GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: POLYPHASE TRANSFORMERS AND ROTATING AC MACHINES
(Code: 3340901)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	4th Semester

1. RATIONALE

Polyphase (mainly 3 phase) transformers are widely employed in power grids and transmissions lines starting from generating station till the consumer end. Every generating station uses alternators for electricity generation. Induction motors and Synchronous motors are widely used in industries, farms and domestic applications. It is therefore must for electrical engineers to posses knowledge and skills required to operate and maintain 3 phase transformers, induction motors, synchronous motors and alternators. This course attempts to develop these skills into the students.

2. COMPETENCY

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:

- **Operate and Maintain transformers and rotating AC machines.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Conduct various routine tests on 3 phase transformer.
ii. Operate 3- phase transformers in parallel.
iii. Select a 3- phase or 1- phase induction motor for a given application.
iv. Synchronize an alternator with bus bar or another alternator.
v. Use Synchronous machines for power factor improvement.
vi. Maintain rotating AC machines.

4. 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	
4	0	4	8	70	30	40	60	200

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I. Poly Phase Transformer	1a. Justify the advantage of using 3-phase transformer over a bank of 3 single phase transformers 1b. With sketches explain the major parts of the 3-phase transformer 1c. Sketch the different types of connections of 3-phase transformer including vector groups 1d. With sketches the describe the need of parallel operation of 3 phase transformers . 1e. State the maintenance procedure and the transformer oil change process	1.1 Comparison of three phase transformer with bank of three single phase transformers. 1.2 Arrangement of Core and windings in transformer, use of tap changer. Types of losses in transformers. 1.3 Construction - Accessories of 3 phase transformer: Main tank, bushings, conservator with breather, oil level gauge, radiators, buchholz relay, explosion vent, temperature indicators, junction box 1.4 Star delta connections and vector groups 1.5 Cooling of transformer: Natural cooling, Forced cooling 1.6 Parallel operation – Essential and desirable Conditions 1.7 Maintenance of different types of transformers
Unit– II Poly Phase Induction Motors	2a. Explain how a rotational field is produced in a 3 phase induction motor. 2b. Differentiate between squirrel cage and wound rotor induction motor with their salient features. 2c. Explain the torque slip characteristics of squirrel cage and wound rotor induction motor including the generation operation. 2d. Explain various methods of speed control of 3 phase induction motor. 2e. State the maintenance procedure of both squirrel cage and wound rotor induction motor	2.1 Construction, types - Squirrel cage - Single and double cage, Wound rotor 2.2 Working principle with Torque-slip curve, equivalent circuit and phasor diagram 2.3 Torque equation , Starting, running and condition for the maximum torque 2.4 Necessary and types of starters- DOL, Star delta, autotransformer type and rotor resistance starter. 2.5 No load test and Blocked rotor test, Losses and efficiency 2.6 Speed control of squirrel cage and slip-ring inductionmotor 2.7 Maintenance of different types of induction motors
Unit– III Alternator	3a. Explain the working principle of an alternator 3b. Differentiate between turbo generator and hydrogenerators 3c. Derive emf equation 3d. Determine the voltage regulation of an alternator by synchronous impedance method 3e. Synchronize an alternator with infinite bus bar. 3f. State the maintenance requirements of the alternators including the different cooling systems of the alternators	3.1 Principle of working and construction.- Salient and Cylindrical rotor 3.2 Equivalent circuit and phasor diagram 3.3 Voltage regulation by synchronous impedance method, OC, SC characteristics 3.4 Synchronization of alternator with bus bar/alternator 3.5 Cooling system of alternator 3.6 Maintenance of different types of alternators

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit–IV Synchronous Motor	4a. Connect and operate synchronous motor using proper starting method 4b. Improve the power factor of the system using synchronous condenser 4c. State the maintenance requirements of the synchronous motor 4d. Differentiate the features between the synchronous and induction motor	4.1 Principle of working, starting methods 4.2 Equivalent circuit and phasor diagram 4.3 Effect of change in excitation 'V'-curves 4.4 Synchronous condenser 4.5 Hunting and its prevention 4.6 Different torque of a synchronous motor 4.7 Maintenance of synchronous motors
Unit-V Single Phase Induction Motors	5a. Describe the working principle of different types of single phase motors. 5b. Describe the working principle of different types of fractional horse power motors 5c. Troubleshoot single phase induction motor in a ceiling fan/ cooler 5d. State the maintenance requirements of the single phase induction motor	5.1 Working of different types of single-phase induction motors 5.2 Fractional horse power motors 5.3 Speed torque characteristics 5.4 Maintenance of different types of single phase motors

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Polyphase Transformer	10	04	04	04	12
II	Polyphase Indcution Motors	16	08	06	04	18
III	Alternator	12	06	05	05	16
IV	Synchronous Motor	10	04	06	04	14
V	Single Phase Induction Motors	8	02	02	06	10
	Total	**56**	**24**	**23**	**23**	**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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours. required
1	I	Identify various accessories of three phase transformer by visiting to nearby substation and draw its sketch with cooling arrangement .	4
2	I	Perform parallel operation on three phase transformer.	4
3	II	Measure the slip of 3-phase Induction motor by using Tachometer and by Stroboscopic method.	4
4	II	Reverse the direction of rotation of a 3-phase IM.	2
5	II	Perform direct load test on three phase induction motor and draw performance curves	4
6	II	Perform no load and blocked rotor test on a three phase induction motor to obtain various parameters. Also construct circle diagram to determine its performance characteristics.	4
7	II	Make connections of DOL starter / star-delta starter / auto transformer / rotor rheostat starter for appropriate three phase induction motor.	8
8	II	Perform speed control of squirrel cage induction motor by: 1. By changing the supply voltage. 2. By changing the applied frequency.	2
9	II	Perform speed control of slip-ring induction motor by: 1. Rotor rheostat control. 2. Injecting an emf from rotor side. 3. operating two motors in cascade connection.	4
10	III	Perform direct loading test on alternator to find out voltage regulation	4
11	III	Find out voltage regulation of alternator by synchronous impedance method for Unity, lagging and leading power factor.	4
12	III	Find out voltage regulation of alternator by ampere turn method for Unity, lagging and leading power factor.	4
13	III	Synchronize a given alternator with bus bar.	2
14	IV	Construct V-curves of synchronous motor at different load conditions to see the effect of variation of excitation	2
15	V	Test the circuit of capacitor start capacitor run single phase induction motor used in a ceiling fan	2
16	V	Perform No load test on single phase induction motor to determine the friction and windage loss	2
		Total Hours	**56**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Prepare journals based on practical performed in laboratory.
ii. Assignments on solving numericals
iii. Prepare chart displaying various accessories of three phase transformer
iv. Prepare/Download a dynamic animation to illustrate the following:
   - Working principle of 3 phase induction motor
   - Working principle of 3 phase alternator
   - Working of different types of 3 phase induction motor starters
v. Carry out a market survey of local dealers for 1-phase Induction motor and compare them on following points:
   (a) Rating (b) Method of starting (c) Cost (d) Starting torque and (e) Performance

