Problem Based Learning Assignments
for

Basics Electrical Engineering (BE01R00051)

B.E. Semester-II (All Branches)

Directorate of Technical Education, Gandhinagar, Gujarat

Government Engineering College, Bhuj

Certificate

This is to certify that Mr./Ms. ____________________________________
Enrollment No. _______________ of B.E. Semester-II ___________________________Engineering of this Institute (GTU Code: 015)

has satisfactorily completed the Problem Based Learning Assignment work for the subject **Basics Electrical Engineering (BE01R00051)** for the academic year ___________

Place: __________

Date: __________

Name and Sign of Faculty member

Head of the Department

Preface

Main motto of any laboratory / practical / assignment / field work is for enhancing required skills as well as creating ability amongst students to solve real time problem by developing relevant competencies in psycho-motor domain. By keeping in view, GTU has designed competency focused outcome-based curriculum for engineering degree programs where sufficient weightage is given to practical work. It shows importance of enhancement of skills amongst the students. It is must for effective implementation of competency focused outcome-based curriculum that every practical / assignment is keenly designed to serve as a tool to develop and enhance relevant competency required by the various industry among every student.

By solving these assignments students can try to develop a better understanding of the subject. This in turn enhances pre-determined outcomes amongst students.

Basics Electrical Engineering assignment is designed to supplement the theoretical knowledge gained in this subject. It provides hands-on experience to reinforce concepts such as Ohm's Law, Various laws and theorems, AC/DC circuits, Electrical Machines and safety & protection. The assignments have been carefully selected to cover the key topics in Basics Electrical Engineering and to help students develop critical thinking, problem-solving, and troubleshooting skills.

The utmost care has been taken while preparing these assignments however always there is chances of improvement. Therefore, we welcome constructive suggestions for improvement and removal of errors if any.

Note:

The theory, questions and figures used in this manual are used from the prescribed texts and references as mentioned in the GTU syllabus:

1. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
2. Basic Electrical Engineering- U. A. Bakshi, H. N. Raval, Technical Publication, 2024.
3. Website: nptel.ac.in
4. Google sites

Government Engineering College, Bhuj
Institute Vision and Mission

Vision

To optimize perseverance, quality and ethics in the higher technical education and research as can groom the learners into the owners of global trends in engineering.

Mission

- To facilitate the learners with fundamental and advanced technical knowledge in theory and practice
- To facilitate the learning with concerned industrial exposure to the obtaining technology
- To help the learners acquire professional ethics, acumen and zeal for research and entrepreneurship

Government Engineering College, Bhuj
Electrical Engineering Department
Department Vision and Mission, PEOs and PSOs

Vision

To empower Electrical Engineers with technical expertise, social responsibility and adaptability to vibrant industries.

Mission

M1: To provide sound fundamental knowledge and skill of electrical engineering field.

M2: To provide platform for higher study, entrepreneurship and placement.

M3: To produce Electrical Engineers with an attitude to adapt themselves to changing technological environment.

M4: To create lifelong learning environment in department.

Program Educational Objectives (PEOs)

Within few years after Graduation, the Student will be able:

PEO1: To implant a strong foundation in the Electrical Engineering fundamentals to solve and analyze the Electrical Engineering problems. (Core Technical)

PEO2: To produce graduates who are well placed in the field of Electrical Engineering and contributing towards nation development. (Placement and Entrepreneurship)

PEO3: Building a professional culture within the department community that embodies the ethics and honesty. (Ethics)

Program Specific Outcomes (PSOs)

PSO 1: Graduates will be able to demonstrate fundamental knowledge of electrical power system, electrical machines, power electronics using appropriate concepts.

PSO 2: Graduates will be able to design electrical machines, transmission lines and Power apparatus.

PSO 3: Graduates will be able to develop support system based on renewable and sustainable energy sources.

Program Outcomes (POs)

- POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability, attitude and behavior that students acquire through the program.
- The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of an engineering graduate.
- NBA has defined the following eleven POs for an engineering graduate. These are in line with the Graduate Attributes as defined by the Washington Accord:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course Outcome (COs):

After learning the course, the students should be able to:

CO-1 : Apply fundamental electrical laws and circuit theorems to electrical circuits.

