



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

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



END SEMESTER November 2025 / ~~RE-EXAM~~ January 2026

Program: B. Tech (Electrical) Final Year VII Duration: 3Hr

Course Code: PEBTE704

Maximum Points: 100

Course Name: Industrial Automation

Semester: VII

21/11/2025

Notes: 1) Question no. 1 is compulsory. Solve any four from remaining questions.

2) Assume suitable data if required and justify the same.

Q. No.	Questions	Points	CO	BL	Mod No.
1 a)	Explain the terms "economy of scale" and "economy of scope". How does industrial automation help in achieving these?	05	01	01	01
1 b)	What is MTBF and MTTR? Explain in detail.	05	04	02	04
1 c)	What is the effect of noise when derivative controller is used? How this effect can be eliminated?	05	02	03	02
1 d)	What are the different data files in PLC.	05	03	02	03
2 a)	Explain any two auto-tuning methods in detail and compare them	10	02	02 03	02
2 b)	Consider a first order system with $G(s) = \frac{0.5}{10s+1}$. Design a controller to ensure no steady state offset to step reference signals, to achieve a 5% settling time of less than 20 seconds and damping ratio of 0.8.	10	02	04	02
3 a)	Differentiate between PFD and P&ID.	05	02	03	03
3 b)	For the following instruments draw the symbols used in P&ID- a) Control Valve, b) Pressure indicator mounted near the pipe c) Temperature control and indication on the control panel d) Pump, e) Tank	05	02	03	03
3 c)	Identify the symbols used in the flowing diagram and describe process.	10	02	04	03



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4 a)	<p>Write a program to manufacture three 5MH and four 10 MH inductors a day. A lathe machine is used to make turns of copper wire on a core. For manufacturing 5 MH machine should make 400 turns & for 10 MH, it should make 800 turns. Assume that there is a sensor which indicates a turn in over and send a pulse signal.</p>	10	03	04	05
4 b)	<p>Write a program to alternately turn on and off a lamp once the process starts. There are two control inputs – start push button of NO type, Stop Push button of NC type. On time and OFF time are both 5 seconds. When start push button is pressed process starts and lamp is turned ON for 5 seconds and then turned OFF for 5 seconds. This process repeats until stop command is given.</p>	10	03	04	05
5 a)	<p>List types of communication protocols used in automation. Explain any one in detail.</p>	10	03	02	06
5 b)	<p>What is IED and RTU? What is MIS, MES and ERP?</p>	10	03	02 03	05 07
6 a)	<p>Discuss operation, applications and syntax of following instructions- i) JMP & LBL ii) TOF iii) CTD iv) MUL</p>	10	03	03	05
6 b)	<p>What is FAT and SAT? Differentiate between the two. Justify the need of Quality Assurance in Industrial Automation.</p>	10	04	03	04
7 a)	<p>For a unity negative feedback system with the forward transfer function $G(s) = \frac{K(s+20)}{s(s+2)(s+3)}$ find the range of K to make the system stable. Determine steady state error for reference input $=u(t)$ when $K=1$.</p>	10	02	04	02
7 b)	<p>What are the advantages of using electric drives in industrial automation? Describe the energy-saving opportunities in pump and fan applications using electric drives.</p>	10	04	03	07

~~END SEMESTER November 2025~~ / RE - EXAM January 2026Program: B. Tech (Electrical) Final year

Duration: 3Hr

Course Code: PEBTE704

Maximum Points: 100

Course Name: Industrial AutomationSemester: VII

Notes: 1) Question no. 1 is compulsory. Solve any four from remaining questions.

2) Assume suitable data if required and justify the same.

Q. No.	Questions	Poi nts	CO	BL	M od. No
1a	Describe different levels in the automation pyramid.	05	01	01	01
1b	Differentiate between DCS and SCADA.	05	03	03	05
1c	What is FAT and SAT? Differentiate between the two.	05	04	03	04
1d	What is Integral windup effect? How to eliminate this effect?	05	02	02 03	02
2a	List the methods of auto-tuning. Explain any one tuning method in detail.	10	02	02 03	02
2b	Using pole placement method design a PD controller to place the closed loop poles of the following system at $s_{1,2} = -1.414 \pm j1$.	10	02	03	02
3a	Compare manual operation with automated operation in terms of productivity, quality, and safety.	05	01	04	01
3b	What if PBD, PFD and P&ID?	05	02	02	03



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End Sem/ Re-Exam - November 2025 Examinations

Program: Electrical/Mechanical/Civil Final year Ele

Duration: 3 hours

Course Code: OE-BTE702

Maximum Points: 100

Course Name: Artificial Intelligence

Semester: VII

- Question No. 1 is compulsory
- Attempt any 4 questions from remaining 6 questions
- Make suitable assumptions wherever necessary

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Q.No.	Questions	Points	CO	BL
1a.	Discuss the different Ambiguities in NLP with appropriate examples.	05	3	2
1b.	Discuss the Hill climbing algorithm.	05	2	2
1c.	An agents Knowledge base has the following facts: Knows (Geeta , x) Knows (y, Sita) Knows (Geeta, Pooja) Knows (y, Mother(x)) Knows (x, Reena) Whom does Geeta know? Specify the Rule used to arrive at the inference.	05	3	3
1d.	Differentiate between Human and Machine intelligence. When can you say that the machine is intelligent?	05	1	3
2a.	I. Discuss how Simulated Annealing converts Random walk to Hill climbing with the help of the controlling parameter T. II. Does it help in overcoming the problem of Local maxima? Comment Assume that the Probability is calculated using the sigmoid function.	10	2	3
2b.	Write a short note on Components of AI.	10	1	2
3a.	Discuss the different uninformed search algorithms with respect to completeness, space complexity, time complexity, and optimality.	10	2	2



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3b.	<p>A company wants to predict the monthly sales (in Rs.1000) of one of its products based on the amount spent on advertising (in Rs.1000). The data for the last 8 months is given below:</p> <table border="1" data-bbox="331 562 979 1265"><thead><tr><th>Month</th><th>Advertising Spend (X)</th><th>Sales (Y)</th></tr></thead><tbody><tr><td>1</td><td>2</td><td>4</td></tr><tr><td>2</td><td>3</td><td>5</td></tr><tr><td>3</td><td>5</td><td>7</td></tr><tr><td>4</td><td>7</td><td>10</td></tr><tr><td>5</td><td>9</td><td>15</td></tr><tr><td>6</td><td>10</td><td>17</td></tr><tr><td>7</td><td>11</td><td>19</td></tr><tr><td>8</td><td>14</td><td>25</td></tr></tbody></table> <p>Calculate the sales if the amount spend for advertising is Rs. 12000.</p>	Month	Advertising Spend (X)	Sales (Y)	1	2	4	2	3	5	3	5	7	4	7	10	5	9	15	6	10	17	7	11	19	8	14	25	10	3	3
Month	Advertising Spend (X)	Sales (Y)																													
1	2	4																													
2	3	5																													
3	5	7																													
4	7	10																													
5	9	15																													
6	10	17																													
7	11	19																													
8	14	25																													
4a.	<p>Convert the following statements to First order Logic statements.</p> <ol style="list-style-type: none">1. If the robot is at room A and room A is connected to room B, then the robot can move to room B.2. The robot is currently at room A.3. Room A is connected to room B. <p>Also determine the Inference of the above statements with respect to the movement of the Robot using Forward Chaining.</p>	10	3	3																											



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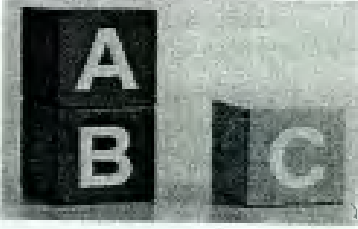

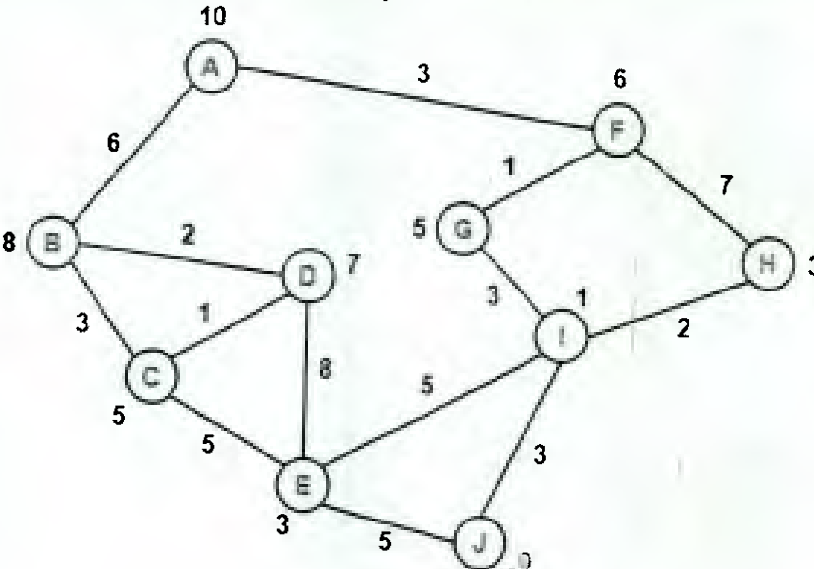
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End Sem/ ~~Re Exam~~ - November 2025 Examinations

4b.	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Initial State</p> </div> <div style="text-align: center;">  <p>Goal State</p> </div> </div> <p>With reference to the above:</p> <ol style="list-style-type: none"> 1. Represent the initial state and goal state. 2. Define appropriate STRIPS operators (actions). 3. Derive the plan sequence of actions to reach the goal. 	10	3	3
5a.	Write a short note on Expert Systems.	10	3	2
5b.	<p>We need to travel from node A to node J at minimum cost. Apply A* algorithm to find the least cost path.</p> 	10	2	3

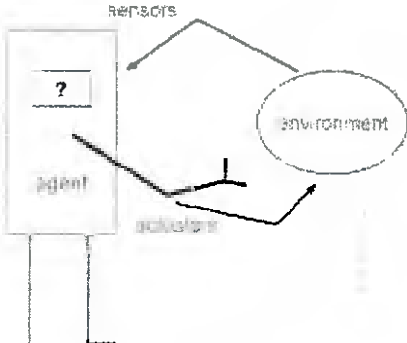


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6a.	Age	Competition	Type	Profit	10	3	5
	Old	Yes	software	Down			
	Old	No	software	Down			
	Old	No	hardware	Down			
	Mid	Yes	software	Down			
	Mid	Yes	hardware	Down			
	Mid	No	hardware	Up			
	Mid	No	software	Up			
	New	Yes	software	Up			
	New	No	hardware	Up			
	New	No	software	Up			
	Built Decision Tree for the above data using ID3 algorithm.						
6b.	Explain the supervised and unsupervised learning with proper examples.				10	3	2
7a.	Discuss the following rules of inference 1. Modus Ponens 2. Resolution 3. Universal Instantiation 4. Existential Instantiation 5. AND elimination				10	3	2
7b.	 <p>A typical agent is given in the above figure. If a utility-based agent is to be designed, then what modifications are required in place of the question mark? How is it different from simple reflex agent?</p>				10	1	2



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~~End Sem~~ Re Exam - November 2025 Examinations