vi. Download the catalogue of three phase transformer, three phase induction motor, synchronous motor and alternator from websites of reputed manufacturers such as BHEL, SIMENS, CROMPTON, JYOTI, ABB, VOLTAS etc. to learn the latest developments

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

(i) Arrange visit to nearby transformer and induction motor manufacturer/testing facilities

(ii) Show video/animation films to explain functioning of induction motor/synchronous machines/transformers and their accessories.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Electrical Technology Vol. II	B. L. Theraja	S Chand and Co., New Delhi
2.	Electrical Machines	Smarajit Ghosh	Pearson Learning, New Delhi
3.	Electrical Machinery	A.E.Fitzgerald, Charles Kingsley, Jr., Stephen D. Umans	Mc. Graw Hill, New Delhi
4.	Theory and performance of Electrical Machines	J.B.Gupta	S.K. Kataria and sons, New Delhi
5.	Electrical Machines	Ashfaq Hussain	Dhanpat Rai and Company, New Delhi

B) List of Major Equipment/ Instrument with Broad Specifications

i.	Three phase transformer	2KVA, 415V /415V, 50 Hz, 2.8A
ii.	Three phase induction motor	5 HP, 440V, 8.0A, 1400 RPM Squirrel cage type with brake drum arrgangement
iii.	Three phase induction motor	5 HP, 440V, 8.0A, 1400 RPM Slip-ring induction motor
iv.	Synchronous motor	3 HP, 415V, 3-phase, 50Hz, 1500 RPM
v.	DC shunt motor-Alternator set :	5HP,220V, 1500 RPM, 18A, Excitation- 220V DC
vi.	DC shunt motor Alternator	3KVA,415V, 3-phase,3.5A, 1500RPM, Excitation-220V DC
vii.	Single phase induction motor	1 HP, 220 V, 50Hz, 1440 RPM Drum brake with spring balances

C) List of Software/Learning Websites

i. www.sskphdmm.com

ii. www.nptel.iitm.ac.in

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. H.C. Chawda**, Lecturer in Electrical Engineering, RC Technical Institute, Ahmedabad.
- **Prof. R.D. Panchal**, Lecturer in Electrical Engineering, RC Technical Institute, Ahmedabad

- **Prof. J.C. Gadani,** Lecturer in Electrical Engineering, C.U.Shah Govt.Poly., Surendranagar.

Coordinator and Faculty Members from NITTTR Bhopal

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

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER
(Code: 3340902)

Diploma Programmes in which this course is offered	Semester in which offered
Electrical Engineering	4th semester

1. RATIONALE

The electricity is generated in bulk at remote places near to coal mines (thermal power plants, dams (hydro power) and transmitted to long distances and then distributed in cities and villages and to industry. The transmission and distribution of electric power is a complex issue which requires knowledge of different types of transmission lines and power equipments. Technicians are required to operate and maintain the power transmission and distribution system so that electrical energy is continuously available to the consumers economically. It is therefore required that the technicians should be also able to work independently in the various area of transmission and distribution system. S/he should be able to operate various control equipments independently in normal and abnormal conditions. Essential efforts are made in this course to develop above skills in the students.

2. COMPETENCY

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:

- **Operate and maintain various transmission and distribution system.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i Differentiate various types of transmission and distribution systems.
ii Interpret the various transmission concepts
iii Maintain voltage regulation and efficiency of transmission system.
iv Minimize the voltage drop of distribution systems.

4. 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	
4	0	2	6	70	30	20	30	150

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5.COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
UNIT – I Transmission Line Components	1a. State the features of different transmission systems. 1b. State the need for different types of insulators. 1c. State the features of different types of conductors 1d. Explain the criteria for spacing of conductors 1e. Solve simple numerical problems	1.1 Classification of transmission lines. 1.2 Comparison of different types of transmission systems. 1.3 Types of conductors-Copper, Aluminum: Solid, stranded and bundled conductors. 1.4 Line insulators – requirements, types, Failure of insulator. 1.5 String efficiency, methods of improving string efficiency. 1.6 Spacing between conductors, span length and sag calculation.
UNIT– II Performance Of Transmission Lines	2a. Discriminate between skin effect, proximity effect, Ferranti effect and corona 2b. Differentiate between efficiency and regulation of a transmission line 2c. State the effect of low power factor on the performance 2d. Explain the effects of R, L and C on 1-ph and 3-ph transmission line. 2e. Differentiate the features of the short, medium and long transmission lines 2f. Describe the importance and functions of the load dispatch centre. 2g. Solve simple numerical problems	2.1 Skin effect, proximity effect and Ferranti effect. Corona 2.2 Transposition of conductors 2.3 Losses, efficiency and regulation of line. 2.4 Performance of single phase short transmission 2.5 Effect of load power factor on performance. 2.6 Features of short, medium and long transmission lines. 2.7 Load dispatch Centre

