GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

AC CIRCUITS
(Code: 3330901)

Diploma Programme in which this course is offered	**Semester in which offered**
Electrical Engineering	3rd semester

1. RATIONALE

Most of electrical power generation, transmission, distribution and utilization are in the form of alternating current. Therefore it is essential for every electrical engineer to know the behaviour of resistance, capacitance, inductance and related concepts in AC systems.

This course is not only a prerequisite to learn the advanced electrical courses and develop the skills but also enable the students to apply the principle of ac circuits to troubleshoot electrical circuits in industries/Power System. This is one of the most important core engineering courses for electrical engineers and hence students should try to develop mastery over concepts of AC circuits for effective working as an electrical engineer.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency:

- **Apply the principles of AC circuits to maintain electrical systems**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**	**Examination Scheme**				
				Theory Marks		**Practical Marks**		**Total Marks**
L	**T**	**P**	**C**	**ESE**	**PA**	**ESE**	**PA**	
03	02	02	7	70	30	20	30	**150**

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I AC Fundamentals	1a. Explain generation of alternating EMF. 1b. Define various electrical parameters 1c. Derive equation for RMS and average value of sinusoidal wave.	1.1 Principle of generating an alternating voltage 1.2 Cycle, Time period, Frequency, Amplitude, Phase and Phase difference, Average value, R.M.S. value, Form factor, Peak Factor and Power Factor
	1d. Explain the vector representation and mathematical operations of alternating vector quantities 1e. Solve numerical based on AC fundamentals	1.3 Vector representation of alternating quantities, addition, subtraction, multiplication and division
Unit – II AC Series circuits	2a. Explain the behaviour of AC voltage, current and power through pure resistance, pure inductance and pure capacitance with sketches	2.1 Waveforms, phasor diagram and expression of voltage, current and power in pure: Resistance, Inductance, Capacitance
	2b. Explain behaviour of AC voltage, current and power through RL, RC and RLC series circuit with sketches	2.2 AC through RL, RC, LC, RLC series circuit
	2c. Explain resonance in RLC series circuit with sketches 2d. Solve numerical based on AC series circuits and series resonance.	2.3 Resonant frequency and Resonance condition in RLC series circuit
Unit – III AC Parallel Circuits	3a. Explain behaviour of AC voltage, current and power through RL, RC and RLC parallel circuit.	3.1 Solution of AC RL, RC, LC and RLC parallel circuits using phasor method. 3.2 Solution of AC RL, RC, LC and RLC parallel circuits using admittance method.
	3b. Explain resonance in RLC parallel circuit.	3.3 Resonant frequency and resonance condition in parallel AC circuits
	3c. Solve numerical based on AC parallel circuit and parallel resonance	3.4 Numerical based on AC parallel circuits and parallel resonance.
Unit – IV Poly phase circuits	4a. Explain generation of three phase alternating voltage. 4b. Differentiate between single and three phase circuits. 4c. Distinguish between line and phase voltage, line and phase currents in 3-phase AC circuits 4d. Describe the star and delta connection with phasor diagrams	4.1 Principle of generation of three phase alternating voltage. 4.2 Line and phase voltage, line and phase current 4.3 Single and three phase circuits 4.4 Three-phase star connection 4.5 Three phase delta connection

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – V Power in AC Circuits	5a. Explain the concept of active power, reactive power and power factor with power triangle 5b. Explain the concept of lag and lead	5.1 Active, reactive and apparent power with examples. 5.2 Lagging, leading power and unity power factor
	5c. Illustrate the effects of power factor	5.3 Effects of poor power factor.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	AC Fundamentals	10	06	06	04	16
II	AC Series circuits	10	06	06	06	18
III	AC Parallel circuits	08	04	05	05	14
IV	Poly phase circuits	08	05	05	04	14
V	Power in AC Circuits	06	04	02	02	08
Total		**42**	**25**	**24**	**21**	**70**

Legends: R = Remember; U = Explain; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Apprx. Hrs. Required
1.	I	Use CRO to measure peak value, RMS value, Period and frequency of alternating quantity.	2
2.	II	Measure of inductance and resistance of choke coil and also the active power through resistor	2
3.	II	Measure voltage, current, power and power factor in a series RL circuit with relevant phasor diagram.	2
4.	II	Measure voltage, current, power and power factor in a series RC circuit with relevant phasor diagram.	2
5.	II	Measure voltage, current, power and power factor in a series RLC circuit with relevant phasor diagram.	2
6.	II	Measure voltage, current, power and power factor in a RL parallel circuit with relevant phasor diagram.	2

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Apprx. Hrs. Required
7.	III	Measure voltage, current, power and power factor in a RC parallel circuit with relevant phasor diagram.	2
8.	III	Measure voltage, current, power and power factor in a RLC parallel circuit with relevant phasor diagram.	2
9.	III	Measure voltage, current, power and power factor for combined series-parallel circuits	2
10.	III	Identify of electrical components (R, L, C) using high frequency generator.	4
11.	III	Measure resonance frequency and resonant impedance in RLC series circuit.	2
12.	IV	Test voltage and current relation for 3 phase star and delta connections.	2
13.	V	Measure active and reactive power of three phase circuits.	2
		Total	**30**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Preparing journals based on experiments performed in laboratory
ii. Assignments for solving numerical

8. SPECIAL INSTRUCTION STRATEGY (If ANY)

i. Students should be shown animations/video films to explain the principle of ac wave form and ac circuits
ii. Tutorial hours should be used to develop the ability in students to solve the numerical problems related to ac wave form and circuits. It is must because only by solving the numerical they would develop the understanding of the ac wave form and circuits. Students must be classified in three groups i.e. academically weak students, average students and good students and they should be given problem according to their abilities in each unit. This would provide them a challenge which they can face without indulging in unfair means.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1	Electrical Technology Vol-1	Theraja, B. L.	S. Chand, New Delhi, 2011 or latest
2	Principles of Electrical Engineering	Gupta, B. R.	S. K. Kataria & Sons, New Delhi, 2011 or latest
3	Basic Electrical Engineering	Rao, Uma. K.	Pearson Education, New Delhi, 2011 or latest
4	Basic Electrical Engineering	Murthy, R. S.	Pearson Education, New Delhi, 2011 or latest
5	Fundamentals of Electrical Engineering	Singh, Tarlok	S. K. Kataria & Sons, New Delhi, 2011
6	Basic Electrical and Electronics Engineering	Singh, Ravish. R.	Tata Mc Graw Hill Education Pvt.Ltd., New Delhi, 2011.