09/10/26

Program: Electrical/Mechanical/Civil - Final year

Duration: 3 hours

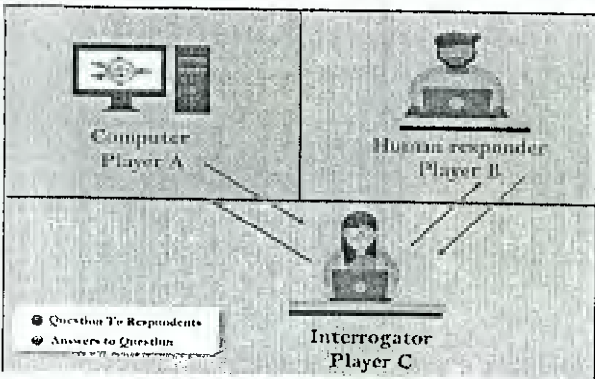
Course Code: OE-BTE702

Maximum Points: 100

Course Name: Artificial Intelligence

Semester: VII

- Question No. 1 is compulsory
- Attempt any 4 questions from remaining 6 questions
- Make suitable assumptions wherever necessary

Q.No.	Questions	Points	CO	BL
1a.	Discuss the Knowledge and Inference Engine with respect to Expert System	05	3	2
1b.	Discuss the Beam Search algorithm.	05	2	2
1c.	Suppose an email classification system is trying to decide if an incoming email is "Spam" (S) or "Not Spam" (~S). <ul style="list-style-type: none"> • Prior probability that an email is spam 0.20 • The system notices that the email contains the keyword "lottery". The probability that a spam email contains "lottery" is 0.70 • The probability that a non-spam email contains "lottery" is 0.05 If the given email contains the keyword "lottery", what is the probability that it is Spam?	05	3	3
1d.	Discuss the following Senerio 	05	1	3



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~~End Sem /~~ **Re Exam - November 2025** Examinations

2a.	<div style="text-align: center;"> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <table border="1" style="border-collapse: collapse;"> <tr><td>$P(S=T)$</td></tr> <tr><td style="text-align: center;">0.30</td></tr> </table> <table border="1" style="border-collapse: collapse;"> <tr><td>$P(P=L)$</td></tr> <tr><td style="text-align: center;">0.90</td></tr> </table> <table border="1" style="border-collapse: collapse;"> <tr><th>P</th><th>S</th><th>$P(C=T P,S)$</th></tr> <tr><td>H</td><td>T</td><td style="text-align: center;">0.05</td></tr> <tr><td>H</td><td>F</td><td style="text-align: center;">0.02</td></tr> <tr><td>L</td><td>T</td><td style="text-align: center;">0.03</td></tr> <tr><td>L</td><td>F</td><td style="text-align: center;">0.001</td></tr> </table> <table border="1" style="border-collapse: collapse;"> <tr><th>C</th><th>$P(X=pos C)$</th></tr> <tr><td>T</td><td style="text-align: center;">0.90</td></tr> <tr><td>F</td><td style="text-align: center;">0.20</td></tr> </table> <table border="1" style="border-collapse: collapse;"> <tr><th>C</th><th>$P(D=T C)$</th></tr> <tr><td>T</td><td style="text-align: center;">0.65</td></tr> <tr><td>F</td><td style="text-align: center;">0.30</td></tr> </table> </div> <p style="margin-top: 20px;">i. Calculate the Probability that the person has cancer and X-ray is positive also Dyspnea is true given that the Pollution is low and person is nonsmoker.</p> <p>ii. Calculate the Probability that the X-ray is positive.</p>	$P(S=T)$	0.30	$P(P=L)$	0.90	P	S	$P(C=T P,S)$	H	T	0.05	H	F	0.02	L	T	0.03	L	F	0.001	C	$P(X=pos C)$	T	0.90	F	0.20	C	$P(D=T C)$	T	0.65	F	0.30	10	3	3
$P(S=T)$																																			
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F	0.30																																		
2b.	<div style="text-align: center;"> </div> <p style="margin-top: 10px;">To the above gaming tree apply the Alpha Beta pruning algorithm and hence find the gaming path</p>	10	2	3																															
3a.	<p>The Law says that it is a crime for an American to sell weapons to hostile nations. The country Nono, and enemy of America, has some missiles, and all of its missiles were sold to it by Colonel West, who is American.</p> <p>Prove that Colonel West is a Criminal using First Order Logic.</p>	10	3	3																															



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End Sem/ Re Exam -- ~~November 2025~~ Examinations

6a.	Discuss Partial Order planning with an example.	10	3	2																		
6b.	Discuss the different uninformed search algorithms with respect to completeness, space complexity, time complexity, and optimality.	10	2	2																		
7a.	Initial and Final States are given. <table border="1" data-bbox="426 743 561 879"><tr><td>1</td><td>2</td><td></td></tr><tr><td>4</td><td>6</td><td>3</td></tr><tr><td>7</td><td>5</td><td>8</td></tr></table> <p>Initial state</p> <table border="1" data-bbox="711 734 840 870"><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td></td></tr></table> <p>Final state</p> <p>Generate the search tree. Mark the Final state and hence show the path to reach the final state.</p>	1	2		4	6	3	7	5	8	1	2	3	4	5	6	7	8		10	2	3
1	2																					
4	6	3																				
7	5	8																				
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7b.	Explain the supervised and unsupervised learning with proper examples.	10	3	2																		



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Sardar Patel College of Engineering

(Govt. Aided Autonomous Institute Affiliated to University of Mumbai)
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai 400058.



Academic Year 2025 – 26 [First Half]

Regulation – 2022

End Semester Examination [November 2025] / ~~Re-Examination~~ [January 2026]

28/11/25

Program: B. Tech. Electrical Engineering Final year
Course: Engineering Economics [Open Elective]
Course Code: OE –BTE704

Semester: VII
Total Points: 100
Question Paper Set-II

Note: Solve any FIVE questions of the following. Each question carries equal points.

CO: Course Outcomes

BL: Bloom's Taxonomy Level

Q. No.	Question	Points	CO	BL
1.	a. Discuss the flow of goods, services, resources and money payments in a simple economy with the help of a suitable diagram.	05	2	L2
	b. Define <i>Value</i> ? What are the types of value?	05	3	L2
	c. A person is planning for his retired life. He has 10 more years of service. He would like to deposit Rs. 8,500 at the end of the first year and thereafter he wishes to deposit the amount with an annual decrease of Rs. 500 for the next 9 years with an interest rate of 15%. Find the total amount at the end of the 10 th year of the above series.	05	2	L2
	d. Distinguish between <i>breakdown maintenance</i> and <i>preventive maintenance</i> .	05	3	L2
2.	a. Define the terms <i>depreciation</i> and <i>book value</i> . Explain the different types of depreciation with example of each type.	10	2	L5
	b. A company has purchased an equipment whose first cost is Rs. 1,00,000 with an estimated life of eight years. The estimated salvage value of the equipment at the end of its lifetime is Rs. 20,000. Determine the depreciation charge and book value at the end of various years using <i>the sum-of-the-years-digit method of depreciation</i> with an interest rate of 12%, compounded annually	10	1	L3

3.	<p>a. Alpha Industry is planning to expand its production operation. It has identified three different technologies for meeting the goal. The initial outlay and annual revenues with respect to each of the technologies are summarized in the table below. Suggest the best technology which is to be implemented based on the <i>present worth method</i> of comparison assuming 20% interest rate, compounded annually.</p> <table border="1" data-bbox="375 351 1125 555"> <thead> <tr> <th></th> <th><i>Initial outlay</i> (Rs.)</th> <th><i>Annual revenue</i> (Rs.)</th> <th><i>Life</i> (years)</th> </tr> </thead> <tbody> <tr> <td>Technology 1</td> <td>12,00,000</td> <td>4,00,000</td> <td>10</td> </tr> <tr> <td>Technology 2</td> <td>20,00,000</td> <td>6,00,000</td> <td>10</td> </tr> <tr> <td>Technology 3</td> <td>18,00,000</td> <td>5,00,000</td> <td>10</td> </tr> </tbody> </table> <p>b. Two possible routes for laying a power line are under study. Data on the routes are as follows:</p> <table border="1" data-bbox="367 759 1157 1088"> <thead> <tr> <th></th> <th></th> <th><i>Around the lake</i></th> <th><i>Under the lake</i></th> </tr> </thead> <tbody> <tr> <td>Length</td> <td></td> <td>15 km</td> <td>5 km</td> </tr> <tr> <td>First cost</td> <td>(Rs.)</td> <td>1,50,000/km</td> <td>7,50,000/km</td> </tr> <tr> <td>Useful life</td> <td>(years)</td> <td>15</td> <td>15</td> </tr> <tr> <td>Maintenance cost</td> <td>(Rs.)</td> <td>6,000/km/yr</td> <td>12,000/km/yr</td> </tr> <tr> <td>Salvage value</td> <td>(Rs.)</td> <td>90,000/km</td> <td>1,50,000/km</td> </tr> <tr> <td>Yearly power loss</td> <td>(Rs.)</td> <td>15,000/km</td> <td>15,000/km</td> </tr> </tbody> </table> <p>If the rate of interest is 15%, then using <i>annual equivalent method</i> suggest whether the power line be routed around the lake or under the lake?</p>		<i>Initial outlay</i> (Rs.)	<i>Annual revenue</i> (Rs.)	<i>Life</i> (years)	Technology 1	12,00,000	4,00,000	10	Technology 2	20,00,000	6,00,000	10	Technology 3	18,00,000	5,00,000	10			<i>Around the lake</i>	<i>Under the lake</i>	Length		15 km	5 km	First cost	(Rs.)	1,50,000/km	7,50,000/km	Useful life	(years)	15	15	Maintenance cost	(Rs.)	6,000/km/yr	12,000/km/yr	Salvage value	(Rs.)	90,000/km	1,50,000/km	Yearly power loss	(Rs.)	15,000/km	15,000/km	10	1	L3
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4.	<p>a. What are the types of models of inventory system? Explain them in brief.</p> <p>b. The demand for an item is 12,000/year. Its production rate is 2,000/month. The carrying cost is Re. 0.20/unit/month and the set-up cost is Rs. 400.00/set-up. The shortage cost is Rs. 15.00/unit/year. Find all the parameters of the <i>manufacturing model of inventory system with shortages</i>.</p>	10	3	L3																																												
5.	<p>a. A diesel engine was installed 10 years ago at a cost of Rs. 50,000. It has a present realizable market value of Rs. 15,000. If kept, it can be expected to last five years more, with operation and maintenance cost of Rs. 14,000 per year and to have a salvage value of Rs. 8,000 at the end of the fifth year. This engine can be replaced with an improved version costing Rs. 65,000 which has an expected life of 20 years. This improved version will have an estimated annual operating and maintenance cost of Rs. 9,000 and ultimate salvage value of Rs. 13,000. Using an interest rate of 15%, make an <i>annual equivalent cost analysis</i> to determine whether to keep or replace the old engine.</p>	10	2	L5																																												

b. What is an economic life of an asset? The following table gives the operation & maintenance costs and salvage value at the end of every year of a machine whose purchase value is Rs. 20,000. Find the economic life of the machine assuming interest rate, $i = 15\%$.