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
UNIT-III EHV Transmission	3a. State the need for EHV transmission 3b. State the features of HVAC transmission 3c. State the features of HVDC transmission 3d. Describe the impact of wind power and solar power on the transmission system 3e. Describe the impact of other renewable energy on the transmission system 3f. State the need for FACTS devices 3g. State the salient features of FACTS devices	3.1 Requirement of EHV transmission. 3.2 HVAC Transmission 3.3 HVDC Transmission 3.4 Impact of Wind power and solar power on Transmission Systems 3.5 Impact of other renewable energy sources on Transmission Systems 3.6 FACTS devices
UNIT–IV Distribution System Components	4a. State the need for distribution system 4b. With sketches describe the various connection schemes of the distribution system 4c. Describe the Impact of wind power on the distribution system 4d. Describe the measures to be adapted to take of the distributed generation in the distribution system 4e. Solve simple numerical problems	4.1 AC distribution and its Requirements 4.2 Connection schemes of distribution system. 4.3 A.C. distribution calculations. 4.4 Issues of Distributed Generation Integrated to distribution Grid. 4.5 Methods of solving A.C.-1 phase and 3 Ø –phase connected (balanced) distribution system.
UNIT-V Sub-Station And Cables	5a. State the need for electrical substations 5b. Sketch the elevation layout of a typical 11/33/66/110 kV electrical substation with various switchgear and typical spacing between them and the ground level as well. 5c. State the selection of the bus bar and their arrangement. 5d. With sketches describe the various types of earthing adapted for substations. 5e. State the procedures to undertake the earth test and megger test	5.1 Types of substations: 11, 33, 66 and 110 kV 5.2 Selection and location of site 5.3 Main connection schemes 5.4 Substation Equipment 5.5 Busbar arrangement
	5f. State the features of unarmored and armored cables 5g. State the features of different types of cables used in a substation 5h. Select the cables for relevant applications using data sheets/catalogues 5i. Solve simple numerical problems on selecting cables	5.6 Different types of cables: unarmored and armored 5.7 Selection of cables as per IS /data sheet / catalogues

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

Unit No	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Transmission Line Components.	12	4	5	6	15
II	Performance of Transmission Lines	12	4	5	6	15
III	EHV Transmission	08	4	3	3	10
IV	Distribution System Components	12	4	4	7	15
V	Sub-Station and Cables	12	4	4	7	15
Total		**56**	**20**	**21**	**29**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Revised Bloom's 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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Tutorial Exercises (outcomes in psychomotor domain)	Approx Hours. required
1	I	Demonstrate cable jointing procedures of unarmored cables	02
2	I	Demonstrate cable jointing procedures of armored cables	02
3	I	Prepare a report on different type of insulators and bushings used in transmission system with their specifications.	04
4	I	Prepare a report about types of cables used in distribution system by visiting nearby cable suppliers/industries or otherwise with the help of internet	04
5	II	Prepare Technical Report after visit to the Load Dispatch Centre.	02
6	I and III	Prepare a report on different type of Transmission Towers used in the industry	04
7		Prepare a report on different types of connectors used in the transmission lines.	04
8	IV	Prepare a report after studying distribution system of a residential colony.	02
9	V	Interpret and explain the given Blue Print of a Sub-Station,	02
10	V	Prepare a report on substation with its layout after visiting a nearby substation	02
11	V	Use crimping tools to fit lugs at cable ends of unarmored cables	02
12	V	Use crimping tools to fit lugs at cable ends of armored cables	02

S. No.	Unit No.	Practical/Tutorial Exercises (outcomes in psychomotor domain)	Approx Hours. required
13	V	Use earth testers	02
14	V	Undertake pipe earthing	02
Total Hours (Perform any practical worth 28 hours from above depending upon the availability of resources so that most units are covered)			**36**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i Visit 66 kV distribution sub-station and draw line diagram with equipment specifications

ii Visit 132/220/400kV transmission sub-station and draw line diagram with equipment specifications.

9. SPECIAL INSTRUCTIONAL STRATEGIES (IF ANY)

i Show actual insulators/sample of cables/connectors in the classroom

ii Show charts/slides/photos/video films depicting different types of transmission lines, substations and their components.

iii Give some field-based projects

iv Give some internet based projects.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1	Electric Power Transmission and Distribution	Sivanagaraju S. Satyanarayana S.	Pearson Learning, New Delhi, Latest edition
2	A Course in electrical Power	Soni-Gupta-Bhatnagar	Dhanpat Rai, New Delhi, Latest edition
3	Principles of power system	Mehta V. K.	S. Chand and Co., New Delhi,
4	Transmission and Distribution of electrical energy	Gupta J. B.	S. K. Khanna, New Delhi, Latest edition
5	Electrical Power System	Wadhwa C. L.	New Age, New Delhi, Latest edition

B) List of Major Equipment/ Instrument with Broad Specifications

i 3-phase transmission line trainer

ii 1-phase transmission line trainer

iii 11 KV pin insulator

iv 11kV string insulator

v 33 KV string insulator

vi Different types of 2 metre length 1-phase and 3-phase aluminum and copper armored cables

vii Different types of 2 metre length 3-phase and 3-phase aluminum and copper armored cables

viii Cable crimping tool

ix Cable end dongles.

x Earth Tester.

xi Megger.

