

# **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

Subject code: **EE401ES**

Regulations: R18-JNTUH

Class: II Year B. Tech CE II Sem



DEPARTMENT OF CIVIL ENGINEERING  
BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY  
Ibrahimpattam - 501 510, Hyderabad

## BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (EE401ES)

### B.TECH II Year II Sem

### COURSE PLANNER

#### I. COURSE OVERVIEW:

The main objective of this subject is to understand and to know the following concepts:

- To introduce the basic principles and operation of all electrical and electronics components
- To deal with the measurement of voltage, current, Power factor, power, energy and Magnetic measurements.
- To understand the basics on switches.

#### II. PREREQUISITES:

Level	Credits	Periods/ Week	Prerequisites
UG	3	3	1. Basic Electrical Engineering 2. Intermediate Mathematics. 3. Intermediate physics.

#### III. COURSE OBJECTIVES:

At the end of the course, the students will be able to:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers. • To impart the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors.
- To impart the knowledge of various configurations, characteristics and applications.

#### IV. COURSE OUTCOME:

S.No	Description	Bloom's Taxonomy Level
CO1	<i>Analyze</i> and solve electrical circuits using network laws and theorems	Knowledge, Understand (Level 1, Level 2)
CO2	<i>Analyze</i> basic Electric and Magnetic circuits	Knowledge, Understand (Level 1, Level 2)
CO3	<i>Study</i> the working principles of Electrical Machines	Apply (Level 3)

CO4	<i>Understand</i> characterize diodes and various types of transistors	Understand, Apply (Level2, Level 3)
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#### V.HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (PO)		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems related to Electrical and Electronics Engineering.	2	<b>Lectures, Mock tests</b>
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems related Electrical and Electronics Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1.5	<b>Assignments and Mock tests</b>
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems related to Electrical and Electronics Engineering 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.	2	<b>Case studies</b>
PO4	<b>Conduct investigations of complex problems:</b> 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.	-	
PO5	<b>Modern tool usage:</b> 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.	1.25	<b>Assignments and Mock tests</b>
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Electrical and Electronics Engineering professional engineering practice.	-	
PO7	<b>Environment and sustainability:</b> Understand the impact		--

	of the Electrical Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.		
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.		--
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.		--
PO10	<b>Communication:</b> 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.		--
PO11	<b>Project management and finance:</b> 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.	1.25	<b>Assignments</b>
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	<b>Assignments</b>

**1: Slight (Low)    2: Moderate (Medium)    3: Substantial (High)    -: None**

**VI.HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:**

Program Specific Outcomes (PSO)		Level	Proficiency assessed by
PSO1	<b>Talented to Analyze, Design and implement electrical &amp; electronics systems and deal with the rapid pace of industrial innovations and developments</b>	1.75	Assignments, Mock tests
PSO2	<b>Skillful to use application and control techniques for research and advanced studies in Electrical &amp; Electronics Engineering domain</b>	-	-

**1: Slight (Low)    2: Moderate (Medium)    3: Substantial (High)    -: None**

## VII. SYLLABUS:

### JNTUH SYLLABUS

**UNIT - I: D.C. CIRCUITS** Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation. **A.C. CIRCUITS**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits, Three-phase balanced circuits, voltage and current relations in star and delta connections.

**UNIT - II: ELECTRICAL INSTALLATIONS** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

**UNIT - III: ELECTRICAL MACHINES** Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

**UNIT - IV: P-N JUNCTION AND ZENER DIODE:** Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

**RECTIFIERS AND FILTERS:** P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters,  $\pi$ - section Filters.

**UNIT - V: BIPOLAR JUNCTION TRANSISTOR (BJT):** Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations. **FIELD EFFECT**

**TRANSISTOR (FET):** Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

## **SUGGESTED BOOKS:**

### **TEXT BOOKS:**

1. ““M S Sukija , TK Nagasarkar”, “Basic Electrical and electronics Engineering”, Oxford University.
2. “-D P Kothari. I J Nagarath”, “Electrical Basic Electrical and electronics Engineering”, BS McGraw Hill Education.

### **REFERENCE BOOKS:**

3. “– R. L. Boylestad and Louis Nashelsky”, “Electronic Devices and Circuits”, PEI/PHI, 9th Ed, 2006.
4. “J. Millman and C. C. Halkias”, “Millman’s Electronic Devices and Circuits”, TMH, 2/e, 1998.
5. “William Hayt and Jack E. Kemmerly”, “Engineering circuit analysis”, McGraw Hill Company, 6th edition.
6. “N. C. Jagan& C. Lakshminarayana,”, “Network Theory”, B.S. Publications..
7. “Sudhakar, Shyam Mohan Palli”, “Network Theory”, TMH.