End of year (n)	Operation cost at the end of year (Rs.)	Maintenance cost at the end of year (Rs.)	Salvage value at the end of year (Rs.)
1	3,000	300	9,000
2	4,000	400	8,000
3	5,000	500	7,000
4	6,000	600	6,000
5	7,000	700	5,000
6	8,000	800	4,000
7	9,000	900	3,000
8	10,000	1,000	2,000
9	11,000	1,100	1,000
10	12,000	1,200	0

10

3

L5

6. a. M/s. Krishna Castings Ltd. is planning to replace its annealing furnace. It has received tenders from three different original manufacturers of annealing furnace. The details are as follows:

	Manufacturer		
	1	2	3
Initial cost (Rs.)	80,00,000	70,00,000	90,00,000
Life (years)	12	12	12
Annual operation and maintenance cost (Rs.)	8,00,000	9,00,000	8,50,000
Salvage value after 12 years	5,00,000	4,00,000	7,00,000

Which is the best alternative based on *future worth method* at $i = 20\%$?

b. A state government is planning a hydroelectric project for a river basin. In addition to the production of electric power, this project will provide flood control, irrigation and recreation benefits. The estimated benefits and costs that are expected to be derived from this project are as follows:

Initial cost = Rs. 8,00,00,000
 Annual power sales = Rs. 60,00,000
 Annual flood control savings = Rs. 30,00,000
 Annual irrigation benefits = Rs. 50,00,000
 Annual recreation benefits = Rs. 20,00,000
 Annual operating and maintenance costs = Rs. 30,00,000
 Life of the project = 50 years
 Check the feasibility of the project assuming interest rate of 12%.

10

2

L2

7.	<p>a. A company wants to set-up a reserve which will help it to have an annual equivalent amount of Rs. 15,00,000 for the next 20 years towards its employees welfare measures. The reserve is assumed to grow at the rate of 15% annually. Find the single-payment that must be made as the reserve amount now?</p>	05	2	L5
	<p>b. An automobile company recently advertised its car for a down payment of Rs. 1,50,000. Alternatively, the car can be taken home by customers without making any payment, but they have to pay an equal yearly amount of Rs. 25,000 for 15 years at an interest rate of 18%, compounded annually. Suggest the best alternative to the customers.</p>	05	3	L3
	<p>c. An insurance company gives an endowment policy for a person aged 30 years. The yearly premium for an insured sum of Rs. 1,00,000 is Rs. 4,000. The policy will mature after 25 years. Also, the person is entitled for a bonus of Rs. 75 per thousand per year at the end of the policy. If a person survives till the end of the 25th year:</p> <p><i>i</i> What will be the total sum that he will get from the insurance company at that time?</p> <p><i>ii</i> Instead of paying the premiums for the insurance policy, if the person invests an equal sum of Rs. 4,000 at the end of each year for the next 25 years in some other scheme which is having similar tax benefit, find the <i>future worth</i> of the investment at 15% interest rate, compounded annually.</p> <p><i>iii</i> Rate the above alternatives assuming that the person is sure of living for the next 25 years.</p>	10	3	L3



Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(Govt. Aided Autonomous Institute Affiliated to University of Mumbai)
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai 400058.



Academic Year 2025 – 26 [First Half]

Regulation – 2022

~~End Semester Examination [November 2025]~~ / Re-Examination [January 2026]

09/01/26

Program: B. Tech. Electrical Engineering - *Final year*
Course: Engineering Economics [Open Elective]
Course Code: OE-BTE704

Semester: VII
Total Points: 100
Question Paper Set-I

Note: Solve any FIVE questions of the following. Each question carries equal points.

CO: Course Outcomes

BL: Bloom's Taxonomy Level

Q. No.	Question	Points	CO	BL																																									
1.	<p>a. The process planning engineer of a firm listed the sequences of operations as shown in the following table to produce a component:</p> <table border="1"> <thead> <tr> <th>Sequence</th> <th>Process sequence</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Turning – Milling – Shaping – Drilling</td> </tr> <tr> <td>2</td> <td>Turning – Milling – Drilling</td> </tr> <tr> <td>3</td> <td>All operations are performed with CNC machine</td> </tr> </tbody> </table> <p>The details of processing times of the component for various operations and their machine hour rates are summarized in the following table:</p> <table border="1"> <thead> <tr> <th rowspan="2">Operation</th> <th rowspan="2">Machine hour rate (Rs.)</th> <th colspan="3">Process sequence</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> </tr> </thead> <tbody> <tr> <td>Turning</td> <td>200</td> <td>5</td> <td>5</td> <td>–</td> </tr> <tr> <td>Milling</td> <td>400</td> <td>8</td> <td>14</td> <td>–</td> </tr> <tr> <td>Shaping</td> <td>350</td> <td>10</td> <td>–</td> <td>–</td> </tr> <tr> <td>Drilling</td> <td>300</td> <td>3</td> <td>3</td> <td>–</td> </tr> <tr> <td>CNC operations</td> <td>1,000</td> <td>–</td> <td>–</td> <td>8</td> </tr> </tbody> </table> <p>Find the most economical sequence of operations to manufacture the component.</p>	Sequence	Process sequence	1	Turning – Milling – Shaping – Drilling	2	Turning – Milling – Drilling	3	All operations are performed with CNC machine	Operation	Machine hour rate (Rs.)	Process sequence			1	2	3	Turning	200	5	5	–	Milling	400	8	14	–	Shaping	350	10	–	–	Drilling	300	3	3	–	CNC operations	1,000	–	–	8	08	2	L2
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	b. Explain the terms breakeven analysis and the margin of safety.	06	2	L2																																									
	c. A person is planning for his retired life. He has 10 more years of service. He would like to deposit Rs. 8,500 at the end of the first year and thereafter he wishes to deposit the amount with an annual decrease of Rs. 500 for the next 9 years with an interest rate of 15%. Find the total amount at the end of the 10 th year of the above series.	06	2	L3																																									

2.	<p>a. An engineer has two bids for an elevator to be installed in a new building. The details of the bids for the elevators are as follows.</p> <table border="1" data-bbox="347 274 1166 523"> <thead> <tr> <th rowspan="2">Bid</th> <th colspan="3">Engineer's estimates</th> </tr> <tr> <th>Initial cost (Rs.)</th> <th>Service life (years)</th> <th>Annual operations & maintenance cost (Rs.)</th> </tr> </thead> <tbody> <tr> <td>Alpha Elevator Inc.</td> <td>4,50,000</td> <td>15</td> <td>27,900</td> </tr> <tr> <td>Beta Elevator Inc.</td> <td>5,40,000</td> <td>15</td> <td>28,500</td> </tr> </tbody> </table> <p>Determine which bid should be accepted, based on the <i>present worth method</i> of comparison assuming 15% interest rate, compounded annually.</p> <p>b. A firm has identified three mutually exclusive investment proposals whose details are given below. The life of all the three alternatives is estimated to be five years with negligible salvage value. The minimum attractive rate of return for the firm is 12%.</p> <table border="1" data-bbox="359 886 1150 1068"> <thead> <tr> <th rowspan="2"></th> <th colspan="3">Alternative</th> </tr> <tr> <th>A1</th> <th>A2</th> <th>A3</th> </tr> </thead> <tbody> <tr> <td>Investment</td> <td>Rs. 1,50,000</td> <td>Rs. 2,10,000</td> <td>Rs. 2,55,000</td> </tr> <tr> <td>Annual net income</td> <td>Rs. 45,570</td> <td>Rs. 58,260</td> <td>Rs. 69,000</td> </tr> </tbody> </table> <p>Find the best alternative based on the <i>rate of return method</i> of comparison.</p>	Bid	Engineer's estimates			Initial cost (Rs.)	Service life (years)	Annual operations & maintenance cost (Rs.)	Alpha Elevator Inc.	4,50,000	15	27,900	Beta Elevator Inc.	5,40,000	15	28,500		Alternative			A1	A2	A3	Investment	Rs. 1,50,000	Rs. 2,10,000	Rs. 2,55,000	Annual net income	Rs. 45,570	Rs. 58,260	Rs. 69,000	10	1	L3
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3.	<p>a. A company has purchased an equipment whose first cost is Rs. 1,00,000 with an estimated life of eight years. The estimated salvage value of the equipment at the end of its lifetime is Rs. 20,000. Give the calculations of <i>net depreciation</i> and <i>book value</i> till the end of life of the equipment, using the <i>sinking fund method of depreciation</i> with an interest rate of 12%, compounded annually.</p> <p>b. In a particular locality of a state, the vehicle users take a roundabout route to reach certain places because of the presence of a river. This results in excessive travel time and increased fuel cost. So, the state government is planning to construct a bridge across the river. The estimated initial investment for constructing the bridge is Rs. 40,00,000. The estimated life of the bridge is 15 years. The annual operation and maintenance cost is Rs. 1,50,000. The value of fuel savings due to the construction of the bridge is Rs. 6,00,000 in the first year and it increases by Rs. 50,000 every year thereafter till the end of the life of the bridge. Check whether the project is justified based on BC ratio by assuming an interest rate of 12%, compounded annually.</p>	10	2	L5																														

4.	<p>a. A diesel engine was installed 10 years ago at a cost of Rs. 50,000. It has a present realizable market value of Rs. 15,000. If kept, it can be expected to last five years more, with operation and maintenance cost of Rs. 14,000 per year and to have a salvage value of Rs. 8,000 at the end of the fifth year. This engine can be replaced with an improved version costing Rs. 65,000 which has an expected life of 20 years. This improved version will have an estimated annual operating and maintenance cost of Rs. 9,000 and ultimate salvage value of Rs. 13,000. Using an interest rate of 15%, make an <i>annual equivalent cost analysis</i> to determine whether to keep or replace the old engine.</p> <p>b. An inland state is presently connected to a seaport by means of a railroad system. The annual goods transported is 1,00,00,000 ton km. The average transport charge is Rs. 30/ton/km. Within the next 20 years, the transport is likely to increase by 10,00,000 ton km per year. It is proposed to broaden a river flowing from the state to the seaport at a cost of Rs. 2,50,00,00,000. This will make the river navigable to barges and will reduce the transport cost to Rs. 10.00/ton/km. The project will be financed by 10% bond at par. There would be some side effects of the change-over as follows:</p> <ul style="list-style-type: none"> c. The railroad would be bankrupt and be sold for no salvage value. The right of way, worth about Rs. 3,00,00,000, will revert to the state. d. 300 employees will be out of employment. The state will have to pay to each of them a welfare cheque of Rs. 48,000/year. e. The reduction in the income from the taxes on the railroad will be compensated by the taxes on the barges. <p>What is the benefit-cost ratio based on the next 20 years of operation? Also, check whether broadening the river is justified.</p>	10	2	L5
		10	3	L5
5.	<p>a. Explain the different types of models of inventory system in brief.</p> <p>b. The annual demand for a component is 30,000 units. The carrying cost is Rs. 2.00/unit/year, the ordering cost is Rs. 100.00/order, and the shortage cost is Rs. 12.00/unit/year. Find the optimal values of the following for the <i>purchase model with shortages inventory system</i>:</p> <ul style="list-style-type: none"> i. Ordering quantity ii. Maximum inventory iii. Maximum shortage quantity iv. Cycle time v. Inventory period (t1) vi. Shortage period (t2) 	10	3	L3
		10	2	L3

6.	a.	A manufacturer of TV buys TV cabinet at Rs. 500 each. In case the company makes it within the factory, the fixed and variable costs would be Rs. 4,00,000 and Rs. 300 per cabinet respectively. Should the manufacturer make or buy the cabinet if the demand is 1,500 TV cabinets?	05	2	L3
	b.	Briefly explain the various criteria for <i>make or buy decisions</i> .	10	2	L2
	c.	There are three alternatives available to meet the demand of a particular product. They are as follows: i. Manufacturing the product by using process A ii. Manufacturing the product by using process B iii. Buying the product The details are as given in the following table:	05	2	L3

Cost elements	Manufacturing the product by process A	Manufacturing the product by process B	Buy
Fixed cost/year (Rs.)	5,00,000	6,00,000	
Variable/unit (Rs.)	175	150	
Purchase price/unit (Rs.)			125

The annual demand of the product is 8,000 units. Should the company make the product using process A or process B or buy it?