C) List of Software/Learning Websites

i Open source computer simulation software for transmission system
ii http://www.ketraco.co.ke/learn/
iii http://www.gatewaywestproject.com/faq_general_transmission.aspx
iv http://www.gatewaywestproject.com/construction.aspx

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. A. A. Amin**, Lecturer in Electrical Engineering, G.P. Vadnagar.
- **Prof. S. V. Jagani**, Lecturer in Electrical Engineering, G.P. Dahod
- **Prof. V. S. Tejwani**, Lecturer in Electrical Engineering, G.P. Rajkot
- **Prof. N. N. Pandya**, Lecturer in Electrical Engineering, G.P. Ahmedabad

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GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

COURSE TITLE: UTILIZATION OF ELECTRICAL ENERGY (Code: 3340903)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	4th Semester

1. RATIONALE

Electricity is used in every walk of life whether it is home, office, industry or farm. It is being used for lighting, heating, refrigeration, cooking, air conditioning, operating machines/computers, welding, traction, irrigation and so on. In this era of energy crisis it is must that electricity is consumed efficiently. Every diploma electrical engineer therefore should know to operate and maintain main electrical utilities for their efficient operations. This course will enable the students to develop skills to maintain /troubleshoot various electrical equipment / gadgets/appliances in domestic, commercial and industrial sector. The students will be able to make proper selection of equipment according to requirement to ensure economical and efficient use of electricity. Essential theoretical and practical knowledge will be achieved by this course.

2. COMPETENCY

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:

- **Maintain different types of electrical utilities and systems**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Maintain/Troubleshoot various lamps and fittings in use.
ii. Maintain various electric heating and welding equipments used in industries.
iii. Maintain Electric Drive and elevator used in industries.
iv. Maintain Electric Traction system.
v. Maintain various domestic electrical appliances.

4. 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	
4	0	2	6	70	30	20	30	150

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Illumination	1a. Define various illumination terminology and its units 1b. Explain the laws of illumination and its significance	1.1 Illumination terminology: Solid and plane angle, Luminous Flux, Luminous Intensity, Lumen, Candle Power, Lux, Lamp Efficiency, Specific Consumption, Glare, Space-Height Ratio, Utilization Factor, Maintenance Factor, Absorption Factor, Reflection Factor 1.2 Law of Inverse Squares and Lambert's Cosine Law
	1c. Describe the working and applications of the various lamps and fittings in use.	1.3 Incandescent Lamp, 1.4 Low Pressure Mercury Vapour Lamps (Fluorescent Tube) 1.5 High Pressure Mercury Vapour (HPMV) Lamps 1.6 High Pressure Sodium Vapour(HPSV) Lamps 1.7 Compact Fluorescent Lamps (C.F.L.), 1.8 Halogen Lamps 1.9 Metal Halide lamp 1.10Electronic ballasts
Unit– II Electrical Heating and Welding	2a. Explain the requirements of heating element materials 2b. Explain the principle of Resistance Heating 2c. Explain the principle of arc Heating 2d. Describe the working of salt bath furnace 2e. Describe the working of resistance oven 2f. Describe the working of arc furnaces 2g. Solve simple numerical	2.1 Requirements of heating element materials 2.2 Resistance and Arc heating 2.3 Resistance Heating : Direct(Salt Bath Furnace), Indirect Resistance Heating(Resistance Ovens) 2.4 Arc Heating and its applications 2.5 Types of Arc furnace -Direct and Indirect 2.6 Methods of Temperature Control.
	2e. Explain the principle of induction heating and their applications 2f. Describe the working of various types of induction furnaces 2g. Solve simple numerical	2.7 Induction Heating and its applications 2.8 Types of induction furnace • Core Type (Ajax Wyatt) and • Coreless type Induction Furnace
	2h. Explain the principle of dielectric heating and their	2.9 Dielectric Heating and its applications

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	applications 2i. Solve simple numerical	
	2j. State the significance of good welds 2k. Explain the principle Resistance Welding and list its types 2l. Explain the principle of electric arc Welding and its types	2.10 Quality of a good weld, welding defects 2.11 Principle of Resistance Welding 2.12 Types of Resistance welding – Spot, Seam, Butt, Projection, Percussion and flash butt welding 2.13 Principle of Electric Arc welding 2.14 Types of Arc welding Machines: a. DC Welding Machines–MG Set,AC Rectified welding unit. b. AC welding Machines–welding Transformer.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit–III Electric Drives And Elevators	3a. Explain function of major parts of an electric drive with block diagrams 3b. State the factors governing selection of electric motors in a electric drive 3c. Differentiate between: i. AC and DC Drive ii. Individual & group drive 3d. Steady state and transient characteristics of various motors	3.1 Source, Power modulator, Electric motor, Control unit and Load 3.2 Electrical characteristics, Mechanical factors, Nature of load torque, Size and cost . 3.3 Comparison of DC & AC Drive and Individual & Group Drive 3.4 Speed Torque Characteristics of the Motor
	3e. Classify various types of elevator machines and their motors. 3f. State the salient features of the latest Lift and elevator Act.	3.5 Types of electric elevator machines and their motors 3.6 Power transmission gears and braking 3.7 Safety in elevators 3.8 Lift and elevator Act; such as Gujarat Lift Act Nov 2001and others
Unit-IV Electric Traction	4a. Explain the concept of Electric Traction and the ideal conditions 4b. State the need of single phase 25 kV AC for traction	4.1 Requirements of ideal Traction System. 4.2 Traction Mechanics: Types of Services, Speed Time Curve. 4.3 Supply system: DC System, Composite System, Single Phase ac system with low and normal frequency and 3 phase system
Unit-V Domestic Electrical Appliances	5a. Explain the working of various domestic electrical appliances in use. 5b. State the energy conservation measures adopted in using various domestic gadgets.	5.1 Domestic electrical appliances: i. Electric iron. ii. Electric toaster. iii. Electric water heater. iv. Microwave oven. v. Fans (Ceiling and Table fan) vi. Washing Machine. vii. Grinder/ Mixer/ juicer. viii. Vacuum Cleaner. ix. Flour Mill etc. x. Air conditioner 5.2 Concept of Star System for energy conservation

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Illumination	12	4	4	6	14
II	Electrical Heating And Welding	10	4	5	5	14
III	Electric Drives and Elevators	10	5	4	3	12
IV	Electric Traction	12	4	4	6	14
V	Domestic Electrical Appliances	12	4	4	8	16
	Total	**56**	**21**	**21**	**28**	**70**