CO-2 : Analyze single phase and three phase AC circuits.

CO-3 : Describe operating principle and applications of static and rotating electrical machines.

CO-4 : Understand the LT switchgear, earthing and safety of electrical appliances.

CO-5 :Comprehend illumination system, batteries, electrical consumption & billing and electrical measuring instruments.

Assignments – Course Outcome matrix

Course Outcomes (COs):

CO-1 : Apply fundamental electrical laws and circuit theorems to electrical circuits.

CO-2 : Analyze single phase and three phase AC circuits.

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CO-4 : Understand the LT switchgear, earthing and safety of electrical appliances.

CO-5 : Comprehend illumination system, batteries, electrical consumption & billing and electrical measuring instruments**.**

Sr. No.	Assignment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
1.	Assignment-1	√				
2.	Assignment-2		√			
3.	Assignment-3			√		
4.	Assignment-4				√	
5.	Assignment-5					√

Government Engineering College, Bhuj
Department of Electrical Engineering
Subject: Basic Electrical Engineering (BE01R00051)
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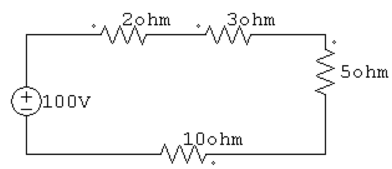
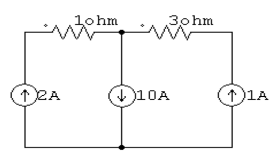
Exp. No.	Title of Experiment	Date of Performance	Date of Submission	Marks	Sign
1	Assignment-1				
2	Assignment-2				
3	Assignment-3				
4	Assignment-4				
5	Assignment-5				
		Total			

Assignment : 1

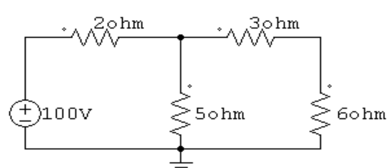
1. A resistor of 20 Ω is connected across a 200 V DC supply. Calculate (a) Current flowing, (b) Power dissipated
2. A coil has resistance 10 Ω and inductance 2 H. If a DC voltage of 50 V is applied, find the steady-state current.
3. A capacitor of 50 µF is connected to a 100 V DC source. Determine (a) Charge stored, (b) Energy stored in the capacitor
4. Three resistors of 4 Ω, 6 Ω and 12 Ω are connected in parallel across a 24 V source. Find the total current drawn.
5. A 10 A current source supplies a parallel combination of 5 Ω and 10 Ω resistors. Find the voltage across each resistor.
6. A 24 V voltage source is connected in series with a 6 Ω resistor and a 12 Ω resistor. Calculate current and voltage across each resistor.
7. Convert a 20 V voltage source in series with 5 Ω resistance into its equivalent current source.
8. Evaluate (i) current from 5 ohm resistor, (ii) voltage drop in 10 ohm resistor, (iii) power dissipated in 2 ohm resistor, (iv) total power dissipated in the circuit.



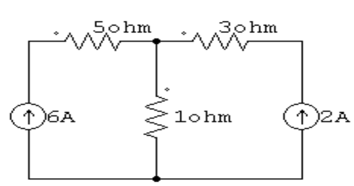
9. Evaluate (i) current from 1 ohm resistor, (ii) voltage drop in 3 ohm resistor, (iii) total power dissipated in circuit.



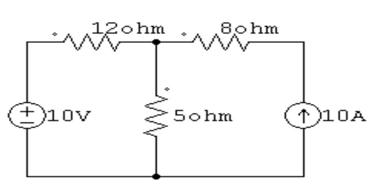
10. Evaluate (i) current from 6 ohm resistor, (ii) voltage drop in 5 ohm resistor, (iii) power dissipated in 2 ohm resistor, (iv) total power dissipated in circuit.