B) List of Major Equipment/Materials with Broad Specifications

i. Ammeter: 0A-1A/0A-5A/0A-10A
ii. Voltmeter: 0V-50V/0V-150V/0V-300V/0V-500V
iii. Wattmeter: 0-1000W(5A/10A,300V/600V)
iv. Multimeter: $5^{1/2}$ digits resolutions with all basics measurement facility like DC Voltage: 200 mV ~ 1000 V, DC Current: 200 µA ~ 10 A, AC Voltage: True-RMS, 200 mV ~ 750 V, AC Current: True-RMS, 20 mA ~ 10 A, 2-Wire, 4-Wire Resistance: 200 Ω ~ 100 MΩ, Capacitance Measurement: 2 nF ~ 10000µF, Frequency Measurement: 20 Hz ~ 1 MHz etc., 0.015% DC Voltage Accuracy.
v. CRO: 30 MHz Bandwidth, 2 channel, 20 ns sampling time
vi. Function generator: 10 HZ to 10MHZ , 10 Vpp , rise & fall time =20ns, manual / external triggering
vii. RF ammeter:
viii. Choke coil: 0- 80 mH, variable choke coil
ix. Single phase variac : 0-300V/ 1KVA

C) List of Software/Learning Websites

i. Electronic Work bench or Circuit maker
ii. www. kpsec.freeuk.com
iii. www.howstuffworks.com/

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. R.L. Patel**, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Jamnagar
- **Prof. M. J. Aghara**, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Rajkot
- **Prof. A.A. Amin**, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Vadnagar
- **Prof.(Mrs) V.R. Kotdawala**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Himmatnagar.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Joshua Earnest**, Professor, Department of Electrical Engineering
- **Dr. (Mrs.) C.S. Rajeshwari**, Professor & Head Department of Electrical Engineering

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

D C MACHINES AND TRANSFORMERS
(Code: 3330902)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	3rd semester

1. RATIONALE

This course deals with single phase transformer and DC Machines which are widely used in power systems, industries and commercial applications. This course will enable the students to develop skills to select, install, operate, and maintain various types of DC machines and transformers. Practical aspects of the course will make the students capable of performing various tests on these machines. It is therefore very important for every electrical engineer to learn this course if he/she wants to excel in his/her professional life.

2. COMPETENCY (Programme Outcome according to NBA Terminology)

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain various types of DC machines and single phase transformers safely.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
04	00	04	08	70	30	40	60	**200**

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Energy Conversion Principles	1a. Explain law of conservation of energy and role of electrical energy	1.1 Law of conservation of energy 1.2 Role of electrical energy and uses
	1b. State the conditions for EMF production 1c. Differentiate between singly and doubly excited electrical machines	1.3 Electro-mechanical energy conversion principle and EMF 1.4 Singly excited and doubly excited electrical machines.
Unit – II DC Generators	2a. Describe function of different parts of DC machine with sketches. 2b. Derive emf equation of DC generator 2c. Explain the working DC Generator. 2d. Different types of armature winding.	2.1 Construction and materials used for various parts of DC generator. 2.2 Functions of various parts of DC generator. 2.3 EMF equation of DC generator 2.4 Working principle of DC generator 2.5 Simplex lap and wave winding.
	2e. Classify different types of DC generator with sketches 2f. Describe performance characteristic of different types of DC Generators 2g. Calculate losses and efficiency. 2h. Explain armature reaction and commutation 2i. Given the data diagnose the problems of DC generators	2.6 Different types of DC generators 2.7 Characteristics of various types DC generators. 2.8 Efficiency and losses of DC generator. 2.9 Armature reaction and its effects and commutation
Unit – III DC Motors	3a. Explain working of DC motor 3b. Derive torque equation of DC motor 3c. Justify the need of DC motor starter 3d. Explain working of DC motor starter	3.1 Working principle of DC motor, back emf. 3.2 Torque equation for DC motor. 3.3 Need DC motor starters 3.4 Construction and working of DC motor starters
	3e. Classify different types of DC motors 3f. Compare performance of different types of DC motors 3g. Explain the speed control of DC motor	3.5 Series, Shunt and Compound DC motors 3.6 Performance characteristics of DC Series, Shunt and Compound motor. 3.7 Speed control of D.C. motor
	3h. Calculate the losses and efficiency 3i. State the need of Brake test, Swinburne's test and field test. 3j. List the applications of various types of DC motors 3k. Given the data diagnose the problems of DC machines	3.8 Losses in DC motors and its computation 3.9 Brake test, Swinburne's test, field test. 3.10 Applications of DC Series, Shunt and compound motor.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – IV Single Phase Transformers	4a. Explain the working of a single phase transformer with sketches 4b. Derive EMF equation of transformer and transformation ratio 4c. Differentiate between core and shell type transformer with sketches. 4d. State the materials used for the different parts of the transformer	4.1 Single phase transformer: Working principle, construction, materials used for different parts 4.2 EMF equation and transformation ratio. 4.3 Core and shell type of transformers.
	4e. Explain the performance of the transformer on no load, resistive, inductive and capacitive loads with phasor diagrams 4f. Explain various losses in transformer. 4g. Derive expression for efficiency and the condition for maximum efficiency of a single phase transformer	4.4 Phasor diagram for load and different types of loads 4.5 Losses in transformer: Iron loss, Copper loss, Hysteresis loss and eddy current loss 4.6 Efficiency Condition for maximum efficiency of single phase transformer.
	4h. Describe the significance of voltage regulation 4i. Explain the various parameters for the transformer equivalent circuit 4j. Solve numerical problems with respect to the performance and maintenance of single phase transformer.	4.7 Voltage regulation 4.8 Equivalent circuit of single phase transformer.
Unit – V Testing of Single Phase Transformers	5a. State the need for conducting different types of tests on single phase transformers. 5b. State the steps for conducting the OC and SC tests of the single phase transformer	5.1 Direct load test, OC and SC test and Sumpner Test along with connection diagrams, efficiency and regulation of transformer 5.2 Derivation of equivalent circuit and its related parameters
	5c. Describe the need and conditions for parallel operation of transformers 5d. Solve numerical on various tests of single phase transformers	5.3 Need of parallel operation, essential and desirable conditions for parallel operation. 5.4 Parallel operation and load sharing of single phase transformer
	5e. Describe working of an autotransformer with sketches. 5f. Distinguish between autotransformer and welding transformer	5.5 Construction and working of autotransformer; welding transformer