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

7. SUGGESTED LIST OF PRACTICAL/EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercises (outcomes in psychomotor domain)	Approx. Hrs. Required
1	I	Measure Illumination at different places in college by luxmeter.	2
2	I	Prepare a survey report after collecting technical information of various lamps available in the local market.	2
3	I	Prepare an industrial visit report after visiting nearby lamp manufacturing industry (otherwise from internet)	2
4	I	Prepare a report on different luminaries available in the market & collect the technical data	2
5	I	Identify the different lighting accessories required for various types of lamps.	2
6	II	Prepare a technical report after visiting an industry, manufacturing electrical heating furnaces. (otherwise from internet)	2
7	II	Prepare a report of specification of various heating furnaces used in industries.	2
8	II	Prepare a report of specification of various electrical welding machines available in college workshop.	2
9	III	Prepare a report on various elevators after visiting nearby elevators	2

S. No.	Unit No.	Practical/Exercises (outcomes in psychomotor domain)	Approx. Hrs. Required
		manufacturing/repairing industry.	
10	III	Compare various Electric Drives for Traction	2
11	IV	Select the appropriate motors and justify selection for given different load situations (at least 5)	2
12	IV	Given a specific load condition determine the rating of a motor (motor for a pump, motor for a lift).	2
13	V	Prepare a report after visiting nearby electric-traction substation. (otherwise from Internet)	2
14	V	Prepare a report /chart on various types traction systems.	2
15	V	Prepare a report/chart on speed time curves.	2
16	V	Demonstration of different components of domestic appliances and their functions with study of their energy consumption and procedures for basic testing and maintenance. Also study of their specification and costs. (Any two of following) a) Electric toaster. b) Electric Oven c) Electric water heater. d) Microwave oven. e) Fans (ceiling and table fan) f) Washing Machine. g) Grinder / mixer / juicer. h) Vacuum cleaner. i) Flour Mill. j) Air conditioner	2 hr for each appliances
17	V	Write the procedure of servicing of any two domestic appliances after visiting nearby servicing centers of electrical domestic appliances,	2
18	V	Prepare a report on manufacturing of a domestic appliance by visiting a manufacturing unit of electrical domestic appliances (or from internet).	2
19	V	Prepare a comparative chart of two different manufacturing company in India for any two electrical domestic appliances.	2
20	V	Prepare test reports & bills for servicing of electrical domestic appliances.	2
Total Hours (perform any practical worth 28 hours from above depending upon the availability of resources so that most units are covered)			40

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Preparing reports based on tutorial practices
ii. Assignments for solving numerical
iii. Identify different types of illumination schemes in the Institute.
iv. Note the ratings of various types of welding machines in the Institute workshop.
v. Prepare chart of various electrical equipment used for heating.
vi. Seminar on elevators.
vii. Seminar on latest electric traction in world.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Industrial visit
ii. Visit to railway loco shed

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Art & Science of Utilization of Electrical Energy	H. Partab	Dhanpat Rai & Sons , New Delhi, Latest edition
2.	Utilization of Electric Power & Electric Traction.	J. B. Gupta	S. K. Kataria & Sons, New Delhi, Latest edition
3.	Utilization of Electric Power & Electric Traction	G. C. Garg	Khanna Publishers, New Delhi, Latest edition
4.	Electric Traction	J. Upadhyay S. N. Mahendra	Allied Publisher Ltd., New Delhi, Latest edition
5.	Fundamentals of Electrical Drives	G. K. Dubey	Narosa Publishing House. New Delhi, Latest edition
6.	Electrical Power system	V.K.Mehta	S.Chand, New Delhi, Latest edition

B) List of Major Equipment/ Instrument with Broad Specifications

i. Three phase transformer : 2kVA, 415V / 415 V, 50 Hz, 2.8A
ii. Three phase induction motor: 5 HP, 440 Volts, 1460 rpm, 8.0A, 50Hz, Squirrel cage.
iii. Three phase induction motor: 2 HP, 440 Volts, 1460 rpm, 50Hz, 4.2 A Slip ring cage.
iv. DOL starter, star delta starter, auto transformer starter.
v. Synchronous motor : 5HP, 3-Φ, 415 V, 50 Hz, 6.0 A, 1500 RPM, Excitation-120V DC
vi. Single phase induction motor: 1 HP, 220 V, 50Hz, 1440 RPM .
vii. Ceiling fan and other domestic appliances as given in list of practical above
viii. Various types of cables

C) List of Software/Learning Websites

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

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. H. C. Chawda**, Lecturer in Electrical Engineering RCTI, Ahmedabad
- **Prof. Alpa. A. Amin**, Lecturer in Electrical Engineering GP, Vadnagar
- **Prof. R. D. Panchal**, Lecturer in Electrical Engineering RCTI, Ahmedabad
- **Prof. V. S. Tejwani**, Lecturer in Electrical Engineering G.P. Rajkot.

Coordinator and Faculty Members from NITTTR Bhopal

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

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: DIGITAL ELECTRONICS AND DIGITAL INSTRUMENTS
(Code: 3340904)

Diploma Programmes in which this course is offered	Semester in which offered
Electrical Engineering	4th semester

1. RATIONALE

Digital electronics has invaded all branches of engineering and electrical engineering in particular. Hence it is essential that the diploma electrical engineer have a sound understanding of the basic fundamentals of digital electronics. Similarly digital instruments are replacing the analog instruments. Therefore, this course has been designed so that basic skills to operate and maintain the basic digital circuits and digital instruments are developed in the students.

2. COMPETENCY

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:

- **Maintain digital electronic circuits and instruments.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Use digital integrated circuit logic family chips.
ii. Perform computational and measurement activities using digital techniques.
iii. Build sequential and combinational logic circuits.
iv. Analyse working of A/D and D/A converters.
v. Use display devices for digital circuits.
vi. Use digital meters for measurements.