## **VIII.COURSE PLAN (WEEK-WISE):**

<b>Session</b>	<b>Week</b>	<b>Topic</b>	<b>Course Learning Outcomes</b>	<b>Teaching Methodologies</b>	<b>Reference</b>
		<b>UNIT-1</b>			
1.	1	Introduction		chalk & talk	T1,T2
2.		Electrical circuit elements (R, L and C)	Understand	PPT	
3.		voltage and current sources	Understand	chalk & talk	
4.		KVL&KCL	Understand and analyse	chalk & talk	

5.	2	analysis of simple circuits with dc excitation	Derive the expression	chalk & talk	
6.		Representation of sinusoidal waveforms	Understand and derive	chalk & talk	
7.		peak and rms values, phasor representation	Derive the expression	chalk & talk	
8.		real power, reactive power, apparent power, power factor	Derive the expression	chalk & talk	
9.	3	Analysis of single-phase ac circuits, Three-phase balanced circuits	Analysis	chalk & talk	
10.		voltage and current relations in star and delta connections	Derive the expression	chalk & talk	
11.		<b>Topics beyond Syllabus: Electronic Multimeter</b>		chalk & talk	
12.		<b>Mock Test – I</b>			
		<b>UNIT-2</b>			
13.	4	Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB	Know and understand	chalk & talk	T1,T2
14.		Types of Wires and Cables, Earthing	Understand	chalk & talk	
15.		Types of Batteries, Important Characteristics for Batteries	Evaluate the variables	chalk & talk	
16.		A.C Potentiometers: polar and coordinate type	Distinguish the types	chalk & talk	
	5	<b>Tutorial / Bridge Class # 1</b>			

17.		Elementary calculations for energy consumption	Understand and evaluate	chalk & talk	
18.		power factor improvement and battery backup	Understand and differentiate	chalk & talk	
		<b>Tutorial / Bridge Class # 2</b>			
20.	6	Numerical Problems	Evaluate the problem	chalk & talk	
21.		Numerical Problems	Evaluate the problem	chalk & talk	
22.		Revision of 1 & 2 units		chalk & talk	
23.		Revision of 1 & 2 units		chalk & talk	
		<b>Tutorial / Bridge Class # 3</b>			
		<b>UNIT-3</b>			
24.	7	Working principle of Single-phase transformer, equivalent circuit	Understand	chalk & talk	T1,T2,R1
25.		losses in transformers, efficiency, Three-phase transformer connections	Understand and evaluate	chalk & talk	
26.		Construction and working principle of DC generators	Understand and evaluate	chalk & talk	
27.		EMF equation and numerical problems	Derive the expression	chalk & talk	
		<b>Tutorial / Bridge Class # 4</b>			
28.	8	working principle of DC motors,	Understand	chalk & talk	



29.		Torque equations and Speed control of DC motors	Derive the expression	chalk & talk	
30.		Construction and working principle of Three-phase Induction motor	Understand and evaluate	chalk & talk	
31.		Torques equations and Speed control of Three-phase induction motor	Derive the expression	PPT	
	9	Construction and working principle of synchronous generators	Understand	chalk & talk	
		<b>Tutorial / Bridge Class # 5</b>			
<b>I Mid Examinations</b>					
		<b>UNIT-4</b>			
36.	10	Principle of Operation Diode equation	Know and understand	chalk & talk	T1,T2,R2
37.		Volt-Ampere characteristics, Temperature dependence	Know and understand	chalk & talk	
38.	10	Ideal versus practical, Static and dynamic resistances	Know and understand	chalk & talk	
39.		Equivalent circuit, Zener diode characteristics and applications	Understand and evaluate	chalk & talk	
		<b>Tutorial / Bridge Class # 6</b>			
40.		P-N junction as a rectifier - Half Wave Rectifier	Understand and evaluate	chalk & talk	
41.	11	Ripple Factor - Full Wave Rectifier, Bridge Rectifier	Understand and evaluate	chalk & talk	