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Energy Conversion Principles	04	02	02	00	04
II	DC Generators	14	06	06	06	18
III	DC Motors	14	06	06	06	18
IV	Single Phase Transformers	16	06	08	06	20
V	Testing of Single Phase Transformers	08	02	04	04	10
Total		**56**	**22**	**26**	**22**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1	II	Identify various parts of DC machine	01
2	IV	Identify various parts of single phase transformer	01
3	II	Test the performance of DC compound machine	01
4	II	Maintain constant voltage of DC generator at different load conditions.	04
5	II	Test the performance of a separately excited DC shunt generator	04
6	II	Test the performance of DC series generator	04
7	II	Test DC compound generator for external and internal load characteristic.	04
8	III	Connect three point and four point starters for DC motor.	02
9	III	Control the speed of DC shunt motor by armature and field control.	04
10	III	Control the speed of DC series motor.	04
11	III	Perform Swinburne's test of DC machine.	04
12	V	Perform Load test on single phase transformer.	04
13	V	Perform OC and SC test of single phase transformer.	04
14	V	Perform polarity test on single phase transformer.	04
15	V	Operate two single phase transformers in parallel having i) Equal impedances ii) Different impedances.	04
16	V	Perform Sumpner's test on single phase transformer.	04
17	II	Troubleshoot DC shunt generator/motor	02
18	II	Troubleshoot DC series generator/motor	02
19	II	Troubleshoot DC compound machine	02

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
20	IV, V	Troubleshoot single phase transformers	02
		Total	**65**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities:

i. Prepare journals based on practical performed in laboratory.
ii. Assignments on solving numerical
iii. Identify different types of dc machine based on their winding arrangement
iv. Identify different types of transformer based on application
v. Prepare chart displaying the various parts of dc machine
vi. Prepare chart displaying the various parts of transformer
vii. Prepare chart displaying the various parts of a three and four point dc motor starter

8. SPECIAL INSTRUCTIONAL STRETAGIES (If Any):

i. Students should be shown in animations/video films to explain the working concept of DC machines and transformers based on the principle of electromagnetic induction
ii. Students should be taken to nearby industries/substation where medium or big size DC Machines/Transformers are installed. Students should be shown major parts/accessories and their features and functions should be explained to them.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1.	Electrical Technology Vol-II	Theraja, B.L.	S. Chand, New Delhi, 2011 or latest
2.	Electrical Machines	Despande, M.V.	PHI Learning,, New Delhi, 2011 or latest
3.	Electrical Technology	Uppal, S.L.	Khanna Publication, New Delhi, 2011 or latest
4.	Electrical Machine	Nagrath, I.J. and Kothari, D.P.	Tata McGraw Hill, New Delhi, 2011 or latest
5.	Electrical Machine-I	Gupta, J. B.	S. K. Kataria & Sons, New Delhi, 2011 or latest

B) List of Major Equipment/Materials with Broad Specifications

i. DC shunt, series and compound motor – 230 V DC , 19 A, 1000 RPM, 5HP
ii. DC shunt motor-generator set – 230 V DC, 16 A, 1000 RPM, 5 HP
iii. Single phase transformer – 230 V / 115 V, 1 kVA 1-phase transformer
iv. Auto transformer : 0 – 230 V, 10 Amp
v. Welding transformer: 50 V, 50 /100 Amp

C) List of Software/Learning Websites

i. www.nptel.com/iitm/
ii. www.howstuffworks.com/
iii. www.vlab.com

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- **Prof. A. P. Shah**, Lecturer, Electrical Engineering Department, B. & B. Institute of Technology, V.V.Nagar
- **Prof. V. C. Jagani**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Junagadh.
- **Prof. K. V. Dave**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Rajkot

Coordinator and Faculty Members from NITTTR Bhopal

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- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

ELECTRICAL INSTRUMENTATION
(Code: 3330903)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	3rd semester

1. RATIONALE

Precise measurement of the quantities such as voltage, current, power, temperature, pressure etc. is essential to operate and maintain the electrical machines and systems effectively and efficiently. Transducers and instruments are the devices which are used to measure such parameters. The electrical diploma engineer should therefore be competent to use, calibrate and maintain different types of electrical instrumentation systems and transducers used in the industry and power systems. This demands a better understanding of the construction, material used and principle of operation of various types of measuring instruments. This course is therefore designed to meet these needs and hence it is a core course for any electrical engineer.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency

- **Maintain different types of electrical instrumentation systems and transducers.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
04	00	02	06	70	30	20	30	150