4. 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	
4	0	2	6	70	30	20	30	150

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Number Systems	1a. Convert numbers from one to another system 1b. Perform binary arithmetical operations. 1c. Explain various types of binary codes and its applications.	1.1Types of number system, inter conversion 1.2 Basic mathematical operations – 1's complement,2's complement, 9s complement and 10's complement 1.3 Binary addition, subtraction, multiplication and division. 1.4 Introductions to codes –Binary, weighted ,non weighted codes, Excess code, Grey code, BCD code, Hamming code (only introduction)
Unit– II Logic Gates And Wave Shaping Circuits	2a. Use of Diode as Wave shaping circuit with the output waveforms of the clipper circuit.	2.1 Diode and transistor as a switch. 2.2 Diode as a clipper circuit
	2b. Differentiate different logic levels 2c.Prepare the truth table of various logic gates. 2d. Develop basic gates using Universal gates	2.3 Positive logic and negative logic levels 2.4 Different types of logic gates, symbol and truth table 2.5 Universal gates - NAND and NOR
	2e. State the features of various logic families	2.6 Logic family RTL, DTL 2.7 NMOS, PMOS and CMOS
Unit– III Boolean Algebra and Combinational Circuits	3a.Apply laws of Boolean algebra 3b.State the need for Demorgan's theorems.	3.1 Laws of Boolean algebra. 3.2 Demorgan's theorems.
	3c.Build logic circuit for a given Boolean expression 3d.Build various combinational circuits. 3e.Describe the working of 3 to 8 decoder and BCD to Seven segment decoder	3.3 Boolean expression and logic diagram and vice versa 3.4 Simplification of given Boolean equation. 3.5 Combinational circuits: Half and Full Adder, half and full Subtractor, Multiplexer and Demultiplexer Encoder and Decoder
Unit- IV Sequential Circuits	4a.Explain the working of various Flip Flops with the help of truth table.	4.1Flip-Flop (FF) circuits: R-S, D, J-K and master slave J-K.
	4b.Describe the working of various types of shift generator.	4.2Shift register: series, parallel left and right
	4c.Draw the waveform of Asynchronous and Synchronous counter counters	4.3Asynchronous and Synchronous counter using 7493 and 7490
	4d. Select various	4.4 Introduction of Semiconductor memory

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	semiconductor memories	RAM, ROM, PROM, EPROM and EEPROM
Unit-V A to D And D to A Convertors and Display Devices	5a.Describe the working of various types of A to D convertors. 5b.Describe the working of various types of and D to A convertors.	5.1 Digital to Analog conversion. • Weighted Resistor Network type • Binary Ladder Network type 5.2 Analog to Digital conversion • Parallel Comparator type • Successive approximation type • Counter OR Staircase type
	5c.Explain working of various display devices used with digital circuits.	5.3 Display devices • Mechanical Drum or Disc type • Light Emitting Diode type • Liquid Crystal Display
Unit-VI Digital Instruments	6a. State the features of digital over analog instruments.	6.1 Comparison of digital instrument with analog instrument.
	6b.Draw the block diagram of digital instruments and explain each block.	6.2 Basic building blocks of -digital instruments.
	6c. Explain the working of various Digital instruments	6.3 Digital volt-meter - Ramp and Staircase type 6.4 Digital frequency meter, multi meter, Digital watt meter, Digital energy meter

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Number Systems	8	2	4	4	10
II	Logic Gates and Wave shaping Circuits	11	4	4	6	14
III	Boolean Algebra And Combinational Circuits	12	3	4	8	15
IV	Sequential Circuits	11	4	6	4	14
V	A to D and D to A Convertors and Display Devices	8	4	4	2	10
VI	Digital Instruments	6	3	3	1	7
	Total	**56**	**20**	**25**	**25**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Revised Bloom's 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.

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (outcomes in psychomotor domain)	Approx Hrs. required
1	II	Verify the truth table of the different Logic Gates**.**	2
2	II	Build basic Gates using NAND Universal Gate.	2
3	II	Build basic Gates using NOR Universal Gate.	2
4	II	Build diode positive clipper circuits and observe the output waveform	2
5	II	Build diode negative clipper circuits and observe the output waveform.	2
6	III	Build and test the logic circuit to prove commutative laws, Associative laws and Distributive laws.	2
7	III	Verify Demorgan's theorems.	2
8	III	Build and test the logic circuit for a given Boolean Expression.	2
9	III	Build and test the logic circuit for simplification of a given Boolean Expression.	2
10	III	Build and test Half Adder Circuit.	2
11	III	Build and test Full Adder Circuit.	2
12	III	Build and test Half Subtractor Circuit.	2
13	III	Build and test Full Subtractor Circuit.	2
14	IV	Build and test the working of the R-S Flip-Flop for Active High inputs.	2
15	IV	Build and verify the truth table of R-S Flip-Flop for Active Low inputs.	2
16	IV	Build and verify the truth table of D Flip-Flop.	2
17	IV	Build and verify the truth table of JK Flip-Flop.	2
18	IV	Build and test the working of the Shift Register.	2
19	IV	Build and Test the working of the Decade counter.	2
20	IV	Display various alphanumeric characters on BCD and Seven segment LED Display.	2
21	IV	Build/Test the 4 bit Decoder circuit.	2
22	IV	Build/Test the 4 bit Encoder circuit.	2
23	V	Convert given analog signal to 4 bit Digital output using ADC	2
24	V	Convert the given digital signal to analog output using DAC.	2
25	VI	Build and Test various digital circuits with the help of simulation software.	2
Total Hours (Perform any practical worth 28 hours from above depending upon the availability of resources so that most units are covered)			**50**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Student may validate the experimental results with that of results obtained using various simulation soft ware's.

ii. Student may present seminar on a given topic of this subject
iii. Students may develop counters for practical use

9. SPECIAL INSTRUCTIONAL STRATEGIES (IF ANY)

- Visit to nearby electronic component manufacturing factories
- Display of animation/video films on functioning of digital instruments.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