7.	a.	The cash flow diagrams of two mutually exclusive alternatives are given below.	10	2	L5
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Cash flow diagram for alternative 1

Cash flow diagram for alternative 2

Select the best alternative based on *future worth method* at $i = 8\%$.

b.	What is <i>value engineering</i> ? What are the aims of <i>value engineering</i> ?	10	2	L5
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SARDAR PATEL COLLEGE OF ENGINEERING

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Munshi Nagar, Andheri (W) Mumbai - 400058



END SEMESTER November 2025 / ~~RE-EXAM~~ January 2026

Program: B. Tech. (Electrical)

Course Code: PE-BTE723

Course Name: High Voltage Engineering

Duration: 3 hrs.

Maximum Points: 100

Semester: VII

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.

26/11/2025

Q.No.	Questions	Points	CO	BL	Mod. No.
1.(a)	Draw neat diagram of equivalent circuit of single stage impulse generator. A ten-stage impulse generator has 0.126 μ F capacitors. The wave front and wave tail resistances are 800 ohms and 5000 ohms respectively. If the load capacitance is 1000 pF, determine the wave front and wave tail times of the impulse wave.	10	2	L3	3
1.(b)	Explain the power factor-voltage test for bushings. Discuss the procedure, measurements and interpretation.	10	4	L4	6
2(a)	Explain 'Generating Voltmeter' for H.V. measurement and prove that $i_{rms} = \frac{VC_m\omega}{\sqrt{2}}$	10	2	L2	4
2(b)	Using a neat layout diagram, explain the arrangement, components, and working procedure of an Ultra High Voltage (UHV) Test Laboratory.	10	4	L4	7
3. (a)	Draw a neat diagram of a valve type lightning arrester and explain its working under normal and abnormal conditions. What is follow current? How does the lightning arrester design help in reducing follow current?	10	2	L1	5



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END SEMESTER November 2025 / RE-EXAM January 2026

3.(b)	<p>The suspended solid particle of paper and air pocket present in transformer oil with diameter 0.8 mm and 1.5 mm respectively. Find the force on each suspended particle if applied electric field is</p> $E^2 = 20x + 6 \text{ V/m}$ <p>Given: Relative permittivity of paper = 3.1 Relative Permittivity of transformer oil = 2.2</p>	05	3	L3	2
3.(c)	<p>Explain Chopped-Wave Impulse Test on HV bushings. Why is this test needed for 220 kV and above systems?</p>	05	4	L4	6
4.	<p>Explain the term</p> <ol style="list-style-type: none">1. Partial discharge or internal discharge2. Solid dielectric used in practice3. Series-parallel resonance circuit for generation of high voltage AC4. Characteristics of impulse voltage waveform5. Series impedance voltmeter	20	1	L1	2,4,5
5. (a)	<p>Derive expression for Townsend's first and secondary ionization coefficients. How is the condition for breakdown obtained in a Townsend's discharge?</p>	10	1	L2	1
5.(b)	<p>Discuss the effect of the following parameters on the breakdown strength of liquids:</p> <ol style="list-style-type: none">a) Suspended particle mechanismb) Cavitation and bubble theoryc) Stressed oil volume theory	10	1	L2	2
6.(a)	<p>A 100 kVA, 400 V/250 kV testing transformer has 6% leakage reactance and 4% resistance on 100 kVA base. A cable has to be tested at 500 kV using the above transformer as a resonant transformer at 50 Hz. If the charging current of the cable at 500 kV is 0.2 A, find the series inductance required. Assume 1 % resistance for the inductor to be used and the connecting leads. Neglect dielectric loss of the cable. What will be the input voltage to the transformer?</p>	10	2	L3	3



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END SEMESTER November 2025 / ~~RE-EXAM~~ January 2026

6.(b)	A generating voltmeter has to be designed so that it can have a range from 10 to 100 KV d.c. If the indicating meter reads a minimum current of $1.5 \mu\text{A}$ and maximum current of $18 \mu\text{A}$, what should the capacitance of the generating voltmeter?	05	2	L3	5
6.(c)	Explain the terms as referred to high voltage testing. (Explain is short) 1. Withstand voltage 2. Flashover voltage 3. 50% flash over voltage 4. Wet and dry power frequency tests 5. Chopped wave	05	1	L1	3
7.(a)	Explain in detail Streamer theory for breakdown in gas insulating material.	05	1	L1	1
(b)	A solid specimen of dielectric has a dielectric constant of 4.2 and $\tan\delta$ as 0.001 at a frequency of 50 Hz. If it is subjected to an alternating field of 50kV/cm, calculate the heat generated in the specimen due to the dielectric loss.	03	3	L3	2
(c)	Explain in detail construction and working principle of cascaded transformer for generation of power frequency AC voltage.	08	1	L2	3
(d)	Determine the electromechanical breakdown voltage stress of PMMC sheet 4 mm thick, relative permittivity 4 and Young's modulus 1000 kg/m^2 when subjected to an impulse voltage.	04	3	L3	3



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~~END SEMESTER November 2025~~ / RE - EXAM January 2026

Program: B. Tech. (Electrical) Final year - Sem VII Duration: 3 hrs.

Course Code: PE-BTE723

Maximum Points: 100

Course Name: High Voltage Engineering

Semester: VII

Notes:

08/01/2026

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)	A 100 kVA, 400 V/250 kV testing transformer has 6% leakage reactance and 4% resistance on 100 kVA base. A cable has to be tested at 500 kV using the above transformer as a resonant transformer at 50 Hz. If the charging current of the cable at 500 kV is 0.2 A, find the series inductance required. Assume 1 % resistance for the inductor to be used and the connecting leads. Neglect dielectric loss of the cable. What will be the input voltage to the transformer?	10	2	L3	3
1(b)	Explain with a neat diagram the construction and working principle of a valve type lightning arrester. Discuss the significance of the by-pass gap and clearly explain what is meant by follow current in a lightning arrester.	10	2	L1	5
2(a)	Explain 'Generating Voltmeter' for H.V. measurement and prove that $i_{rms} = \frac{VC_m\omega}{\sqrt{2}}$	10	2	L2	4
2(b)	Using a neat layout diagram, explain the arrangement, components, and working procedure of an Ultra High Voltage (UHV) Test Laboratory.	10	4	L4	7



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Munshi Nagar, Andheri (W) Mumbai - 400058



END SEMESTER ~~November 2025~~ / RE - EXAM January 2026

3.	Describe the various tests performed on high-voltage bushings as per IS/IEC standards, including: <ol style="list-style-type: none">1. Power Factor-Voltage Test2. Partial Discharge Test3. Momentary and One-Minute Withstand Tests4. Impulse Withstand and Chopped Wave Tests5. Thermal Stability Test Provide neat diagrams where necessary.	20	4	L4	6
3.(b)	The suspended solid particle of paper and air pocket present in transformer oil with diameter 0.8 mm and 1.5 mm respectively. Find the force on each suspended particle if applied electric field is $E^2 = 20x + 6 \text{ V/m}$ Given: Relative permittivity of paper = 3.1 Relative Permittivity of transformer oil = 2.2	06	3	L3	2
4.	Explain the term <ol style="list-style-type: none">1. Partial discharge or internal discharge2. Solid dielectric used in practice3. Series-parallel resonance circuit for generation of high voltage AC4. Characteristics of impulse voltage waveform5. Series impedance voltmeter	20	1	L1	2,4,5
5. (a)	Derive expression for Townsend's first and secondary ionization coefficients. How is the condition for breakdown obtained in a Townsend's discharge?	10	1	L2	1
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~~END SEMESTER November 2025~~ / RE - EXAM January 2026

6.(a)	<p>Draw neat diagram of equivalent circuit of single stage impulse generator.</p> <p>A ten-stage impulse generator has $0.126 \mu\text{F}$ capacitors. The wave front and wave tail resistances are 800 ohms and 5000 ohms respectively. If the load capacitance is 1000 pF, determine the wave front and wave tail times of the impulse wave.</p>	10	2	L3	3
6.(b)	<p>A generating voltmeter has to be designed so that it can have a range from 10 to 100 KV d.c. If the indicating meter reads a minimum current of $1.5 \mu\text{A}$ and maximum current of $18 \mu\text{A}$, what should the capacitance of the generating voltmeter?</p>	05	2	L3	5
6.(c)	<p>Explain the terms as referred to high voltage testing. (Explain is short)</p> <ol style="list-style-type: none">1. Withstand voltage2. Flashover voltage3. 50% flash over voltage4. Wet and dry power frequency tests5. Chopped wave	05	1	L1	3
7.(a)	<p>Explain in detail Paschen's theory for breakdown in gas insulating material.</p>	05	1	L1	1
(b)	<p>A solid specimen of dielectric has a dielectric constant of 4.2 and $\tan\delta$ as 0.001 at a frequency of 50 Hz. If it is subjected to an alternating field of 50kV/cm, calculate the heat generated in the specimen due to the dielectric loss.</p>	03	3	L3	2
(c)	<p>Explain in detail construction and working principle of Van de Graff generator.</p>	08	1	L2	3
(d)	<p>Determine the electromechanical breakdown voltage stress of PMMC sheet 4 mm thick, relative permittivity 4 and Young's modulus 1000 kg/m^2 when subjected to an impulse voltage.</p>	04	3	L3	3

**SARDAR PATEL COLLEGE OF ENGINEERING**(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai - 400058End Sem
~~MID TERM~~ TEST NOV 2025Program: Electrical Engineering Final year

Course Code: PE-BTE724

Course Name: Embedded System

Instructions:

1. Question 1 is COMPULSORY.
2. Attempt any FOUR from the remaining questions (Q.2 to Q.7).
3. All questions carry 20 marks.
4. Assume suitable data if necessary.

Duration: 3 ~~Min.~~ Hrs.

Maximum Points: 100

Semester: VII

26/11/2025

Q. No.	Questions	Points	CO	BL	Module No.
Q.1	a. Compare Von Neumann and Harvard architectures. Why is Harvard architecture generally preferred in modern embedded processors?	5	1	4	3
	b. Illustrate the use of the Barrel Shifter in the ARM architecture by explaining the operation of the instruction MOV R1, R0, LSL #2. What will be the value in R1 if R0 contains 0x05?	5	2	3	4
	c. Explain the concept of Software Interrupt Instruction (SWI) in ARM. How does the processor handle an SWI exception, and what is the role of the SWI number?	5	3	2	4
	d. List and briefly explain four key characteristics of an embedded system, using a digital camera as a case study.	5	3	2	1 & 7
Q.2	a. Classify Integrated Circuit (IC) technologies into Full-Custom, Semi-Custom (ASIC), and Programmable Logic Devices (FPGA). Compare them based on NRE cost, unit cost, and flexibility.	10	1	4	1
	b. Describe the steps involved in formulating a Requirement Specification for an embedded system. What is the purpose of an SRS document?	10	2	2	2
Q.3	a. Explain the role of the Vectored Interrupt Controller (VIC) in an ARM7-based microcontroller like the LPC2148. Differentiate between IRQ and FIQ.	10	3	2	5
	b. Explain the ARM instructions and the logic required to calculate the sum of the first 10 natural numbers. Describe how loop control, conditional execution, and register updates are used to perform this operation.	10	1	3	4



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End Sem.