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Fundamentals of measurement & instrumentation	1a. Differentiate between direct and indirect measurement 1b. Discriminate between Indicating, integrating and recording, absolute and secondary instrument 1c. Differentiate between deflecting, controlling and damping torques	1.1 Methods of measurement -Direct and indirect methods 1.2 Types of Instruments - Indicating, integrating and recording, absolute and secondary instrument 1.3 Deflecting, Controlling and damping torques
	1a. Explain different terms related to measurement	1.4 Range, true value, indicated value, correction, sensitivity, repeatability, reproducibility, precision, Accuracy, significant figure, etc.
	1b. Differentiate between different types of errors with examples	1.5 Types and sources of error : gross error, systematic error , random error
Unit – II Potentiometers and Bridges	2a. Explain the working of the DC potentiometer 2b. Differentiate between different types of potentiometers	2.1 Construction and working of DC potentiometer, and its applications 2.2 Dial type and Crompton type.
	2c. Classify different types of resistances 2d. Explain the procedure to measure low resistance by Kelvin's double bridge with sketches 2e. Explain the procedure to measure medium resistances by Wheatstone's bridge and other methods with sketches.	2.3 Low, medium, and high resistance 2.4 Kelvin's double bridge, 2.5 Medium resistance by Wheatstone bridge, Ammeter-voltmeter method, Ohmmeter,
	2a. Justify the need of a Megger 2b. Justify the need of a earth tester.	2.6 High resistance by Mugger, 2.7 Earth resistance by Earth tester.
	2c. Select an A.C. bridge to determine Inductance and capacitance	2.8 Measurement of inductance and capacitance by Universal impedance bridge, A.C. bridge - Maxwell, Anderson, Hays, Desauty and Wien's bridge. (no phasor diagram)
Unit – III Electromechanical Instruments	3a. List the common errors in various electromechanical measuring instruments. 3b. Differentiate between moving iron and PMMC instruments 3c. Distinguish between electrodynamometer type and induction type meters	3.1 Common errors in electromechanical instruments 3.2 Moving iron instruments: Ammeter, voltmeter, 3.3 PMMC instruments: ammeter, voltmeter, Vibration galvanometer. 3.4 Electrodynamometer type meter: ammeter, voltmeter, wattmeter, power

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	3d. Describe the working of a hot wire instruments	factor meter. 3.5 Induction type Energy meter (single phase, three phase) 3.6 Hot wire type instruments
	3e. Select different types of electro-mechanical instruments for different kinds of measurement. 3f. Illustrate the use of shunt and multipliers for range extension of ammeters and voltmeters 3g. Illustrate the use of Current Transformer and Potential Transformer for range extension of meters	3.7 Frequency meter, Tri vector meter, Maximum demand meter, Phase sequence indicator, Solid state energy meter, Clip on meter 3.8 Extension of range using shunt, multipliers and derive equation for them. 3.9 Extension of range of meters using instrument transformer like CT and PT
Unit – IV Calibration and Testing	4a. Justify the necessity of calibration	4.1 Calibration and its importance.
	4b. State the procedure to calibrate various electrical instruments	4.2 Calibration of ammeter, voltmeter and wattmeter and single phase energy meter(along with adjustments) as per IS
Unit – V Transducers	5a. State the basic requirements of transducers 5b. Classify different types of transducers.	5.1 Basic requirements of transducers 5.2 Classification based on : Transduction phenomenon, type of application, types of input and output signal, electrical principle involved.
	5c. Describe working principle of different types of electrical transducers	5.1 Resistive Transducers, Inductive Transducers: LVDT, RVDT, Capacitive Transducers, Piezoelectric Transducers, Strain Gauge Transducers (unbonded and bonded), Thermocouple, RTD, Thermistor and semiconductor sensors
	5d. Describe working principle of different types of electro optical transducers	5.2 Opto-electronic devices: Photo emissive cells, Photoconductive cells, Photodiode, Photo transistor, Photovoltaic cells, Photo optic transducer

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of measurement and instrumentation	06	04	04	01	09
II	Potentiometers and Bridges	10	04	07	03	14
III	Electromechanical Instruments	16	07	08	06	21
IV	Calibration and Testing	06	01	02	02	05
V	Transducers	18	06	07	08	21
Total		**56**	**22**	**28**	**20**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Apprx. Hrs. Required
1	II	Test the medium resistance using Wheatstone bridge	2
2	II	Test the low resistance using Kelvin bridge	2
3	II	Test the inductance by using Universal Impedance bridge	2
4	II	Test the capacitance by using Universal Impedance bridge	2
5	II	Use DC ammeter and voltmeter for different ranges	4
6	II	Use Moving Iron voltmeter and ammeter for different ranges	4
7	II	Measure maximum demand using Maximum demand meter	2
8	II	Find resistance of winding insulation by using Megger	2
9	III	Calibrate Ammeter(MI/MC) as per IS	2
10	III	Calibrate Voltmeter(MI/MC) as per IS	2
11	III	Calibrate Single phase energy meter as per IS	2
12	III	Measure different electrical parameters using clip on meter.	2
13	V	Measure Linear displacement using LVDT.	2
14	V	Use Thermocouple to control the temperature of a furnace/machine.	2
15	V	Test the Automatic Control of speed control for D.C. motor using tachogenerator	2

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Apprx. Hrs. Required
16	V	Test the strain using strain gauge.	2
17	VI	Test Power and Power factor(using power factor meter) using two wattmeter method for three phase circuits	4
		Total	**36**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Prepare charts for understanding various electro-mechanical instruments
ii. Seminar by students on working of various instruments
iii. Prepare a survey report for various latest measuring instruments available in market
iv. Prepare a survey report to know the ratings of current transformer and potential transformer used in substation/industries

8. SPECIAL INSTRUCTION STRATEGIES (If Any)

i. Students should be shown animations/video films to explain the working concept of different transducers and instruments.
ii. Students should be taken to nearby industries/substations where different type of transducers and instruments are installed and they should be asked to observe their specifications including their range and least count etc. They should be encouraged to discuss with operators about what type of errors they encounter in these instruments and how they are eliminated and how instruments are maintained and calibrated?

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1.	Electrical and electronic instruments	Sawhney, A .K .	Dhanpat Rai Publications, New Delhi, 2010
2.	Electrical Measurements: fundamentals, concepts, applications	Reissland, M.U.	New Age International publishers, New Delhi, 2008
3.	A course in electronics & electrical measurement & instrumentation	Gupta ,J.B.	S.K. Kataria and Sons, New Delhi, 2011
4.	Principles of measurement & Instrumentation	Morris ,Alan. S	PHI publication, New Delhi, 2011
5.	Electrical Instrumentation	Bakshi, U.A., Bakshi A.V.	Technical Publication, Pune,2009
6.	Mechanical and industrial measurements ,	Jain ,R.K.	Khanna Publication, New Delhi, 2010
7.	Electrical Measurements and measuring instruments	Golding, E.W., Widdis, F.C.	Reem publications New Delhi, 2011
8.	Electronic Measurements and Instrumentation	K. Lal Kishore	Pearson, New Delhi, 2011