42.		Harmonic components in Rectifier Circuits	Understand and evaluate	chalk & talk	
43.		Filters – Inductor Filters, Capacitor Filters, L- section Filters, $\pi$ - section Filters	Understand and evaluate	chalk & talk	
		Problems	Evaluate	chalk & talk	
47.	12	Problems	Evaluate	chalk & talk	
		problems	Evaluate	chalk & talk	
		Revision of 3 and 4 units			
		<b>Mock Test – II</b>			
		<b>UNIT-5</b>			
48.	13	Construction, Principle of Operation of BJT	Know and understand	chalk & talk	
49.		Amplifying Action, Common Emitter	Know and understand	chalk & talk	
50.		Amplifying Action, Common Base	Understand and evaluate	chalk & talk	
51.		Amplifying Action, Common Source	Know and understand	chalk & talk	T1,T2,R2
52.	14	Comparison of CE, CB and CC configurations	Understand and evaluate	chalk & talk	
53.		Construction, Principle of Operation of FET	Know and understand	chalk & talk	
54.		Comparison of BJT and FET, Biasing FET	Know and understand	chalk & talk	

55.		problems		chalk & talk	
		Review			
<b>II Mid Examinations</b>					

**IX.MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OFPROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

Course Objectives	Program Outcomes (PO)												Program Specific Outcomes (PSO)		
	P O1	P O2	PO 3	P O4	P O5	PO 6	P O7	P O8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3
<b>I</b>	2	2	2	-	1	--	--	--	--	--	2	1	1	-	-
<b>II</b>	2	2	2	-	2	--	-	--	--	--	1	1	2	-	-
<b>III</b>	2	1	3	-	1	--	-	--	--	--	1	1	2	-	-
<b>IV</b>	2	1	1	-	1	--	-	--	--	--	1	1	2	-	-
<b>AV G</b>	2	1.5	2	-	1.25	-	-	-	-	-	1.25	1	1.75	-	-

**1: Slight (Low)**

**2: Moderate (Medium)**

**3: Substantial (High)**

**- : None**

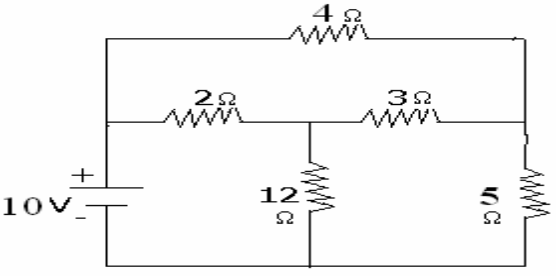
**X.QUESTION BANK (JNTUH):**

**UNIT I**

**Short Answer Questions**

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain about Resistor, Inductor and Capacitor	Understand	2
2	Explain voltage and current source and draw characteristics	Understand	1
3	Explain about KVL and KCL?	Knowledge	2
4	Define peak and rms value?	knowledge	2
5	Name different types of powers?	Knowledge	2

### Long Answer Questions

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain about linear elements with necessary equations?	Knowledge	2
2	Nam different types of electrical sources and explain with necessary graphs?	Understand	2
3	Find the voltages at the nodes for the below figure	Understand	1
4	Find the Loop currents for the circuit shown below. 	Understand	2
5	Find current in each branch for the circuit in question number 4?	Understand	2
6	Find power dissipation across every resistor for the circuit in question number 4	Understand	3
7	Derive average and rms value of sinusoidal voltage waveform?	Understand	1
8	Draw 3 phase power source with wave form having $120^\circ$ phase shift and also indicate voltage equations in sinusoidal quantities?	Knowledge	1

9	Convert voltage and current relations from star to delta connections and delta to star?	Understand	2
10	For the circuit diagram belongs to question number 4 minimize using start to delta conversation?	Understand	1

### UNIT II

#### Short Answer Questions

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain the causes and effects of low power factor?	Understand	2
2	Define MCB	Knowledge	2
3	Define MCCB	Understand	2
4	Define ELCB	Knowledge	2
5	What are different types of cables?	Understand	2

#### Long Answer Questions

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain various types of batteries along with their characteristics?	Understand	2
2	Explain the following devices SFU, MCB, ELCB & MCCB	Understand	2
3	Compare & explain different types of wires and cables.	Understand	2
4	Explain earthing and its importance.	Understand	2

### UNIT III

#### Short Answer Questions

S.No	Question	Blooms Taxonomy	Course Outcome
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		<b>Level</b>	
1	What is the principle of operation Transformer?	Understand	2
2	Write the types of losses in transformer?	Understand	2
3	What is the principle of operation of DC generator?	Apply	3
4	What is the principle of operation of DC motor?	Understand	2

### Long Answer Questions

<b>S.No</b>	<b>Question</b>	<b>Blooms Taxonomy Level</b>	<b>Course Outcome</b>
1.	Explain about working principal of single phase transformer with equivalent circuit diagram.	Understand	3
2.	Derive the emf equation of single phase transformer.	Apply	3
3.	Explain in detail about losses in transformer	Understand	3
4.	Construction and working principle of DC generators	Understand	2
5.	Derive emf equation of DC generators.	Understand	2
6.	working principle of DC motors and also derive Torque equations	Apply	3
7.	Explain about Speed control of DC motors	Understand	2
8.	Construction and working principle of Three-phase Induction motor	Understand	3
9.	Torques equations and Speed control of Three-phase induction motor	Understand	2
10.	Construction and working principle of synchronous generators	Understand	2