~~MID-TERM~~ TEST NOV 2025

Q.4	a. Interface a common cathode 7-segment display with an ARM7 microcontroller to display digits 0-9. Provide the connection diagram and the lookup table (hex values) for the digits.	10	2	3	5
	b. What is the software debugging and software simulating tools? Discuss its advantages and limitations in the context of embedded software development. Give any three examples of electronic measurement tools.	10	3	2	6
Q.5	a. Explain with examples how embedded systems are used in the field of Computer Networking and Peripherals.	10	1	2	7
	b. Describe the concept of Hardware/Software Partitioning in embedded system design. What factors influence the decision to implement a function in hardware versus software?	10	2	4	2
Q.6	a. A system has a performance requirement of 100 MIPS and a power budget of 200 mW. As a designer, which processor technology (GPP, ASIP, SPP) would you choose and why? Discuss the trade-offs involved.	10	3	5	1
	b. Explain the ARM-Thumb interworking concept. Which instructions are used to switch between the ARM and Thumb states? What is the role of the T bit in the CPSR?	10	1	2	4
Q.7	a. Explain the following Thumb instruction set characteristics: (i) Register Usage (ii) Code Density (iii) Two-address format.	10	2	2	4
	b. Explain how a timer in an ARM7 microcontroller can be configured and used to generate a square wave on a GPIO pin. Describe the key timer configuration concepts, such as prescaler, match registers, and interrupt generation, and explain the logical steps involved in using the timer to toggle the output pin.	10	3	3	5

**SARDAR PATEL COLLEGE OF ENGINEERING**(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058*Re-exam 2026*~~MID TERM TEST NOV 2025~~Program: Electrical Engineering*Final year Elec - Sem VII*

Duration: 3 Min.

Course Code: PE-BTE724

Maximum Points: 100

Course Name: Embedded System

Semester: VII

Instructions:

1. Question 1 is COMPULSORY.
2. Attempt any FOUR from the remaining questions (Q.2 to Q.7).
3. All questions carry 20 marks.
4. Assume suitable data if necessary.

08/01/26

Q. No.	Questions	Points	CO	BL	Module No.
Q.1	a. Differentiate between General-Purpose, Single-Purpose, and Application-Specific Processors (ASIPs) with respect to key design metrics like performance, flexibility, and NRE cost.	5	1	4	1
	b. Explain the function of the following ARM7TDMI registers with their specific roles: (i) CPSR (ii) SP (R13) (iii) LR (R14) (iv) PC (R15).	5	2	2	3
	c. A temperature sensor is interfaced to the ADC of an ARM7 microcontroller. The 10-bit ADC output is 682. Given $V_{ref} = 3.3V$, calculate the corresponding analog voltage. List any three registers used in the ADC configuration and their purpose.	5	3	3	5
	d. Discuss the role of Hardware-in-the-Loop (HIL) testing in the validation of an automotive Anti-lock Braking System (ABS). What are its advantages over testing with the final physical system only?	5	3	4	6 & 7
Q.2	a. Explain the design and development process of an embedded system, starting from system specification and continuing through all major stages until deployment.	10	1	2	2
	b. Compare and contrast the Top-Down (Waterfall) and Spiral design process models. Which model is more suitable for a project with evolving requirements and why?	10	2	4	2
Q.3	a. Explain the significance of the following concepts in the ARM architecture: (i) Pipeline (ii) Processor Modes (iii) Conditional Execution. How does conditional execution enhance code efficiency?	10	3	4	3



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Re-exam 2026
~~MID TERM TEST NOV 2025~~

	b. Explain how ARM instructions can be used to copy 10 words of data from a source memory location (pointed to by R1) to a destination memory location (pointed to by R2). Describe the instructions involved—such as load/store multiple (LDM/STM) and loop-control instructions—and how they work together to perform the operation.	10	1	3	4
Q.4	a. Explain the logic used to interface a 4×4 matrix keypad with an ARM7 microcontroller. Describe the key-scanning method, key-detection process, and the GPIO registers typically involved in this interface.	10	2	3	5
	b. Compare the following debugging tools: (i) In-Circuit Emulator (ICE) vs. JTAG, (ii) Logic Analyzer vs. Oscilloscope. State one primary use case for each.	10	3	4	6
Q.5	a. Embedded systems are the backbone of modern telecommunications. Justify this statement with four specific examples of embedded systems used in this domain.	10	1	3	7
	b. What are Design Metrics? Explain any FIVE critical design metrics that an embedded system designer must optimize, giving one example for each.	10	2	2	1
Q.6	a. Explain the tasks involved in System Synthesis for a complex embedded system. How does Hardware/Software Co-design improve the overall design process?	10	3	4	2
	b. With a neat diagram, explain the 3-stage pipeline (Fetch, Decode, Execute) of the ARM7 processor. What is the value of the Program Counter (PC) during the execution stage of an instruction?	10	1	2	3
Q.7	a. Explain the following ARM instructions with an example for each: (i) LDR with post-indexed addressing (ii) LDR pre-indexed with writeback (iii) LDMIA (iv) BIC (v) SWI.	10	2	2	4
	b. Design the interface for a DC motor with an ARM7 microcontroller using an L293D driver IC. Provide a circuit diagram and a code snippet to run the motor in clockwise and anti-clockwise directions.	10	3	3	5



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End Semester Examination/ ~~Re-Examination~~
November/December 2025

Max. Marks: 100

Class: B.TECH. Final Year Semester: VII

Name of the Course: Vehicular System and Control of Electrical Vehicle

Course Code: PE-BTE-711

Duration: 03 Hours

Program: B.TECH (Electrical)

24/11/2025

Instructions:

- Solve Any Five Questions
- Answers to all sub questions should be grouped together
- Figures to the right indicates full mark
- Assume suitable data if required and justify the same.

Ques. No.	Description of question	Max. Marks	CO
Q.1 a)	Compare the scalar control and vector control of three phase induction motor.	05	02
Q.1 b)	Discuss the procedure for testing of EV for range per charge for a given drive cycle.	05	02
Q.1 c)	Discuss the reasons for exploitation of permanent magnet machines in Electrical vehicle applications.	05	01
Q.1 d)	Explain the New European Driving Cycle (NEDC).	05	04
Q.2 a)	Develop the dynamic model of three phase induction motor in synchronously rotating reference frame. What are the benefits of dynamic model of induction motor in synchronously rotating reference frame?	12	01
Q.2 b)	A 4 pole, three phase induction motor having supply frequency of 50 Hz. A vector \hat{Y} is in rotor frame: (i) What is the frequency of pulsation of components of vector \hat{Y} in two phase rotor frame when the slip 5%? (ii) Find the components of vector \hat{Y} in two phase stationary reference frame.		01

	<p>(iii) Find the relative speed of vector \hat{Y} and rotor frame when the slip of induction motor is 10%.</p> <p>(iv) What is the relative speed of rotor vector and stator vector observed from stationary reference frame?</p> <p>(Note: Assume suitable data if required and justify it)</p>	08	02
Q.3 a)	What is the orientation of rotating reference frame? Draw the phasor diagram and discuss the Rotor Flux Orientation and Stator Flux Orientation and the torque equations for two schemes.	08	02
Q.3 b)	What is stator flux oriented control (FOC) of three phase induction motor? Draw the block diagram and discuss the closed-loop implementation under constant flux operation of induction motor.	12	01
Q.4 a)	Draw the block diagram and explain the implementation of DTC of three phase induction motor.	10	02
Q.4 b)	In space vector modulation, calculate the time of application (T_1 , T_2 and T_z) of switching vectors in the given sampling time (T_s).	10	02
Q.5 a)	For space vector modulation technique, what is the maximum value of space vector, so that the output voltages of inverter are pure sinusoidal? What is the nature of phase voltage and line voltage output of inverter when the output space vector occupies only vertices of hexagon.	12	02
Q.5 b)	Draw the implementation block diagram and discuss the closed loop V/F control of three phase induction motor.	08	01
Q.6 a)	A PMSM is controlled in field weakening mode for electrical vehicle applications. Draw the block diagram and suggest the suitable control technique.	10	01
Q.6 b)	Discuss the control of Brushless DC Motor and draw the back EMF and phase current waveforms.	10	01
Q.7 a)	Explain in brief the federal test procedure (FTP-75).	07	04
Q.7 b)	Enlist the different regulatory bodies in India and responsibilities pertaining to electrical vehicles.	07	03
Q.7 c)	Compare the on board charger and off board charger.	06	03



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~~End Semester Examination~~/ Re-Examination
November/December 2025

07/01/26

Max. Marks: 100

Duration: 03 Hours

Class: **B.TECH. Final year** Semester: VII

Program: **B.TECH (Electrical)**

Name of the Course: **Vehicular System and Control of Electrical Vehicle**

Course Code: PE-BTE-711

Instructions:

- Solve Any Five Questions
- Answers to all sub questions should be grouped together
- Figures to the right indicates full mark
- Assume suitable data if required and justify the same.

Ques. No.	Description of question	Max. Marks	CO
Q.1 a)	Explain the need of dynamic model of three phase induction motor.	05	02
Q.1 b)	What are the ways by which the frequency and magnitude of output voltage of square wave inverter is controlled?	05	02
Q.1 c)	Discuss the reasons for exploitation of permanent magnet machines in Electrical vehicle applications.	05	01
Q.1 d)	Discuss the purpose and scope of regulatory standards developed for electrical vehicles.	05	04
Q.2 a)	What are the issues of the dynamic model of three phase induction motor in three phase system? How these issues are addressed? What are the benefits of dynamic model of induction motor in synchronously rotating reference frame?	12	01
Q.2 b)	A 4 pole, three phase induction motor having supply frequency of 50 Hz. A vector \hat{Y} is in rotor frame: (i) What is the frequency of pulsation of components of vector \hat{Y} in two phase rotor frame when the slip 5%? (ii) Find the components of vector \hat{Y} in two phase stationary reference frame.		01

	<p>(iii) Find the relative speed of vector \hat{Y} and rotor frame when the slip of induction motor is 10%.</p> <p>(iv) What is the relative speed of rotor vector and stator vector observed from stationary reference frame?</p> <p>(Note: Assume suitable data if required and justify it)</p>	08	02
Q.3 a)	What is the orientation of rotating reference frame? Draw the phasor diagram and discuss the Rotor Flux Orientation and Stator Flux Orientation and the torque equations for two schemes.	08	02
Q.3 b)	What is indirect rotor flux oriented control (FOC) of three phase induction motor? Draw the block diagram and discuss the closed-loop implementation under constant flux operation of induction motor.	12	01
Q.4 a)	When the modulation index approaches to 1, there are issues with sine triangle PWM technique. How these issues are resolved using sine-triangle PWM technique with third harmonic injection technique.	10	02
Q.4 b)	In space vector modulation, calculate the time of application (T_1 , T_2 and T_z) of switching vectors in the given sampling time (T_s).	10	
Q.5 a)	For space vector modulation technique, what is the maximum value of space vector, so that the output voltages of inverter are pure sinusoidal? What is the nature of phase voltage and line voltage output of inverter when the output space vector occupies only vertices of hexagon.	12	02
Q.5 b)	Draw the implementation block diagram and discuss the open loop V/F control of three phase induction motor.	08	01
Q.6 a)	A PMSM is controlled in field weakening mode for electrical vehicle applications. Draw the block diagram and suggest the suitable control technique.	10	01
Q.6 b)	Compare the synchronous reluctance motor and switched reluctance motor. Discuss the control technique for switched reluctance motor.	10	
Q.7 a)	Discuss the IDC and modified IDC.	07	04
Q.7 b)	Enlist the different regulatory bodies in India and responsibilities pertaining to electrical vehicles.	07	03
Q.7 c)	What are the Power Quality Issues associated with high power fast charging station (FCS). How these issues can be resolved.	06	03



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END SEMESTER November 2025 / ~~RE-EXAM~~ January 2026

Program: **B.Tech Electrical Engineering** Final year Duration: 3 hours

Course Code: **PE- BTE 714** Maximum Points: 100

Course Name: **Advance Techniques in Power System Protection** Semester: VII

Note: Question 1 is compulsory. Solve any 4 from remaining 6 Questions.