Sr. No.	Title of Book	Author	Publication
1.	Digital Electronics	Sanjay Sharma	S.K.Kataria & sons.
2.	Digital Electronics	Dr.B.R.Gupta & V.Singhal	S.K.Kataria & sons.
3.	Digital Electronics (for Polytechnics)	Pratima Manhas Shaveta Thakral	S.K.Kataria & sons.
4.	Trouble shooting & Maintenance of Electronic equipments	K. Sudeep singh	S.K.Kataria & sons.
5.	Digital design : with an introduction to the verilog hdl	M. Morris Mano, Michael D. Ciletti	Pearson, 5th edition.
6.	Morden Digital Electronics	R P Jain	TMH
7.	Fundamentals of Digital circuits	A. Anand Kumar	PHI
8.	Digital Electronics	K. Meena	PHI
9.	Digital principles & applications	Malvino. A. P., Leach D. P., Saha Goutam	Tata Mcgraw Hill Education Private Limited (2010), 7th Edition
10.	Pulse digital & switching wave forms	Millman & Taub	Mc. Graw Hill
11.	Electronic devices & circuits	Allen Mottershed.	Prentice Hall of India
12.	Principles of digital electronics	Malvino & Leach	Tata Mc. Graw Hill
13.	Digital circuits & systems	Douglass V. Hall	Mc. Graw Hill

B) List of Major Equipment/ Instrument with Broad Specifications

- Bread board with connecting wires & various logic input/output facilities
- Various Logic Gates, Flip-Flop, Registers, Counters, Encoder, Decoder,
- ADC, DAC, Seven Segment Code converter related ICs
- Digital Logic trainer board.
- A/D and D/A trainer modules.
- Universal counter module
- Demonstration kit for various display devices
- Digital IC tester
- Regulated Power Supply
- Digital Storage Oscilloscope
- Digital Multimeter

- Various kits of Digital Voltmeter, Frequency meter, Watt meter, Energy meter.
- Digital Function Generators
- The Virtual Instrumentation Educational Laboratory Suite specifically for teaching analog, digital, and power laboratories

C) List of Software/Learning Websites

- Matlab 2011a
- Psim
- Electronics Work Bench
- www.nptel.iitm.ac.in
- www.ocw.mit.edu
- www.slideshare.net/
- www.alldatasheet.com
- www.nptl.iitm.ac.in
- www.ocw.mit.edu
- www.slideshare.net
- www.authorstream.com
- www.daenotes.com
- www.youtube.com/nptelhrd
- www.Howstuffworks.com
- Various Simulation soft ware's such as Electronics Workbench etc.

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. S.V. Jagani** Lecturer, Govt. Polytechnic Dahod.
- **Prof J.C. Gadani**, Lecturer, C U Shah Govt. Polytechnic Surendranagar.
- **Prof H.I. Joshi**, Lecturer, Govt. Polytechnic, Ahmedabad.

Coordinator and Faculty Members from NITTTR Bhopal

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

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: COMPUTER AIDED ELECTRICAL DRAWING AND SIMULATION
(Code: 3340905)

Diploma Programmes in which this course is offered	Semester in which offered
Electrical Engineering	4th Semester

1. RATIONALE

All equipment, installations, circuits and other electrical and electronic systems in commercial, power and industrial sector need drawings for their manufacturing, installation, operation and maintenance. A technician working in design and shop floor must possess the skill of reading, interpreting different drawings and simulating electrical and electronics circuit for most of the activities. With the evolution of various computer software's the role of earlier draftsman is now taken over by Computer software. The Computer Aided Drawing (CAD) and simulation (MATLAB/SIMULINK, PSpice, MULTISIM) software will be used to perform various practical exercises in this course. This will enable the students to become competent for working in the fast growing information technology environment by enhancing their computer aided drawing, designing and simulating skills in the field of electrical and electronics engineering.

2. COMPETENCY

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:

- **Draw/simulate electrical and electronics circuit using software.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Use various symbols and notations in electrical and electronics engineering drawings.
ii. Interpret drawings, draw interferences and workout other technical details.
iii. Draw various electrical and electronics circuits according to standard practices using CAD software.
iv. Simulate/test simple electrical and electronics circuits using Simulation software
v. Prepare a PCB for a given mini project.

4. 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	
0	0	4	4	00	00	40	60	100

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5. COURSE DETAILS

Note: There are no separate theory classes for the theory to be taught as below. The relevant theory has to be discussed before students perform the practical during practical sessions.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Computer Aided Electrical Drawing	1a. List the steps of Computer aided electrical drawing 1b. Draw general graphical symbols and notations used in Electrical engineering using CAD software	1.1 Procedure to be adopted for computer aided drawings 1.2 Electrical machines - AC and DC, motor starters, measuring and display instruments etc.
	1c. Draw various electrical circuits using CAD software. 1d. Draw the cross sectional view of various electrical machines using CAD software. 1e. Draw the winding diagrams of AC and DC machines 1f. Draw lighting and power wiring diagram for a given installation	1.3 R-L series, parallel circuit 1.4 R-C series, parallel circuit 1.5 R-L-C series, parallel circuit 1.6 D.C. machine parts and cross sectional view 1.7 A.C. machine parts and cross sectional view 1.8 A.C. and D.C. winding diagrams Lighting and power wiring diagram

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit– II Computer Aided Electronics Drawing	2a. Draw general graphical ssymbols and notations used in electronics engineering using CAD software 2b. Draw various electronics circuits using Auto CAD electrical and Electronics software.	2.1 Symbols and notations of: Electronic components - Resistor, Inductor, transformer and Capacitor Semiconductor device Diodes, Zener diode, Transistors PNP/ NPN, Tunnel diode, photo diode, varactor, FET, MOSFET,IGBT, UJT etc. 2.2 Half-wave, full-wave and bridge rectifier, Power amplifier and voltage amplifier and different types of oscillators circuits
Unit– III Simulation of Electrical Circuits	3a. List the steps of using Simulation software in Electrical engineering 3b. State the procedure to build simple circuits	3.1 Getting started, ending, commonly used blocks, Creating a model, Assigning Variables, Observing Variables during Simulation, Storing/Saving Data, Creating and Masking Sub-systems
	3c. Build, Simulate and test simple electric circuits.	3.2 Series and parallel R-L circuit, 3.3 Series and parallel R-C circuit, 3.4 Series and parallel R-L-C circuit 3.5 Resonance in AC Circuit and 3.6 Electrical machines circuits
	3d. State the steps to generate graphics and plot Waveform/ response for analysis	3.7 Graphics, Plot, sub plot, label, legend etc.
Unit–IV Simulation of Electronics Circuits	4a. Build, Simulate and test simple electronic circuits.	4.1 Half wave, full wave and bridge rectifier 4.2 Power amplifier and voltage amplifier 4.3 Different types of oscillators circuits
Unit-V Computer Aided PCB Design	5a. Design PCB using computer software	5.1 Overview of software for PCB design 5.2 PCB layout of rectifier circuit 5.3 PCB layout of amplifier circuit 5.4 PCB layout of oscillator circuit