B) List of Major Equipment/Materials with Broad Specification

i. DC potentiometer : 0 - 1.1V D.C, TEST TERMINALS, COARSE & FINE adjustment
ii. Wheatstone bridge : Measuring Range- 1.000Ω to 10.00MΩ, Measuring Arm- x 1mΩ, x 10Ω + 10Ω x 10 + 100Ω x 10 + 1000Ω x10 (min. one step: 1Ω), **Ratio Arms-** x 0.001 x 0.01, x 0.01, x 0.1, x 1, x 10, 100, x 1000 (M10, M100, M1000 Murray & Varley loop testing), **Galvanometer Power Source** -Three 1.5V batteries (built-in), Range, ±0.1% of reading on 100Ω to 100kΩ Range, **Accuracy-** ±0.3% of reading on 10Ω to 1MΩ Range, ±0.6% of reading on 1Ω to 10MΩ Range
iii. Kelvin double bridge : Range : 0.2 Micro - Ohms to 11 ohms, Accuracy : 0.1% (or ±1 Slide wire division whichever is greater), Multiplier : 5 Ranges (0.01, 0.1, 1, 10 & 100)
iv. Weins bridge: Biasing Voltage : +12V, -12V DC etc..
v. Universal impedance bridge: Basic accuracy- 0.3%, Versatile , portable , compact LCR Meter for L-Q , C-D , R-Q, |Z|-Q measurements, Measurement frequencies 100 Hz, 120 Hz and 1 kHz
vi. LCR meter : Basic accuracy- 0.3%, Versatile , portable , compact LCR Meter for L-Q, C-D , R-Q, |Z|-Q measurements, Measurement frequencies 100 Hz, 120 Hz and 1 kHz
vii. Energy meter : 1Ø and 3Ø analog and digital meters with latest specifications
viii. Power factor meter : Analog and digital meters with latest specifications
ix. Trivector meter : With latest specifications
x. Two element wattmeter : With latest specifications
xi. Three phase power factor meter : Analog and digital meters with latest specifications
xii. Megger : Mains / battery pack operated (Capable of continuous duty for P.I. measurement of large Generators) analog/digital insulation tester with selectable ranges of 50V, 250V, 500 V, 1000 V, 2500 V , 5000 V.
xiii. Phase sequence indicator: Analog and digital meters with latest specifications
xiv. Clip on meter : Analog and digital meters with latest specifications With true-rms ac voltage and current measurements, the Fluke 373 Clamp Meter reads up to 600 A ac and 600 V ac or dc.
xv. Current transformer and Potential transformer
xvi. Decade resistance box: Accuracy: ± 1%, Max. D.C. voltage : 400 volts, jack-topped binding posts are used as output terminals
xvii. Range extension board : +12V D.C. at 50mA I.C.regulated Power Supply for Sine wave Oscillator
xviii. Shunts with ammeters: Accuracy: ± 1%, Measuring Range in ohms like - x 0.001 x 0.01, x 0.01, x 0.1, x 1, x 10, 100, x 1000
xix. Linear variable differential transducer : ±12V D.C. at 50mA I.C.regulated Power Supply for Sine wave Oscillator
xx. Strain gauge: ±12V D.C. at 50mA I.C.regulated Power Supply for Sine wave Oscillator
xxi. Thermo-couple : Types B, E, J, K, R, S, T and C thermocouples
xxii. Thermistor :as per standard specification and latest configurations
xxiii. PH meter:
xxiv. Multiple transducer kit: Inbuilt power supply, measurement facility, expansion facility and with latest features like computer interface etc.

C) List of Software/Learning Websites

i. Electronics work bench
ii. www.scientechworld.com
iii. www.ni.com/labview/
iv. www.scientificindia.com/home/scientificindia.asp
v. http://electricalandelectronics.org/
vi. www.electrical-electronics.co.in/

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. S.S. Mehta**, Sr. Lecturer, Electrical Engineering Department, B&B Institute of Technology,Vallabhvidyanagar.
- **Prof (Ms.).V.R. Kotdawala**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Himmatnagar.
- **Prof. A.A. Parmar**, Sr. Lecturer, Electrical Engineering Department, B&B Institute of Technology,Vallabhvidyanagar
- **Prof. J.K. Rathod**, HOD, Electrical Engg. Dept., Tolani F.G. Polytechnic, Adipur

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering
- **Dr. (Mrs.) C.S. Rajeshwari**, Professor & Head, Department of Electrical and Electronics Engineering

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

ELECTRIC POWER GENERATION
(Code: 3330904)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	3rd semester

1. RATIONALE

Generation of Electric Power is most important activity in power system. With growing demand for electric power at one hand and depleting fossil fuel resources it has become more necessary to generate electric power more efficiently and with the help of renewal energy resources. With advancement in technology it has become possible to generate electric power commercially using wind and solar energy. This course therefore deals in detail about generation of electric power using Thermal (Coal), Hydro, Nuclear, Solar, Wind, Diesel and Other renewal energy sources. These types of power plants need highly skilled technicians who are capable of operating various control equipment to supply uninterrupted power. This course attempts to develop the basic cognitive skills required to take appropriate decisions to maintain the various generating and auxiliary equipment of power plants. Moreover, the safety precautions required to be followed by the engineering diploma holders in various power plants is also included in this course.

2. COMPETENCY ('Programme Outcome' according to NBA Terminology)

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency.