24/11/2025

Q. No.	Questions	Points	CO	BL	Mo. No.
1a	Assume that for a long transmission line, two protection schemes; Distance Relay as Main-1 & Current Differential scheme as Main-2 are to be provided. Both of these schemes should be in OR logic or AND logic to trip the circuit breaker only on fault and not in any other case? Justify your answer. How does WAMS will support the scheme so that %100 reliability is ensured?	10	1,2,3,4	4,5	4,7
1b	Define & briefly analyze with suitable example (such as differential or distance relay), the following desirable properties of protection system. a) a) Dependability b) Security The performance of a distance relay was monitored over a period of one year. It was found that it operated 12 times, 10 were correct trips due to faults in its jurisdiction. It was found that relay failed to issue trip decision on 3 occasions. Compute % dependability, % security and % reliability for the relay.	10	1	3,4	1
2a	Derive and explain full cycle DFT algorithm used for phasor estimation in numerical relay.	10	1	1,2	3
2b	What are the functions of PMU, PDC & GPS in WAMS? Compare WAMS with SCADA system. What does a typical data sheet of a PMU contain?	10	3	1,2	7
3a	Justify the need of adaptive relaying scheme for transformer differential protection. Elaborate the scheme with suitable diagram.	10	3,4	3,4,5	5, 6

**END SEMESTER November 2025 / ~~RE-EXAM~~ January 2026**

3b	<p>What is meant by adaptive protection? Given below is three terminal line with a fault at point F. Suggest the adaptive settings for zone 1 of distance relay A in case circuit breaker at C is 1) ON & 2) OFF</p>	10	3,4	3,5,6	6
4a	<p>Second order polynomial is given as $y = Ax^2 + Bx + C$ Show that in case the samples of y contains noise or error, curve fitting or least square method can be used to estimate A, B, C constants from the data samples of x and y. What is extrapolation & interpolation? Where are they used?</p>	10	1	3,4	2
4b	<p>Given $A = \begin{bmatrix} 1000 & 999 \\ 999 & 998 \end{bmatrix}$ & $b = \begin{pmatrix} 1999 \\ 1997 \end{pmatrix}$ Then find X such that $AX = b$ Now, suppose while measuring b, there is an error which results slight perturbation in its values such that $b = \begin{pmatrix} 1998.99 \\ 1997.01 \end{pmatrix}$ Then find X? What is the possible cause of this huge difference in answer of X?</p>	10	1	3,5	2
5a	<p>How can we distinguish a power swing from a fault? Why it is necessary for equipping distance relays with swing detection and blocking mechanism? With the help of neat diagram explain the basic principle of working of: 1) power swing blocking relays & 2) Out of step tripping relays</p>	10	2	1,3,4	4
5b	<p>Prove that impedance measured by distance relay is inversely proportional to apparent power in the line. Hence explain load encroachment. Do you want distance relay to trip on it? Justify your answer with suitable diagram.</p>	10	2	1,3,4	4
6a	<p>Following diagram shows the protection provided for generator winding. What is the name of the protection scheme? Will the relay trip in case a winding gets short circuited to ground (fault F1)? Also comment if the relay will trip in case of fault outside the line CTs? (Fault F2). Hence comment on the name of the protection scheme.</p>	7	2	3,4,5	5



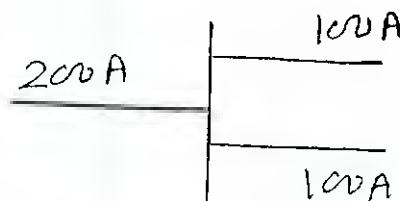
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END SEMESTER November 2025 / RE-EXAM January 2026

6b	<p>A 13.8 kV, 125 MVA star connected alternator has a synchronous reactance of 1.4 p.u./phase and a negligible resistance. It is protected by a Merz-Price balanced current system which operates when the out of balance current exceeds 10% of the full load current. If the neutral point is earthed through a resistance of 2 ohms, determine what proportion of the winding is protected against earth fault.</p>	5	2	2,3	5
6c	<p>Explain with neat diagram the protection scheme using Mho relay to protect generator against loss of excitation to the rotor.</p>	8	2	1,2	5
7a	<p>Compare Single Bus Single Breaker arrangement with Single Breaker Double Bus arrangement with the help of proper diagram.</p>	10	2,4	3,4	5
7b	<p>Design suitable protection for the following bus-bar arrangement against the bus-bar fault. Rated currents are already mentioned on the lines. Redraw the circuit with proper connections of CTs with dots marked on and explain the working of relay in case a fault occurs on the bus-bar. Assume fault currents to be 10 times the rated current of each line.</p>	10	2	3,5,6	5





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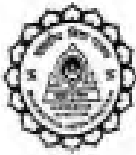
Program: B.Tech Electrical Engineering Final year Duration: 3 hours

Course Code: PE- BTE 714 Maximum Points: 100

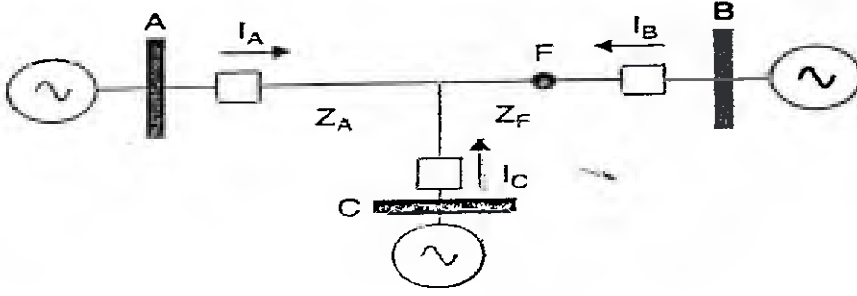
Course Name: Advance Techniques in Power System Protection Semester: VII

Note: Question 1 is compulsory. Solve any 4 from remaining 6 Questions.

Q. No.	Questions	Points	CO	BL	Mo. No.
1a	<p>Define & briefly analyze with suitable example (such as differential or distance relay), the following desirable properties of protection system.</p> <p>a) a) Dependability b) Security</p> <p>The performance of a distance relay was monitored over a period of one year. It was found that it operated 10 times, 8 were correct trips due to faults in its jurisdiction. It was found that relay failed to issue trip decision on 3 occasions. Compute % dependability, % security and % reliability for the relay.</p>	10	1	3,4	1
1b	<p>Assume that for a long transmission line, two protection schemes; Distance Relay as Main-1 & Current Differential scheme as Main-2 are to be provided. Both of these schemes should be in OR logic or AND logic to trip the circuit breaker only on fault and not in any other case? Justify your answer. How does WAMS will support the scheme so that reliability mentioned in Q. 1a is 100% ensured?</p>	10	1,2, 3,4	4,5	4,7
2a	<p>Given $A = \begin{bmatrix} 1000 & 999 \\ 999 & 998 \end{bmatrix}$ & $b = \begin{pmatrix} 1999 \\ 1997 \end{pmatrix}$ Then find X such that $AX = b$</p> <p>Now, suppose while measuring b, there is an error which results slight perturbation in its values such that $b = \begin{pmatrix} 1998.99 \\ 1997.01 \end{pmatrix}$ Then find X. What is the possible cause of this huge difference in answer of X?</p>	10	1	3,5	2
2b	<p>Second order polynomial is given as $y = Ax^2 + Bx + C$</p> <p>Show that in case the samples of y contains noise or error, curve fitting or least square method can be used to estimate A, B, C constants from the data samples of x and y. What is extrapolation & interpolation? Where are they used?</p>	10	1	3,4	2



~~END SEMESTER November 2025~~ / RE - EXAM January 2026

3a	<p>What is meant by adaptive protection? Given below is three terminal line with a fault at point F. Suggest the adaptive settings for zone 1 of distance relay A in case circuit breaker at C is 1) ON & 2) OFF</p> 	10	3,4	3,5,6	6
3b	<p>Justify the need of adaptive relaying scheme for transformer differential protection. Elaborate the scheme with suitable diagram.</p>	10	3,4	3,4,5	5,6
4a	<p>What are the functions of PMU, PDC & GPS in WAMS? Compare WAMS with SCADA system. What does a typical data sheet of a PMU contain?</p>	10	3	1,2	7
4b	<p>Derive and explain full cycle DFT algorithm used for phasor estimation in numerical relay.</p>	10	1	1,2	3
5a	<p>How can we distinguish a power swing from a fault? Why it is necessary for equipping distance relays with swing detection and blocking mechanism? With the help of neat diagram explain the basic principle of working of: 1) power swing blocking relays & 2) Out of step tripping relays</p>	10	2	1,3,4	4
5b	<p>Prove that impedance measured by distance relay is inversely proportional to apparent power in the line. Hence explain load encroachment. Do you want distance relay to trip on it? Justify your answer with suitable diagram.</p>	10	2	1,3,4	4
6a	<p>Following diagram shows the protection provided for generator winding. What is the name of the protection scheme? Will the relay trip in case a winding gets short circuited to ground (fault F1)? Also comment if the relay will trip in case of fault outside the line CTs? (Fault F2). Hence comment on the name of the protection scheme.</p>	7	2	3,4,5	5

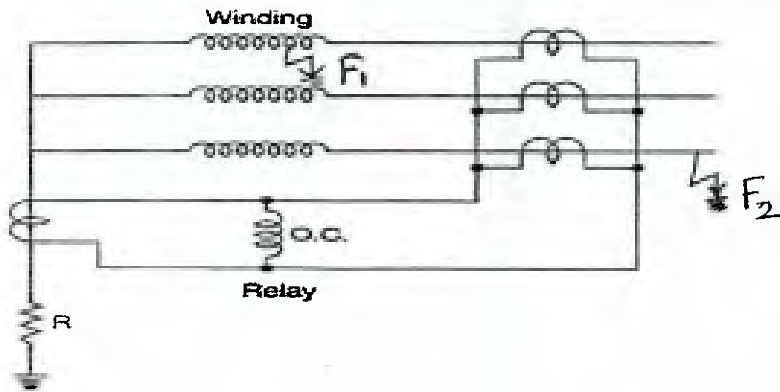


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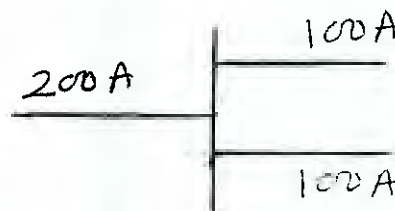
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6b)	A 3-phase 33 kV star connected alternator is to be protected using circulating current protection. The pilot wires are connected to the secondary windings of 100/5 ratio current transformer. The protective relay is adjusted to operate with an out-of-balance current of 1 amp in the pilot wires. Determine the (i) earthing resistance which will protect 90% of the winding, and (ii) the per cent of the winding which would be protected if the earthing resistance is 15 ohm.	5	2	2,3	5
6c	Explain with neat diagram the protection scheme using Mho relay to protect generator against loss of excitation to the rotor.	8	2	1,2	5
7a	Compare Single Bus Single Breaker arrangement with Single Breaker Double Bus arrangement with the help of proper diagram.	10	2,4	3,4	5
7b	Design suitable protection for the following bus-bar arrangement against the bus-bar fault. Rated currents are already mentioned on the lines. Redraw the circuit with proper connections of CTs with dots marked on and explain the working of relay in case a fault occurs on the bus-bar. Assume fault currents to be 10 times the rated current of each line.	10	2	3,5,6	5