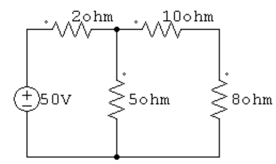
11. Evaluate (i) current from 1 ohm resistor using Superposition Theorem



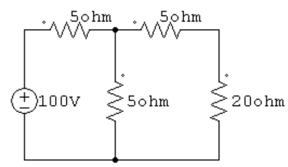
12. Evaluate voltage across 12 ohm resistor and 8 ohm resistor using Superposition Theorem



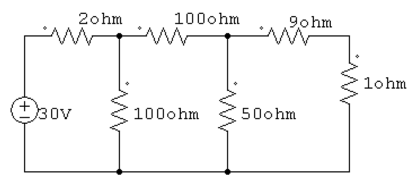
13. Evaluate voltage across 8 ohm resistor using Thevenin's Theoremm



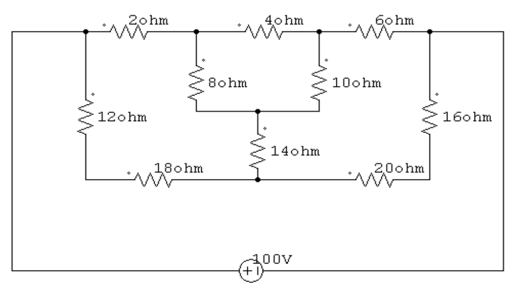
14. Evaluate voltage across 20 ohm resistor using Norton's Theorem



15. Evaluate current from 1 ohm resistor using delta-star transformation.



16. Evaluate current from 1 ohm resistor using delta-star transformation.



17. A series RL circuit has R = 10 Ω and L = 2 H. A DC voltage of 20 V is applied at t = 0. Determine, (a) Time constant, (b) Current at t = 0.2 s
18. A capacitor of 100 μF is charged through a resistor of 2 kΩ from a 50 V DC supply. Find, (a) Time constant, (b) Voltage across capacitor at t = 0.5 s
19. In an RC discharge circuit, R = 5 kΩ and C = 20 μF. If initial voltage is 100 V, find capacitor voltage after 0.2 s.

Rubric wise marks obtained:

Criteria	Level of Knowledge and Understanding	Analytical Ability	Quality & Correctness of Write-up, Ethical Practices and Submission	Total
Marks				

Assignment : 2

1. An alternating voltage is given by v=325sin(314t) Determine: (a) Peak value (b) RMS value (c) Frequency (d) Time period

2. A sinusoidal current has peak value of 15 A. Find: (a) RMS value (b) Average value (c) Form factor (d) Peak factor

3. Two voltages are given as: $V1=100\angle 0°V$ and $V2=80\angle 30°V$. Find the resultant voltage using phasor method.

4. A current of 10 A leads the voltage by 30°, Represent the voltage and current phasors.

5. A single-phase load takes 10 A current from 230 V supply at a power factor of 0.8 lagging. Calculate: (a) Active power, (b) Reactive power, (c) Apparent power

6. A load absorbs 4 kW at a power factor of 0.6 lagging. Find the apparent power and reactive power.

7. A resistor of 20 Ω is connected to 230 V, 50 Hz AC supply. Find the current and power consumed.

8. A pure inductance of 0.2 H and a capacitor of 50 μF is connected to 230 V, 50 Hz supply. Calculate reactance of the circuit and current.

9. An RL series circuit has R = 10 Ω and L = 0.1 H. If supply voltage is 230 V at 50 Hz, find current and power factor.

10. In a series RC circuit, R = 20 Ω and C = 100 μF. Find impedance, current and phase angle.

11. In a parallel RC circuit, R = 40 Ω and C = 100 μF. Find line current and phase angle.

12. A resistor of 40 Ω and an inductor of 0.2 H and capacitor of 120 μF are connected in parallel across 230 V, 50 Hz supply. Find (1) the current of each branch (2) the resultant current (3) Power factor of the circuit

13. A R-C series circuit having Resistance R = 5.77 Ω and reactance X_C = 3.33 Ω is connected across 230 V, 50 Hz ac supply. Find (a) current (b) Power factor (c) Average power.