- **Supervise the functioning of different types of electric power generating plants for safe operation.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
04	02	00	06	70	30	00	00	100

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Thermal Power Station	1a. Explain thermal energy conversion process with block diagrams 1b. Identify the appropriate site of a TPS	1.1 Energy conversion process for thermal power station with plant layout 1.2 Selection criteria for site of thermal power station
	1c. Describe the working of thermal power station (TPS) Using single line diagram 1d. State the functions of the major equipment and auxiliaries of a TPS 1e. Distinguish between load curve and load duration curve 1f. Differentiate between base load and peak load power plants	1.3 Line diagram of thermal power station (TPS); Different cycles of TPS 1.4 Major equipment and auxiliaries of TPS (including Boiler, steam turbine, Turbo Generator, super heater, economizer and electro static precipitator) 1.5 Load curve and load duration curve 1.6 Base load and peak load power plants
	1g. State the critical safe practices to be complied with 1h. Name the major TPS in Gujarat	1.7 Safe Practices of TPS 1.8 Pollution generated by thermal power stations and methods to reduce them. 1.9 Principle of chimney and concept of draught. 1.10 Major TPS in Gujarat
Unit – II Hydro Power Station	2a. Explain hydro energy conversion process with block diagrams 2b. Identify the appropriate site 2c. Classify the different types of HPS 2d. Differentiate between different types of Hydro Turbines.	2.1 Energy conversion process for hydro-power station (HPS) with plant layout 2.2 Selection of site for HPS site 2.3 Major features of HPS 2.4 Classification of HPS: based on head, Storage and pondage, Plant Layout, types of hydro turbines; Auxiliaries
	2e. State the critical safe practices to be complied with 2f. Name the major HPS in Gujarat	2.5 Safe Practices of HPS 2.6 Difference between Generators for Thermal Plant and Hydro Plants. 2.7 Advantages of Hydro Power Plants and their effect on ecology/environment 2.8 Hydro power stations in Gujarat
Unit – III Nuclear Power Station	3a. Explain energy conversion process with block diagrams 3b. Identify the appropriate site for a NPS.	3.1 Energy conversion process for NPS: Nuclear fusion and fission, Chain reaction 3.2 Selection of site for NPS
	3c. Explain the working of Nuclear power station 3d. Describe various types of reactors	3.3 Working of nuclear power station 3.4 Various types of reactors
	3e. State special precautions required for NPS 3f. Name the major TPS in Gujarat	3.5 Special precautions for NPS 3.6 Advantages and disadvantage of NPS 3.7 Nuclear power stations in Gujarat
Unit – IV Solar Power Plant	4a. Explain the various solar energy parameters required for electrical power generation and their	4.1 Solar constants, Measurement of solar radiations 4.2 Large (more than 1 MW) Solar

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	measurement 4b. Name the large solar power plants in Gujarat	photovoltaic (PV) and concentrated solar power (CSP) solar plants in Gujarat
	4c. Describe the working of Solar concentrated power (CSP) systems	4.3 Solar Energy Conversion of CSP 4.4 CSP generators, construction and working principle
	4d. Explain principle of solar photovoltaic (PV)systems 4e. Solve simple numerical related to solar PV 4f. Discriminate between different types of solar PV systems.	4.5 construction of a solar PV systems: Solar cell, Module, Panel and array 4.6 Types of solar PV system: Stand – Alone,, Grid-Tied, Hybrid system
	4g. State the major safe practices for a solar PV power plant	4.6 Safety precautions of Solar PV systems
Unit – V Wind Power Plant	5a. Describe the power curve of wind turbines with single line sketches, 5b. Solve simple numericals related to the power in the wind 5c. Name the large wind farms in Gujarat 5d. State the major safe practices in the maintenance of large WPPs and small wind turbines	5.1 Anemometer, wind vane, site selection, Power of the wind, power curve of wind turbines 5.2 Large wind farms in Gujarat 5.3 Safety precautions to be during the routine maintenance of large and small wind turbines
	5e. Differentiate Horizontal Axis Wind Turbine(HAWT) and Vertical Axis Wind Turbine (VAWT) 5f. Distinguish between downwind and upwind wind turbines 5g. Differentiate the construction of a geared, direct drive and hybrid (semi-geared large wind power plants (WPPs)	5.4 HAWT and VAWT 5.5 Downwind and upwind wind turbines 5.6 Geared wind power plants (WPPs), direct-drive WPPs and Hybrid (semi-geared) WPPs
	5h. Differentiate the three types of aerodynamic control of WPPs Using the power curves.	5.7 Stall control, pitch control and active tall control of WPPs.
	5i. Evaluate the suitability of various types of electric generators adapted in large WPPs	5.8 Squirrel Cage Induction Generators (SCIG), wound rotor (WRIG), doubly-fed (DFIG), wound rotor synchronous generator (WRSG), Permanent magnet synchronous generator (PMSG)
	5j. Using single line sketches, label the major parts of direct-drive and geared small wind turbines 5k. Explain the drag and lift principle of rotation of wind turbines	5.9 Direct-drive and geared small wind turbines 5.10 Drag and lift principle of rotation of wind turbine rotors.
Unit – VI Captive power plant	6a. With single line diagram describe the electrical energy conversion process of DG sets	6.1 Electrical energy conversion of DG sets, advantages and limitations

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
and other renewable energy sources	6b. With single line diagram describe the electrical energy conversion process of gas-based power plants	6.2 Electrical energy conversion of gas-based power plants, advantages, and limitations
	6c. With single line diagram describe the electrical energy conversion process of biomass energy	6.3 Electrical energy conversion of biomas energy, advantages and limitations
	6d. With single line diagram describe the electrical energy conversion process of ocean energy technologies	6.4 Electrical energy conversion of ocean technologies; tidal, wave, ocean current, ocean energy thermal conversion (OTEC), advantages and limitations
	6e. With single line diagram describe the electrical energy conversion process of geothermal energy	6.5 Electrical energy conversion of Geothermal energy, advantages and limitations

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Thermal Power Station	12	04	06	04	14
II	Hydro Power Station	10	03	05	04	12
III	Nuclear Power Station	06	03	03	02	08
IV	Solar Power Plant	10	03	05	04	12
V	Wind Power Plant	10	03	05	04	12
VI	Captive power plant and other renewable energy sources	08	05	04	03	12
Total		**56**	**21**	**28**	**21**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF TUTORIAL EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

