2W, 3W and 4W electric vehicles, highlighting key design considerations.	10	2	3	2
6.a	Discuss on the effect of road conditions and environmental impacts on the design of energy storage for EV.	10	2	2	2
6.b	Describe the various types of AC and DC chargers used in EV charging. Also Explain the control and communication units used.	10	4	3	6
7.a	Apply tractive force equations to determine the motor power requirement of an EV under different operating conditions.	10	1	4	1
7.b	Explain the design considerations for AC EV chargers, including vehicle interface and charging protocol.	10	4	3	5



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END-SEM/RE-EXAM EXAMINATION December 2025/January 2026

Program: Electrical M. Tech. First year

Duration: 3h

Course Code: PE-MTPX105

Maximum Points: 100

Course Name: Restructuring and Deregulation of Power System

Semester: I

13102126

- Attempt *five* questions
- Make suitable assumptions wherever necessary

Q.No	Questions	Points	CO	BL	Module
Q1.(a)	Explain the key features of spot contracts, forward contracts, futures contracts, and option contracts used in financial and commodity markets.	12	1	2	2
Q1.(b)	Contrast the monopoly model and the retail competition model in the power sector with the help of neat diagrams. Also explain which model provides choice to small residential consumers in selecting their service provider.	8	2	3	1
Q2.(a)	A manufacturer estimates that its variable cost for manufacturing a given product is given by the following expression: $C(q) = 65q^2 + 2100q$ [₹] where C is the total cost and q is the quantity produced a. Derive an expression for the marginal cost of production b. Derive expressions for the revenue and the profit when the widgets are sold at marginal cost.	5	2	4	1
Q2.(b)	The inverse demand function of a group of consumers for a given type of widgets is given by the following expression: $\pi = -20q + 3000$ ₹; where q is the demand and π is the unit price for this product. Economists estimate that the supply function for the widget market is given by the following expression: $q = 0.2\pi - 50$ a) Calculate the demand and price at the market equilibrium. b) For this equilibrium, calculate the consumers' gross surplus, the consumers' net surplus, the producers' revenue, the producers' profit, and the global welfare. c) Calculate the effect on the market equilibrium of if minimum price is to be ₹900 per widget. Calculate the market price, the quantity transacted, the consumers' net surplus, the producers' profit, and the global welfare.	15	1,2	3	2



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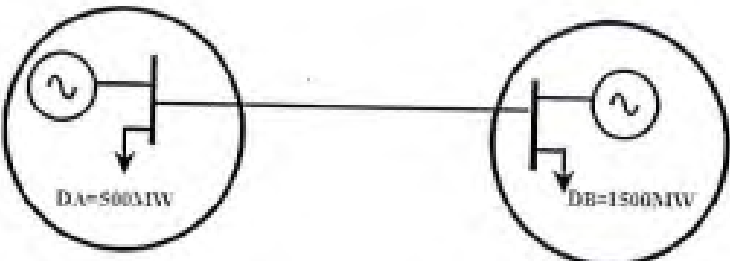
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Q3.(a)	<p>Consider the two-bus power system shown in figure below. The marginal cost of production of the generators connected to buses A and B are given respectively by the following expressions: $MC_A = 24 + 0.03P_A \text{ ₹/MWh}$ $MC_B = 15 + 0.025P_B \text{ ₹/MWh}$</p> <p>Assume that the demand is constant and insensitive to price, that energy is sold at its marginal cost of production and that there are no limits on the output of the generators. Calculate the price of electricity at each bus, the production of each generator and the flow on the line for the following cases:</p> <ol style="list-style-type: none"> The line between buses A and B is disconnected The line between buses A and B is in service and has an unlimited capacity, but the maximum output of Generator B is 1200MW. The line between buses A and B is in service but its capacity is limited to 400MW. The output of the generators is unlimited. Find the merchandising surplus for part c). 	12	3	4	4	
<p style="text-align: center;">A</p>  <p style="text-align: center;">B</p>	<p>Q3.(b) Why physical transmission right is essential for trading electricity? How can these rights acquire? Demonstrate with the help of an example how a player of a market can abuse market power by purchasing physical transmission rights? Discuss, what can be done to avoid its misuse?</p>	8	3	2,3	4	
Q4.(a)	<p>The electricity pool of Syldavia has received the bids and offers shown on the table below for the period between 9 : 00 and 10 : 00 A.M. on 11 June.</p>	15	2	4	2	
Bid	Company	Quantity (MWh)	Price (₹/MWh)			
	Red	200	12			
	Red	50	15			