## UNIT IV

### Short Answer Questions

<b>S.No</b>	<b>Question</b>	<b>Blooms Taxonomy</b>	<b>Course</b>
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		<b>Level</b>	<b>Outcome</b>
1	List different types of switches?	Understand	2
2	Difference between PN and Zeenar diode?	Understand	2
3	What is rectifier?	Apply	3
4	Difference between half and full wave rectifier?	Understand	2
5	List types of filters?	Understand	2

### **Long Answer Questions**

<b>S.No</b>	<b>Question</b>	<b>Blooms Taxonomy Level</b>	<b>Course Outcome</b>
1	Explain about Principle of Operation Diode equation.	Understand	2
2	Draw the Volt-Ampere characteristics of PN junction diode.	Understand	2
3	Explain about Temperature dependence, Ideal versus practical of diode.	Understand	2
4	Explain about Static and dynamic resistances?.	Apply	3
5	Draw Zener diode characteristics and mention some applications?	Understand	2
6	Explain about how P-N junction diode used as a rectifier.	Understand	2
7	Draw the circuit diagram of Half Wave Rectifier with necessary derivation and also find Ripple Factor	Understand	2
8	Draw the circuit diagram of Full Wave Rectifier with necessary derivation	Understand	2
9	Draw Bridge Rectifier with necessary derivation?	Understand	2
10	Explain about Harmonic components in Rectifier Circuits and also explain about different types of filters	Apply	3

## **UNIT V**

### **Short Answer Questions**

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Difference between BJT and MOSFET.	Understand	2
2	What is CS configuration	Understand	2
3	What is CE configuration	Apply	3

### Long Answer Questions

S.No	Question	Blooms Taxonomy Level	Course Outcome
1	Construction and Principle of Operation of BJT?	Understand	2
2	Explain how BJT acts like Amplifying Action.	Understand	2
3	Draw circuit diagram of Common Emitter, Common Base configurations with necessary derivations.	Apply	3
4	Draw circuit diagram of Common Collector configurations with necessary derivations.	Apply	3
5	Comparison of CE, CB and CC configurations.	Understand	2
6	Explain about Construction, Principle of Operation of FET?	Apply	3

### OBJECTIVE QUESTIONS:

#### UNIT-1

- \_\_\_\_\_ elements are capable of delivering power to some external device.  
A) Active B) Passive C) Inductor D) Resistor
- The unit of Inductance is \_\_\_\_\_.  
(A) Ohms (B) Henry (C) Farads (D) Watts
- \_\_\_\_\_ law states that the sum of the currents entering into any node is equal to the sum of the currents leaving that node.  
(A) Kirchhoff's Voltage (B) Faradays (C) Kirchhoff's Current (D) Electromagnetic
- The flow of electric current in a conductor is due to flow of \_\_\_\_\_.  
(A) Electrons (B) protons (C) electrons & ions (D) charged particles
- The unit of capacitance is \_\_\_\_\_.



- 6) \_\_\_\_\_ law states that the algebraic sum of all branch voltages around any closed path in a circuit is always zero at all instants of time.
7. A sine wave has a frequency of 50 Hz. Its angular frequency is \_\_\_\_\_ radians per second.
8. The standard supply frequency in India is \_\_\_\_\_.
9. The form factor is the ratio of \_\_\_\_\_.
10. The Inductor behavior at steady state condition is \_\_\_\_\_.

### UNIT 2 :

1. Which of the following insulation is used in cables?  
A) Varnished Cambric B) Rubber C) Paper D) Any of the Above
2. In case of three core flexible cable the colour of the neutral is \_\_\_\_\_  
A) Blue B) Black C) Brown D) None of the Above
3. Low tension cables are generally used upto  
A) 200V B) 500V C) 700V D) 1000V
- 4) What is the amount of charcoal and salt needed for GI Pipe earthing \_\_\_\_\_  
a) Charcoal 5kg, salt 8kg b) charcoal 10kg, salt 8kg c) charcoal 10kg, salt 10kg d) charcoal 5kg, salt 5kg

### UNIT-3

- 1) A transformer core is laminated to reduce \_\_\_\_\_ losses.  
A) Hysteresis B) Eddy current C) copper D) Windage
- 2) The no-load current drawn by transformer is usually \_\_\_\_\_ percent of the full load current.  
A) 0.2 to 0.5 B) 2 to 5 C) 12 to 15 D) 20 to 30
- 3) Open circuit test on transformers is conducted to determine \_\_\_\_\_ losses.  
A) Hysteresis B) copper C) core D) Eddy current
- 4) The path of a magnetic flux in a transformer should have \_\_\_\_\_ reluctance.
- 5) \_\_\_\_\_ material is used for the construction of transformer core.
- 6) A 4-pole, 440v induction motor is running at a slip of 4%. The speed of the motor is \_\_\_\_\_.