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Not Applicable

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (outcomes mainly in psychomotor domain)	Approx Hrs. required
1	I	Draw electrical and electronic symbols using CAD and take print out	04
2	I	Draw D.C. and A.C machine parts using CAD and take print out	04
3	I	Draw winding diagram for given DC machine using CAD and take print out of (a)Lap winding and (b)Wave winding	04
4	II	Draw different types of rectifier circuit using CAD and take print out of : (a)Single phase half wave (b)Single phase full wave (c)Bridge rectifier	02
5	II	Draw R-C couple amplifier circuit using CAD and take print out	02
6	II	Draw the following oscillator circuit using CAD and take print of (a)Hartley oscillator (b)Colpitt oscillator (c) Phase-Shift Oscillator (d) Wien Bridge Oscillator (e)Crystal Oscillator	06
7	III	Simulate three resistances in series circuit and find out voltage and current in each resistance .	02
8	III	Simulate the following circuits and find out voltage and current in each resistance. (a)Two resistances in parallel (b)Resistance and inductor in parallel	02
9	III	Simulate a given complex circuit having combination of series-parallel resistances and find out current and voltage across each resistor. (Students can use circuit which asked in exams of D.C. Circuits course.)	02
10	III	Simulate R-L series circuit and observe voltage wave forms across each component.	02
11	III	Simulate R-C series circuit and observe voltage wave forms across each component.	02
12	III	Simulate R-L-C series circuit and observe voltage wave forms across each component.	02

S. No.	Unit No.	Practical Exercises (outcomes mainly in psychomotor domain)	Approx Hrs. required
13	III	Simulate R-L parallel circuit and observe current wave forms across each component.	02
14	III	Simulate R-C parallel circuit and observe current wave forms across each component.	02
15	III	Simulate R-L-C parallel circuit and observe current wave forms across each component.	02
16	III	Simulate star connection using resistors and observe voltage current relation of line and phase.	02
17	III	Simulate delta connection using resistors and observe voltage current relation of line and phase.	02
18	III	Simulate one switch one bulb house wiring diagram circuit.	02
19	III	Simulate stair case wiring circuit.	02
20	IV	Simulate single phase half-wave rectifier circuit.	02
21	IV	Simulate single phase full-wave rectifier circuit.	02
22	IV	Simulate single phase bridge rectifier circuit.	02
23	IV	Simulate single phase half-wave rectifier circuit.	02
24	IV	Simulate single phase half-wave rectifier circuit.	02
25	IV	Using CRO find out voltage across resistors.(simulation)	02
26	IV	Using CRO find out unknown frequency by comparing it with known frequency.	02
27	IV	Simulate basic logic gates.	02
28	IV	Using simulation prove that NAND gate is universal gate.	02
29	IV	Using simulation prove that NOR gate is universal gate.	02
30	IV	Using simulation prove De Morgan's theorem.	02
31	IV	Using simulation prove half adder and full adder circuit.	02
32	IV	Using simulation prove half subtractor and full subtractor circuit.	02
33	V	Develop P.C.B. layout for a given electrical circuit using software	04
34	V	Develop P.C.B. layout for a given electronics circuit using software	02
Total Hours(perform any practical worth 56 hours from above depending upon the availability of resources so that most units are covered)			**60**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Download open source simulation software for electrical and electronics circuits on internet.
ii. Validate the simulation results with results obtained from performing experiments.
iii. Seminar on various simulation software.
iv. Design a PCB for a given project using software

9. SPECIAL INSTRUCTIONAL STRATEGIES (IF ANY)

Mini project may be given on CAD and simulating electrical and electronics circuits. Students should be asked to design a PCB to fabricate the circuit of mini project using software

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1	AutoCAD 2013 for Engineers and Designers.	Sham Tickoo	Dream tech press, New Delhi, Latest edition
2	Mastering AutoCAD 2013 and AutoCAD LT 2013	George Omura	Sybex, New Delhi, Latest edition
3	Mastering electronics workbench: Version 5 and Multisim Version 6	John Adams	McGraw-Hill, New Delhi, Latest edition
4	Introduction to PSpice Using OrCAD For Circuits And Electronics	Muhammad H. Rashid	PHI Learning, New Delhi, Latest edition

B) List of Software/Learning Websites

i. Open Source Softwares preferred.
ii. AutoCAD
iii. Work bench
iv. PSIM
v. SPICE (Simulation Program with Integrated Circuit Emphasis)……..
vi. Orcad for pcb design…..
vii. Circuit maker
viii. Multi-Sim
ix. http://coolcadelectronics.com/coolspice/)
x. http://students.autodesk.com/ (register and get free student version of LATEST AutoCAD software for approximately 3 years)
xi. http://www.circuitstoday.com/circuit-design-and-simulation-softwares
xii. http://en.wikipedia.org/wiki/List_of_free_electronics_circuit_simulators
xiii. http://coolcadelectronics.com/coolspice/
xiv. Android applications available on Google Play store like AutoCAD 360, Circuit Builder, Electric Circuit, Circuit Simulator, WeSpice Demo, Electric Circuit Calculator, Electrical Engineering

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

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