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	<table border="1"> <tbody> <tr><td></td><td>Red</td><td>50</td><td>20</td></tr> <tr><td></td><td>Green</td><td>150</td><td>16</td></tr> <tr><td></td><td>Green</td><td>50</td><td>17</td></tr> <tr><td></td><td>Green</td><td>100</td><td>13</td></tr> <tr><td></td><td>Blue</td><td>50</td><td>18</td></tr> <tr><td></td><td>Blue</td><td>50</td><td>13</td></tr> <tr><td>Offer</td><td>Yellow</td><td>100</td><td>23</td></tr> <tr><td></td><td>Yellow</td><td>50</td><td>11</td></tr> <tr><td></td><td>Purple</td><td>50</td><td>22</td></tr> <tr><td></td><td>Purple</td><td>150</td><td>10</td></tr> <tr><td></td><td>Orange</td><td>50</td><td>25</td></tr> <tr><td></td><td>Orange</td><td>200</td><td>28</td></tr> <tr><td></td><td>Orange</td><td>100</td><td>26</td></tr> </tbody> </table> <p>a. Build the supply curve b. Build demand curve c. Calculate the market price, the quantity produced by each company and the revenue of each company. Global welfare</p>		Red	50	20		Green	150	16		Green	50	17		Green	100	13		Blue	50	18		Blue	50	13	Offer	Yellow	100	23		Yellow	50	11		Purple	50	22		Purple	150	10		Orange	50	25		Orange	200	28		Orange	100	26				
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Q4.(b)	<p>Using the graphical method find the optimal solution of LPP; $Max Z = x_1 + 3x_2$ s.t. $x_1 + x_2 \leq 1$ $-3x_1 + x_2 \geq 3$ $x_1, x_2 \geq 0$</p>	5	5	4	3																																																				
Q5.(a)	<p>A two-bus system is shown in figure below. If 100MW is transmitted from plant1 to the load, a transmission loss of 10 MW is incurred. The incremental fuel cost of the two plants are given as: $IC_1 = 0.02P_1 + 16 \text{ ₹/MWh}$ $IC_2 = 0.04P_2 + 20 \text{ ₹/MWh}$</p> <p>a) Find the required generation for each plant and the power received by the load when the system λ is 25 ₹/MWh. b) Consider the system with a load of 237.04 MW at bus 2. Find the optimum load distribution between the two plants when: losses are included but not coordinated, losses are coordinated. c) Also find the saving in rupees per hour when losses are coordinated.</p>	12	2	4	3																																																				



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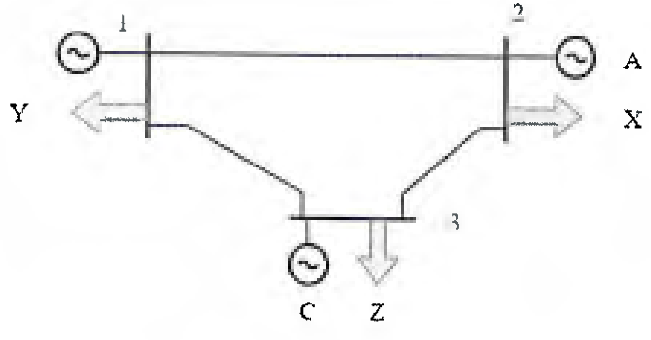
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<p>Q5.(b)</p>	<p>Consider the power system shown in figure given below. Assuming that the only limitations imposed by the network are imposed by the thermal capacity of the transmission lines and that the reactive power flows are negligible, check that the following set of transactions are simultaneously feasible.</p> <table border="1" data-bbox="295 646 1029 839"> <thead> <tr> <th>Branch</th> <th>Reactance (pu)</th> <th>Capacity (MW)</th> </tr> </thead> <tbody> <tr> <td>1-2</td> <td>0.2</td> <td>250</td> </tr> <tr> <td>1-3</td> <td>0.4</td> <td>180</td> </tr> <tr> <td>2-3</td> <td>0.4</td> <td>250</td> </tr> </tbody> </table>  <table border="1" data-bbox="295 1270 1013 1428"> <thead> <tr> <th>Seller</th> <th>Buyer</th> <th>Amount</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>X</td> <td>500</td> </tr> <tr> <td>A</td> <td>Z</td> <td>200</td> </tr> <tr> <td>C</td> <td>Y</td> <td>300</td> </tr> </tbody> </table>	Branch	Reactance (pu)	Capacity (MW)	1-2	0.2	250	1-3	0.4	180	2-3	0.4	250	Seller	Buyer	Amount	B	X	500	A	Z	200	C	Y	300	<p>8</p>	<p>4</p>	<p>3</p>	<p>4</p>
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<p>Q6.(a)</p>	<p>Identify the four reasons why electricity is different from other commodities. List the pillars on which the electric market's foundation rest.</p>	<p>4+4</p>	<p>1,2</p>	<p>3,2</p>	<p>1,2</p>																								
<p>Q6.(b)</p>	<p>What are different ancillary services procured by SO? Name and compare the two mechanisms through which system operators can obtain ancillary services.</p>	<p>12</p>	<p>3</p>	<p>4</p>	<p>6</p>																								
<p>Q7.(a)</p>	<p>Explain the key considerations from an investor's perspective when investing in electricity generation projects.</p>	<p>10</p>	<p>2</p>	<p>2</p>	<p>5</p>																								
<p>Q7.(b)</p>	<p>Discuss in detail methods used for cost allocation of the transmission lines.</p>	<p>10</p>	<p>2</p>	<p>2</p>	<p>7</p>																								