14. A circuit consumes a power of 1000 W at 0.6 leading power factor, when connected to 200 V, 50 Hz ac supply. Calculate (a) Current (b) Apparent power (c) Reactive power.

15. In a series–parallel circuit, the parallel branches A and B are in series with branch C. The impedances are: ZA=(4+j3) Ω, ZB=(4−j316) Ω, ZC=(2+j8) Ω, If the current IC=(25+j0) Amp, Determine the branch currents and voltages and the total voltage. Hence calculate the complex power for each branch and the whole circuit.

16. Two impedances are connected in parallel across a 100 volt, 50 Hz a.c. supply. Impedance no. 1 has resistance of 8 Ω and capacitive reactance of 7 Ω. While impedance no. 2 has resistance of 5 Ω and inductive reactance of 6 Ω. Calculate: (i) Current through each circuit & p.f. of each circuit. (ii) Total current and p.f. of combined circuit. (iii) Power taken by the whole circuit.

17. A series RLC circuit consists of a resistance of 500 Ω, inductance of 50 mH and a capacitance of 20 pF. Find: (i) The resonant frequency, (ii)The Q factor of the circuit of resonance, (iii) The half power frequency

18. A resistance of 1 Ω and inductance of 0.02 H are connected in series with a capacitor across 200 V supply. Find the value of capacitance, so that current drawn by circuit will be maximum at frequency 50 Hz. Find current and voltage across capacitor.

19. A balanced star connected load of (8 + j6) Ω per phase is connected to a 415 V, 50 Hz, 3-φ supply. Find the line current, power factor, power and total volt-amps.

20. For 3-φ star connected load consists of non-inductive resistance of 50 Ω in parallel with a capacitance of 15 μF. Calculate the line current, power absorbed, total kVA and power factor when connected to 415 V, 3-phase, 50 Hz supply.

21. A 3-φ load consists of three similar inductive coils, having resistance 50 Ω and inductance 0.2 H. If supply voltage is 415 V, 50 Hz, calculate: (i) the line current (ii) power factor (iii) total power consumed when load is connected in star and delta.

22. In balanced 3-φ, 415 V system, line current is 100 A. When power is measured by two wattmeters, one wattmeter indicates power and other indicates zero. What will be power factor of load & measured power? If the power factor were unity and same load current what would be the reading of each wattmeter?

23. For 415 V, three phase system, power was measured by two wattmeters and readings were 10.5 kW and −2.5 kW. Calculate (i) power factor (ii) Line current.

Rubric wise marks obtained:

Criteria	Level of Knowledge and Understanding	Analytical Ability	Quality & Correctness of Write-up, Ethical Practices and Submission	Total
Marks				