7) Short circuit test on transformers is conducted to determine \_\_\_\_\_ losses.

8) In a Transformer Core is laminated to reduce\_\_\_\_\_

#### UNIT -4

1. A crystal diode has .....

1. one pn junction
2. two pn junctions
3. three pn junctions
4. none of the above

Answer : 1

2. A crystal diode has forward resistance of the order of .....

1.  $k\Omega$
2.  $\Omega$
3.  $M\Omega$
4. none of the above

Answer : 2

3. If the arrow of crystal diode symbol is positive w.r.t. bar, then diode is ..... biased.

1. forward
2. reverse
3. either forward or reverse
4. none of the above

Answer : 1

4. The reverse current in a diode is of the order of .....

1. kA
2. mA
3.  $\mu A$
4. A

Answer : 3

5. The forward voltage drop across a silicon diode is about .....

1. 2.5 V
2. 3 V
3. 10 V
4. 0.7 V

Answer : 4

6. A crystal diode is used as .....

1. an amplifier
2. a rectifier
3. an oscillator
4. a voltage regulator

Answer : 2

7. The d.c. resistance of a crystal diode is ..... its a.c. resistance

1. the same as
2. more than
3. less than
4. none of the above

Answer : 3

8. An ideal crystal diode is one which behaves as a perfect ..... when forward biased.

1. conductor
2. insulator
3. resistance material
4. none of the above

Answer : 1

9. The ratio of reverse resistance and forward resistance of a germanium crystal diode is about

.....

1. 1 : 1
2. 100 : 1
3. 1000 : 1
4. 40,000 : 1

Answer : 4

10. The leakage current in a crystal diode is due to .....

1. minority carriers
2. majority carriers
3. junction capacitance
4. none of the above

Answer : 1

## UNIT -5

1. A transistor has .....

1. one pn junction
2. two pn junctions
3. three pn junctions
4. four pn junctions

Answer : 2

2. The number of depletion layers in a transistor is .....

1. four
2. three
3. one
4. two

Answer : 4

3. The base of a transistor is ..... doped

1. heavily
2. moderately
3. lightly
4. none of the above

Answer : 3

4. The element that has the biggest size in a transistor is .....

1. collector
2. base
3. emitter
4. collector-base-junction

Answer : 1

5. In a pnp transistor, the current carriers are .....

1. acceptor ions
2. donor ions
3. free electrons
4. holes

Answer : 4

6. The collector of a transistor is ..... doped

1. heavily
2. moderately
3. lightly
4. none of the above

Answer : 2

7. A transistor is a ..... operated device

1. current
2. voltage
3. both voltage and current
4. none of the above

Answer : 1

8. In a npn transistor, ..... are the minority carriers

1. free electrons
2. holes
3. donor ions
4. acceptor ions

Answer : 2

9. The emitter of a transistor is ..... doped

1. lightly
2. heavily
3. moderately
4. none of the above

Answer : 2

10. In a transistor, the base current is about ..... of emitter current

1. 25%
2. 20%
3. 35 %
4. 5%

#### **XI.WEBSITES:**

1. [www.ni.com](http://www.ni.com)
2. [www.rohde-schwarz.com/Test&Measurement](http://www.rohde-schwarz.com/Test&Measurement)
3. <http://iee-ims.org/publications/transactions-tim>
4. <http://www.hpindia.com>
5. [www.isa.org](http://www.isa.org)

#### **XII.JOURNALS:**

1. [www.ieee.org](http://www.ieee.org)
2. [www.worldscientific.com](http://www.worldscientific.com)
3. [www.springer.com](http://www.springer.com)
4. [www.sciencedirect.com](http://www.sciencedirect.com)

#### **XIII.LIST OF TOPICS FOR STUDENT SEMINARS:**

1. Analysis of single-phase ac circuits
2. voltage and current relations in star and delta connections
3. Static and dynamic resistances
4. Comparison of BJT and

#### **XIV.CASE STUDIES/SMALL PROJECTS**

1. Zener diode characteristics and applications.
2. Harmonic components in Rectifier Circuits.