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END SEM/~~RE-EXAM~~ EXAMINATION November/December 2025

Program: Electrical Final Year Sem. VII

Course Code: PE-BTE712

Course Name: Restructuring and Deregulation of Power System

Duration: 3h

Maximum Points: 100

Semester: VII

- All questions are compulsory
- Make suitable assumptions wherever necessary

Q.No	Questions	Points	CO	BL	Module
Q1.(a)	What are the four distinguishing features of electricity as commodity?	5	1	4	1
Q1.(b)	A manufacturer estimates that its variable cost for manufacturing a given product is given by the following expression: $C(q) = 70q^2 + 2100q$ [₹] 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
Q1.(c)	Explain with the help a neat diagrams different models of competition in electricity sector. Also explain which model provides the choice to the small residential consumers to choose their service provider.	10	2	3	1
Q2.(a)	The inverse demand function of a group of consumers for a given type of widgets is given by the following expression: $\pi = -10q + 2000$ ₹; 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: 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.	12	1,2	3	2
Q.2(b)	In liberalized electricity markets, transmission is usually separated from the other components of a traditional vertically integrated utility. Describe the characteristics of	8	2	2	2



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END SEM/~~RE-EXAM~~ EXAMINATION November/December 2025

	transmission as a standalone business.																																																																				
Q3.(a)	Describe briefly the characteristics of spot contracts, forward contracts, futures contracts, and option contracts.	6	1	2	2																																																																
Q3.(b)	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.	14	2	4	2																																																																
	<table border="1"> <thead> <tr> <th>Bid</th> <th>Company</th> <th>Quantity (MWh)</th> <th>Price (₹/MWh)</th> </tr> </thead> <tbody> <tr><td></td><td>Red</td><td>200</td><td>12</td></tr> <tr><td></td><td>Red</td><td>50</td><td>15</td></tr> <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> <th>Offer</th> <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>	Bid	Company	Quantity (MWh)	Price (₹/MWh)		Red	200	12		Red	50	15		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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	Orange	100	26																																																																		
Q4.(a)	Using the graphical method find the optimal solution of LPP; Max $Z=x_1+3x_2$ s.t. $x_1+x_2 \leq 1$ $-3x_1+x_2 \geq 3$ $x_1, x_2 \geq 0$	8	5	4	3																																																																
Q4.(b)	Let the two units of the system have the following cost curve: ₹/h ₹/h Daily load curve s shown below. Assume that the cost of ₹400 is incurred in taking either unit off the line and returning it to service after 12 hours. Consider the 24 hour period from 6 am to 6 am next morning. Estimate whether it would be more economical to keep both the units in	12	5	4	3																																																																



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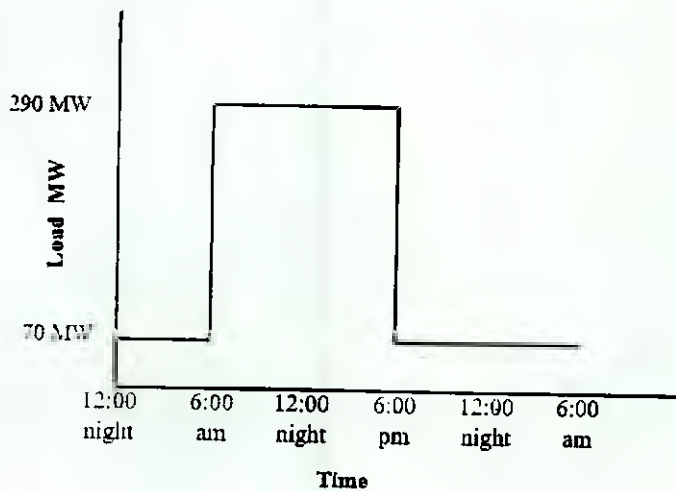
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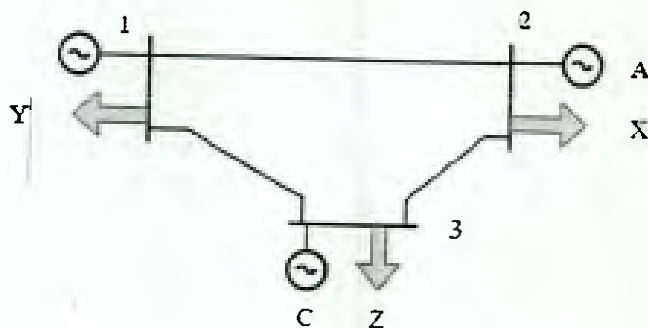
END SEM/RE-EXAM EXAMINATION November/December 2025

service for this 24 hours or to remove on of the unit from services for the 12 hours of the light load.



Q5.(a) 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.


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	200
A	Z	400
C	Y	300

8 4 3 3

**END SEM/RE-EXAM EXAMINATION November/December 2025**

Q5.(b)	<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:</p>  <p>$MC_A = 24 + 0.03P_A \text{ ₹/MWh}$ $MC_B = 15 + 0.025P_B \text{ ₹/MWh}$</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> <p>(a). The line between buses A and B is disconnected (2M) (b). The line between buses A and B is in service and has an unlimited capacity, but the maximum output of Generator B is 1400MW. (2M) (c). The line between buses A and B is in service and has an unlimited capacity, but the maximum output of Generator B is 1000 MW. The output of Generator A is unlimited. (2M) (d). The line between buses A and B is in service but its capacity is limited to 200MW. The output of the generators is unlimited. (2M) (e) Find the merchandising surplus for part (d).(2M)</p>	12	3	4	4
Q6.(a)	List the reasons responsible for imbalance in the system. Describe the typical time signature of various phenomena of imbalance? How these phenomena responsible for imbalances can be mitigated?	8	4	2,3	6
Q6.(b)	What are different ancillary services procured by SO? Name and compare the two mechanisms through which system operators can obtain ancillary services.	12	3	4	6
Q7.(a)	Why physical transmission right is essential for trading electricity? How can these rights can be acquired?	10	3	2,3	4



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END SEM/~~RE-EXAM~~ EXAMINATION November/December 2025

	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?				
Q7.(b)	Discuss in detail methods used for cost allocation of the transmission lines.	10	2	2	7



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~~END-SEM/RE-EXAM EXAMINATION November/December 2025~~

Jan-2026

07/01/26

Program: Electrical

Final year Sem VII

Course Code: PE-BTE712

Course Name: Restructuring and Deregulation of Power System

Duration: 3h

Maximum Points: 100

Semester: VII

- All questions are compulsory
- Make suitable assumptions wherever necessary

Q.No	Questions	Points	CO	BL	Module
Q1.(a)	Hunt and Shuttleworth in 1996 proposed four models to chart the evolution of the electricity supply industry from a regulated monopoly to full competition. Explain with the help of neat diagram each of these model and also compare these models of competition.	12	1	2	1
Q1.(b)	Name different player of a bundled system. What is the role of system operators and market operators? Can market operator and system operator be same entity?	8	1	2	1
Q2.(a)	The Pretty Good Breakfast Company is going to launch a new line of breakfast drinks. To reduce its exposure to the market price, it has bought a call option for 150 000 liters of frozen concentrated orange juice The option fee for this call option is ₹3000 and the strike price is ₹1.1515/liter. Discuss the consequences of this decision if the spot price on the expiry date is: i) ₹1.10/litres ii) ₹1.20/litres iii) ₹1.1715/litres	6	1,2	4	2
Q2.(b)	The inverse demand function of a group of consumers for a given type of widgets is given by the following expression: $\pi = -10q + 2000$ ₹; where q is the demand and π is the unit price for this product. i) Determine the maximum consumption of these consumers. ii) For a price π of 1000 ₹/unit, calculate the consumption, the consumers' gross surplus, the revenue collected by the producers, and the consumers' net surplus. iii) If the price π increases by 20%, calculate the change in consumption and the change in the revenue collected by the producers. iv) What is the price elasticity of demand for this	2+5+2+3	1,2	4	2



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~~END SEM/RE-EXAM EXAMINATION November/December 2025~~ ^{Jan} 2025

	product and this group of consumers when the price π is 1000 ₹/unit.				
Q.3(a)	<p>The rules of the Syldavian electricity market stipulate that all participants must trade energy exclusively through the Power Pool. However, the Syldavia Aluminum Company (SALCo) and the Northern Syldavia Power Company (NSPCo) have signed a contract for difference for the delivery of 100 MW on a continuous basis at a strike price of 20 ₹/MWh.</p> <p>i) Trace the flow of power and money between these companies when the pool price takes the following values: 21 ₹/MWh.</p> <p>ii) What happens if during 1 h the Syldavia Aluminum Company consumes only 200 MWh and the pool price is 13 ₹/MWh?</p>	5	1,2	4	2
Q3.(b)	<p>The following six companies participate, along with others, in the Southern Antarctica electrical energy market:</p> <p>Red: A generating company owning a portfolio of plants with a maximum capacity of 1000 MW.</p> <p>Green: Another generating company with a portfolio of plants with a maximum capacity of 800 MW.</p> <p>Blue: A retailer of electrical energy.</p> <p>Yellow: Another retailer of electrical energy.</p> <p>Magenta: A trading company with no generating assets and no demand.</p> <p>Purple: Another trading company with no physical assets.</p> <p>The following information pertains to the operation of this market for Monday, November 21, 2025 between 1:00 and 2:00 p.m.</p> <p>Load Forecasts</p> <p>Blue and Yellow forecast that their customers will consume, respectively, 1200 and 900 MW during that hour.</p> <p>Long-term contracts</p> <p>June 2015: Red signs a contract for the supply of 600 MW at 15 ₹/MWh for all hours between January 1, 2015 and December 31, 2020.</p> <p>July 2015: Blue signs a contract for the purchase of 700 MW for all hours between February 1, 2025 and December 31, 2025. The price is set at 12 ₹/MWh for off-peak hours and at 15.50 ₹/MWh for peak hours.</p> <p>August 2024: Green signs a contract for the supply of 500</p>	15	2	3	2



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~~END SEM/RE-EXAM EXAMINATION~~ ^{Jan} November/December 2025

	<p>25/2/16 Magenta Sell 100 17.00</p> <p>28/2/16 Purple Buy 250 14.00</p> <p>28/2/16 Yellow Sell 100 14.00</p> <p>Option contracts In November 2024, Red bought a put option for 200 MWh at 14.75 ₹/MWh. The option fee was ₹50. In December 2024, Yellow bought a call option for 100 MWh at 15.50 ₹/MWh. The option fee was ₹25.</p> <p>Outcome The spot price on the Southern Antarctica electricity market was set at 15.75₹/MWh for February 29, 2016 between 1:00 and 2:00 p.m. Due to difficulties at one of its major plants, Red was only able to generate 800 MW. Its average cost of production was 14.00 ₹/MWh.</p> <p>Green generated 770 MW at an average cost of 14.25 ₹/MWh. Blue's demand turned out to be 1250 MW. Its average retail price was 16.50 ₹/MWh.</p> <p>Yellow demand turned out to be 850 MW. Its average retail price was 16.40 ₹/MWh.</p> <p>Assuming that all imbalances are settled at the spot market price, calculate the profit or loss made by each of these participants.</p>				
Q4.(a)	<p>Using the graphical method find the optimal solution of LPP;</p> $\text{Max } Z = x_1 + 3x_2$ <p>s.t. $3x_1 + 6x_2 \leq 8$ $5x_1 + 2x_2 \leq 10$ $x_1, x_2 \geq 0$</p>	6	5	4	3
Q4.(b)	<p>Using Lagrange multiplier method solve the optimisation problem</p> $F(x, y, z) = \min 3x^2 + y$ <p>Subject to: $4x - 3y = 9$ $x^2 + z^2 = 9$</p>	6	5	4	3
Q4.(c)	<p>For the system shown below, the incremental costs for the two plants are:</p> $MC_1 = 15 + 0.08P_1 \text{ ₹/ MWh}$ $MC_2 = 13 + 0.1P_2 \text{ ₹/ MWh}$	8	5	4	3