Assignment : 3

1. A steel ring has a mean length of 90 cm and cross-sectional area of 7 cm^2. It has an air gap of 1 mm. If μ_r of steel is 1500 and flux required is 1 mWb, calculate the total ampere turns required.
2. A magnetic circuit consists of an iron core and a single air gap of 0.5 mm. If flux density in the air gap is 1.2 Wb/m^2, calculate the MMF required for the air gap alone.
3. A ring with one air gap produces a flux of 0.6 mWb. If the air gap length is doubled, determine the new flux assuming MMF remains constant.
4. The mean periphery of the steel ring is 70 cm and the cross-sectional area is 6 cm^2. Calculate the ampere turns necessary to produce flux of 0.9 mWb. If a saw cut of 3 mm is made in the ring and if the MMF remains constant, calculate the new value of the flux. Take μ_r of steel as 1400.
5. A coil is uniformly wound with 400 turns over a steel ring of relative permeability 750 and having mean diameter of 30 cm. The steel ring is made of a bar having cross-section of diameter 3 cm. If the coil has a resistance of 23 Ω and is connected to 230 V DC, calculate: (i) MMF, (ii) Field intensity, (iii) Reluctance, (iv) Total flux.
6. Find the ampere turns required to produce a flux of 0.6 mWb in the air gap of a magnetic circuit which has an air gap of 0.3 mm. The iron ring has a cross section of 6 cm^2 and 70 cm mean length. Take $\mu_r = 2000$ and leakage coefficient = 1.2
7. A steel ring of 25 cm mean diameter has circular cross-section of 3 cm diameter, has a gap of 1.5 mm length. It is wound uniformly with 700 turns of wire carrying a current of 2 A. Calculate: (a) MMF, (b) Flux density, (c) magnetic flux, (d) Reluctance, (e) μ_r for iron
8. An iron core operates at frequency = 50 Hz, maximum flux density = 1.3 Wb/m^2, Volume = 0.01 m^3, hysteresis coefficient is 0.003 Calculate hysteresis loss.
9. Calculate eddy current loss in a core if: Frequency = 50 Hz, Flux density = 1.2 Wb/m^2, Thickness = 4 mm, Volume = 0.02 m^3.
10. A single-phase transformer has 400 primary turns and 100 secondary turns. If primary voltage is 240 V, calculate: (a) Secondary voltage, (b) Turns ratio
11. A 10 kVA, 230/115 V transformer supplies full load at 0.8 power factor. Calculate: (a) Primary current, (b) Secondary current
12. The iron loss of a transformer is 300W and copper loss at full load is 400W. Calculate efficiency at full load and 0.8 power factor.
13. A transformer delivers 5 kW at 0.9 power factor. If losses are 600 W, determine the efficiency.
14. A transformer has no-load loss of 200 W and full-load copper loss of 300 W. At what load will the transformer have maximum efficiency?
15. A transformer has equivalent resistance of 0.5 Ω and reactance of 1.2 Ω referred to secondary. If rated current is 10 A at 0.8 lagging power factor, calculate voltage regulation.
16. Find the percentage regulation of a transformer supplying a unity power factor load if secondary induced voltage is 220 V and terminal voltage is 210 V.
17. A practical transformer has efficiency of 95% at full load. If output is 4 kW, calculate total losses.
18. Two sinusoidal currents of equal magnitude and frequency but phase displaced by 90° are applied to two stator windings. If the maximum flux produced by each winding is 0.04 Wb, determine the magnitude of the resultant rotating magnetic flux.
19. A two-phase stator produces fluxes $\phi1=0.03\sin\omega t$, $\phi2=0.03\cos\omega t$, Find the value of the resultant flux and comment on its nature.
20. A rotating magnetic field is produced by two stator windings carrying currents of 6 A each and displaced by 90°. If the flux per ampere is 0.005 Wb/A, calculate the maximum value of the resultant flux.
21. In a split-phase motor, the main winding carries a current of 8 A and the auxiliary winding carries 5 A with a phase difference of 30°. Calculate the resultant starting current.
22. A split-phase induction motor has main winding impedance of (6 + j4) Ω and auxiliary winding impedance of (10 + j3) Ω. If the supply voltage is 230 V, calculate: (a) Current in main winding, (b) Current in auxiliary winding, (c) Phase angle between the two currents.
23. A capacitor-start motor uses a capacitor of 150 μF at 50 Hz with a supply of 230 V. Calculate: (a) Capacitive reactance, (b) Capacitor current

24. A capacitor start–capacitor run motor delivers 1.5 kW output at an efficiency of 75%. Calculate the input power and input current at 230 V.
25. A single-phase motor driving a water pump delivers 1.1 kW output with efficiency of 70%. Calculate the input power and current drawn from a 230 V supply.
26. A refrigerator motor draws 2.8 A from a 230 V supply at 0.85 power factor. Calculate the input power.
27. A ceiling fan motor consumes 75 W of power at rated conditions. If efficiency is 65%, calculate the mechanical output power.
28. A BLDC motor operates from a 48 V DC supply and draws 12 A. Calculate the electrical input power.
29. A BLDC motor has efficiency of 88% and electrical input of 900 W. Calculate the mechanical output power.

Rubric wise marks obtained:

Criteria	Level of Knowledge and Understanding	Analytical Ability	Quality & Correctness of Write-up, Ethical Practices and Submission	Total
Marks				