Sl. No.	Unit No.	Tutorial/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1	I to VI	Solve simple numerical related to different type of power generation plants	12
2	I	Interpret the line diagram of Thermal Power Station (T.P.S.) and main cycles & explain working of T. P. S.	02
3	I	Prepare technical report of visit to a nearby T.P.S./Prepare a report on thermal power stations in Gujarat by collecting data from Internet	04
4	I	Collect the data from nearest power station for load curve preparation and interpret it.	02
5	II	Prepare technical report of visit to a nearby H.P.S./Prepare a report on Hydro power stations in Gujarat by collecting data from Internet	04
6	III	Interpret the schematic diagram of Nuclear power station & explain the function of each component.	02
7	IV	Prepare technical report of visit to a nearby Solar PV station.	04
8	V	Prepare technical report of visit to a nearby Wind farm.	04
9	I	Visit the website of NTPC and prepare a report	02
10	II	Visit the website of NHPC and prepare a report	02
11	VI	Draw and Interpret schematic diagram of a Diesel Power Station	02
12	VI	Visit the website of MNRE/GEDA and prepare a report	02
13	VI	Visit a nearby Biogas plant and prepare a report	02
14	VI	Draw and Interpret schematic diagram of gas based power plant	02
		Total	**46**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Assignment on solving tutorial
ii. Visit to nearby Thermal power station
iii. Visit to nearby Hydro power station
iv. Visit to nearby Solar PV station
v. Visit to nearby Wind farm.
vi. Visit to nearby diesel power plant.
vii. Collect data of conventional generation for India and Gujarat
viii. Collect data of generating capacity of non- conventional power plants in India. (Total generation of India and Gujarat)

8. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Show video films or animation films on working of different type of power stations from YouTube and other resources.
ii. Visit to nearby power station
iii. Visit to wind power plants
iv. Visit to solar power plant
v. Visit to electrical substation.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1	Electrical Power system	Mehta, V.K.	S. Chand & Co., New Delhi, 2011
2	Wind Power Technology	Earnest, Joshua	PHI Learning, New Delhi, 2013
3	Electrical Power	Uppal, S.L.	Khanna publication, New Delhi, 2011
4	Power plant Engineering	Nag, P K	Tata McGraw Hill, New Delhi, 2011
5	Renewable Energy Technologies	Solanki, Chetan S.	PHI Learning, New Delhi, 2011
6	Generation and Utilization of Electrical Energy	S. Sivanagaraju	Pearson, New Delhi, 2011.
7	Solar PV Lab Manual	Solanki, Chetan S.	PHI Learning, New Delhi, 2013

B) List of Major Equipment/Materials with Broad Specifications

i. 5 kW Solar PV system
ii. 2 kW concentrated solar power (CSP) system
iii. 2 kW DG system
iv. 1 kW direct-drive small wind turbines
v. 5 kW geared small wind turbine
vi. Illustrative charts for TPS
vii. Illustrative charts for HPS
viii. Illustrative charts for NPS
ix. Illustrative charts for gas based plants

C) List of Software/Learning Websites

i. www.alternative-energy-tutorials.com
ii. http://www.mnre.gov.in/
iii. http://www.ntpc.co.in/index.php?option=com_content&view=article&id=64&Itemid=34&lang=en
iv. http://www.nhpcindia.com/hydro-technology.htm
v. http://www.npcil.nic.in/main/KnowledgePortal.aspx#
vi. http://www.powergridindia.com/_layouts/PowerGrid/User/ContentPage.aspx?PId=255&LangID=English
vii. http://www.youtube.com/user/EnergyShouldBe

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. (Smt.) A. A. Amin,** Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Vadnagar. Gujarat
- **Prof. V. C. Jagani**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Junagadh, Gujarat
- **Prof. J.K.Rathod**, Head of Electrical Engineering Department, TFG Polytechnic, Adipur, Gujarat
- **Prof. K. V. Dave**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Rajkot, Gujarat

Faculty Members from NITTTR Bhopal

- **Dr. (Mrs.) C.S. Rajeshwari,** Professor & Head, Department of Electrical and Electronics Engineering
- **Prof. A.S. Walkey,** Associate Professor, Department of Electrical and Electronics Engineering

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

ELECTRONIC COMPONENTS AND CIRCUITS
(Code: 3330905)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	3rd semester

1. RATIONALE

Electronics is becoming a part and parcel of electrical systems in the industry/power system. And hence it has become essential for an electrical diploma engineer to have fundamental understanding of the use of various electronic devices and circuits. This course therefore discusses about the construction, working, and applications of various types of semiconductor components such as diodes and transistors, which are basic building block of amplifier, oscillator, switching circuit, wave shaping circuit and power supply. The skills developed in this course are also essential for comprehending the advanced courses in the later semesters.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency

- **Use discrete electronic devices and components in various circuits**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
04	00	02	06	70	30	20	30	150

Legends: L - Lecture; **T -** Tutorial/Teacher Guided Student Activity; **P -** Practical; **C -** Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Semiconductor Diode and its Applications	1a. Distinguish between intrinsic and extrinsic semiconductor materials 1b. Describe working of PN junction diodes 1c. Differentiate the working of half and full wave bridge rectifier along with sketches	1.1 Intrinsic and extrinsic ssemiconductor materials: P type, N type semiconductors 1.2 P-N junction diode: 1.3 Applications - Diode as rectifier, half wave, full wave and bridge wave rectifier
	1d. Justify the need for different types of filters. 1e. Differentiate between C, L, LC and π filters	1.4 Need of Filters 1.5 C,L,LC, π filters
Unit – II Transistors, voltage & power amplifiers	2a. Discriminate between PNP and NPN transistors	2.1 PNP and NPN transistors, conduction through transistor leakage current, relationship between α and β
	2b. Compare the working of CB, CE and CC transistors. 2c. Describe the load line and biasing methods of the transistor	2.2 Transistor configuration & characteristics for CB,CE,CC 2.3 Load line and biasing methods of transistor
	2d. Justify the need of voltage amplifier 2e. Select the voltage amplifier for a particular application	2.4 Transistor as an amplifier : CE amplifier 2.5 Cascade amplifiers
	2f. Explain the need of power amplifier 2g. Select the power amplifier for a particular application	2.6 Power amplifier: Class A amplifier: Series fed and transformer-coupled amplifier 2.7 Class B push-pull Amplifier Operation 2.8 Amplifier Distortion
Unit – III Oscillators and Other Semiconductor Devices	3a. Explain the working of different types of oscillators with relevant sketches 3b. Select oscillator for different frequency generation 3c. Describe working of the Zener diode, Photo diode, LDR, Photovoltaic Cell, LED with symbols 3d. Describe working of the FET, MOSFET, DIAC ,UJT, TRIAC and SCR	3.1 Working principle of oscillators 3.2 Different types of oscillators: Hartley oscillator, Colpitts oscillator, Phase-Shift Oscillator, Wien Bridge Oscillator, Crystal Oscillator 4.1 Zener diode, Photo diode, LDR, Photovoltaic Cell, Light Emitting Diode 3.3 FET, MOSFET, DIAC, UJT, TRIAC and SCR
Unit – IV Simple circuit using IC	5a. Justify the need of ICs 5b. Describe the working of an OPAMP 5c. Select OPAMP IC 741 for a particular application	5.1 Need of I.C. 5.2 Operational amplifier (OPAMP). 5.3 Characteristic and specification of OPAMP- IC 741