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~~END SEM/RE-EXAM EXAMINATION November/December 2025~~ ^{Jan} 2026

MW at 16 ₹/MWh for peak hours in February 2025.							
September 2025: Yellow signs a contract for the purchase of electric energy. The contract specifies a profile of daily and weekly volumes and a profile for daily and weekly prices. In particular, on weekdays between 1:00 and 2:00 p.m., the volume purchased is 550 MW at 16.25 ₹/MWh.							
Futures contracts: All contracts are for delivery on November 21, 2025 between 1:00 and 2:00 p.m.							
Date	Company	Type	Amount				
Price							
10/9/25	Magenta	Buy 50	14.50				
20/9/25	Purple	Sell 100	14.75				
30/9/25	Yellow	Buy 200	15.00				
10/10/25	Magenta	Buy 100	15.00				
20/10/25	Red	Sell 200	14.75				
30/10/25	Green	Sell 250	15.75				
30/10/15	Blue	Buy 250	15.75				
10/11/15	Purple	Buy 50	15.00				
15/11/15	Magenta	Sell 100	15.25				
20/11/15	Yellow	Buy 200	14.75				
30/11/15	Blue	Buy 300	15.00				
10/12/15	Red	Sell 200	16.00				
15/12/15	Red	Sell 200	15.50				
20/12/15	Blue	Sell 50	15.50				
15/1/16	Purple	Sell 200	14.50				
20/1/16	Magenta	Buy 50	14.25				
10/2/16	Yellow	Buy 50	14.50				
20/2/16	Red	Buy 200	16.00				



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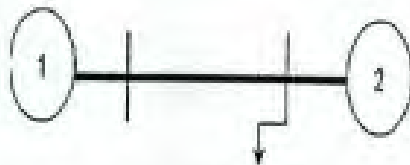
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Jan

~~END SEM~~ RE-EXAM EXAMINATION ~~November~~ December 2025

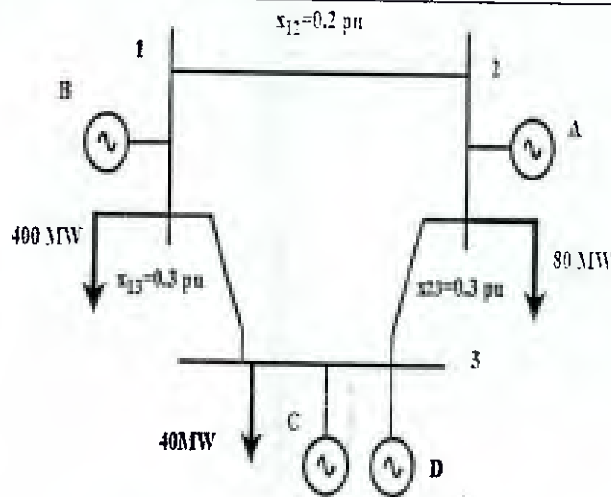
The transmission line loss formula indicates that for a transfer of 150 MW, a loss of 15 MW occurs. If $\lambda = 25 \text{ ₹/MWh}$, find (a) Loss coefficients (b) P_1 and P_2 for the minimum fuel cost (c) power supplied to the load (d) loss in transmission line.



Q5.(a)

Consider the three-bus power system shown in figure below. The table below shows the data about the generators connected to this system. Calculate the unconstrained economic dispatch and the nodal prices for the loading conditions.

Generator	Capacity (MW)	Marginal Price (₹/MWh)
A	350	8
B	200	12
C	150	15
D	150	10



- Calculate the unconstrained economic dispatch and the nodal prices for the loading conditions.
- Using the superposition principle, calculate the flows that would result if the generating units were dispatched as in part a). Identify all the violations of transmission constraints if the maximum capacity of each line is 250 MW.
- Calculate the nodal prices for the three-bus power

20

3

4

4



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~~END SEMESTRE~~ **RE-EXAM EXAMINATION** ~~November~~ **December 2025**

	system when the generating units have been optimally re-dispatched to relieve the constraint violations identified in b).				
Q6.(a)	List the reasons responsible for imbalance in the system. Describe the typical time signature of various phenomena of imbalance? How these phenomena responsible for imbalances can be mitigated?	8	4	2,3	6
Q6.(b)	A small power system consists of two buses connected by three transmission lines. Assuming that this power system must be operated according to the N-1 security criterion and that its operation is constrained only by thermal limits on the transmission lines, calculate the maximum power transfer between these two buses for each of the following conditions: (a). All three lines are in service. Two of them have a continuous thermal rating of 300 MW and the third is rated at 400 MW. (b). All three lines are in service. All of them have a continuous thermal rating of 400 MW. However, during emergencies, they can sustain a 10% overload for 20 min. The generating units on the downstream bus can increase their output at the rate of 10 MW per minute. (c). Same conditions as in (c) except that the output of the downstream generators can only increase at the rate of 6MW per minute. (d). Low temperatures and high winds improve the heat transfer between the conductors and the atmosphere. Assume that this dynamic thermal rating increases the continuous and emergency loadings of (c) by 12%.	8	3	4	6
Q6.(c)	Why spot market is required? Who manages this market? Who can participate in this market? When gates of his market are closed?	4	1,2	2	2
Q7.(a)	How the Electricity Act 2003 paved way for reforms in India? Give the road map of reforms in power sector in India since 2003.	10	1	2	7
Q7.(b)	Investigate the investor perspective to invest into new generation plant. Discuss what difficulties investor may face to build the new plant.	10	2	2	5



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END SEMESTER November 2025 / ~~RE-EXAM January 2026~~

Program: B. Tech Electrical Final year

Course Code: PE-BTE 703

Course Name: Smart Grid

Duration: 3 Hours

Maximum Points: 100

Semester: VII

Instructions:

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

21/11/2025

Q.No.	Questions	Points	CO	BL	Module No.
Q1 (a)	What is CDM? Explain CDM opportunities in smart grid. Hence, explain the threats and securities in Smart Grid implementation.	01+03 +03+03	01	L-1	01
Q1 (b)	Explain the concept of smart grid and hence discuss the evolution of electric grid in detail.	02+08	01	L-1	01
Q2 (a)	Discuss accurate customer to electrical system model of modern Outage Management System to provide accurate predictions of outage locations with OMS architecture.	08+02	02	L-1	02
Q2 (b)	What is the significance of real time pricing in smart grid? and hence discuss the advantages of real time pricing.	04+06	01	L-1	02
Q3 (a)	What is the role of intelligent electronic devices in monitoring and protection of smart grid system? Draw the functional overview diagram of IED and explain in detail.	06+02 +02	02	L-1	03
Q3 (b)	Explain the significance of smart storage. Hence describe superconducting magnetic energy storage (SMES) and pumped hydro compressed air energy storage with diagram.	02+06 +02	02	L-1	03
Q4 (a)	Explain the basic concept of microgrid. What are the different challenges related to protection of microgrid? Hence explain various approaches about the control strategies used in microgrid.	01+03 +06	03	L-1	04



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END SEMESTER November 2025 / ~~RE - EXAM~~ January 2026

Q4 (b)	Write detail notes on the following by explaining working principle, diagram, advantages, disadvantages and application. (a) Variable speed wind generators. (b) Microturbines.	05+05	03	L-1	04
Q5 (a)	Why power quality audit is necessary in smart grid? Hence explain the various steps followed to conduct power quality audit.	02+08	03	L-1	05
Q5 (b)	What is power quality conditioner? Explain different power quality conditioners used in Smart Grid. (Any Two)	01+09	03	L-1	05
Q6 (a)	What is the importance of information and communication technology system (ICT) in smart grid environment? Hence, explain advanced metering infrastructure (AMI) used for Smart Grid in detail.	04+06	04	L-1	06
Q6 (b)	Explain Home area network (HAN), neighbourhood area network (NAN), wide area network (WAN) and do their comparative analysis.	10	04	L-1	06
Q7 (a)	What is the cloud computing? Draw and explain the cloud computing architecture. Hence, explain the different services provided by cloud computing to smart grid?	01+03 +06	04	L-1	07
Q7 (b)	Explain the broadband over power line (BPL) communication system. Hence draw the architecture of BPL.	08+02	04	L-1	07



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End Semester Examination/ ~~Re-Examination~~
Nov/Dec-2025

Max. Marks: 100

Class: **B.TECH. Final year** Semester: VII

Name of the Course: **Advanced Electric Drives**

Duration: 03 Hours

Program: **B.TECH. (Electrical)**

Course Code: **PE-BTE 701**

21/11/2025

Instructions:

- Solve any five questions.
- Answers to all sub questions should be grouped together
- Figures to the right indicates full mark
- Assume suitable data if required and justify the same.

Qu. No	Description of Question	Max. Marks	CO
1. a)	Explain the need of dynamic model of three phase induction motor.	05	02
1.b)	What is rotor flux oriented control of three phase induction motor? What is the major advantage of this scheme?	05	02
1.c)	What is the nature of output voltage of inverter when the space vector occupies only the vertices of hexagon? What is the maximum magnitude of space vector (in SPVM technique) so that the output voltages of the inverter are pure sinusoidal?	02+ 03	02
1.d)	What are the benefits of permanent magnet machines over the conventional machines?	05	01
2. a)	Develop the three phase dynamic model of three phase induction motor.	14	01
2. b)	Derive the relations of stator self-inductances and mutual inductances in three phase induction motor.	06	03

3. a)	What is stator flux oriented control of three phase induction motor? Draw the block diagram and discuss the closed loop implementation.	12	02
3. b)	Develop the torque equation of three phase induction motor in: (i) Stationary reference frame (ii) Synchronously rotating reference frame.	08	02
4. a)	What is indirect rotor flux oriented control (FOC) of three phase induction motor? Draw the block diagram and discuss the closed-loop implementation under constant flux operation of induction motor.	12	03
4. b)	Compare the synchronous reluctance motor and switched reluctance motor. Compare their drive requirements.	08	03
5. a)	Discuss the look up table of voltage vectors used in implementation of hysteresis-based DTC of three phase induction motor.	10	03
5. b)	Discuss the Sine-Triangle PWM technique to control the inverter. Compare the magnitude of output voltage of inverter in sine-triangle PWM technique and square wave inverter technique.	10	01
6. a)	For space vector modulation technique, calculate the time of T1, T2 and Tz used to synthesize the space vector. Discuss the effect of sampling time on the output voltage of inverter.	12	01
6. b)	A PMSM is controlled in field weakening mode. Draw the block diagram and suggest the suitable control technique.	08	02
7. a)	Discuss the control of Brushless DC Motor and draw the back emf and phase current waveforms.	12	03
7. b)	Discuss the different configurations and control techniques of SRM drive.	08	02