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	5d. Justify the need of IC 555 Timer 5e. Explain the working of a IC555 using the block diagram 5f. Select IC 555 timer for a particular application	5.4 IC 555 timer and applications 5.5 Block diagram of IC555 timer
Unit – V Regulated power supplies	6a. Justify the need of regulated DC power supply	6.1 Regulated power supply (module level), Shunt voltage regulator (module level)
	6a. Explain the working of different types of voltage regulator circuits	6.2 Transistorized series voltage regulator (basic and with feedback, without derivation) 6.3 3- Terminal Fixed/variable voltage regulator: 78xx, 79xx, LM317
	6b. Explain working of SMPS and UPS	6.4 Switch mode power supply(SMPS) 6.5 Uninterruptible power supply(UPS)

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Semiconductor diode and its applications	10	4	5	6	15
II	Transistors: voltage and power amplifiers	14	7	7	4	18
III	Oscillators and semiconductor devices	18	8	7	7	22
IV	Simple circuit using IC	06	2	2	3	07
V	Regulated power supplies	08	2	2	4	08
Total		**56**	**23**	**23**	**24**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1.	I	Test PN junction diode.	02
2.	I	Test Half wave rectifier using CRO	02
3.	I	Test full wave centre tapped & bridge rectifier using CRO	02
4.	I	Compare output waveform of different Filters using CRO	02
5.	II	Test the performance of CB transistor amplifier	02
6.	II	Test the performance of CE transistor amplifier	02
7.	II	Testing of transistor using multi meter	02
8.	II	Test the performance class – B push pull amplifier	02
9.	III	Test Hartley oscillator using CRO	02
10.	III	Test Colpitts oscillator using CRO	02
11.	IV	Test LED and LDR	02
12.	IV	Test J-FET amplifier	02
13.	IV	Test MOSFET amplifier	02
14.	IV	Test SCR and UJT	02
15.	V	Identify the pins of IC 741 and IC-555	02
16.	V	Test the performance of IC 555 timer	02
17.	VI	Test Zener diode as voltage regulator	02
18.	VI	Build voltage regulator using 78xx and 79xx and measure the dropout voltage for the given voltage regulator.	02
19.	VI	Test the performance of SMPS	02
20.	VI	Test the performance of UPS	02
		Total	**40**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

The student can perform the following activities such as:

i. Prepare mini project
ii. Testing of electronic components like diode, transistor, SCR, IC etc.
iii. Prepare chart for characteristic of various electronics components.
iv. Survey to collect data sheets for various electronics components used in different circuits.

8. SUGGESTED INSTRUCTION STRATEGIES (If Any)

i. Students should be shown animations/video films to explain the working concept of different types of diodes, transistors, ICs, amplifiers, oscillators, regulated power supply etc.
ii. Samples of the electronic components and devices should be brought in the class for demonstration while teaching those components and devices.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1	Basic Electronics and linear circuits	Bhargava, N.N.	TMH, New Delhi 2012
2	Electronic devices and circuit	Robert Boylestad	PHI, New Delhi 2012
3	Principle of Electronics	Mehta, V.K.	S.Chand, New Delhi 2012

S. No.	Title of Books	Author	Publication
4	Electronics Principles	Malvino, Albert	TMH, New Delhi 2012
5	Basic Electronics and linear circuits	Kulshreshtha,D.C. Gupta, S.C.	TTTI, Chandigarh 2007
6	Opamp and Linear integrated circuits	Gayakwad, Ramakant	PHI, New Delhi 2010
7	Electronics Fundamental and application	Chattopadhyay , D.	New Age International Publishers 2011

B) List of Major Equipment/Materials with Broad Specification

i. Regulated power supply: Dual DC , 0-30V/1A & 5V /1A with resolution of 10mV , 2mA
ii. Digital Storage Oscilloscope : 300 MHZ Bandwidth , 2GSa/s maximum real time sampling rate refresh rate upto 2000 wfams/s , RS232 & USB connectivity
iii. C.R.O. : 30 MHz Bandwidth, 2 channel, 20 ns sampling time.
iv. Function generator: 10 HZ to 10MHZ , 10 Vpp , rise & fall time =20ns, manual / external triggering
v. Different trainer kits of Electronics.
vi. Digital Multimeter : $5^{1/2}$ digits resolutions with all basics measurement facility like DC Voltage: 200 mV ~ 1000 V, DC Current: 200 µA ~ 10 A, AC Voltage: True-RMS, 200 mV ~ 750 V, AC Current: True-RMS, 20 mA ~ 10 A, 2-Wire, 4-Wire Resistance: 200 Ω ~ 100 MΩ, Capacitance Measurement: 2 nF ~ 10000µF, Frequency Measurement: 20 Hz ~ 1 MHz etc., 0.015% DC Voltage Accuracy.

C) List of Software/Learning Websites

i. Electronics work bench
ii. Circuit maker
iii. pSpice
iv. www.howstuffwork
v. www.allaboutcircuits.com/vol_1/chpt_1/1.html
vi. http://openbookproject.net/electricCircuits/DC/DC_5.html
vii. www.kpsec.freeuk.com
viii. www.electical-electronics.org

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. A.A. Parmar**, Sr. Lecturer, Electrical Engg.
- **Prof. N. R. Suchak**, Sr. Lecturer, Electrical Engg. Dept, Government Polytechnic, Rajkot
- **Prof. J.K. Rathod**, HOD, Electrical Engg. Dept., Tolani F.G. Polytechnic, Adipur

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. (Mrs.) C.S. Rajeshwari**, Professor & Head, Department of Electrical and Electronics Engineering
- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering