

**IV Semester**

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory hours	Drawing hours	Practical hours	Total hours
4030410	Electrical Machines -II	5	-	-	5
4030420	Measurements, Instruments and Transducers	5	-	-	5
4040430	Analog and Digital Electronics	4	-	-	4
4020620	E-Vehicle Technology and Policy	4	-	-	4
4030450	Electrical Machines and Instrumentation Practical	-	-	5	5
4040460	Analog and Digital Electronics Practical	-	-	5	5
4030470	Electrical Circuits and Simulation Practical	-	-	4	4
		18	-	14	32
Extra / Co-Curricular activities					
Library		-	-	-	1
Physical Education		-	-	-	2
<b>TOTAL</b>					<b>35</b>

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory hours	Drawing hours	Practical hours	Total hours
4030410	Electrical Machines -II	5	-	-	5
4030420	Measurements, Instruments and Transducers	5	-	-	5
4040430	Analog and Digital Electronics	4	-	-	4
4020620	E-Vehicle Technology and Policy	4	-	-	4
4030450	Electrical Machines and Instrumentation Practical	-	-	5	5
4040460	Analog and Digital Electronics Practical	-	-	5	5
4030470	Electrical Circuits and Simulation Practical	-	-	4	4
		18	-	14	32
Extra / Co-Curricular activities					
Library		-	-	-	1
Physical Education		-	-	-	2
<b>TOTAL</b>					<b>35</b>

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**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**  
**DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS**  
**N-SCHEME**

(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : Diploma in Electrical and Electronics Engineering

Subject Code : 4030410

Semester : IV

Subject Title : Electrical Machines – II

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
<b>ELECTRICAL MACHINES - II</b>	5	80	25	100*	100	3 Hrs.

\* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

**Topics and Allocation of Hours**

UNIT	Topic	Hrs.
I	Alternator Principles and Construction	12
II	Alternator Performance and Testing	16
III	Three Phase Induction Motor	16
IV	Single Phase Induction Motor & Synchronous Motor	15
V	Maintenance of Induction Motors & Starters	14
Test & Model Exam		7
<b>Total</b>		<b>80</b>

## RATIONALE

- This subject is classified under Core Technology group intended to teach Students about facts, concepts, Principles of Electrical Machines such as Induction Motor, Alternator and Synchronous Motor.
- Students will be able to analyze the characteristics and qualitative parameters of these Machines.
- These Machines are widely used in Industries and for generation of electricity.
- The knowledge gained by the student is useful in the study of Technological Subjects such as Utilization System, Manufacturing Processes and Testing and Maintenance of Electrical Machines.
- The knowledge and skills obtained will be helpful in discharging Technical Functions such as Supervision, Controlling and as R & D Technicians.

## OBJECTIVES

. The students will be able to understand the concepts of:

- Alternator Principle, Construction and their Types, EMF Induced and Cooling Techniques of Machines
- Performance of an Alternator, Testing, Characteristics, Parallel Operation, Load Sharing etc.,
- Three Phase Induction Motor, Principle, Construction, Types, Characteristics and Applications, Starting Methods
- Single Phase Motor Types, Construction, Characteristics and Applications, Synchronous Motor, Starting, Construction, Characteristics and Applications
- Maintenance of Induction Motors and Starters.

**DETAILED SYLLABUS**

Contents: Theory

Unit	Name of the Topics	Hours
I	<b>ALTERNATOR PRINCIPLES AND CONSTRUCTION</b>  Basic Principle of Alternators — Types of Alternators — Stationary Armature Rotating Field — Advantages of Rotating Field — Construction Details of Alternator — Salient Pole Rotor — Cylindrical Type Rotor — Types of A.C. Armature Windings — Types of Slots — Full Pitch and ShortPitched Windings — Phase Spread Angle and Effect of Distribution Factor — Pitch Factor — Relation between Frequency, Speed and Number of Poles — EMF Equation — Problems	10
	Methods of obtaining Sine Wave –Critical Speed of Rotor – Ventilation of Turbo Alternators – Advantages of Hydrogen Cooling and its Precaution – Excitation and Exciters.	2
II	<b>ALTERNATOR PERFORMANCE AND TESTING</b>  Load Characteristics of Alternators – Reason for Change in Terminal Voltage –Qualitative Treatment of Armature Reaction for various Power Factor Loads — Effective Resistance — Leakage Reactance — Synchronous Reactance, Synchronous Impedance — Voltage Regulation – Determination of Voltage Regulation of Alternator by Direct Load Test - Pre-Determination of Regulation of Alternator by Indirect Method (EMF, MMF, and ZPF).	10
	Necessity and conditions for Parallel Operation of Alternators – Synchronizing by Dark Lamp Method, Bright Lamp Method, Dark - Bright Lamp Method and Synchro scope Method– Synchronizing Current, Synchronizing Power and Synchronizing Torque – Load Sharing of Alternators –Infinite Bus Bar.	6
III	<b>THREE PHASE INDUCTION MOTOR</b> Rotating Magnetic Field — Principle of Operation of Three Phase Induction Motors – Slip and Slip Frequency – Comparison between Cage and Slip Ring Induction Motors –Development of Phasor Diagram – Expression for Torque in Synchronous Watts — Slip-Torque Characteristics – Stable and Unstable Region – No Load Test and Blocked Rotor Test – Development of Approximate Equivalent Circuit	10

	– Problems on the above Topics – Simplified Circle Diagram.	
	Determination of Maximum Torque, Slip (Problems Not Required) – Starting Torque and Starting Current Expression – Relationship between Starting Torque and Full Load Torque – Speed Control of Induction Motors. Starters of Induction Motors – Direct online Starter and Its Merits for Cage Motors – Star Delta Starter- Auto Transformer Starter - Rotor Resistance Starter – Cogging –Crawling in Induction Motor– Double Cage Induction Motor-Induction Generator.	6
IV	<b>SINGLE PHASE INDUCTION MOTOR</b> Single Phase Induction Motors — Not Self Starting — Methods of Making itself Starting – Construction, Working Principle – Phasor Diagram-Slip Torque Characteristics- Split Phase Motor - Capacitor Motor - Shaded Pole Motor - Repulsion Motor - Universal Motor — Operation of Three Phase Motor with Single Phase Supply.	8
	<b>SYNCHRONOUS MOTOR</b> Principle of Operation –Not Self Starting – Methods of Starting–Effects of Excitation on Armature Current and Power Factor– ‘V’ Curve and Inverted ‘V’ Curve of Synchronous Motor — The Phenomenon of Hunting and Prevention of Hunting by Damper Winding — Comparison between Synchronous Motor and Three Phase Induction Motor - Applications -Problems on Power Factor Improvement.	7
V	<b>MAINTENANCE OF INDUCTION MOTORS AND STARTERS</b> BIS Publication Dealing with The Code of Practice of Induction Motors and Starters – Classification of Cage Motor – Continuous Rating and Intermittent Rating – Various Types of Enclosures – Specifications of Motors – Selecting the Cable Rating – Single Phase Prevention using Current Operated Relay – Commissioning - Annual Maintenance	7
	Selection of Starters of Induction Motor – Common Induction Motor Troubles and their Remedies – Causes of Noise and Vibration – Care of Bearings – Static Balancing – Degreasing – Vacuum Impregnation - Varnishing – Effect of Unbalanced Supply on the Performance of Induction Motor.	7

**TEXTBOOK**

<b>S.No</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
1.	B.L. Theraja	A Textbook of Electrical Technology -Volume II	S.Chand& Co. New Delhi
2.	Edward Hughes	Electrical Technology	Addision– Wesley International Student Edition

**REFERENCE BOOK**

<b>S.No</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
1.	M.G.Say	Performance and Design of ACMachines	Pitman PublishingLtd
2.	Nagarath	Electrical Machines	TMH Publications
3.	Bhattacharya	Electrical Machines	TMH Publications

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS**

**N-SCHEME**

**(Implemented from the Academic year 2020 - 2021 onwards)**

Course Name : Diploma in Electrical and Electronics Engineering  
Subject Code : 4030420  
Semester : IV Semester  
Subject Title : MEASUREMENTS, INSTRUMENTS AND TRANSDUCERS

**TEACHING AND SCHEME OF EXAMINATION**

No. of weeks per Semester: 16 Weeks

Subject	Instruction		Examination			Duration
	Hours/ Week	Hours/ Semester	Internal Assessment	Board Examination	Total	
<b>MEASUREMENTS, INSTRUMENTS AND TRANSDUCERS</b>	5	80	25	100*	100	3 Hrs

\* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

**TOPICS AND ALLOCATION OF HOURS**

Unit	Topic	Hours
I	Classification and Characteristics of Instruments	15
II	Measurement of current Voltage and Resistance	15
III	Measurement of Power, Power Factor and Frequency	15
IV	Measurement of L, C Parameters, Waveforms and Signal Conditioners	13
V	Sensors and Transducers	15
	Revision and Test	07
	<b>Total</b>	<b>80</b>



## **RATIONALE** Anna University, Polytechnic, Schools

Measurement is the basic and primary operation, the result of which is used only to describe the system and hence treated as an independent operation. Automation of any kind begins with the measurement of certain system parameters; In fact, Industrial growth moves hand in hand with the growth of the measurement of Science and Technology. Therefore, it is highly essential for Electrical Students to study about the measurement of various Electrical Parameters in a system and the construction and working of different Instruments used in measurement of such parameters.

### **OBJECTIVES**

At the end of the Semester, Students will be able to:

- To define basic measurement terms.
- To learn about various operating Forces and effects used in Instruments.
- To study the construction and working of Moving coil and Moving Iron instruments, CT and PT and Electrostatic Voltmeter.
- To understand the measurement of Resistance using different means.
- To study Single Phase and Three Phase Power Measurement using Wattmeter.
- To study the construction and working of Single Phase, Three Phase Energy Meter and study about calibrations.
- To study the construction and working of Power Factor Meters, and Phase Sequence Indicators.
- To study about the Frequency Measurement using different types of Frequency Meters.
- To learn about the measurement of Inductance and Capacitance using Bridges.
- To study about CRO and its applications.

**DETAILED SYLLABUS**

**CONTENTS: Theory**

UNIT	NAME OF THE TOPICS	HOURS
<b>I</b>	<p><b>CLASSIFICATION AND CHARACTERISTICS OF INSTRUMENTS</b></p> <p>General - Definition of Measurement – Functions of Measurement System (Indicating, Recording and Controlling Function) – Applications of Measurement Systems – Classification – Absolute and Secondary Instruments – Indicating Recording and Integrating Instruments –Analog and Digital</p>	<b>10</b>
	<p>Definition of True Value, Accuracy, Precision, Error and Error Correction – Instrument Efficiency – Effects used in Instruments – Operating Forces – Deflecting, Controlling and Damping Forces.</p>	<b>5</b>
<b>II</b>	<p><b>MEASUREMENT OF CURRENT, VOLTAGE AND RESISTANCE</b></p> <p>Types of Instruments – Construction, Working and Torque Equation of Moving Coil, Moving Iron, Dynamometer Type (Shaded Pole) Instruments – Extension of Instrument Range Using Shunts and Multipliers. (Calculation, Requirements and Simple Problems). Tong Tester – Electrostatic Voltmeter – Rectifier Type Instruments –Instruments Transformers CT and PT – Testing, Errors and Characteristics of CT and PT.</p>	<b>10</b>
	<p>Classification of Resistance – Measurement using Conventional Method – (Ammeter – Voltmeter Method) Measurement of Low Resistance using Kelvin’s Bridge Ohmmeter – Measurement of Medium Resistance using Wheatstone Bridge – High Resistance using Megger - Earth Resistance- –u Earth Tester – Multimeters.</p>	<b>5</b>

<b>III</b>	<p><b>MEASUREMENT OF POWER, POWER FACTOR AND FREQUENCY</b></p> <p>Power in D.C and A.C Circuits — Watt Meters in Power Measurement —Measurement of Energy in AC Circuits – Single Phase and Three Phase Energy Meters Construction and Operation — Digital Energy Meter.</p>	<b>7</b>
	<p>Power Factor Meters – Single Phase Electro Dynamometer Type – Construction and Working – Phase Sequence Indicator – Phase Difference Measurement using Synchro scope –Tri-vector Meter – Merz Price Maximum Demand Indicator. Frequency Measurement Frequency Meter – Digital Frequency Meter (Simplified Block Diagram)</p>	<b>8</b>
<b>IV</b>	<p><b>MEASUREMENT OF L, C PARAMETERS, WAVEFORMS AND SIGNAL CONDITIONERS</b></p> <p>Inductance – Maxwell’s Inductance Bridge – Andersons Bridge – Measurement of Capacitance using Schering Bridge.</p>	<b>5</b>
	<p>CRO — Block Diagram — CRT — Applications - Measurements of Voltage, Frequency and Phase Difference Using CRO – Digital Storage Oscilloscope – Block Diagram.</p>	<b>5</b>
	<p><b>SIGNAL CONDITIONER:</b> Basic Components of Signal Conditioning System</p>	<b>3</b>
<b>V</b>	<p><b>SENSORS AND TRANSDUCERS</b></p> <p>Definition – Types of Transducers</p> <p><b>PASSIVE TRANSDUCERS:</b></p> <p>Resistive Transducer – Strain Gauge – Capacitive Transducer – Inductive Transducer – Proximity Sensor – Construction and Operation of LVDT and RVDT</p>	<b>8</b>
	<p><b>ACTIVE TRANSDUCERS:</b></p> <p>RTD – Thermistor - Thermocouple – Synchronous – Piezoelectric Transducer-Measurement of Pressure and Vibration – Hall Effect Transducer – Photovoltaic Transducer – Photoconductive Transducer.</p> <p><b>TELEMETRY:</b> Block Diagram and its Applications</p>	<b>7</b>

**TEXT BOOKS:**

<b>S.No</b>	<b>Title</b>	<b>Author</b>	<b>Publishers</b>
1.	A Course in Electrical and Electronics Measurements and Instrumentation	A.K. Sawhney	Puneet Sawhney Dhanpat Rai & Co (P) Ltd., New Delhi 1993

**REFERENCE BOOKS:**

<b>S.No</b>	<b>Title</b>	<b>Author</b>	<b>Publishers</b>
1.	Electronic Instrumentation	HS Kalsi	Tata Mc Graw Hill Publishing Co., Delhi 2010
2.	Modern Electronic Instrumentation and Measurement techniques	Albert D. Helfrick William David Cooper	Prentic – Hall of India (P)Ltd., New Delhi 2010
3.	Electronics and Instrumentation	Dr.S.K.Battachariya Dr. Renu Vig	S.K. Kataria & Sons, New Delhi
4.	A course in Electrical and Electronic Measurement and Instrumentation	Umesh Sinha	Satya Prakashan, New Delhi

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**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**  
**DIPLOMA IN ENGINEERING/TECHNOLOGY SYLLABUS**  
**N SCHEME**

(To be Implemented for the students admitted from the year 2020 - 2021 onwards)

Course Name : All Branches of Diploma in Engineering and Technology  
Subject Code : 4040430  
Semester : IV  
Subject title : ANALOG AND DIGITAL ELECTRONICS

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks/ semester: 16weeks

Subject	Instruction		Examination			Duration
	Hours /Week	Hours /Semester	Marks			
			Internal Assessment	Board Examination	Total	
ANALOG AND DIGITAL ELECTRONICS	4	64	25	100*	100	3 Hrs

\* Examination will be conducted for 100 marks and it will be reduced to 75 marks.

**Topics and Allocation of hours**

Unit	Topic	Hrs
I	Linear ICs and OP-amps	10
II	A/D, D/A, Special Function ICs and IC Voltage Regulators	13
III	Boolean Algebra and Arithmetic operations	10
IV	Combinational and Sequential Logic Circuits	12
V	Memories	12
	Tests and Model Exam	7
	<b>Total</b>	<b>64</b>

**RATIONALE:**

The subject Analog and Digital Electronics holds applications in all branches of engineering instrumentation and Industrial Automation. This will impart in depth knowledge of Number Systems, Logics of Combinational & Sequential circuits and memories.

**OBJECTIVES:**

On completion of the following units of the syllabus contents, the students must be able to

- Understand the basics of operational amplifier.
- Know the op-amp applications.
- Know the waveform generator and Active filter.
- Know the concept of D/A and A/D converters
- Know the applications of Special function IC, IC 555 Timer.
- Understand various Number Systems used in Digital Circuits
- Understand basic Boolean postulates and laws.
- Understand the De-Morgan's theorem.
- Understand the concept of Karnaugh Map.
- Learn about Basic logic Gates.
- Study about Boolean techniques.
- Learn the different digital logic families
- Learn arithmetic circuits- Adder/Subtractor
- Understand the encoder/decoder & MUX / DEMUX
- Understand the concept of parity Generator and checker
- Understand various types of flip-flops.
- Understand various types of counters
- Understand various modes of shift registers
- Understand various types of memories

### DETAILED SYLLABUS

Contents: Theory

Unit	Name of the topics	Hours
I	<b>LINEAR ICS AND OP-AMPS</b> <b>1.1: OPERATIONAL AMPLIFIER</b> Ideal Op-Amp – Block diagram and Characteristics – Op-amp parameters CMRR – Slew rate – Concept of Virtual ground	4
	<b>1.2: APPLICATIONS OF OP-AMP</b> Inverting amplifier –Summing amplifier – Non inverting amplifier – Voltage follower - Comparator – Zero crossing detector – Integrator – Differentiator- waveform generation (Schmitt Trigger only)–RC Low pass Active filter.	4
	<b>1.3: OP-AMP SPECIFICATIONS</b> OP-amp 741 – Symbol – Pin diagram – Specifications	2
II	<b>A/D, D/A, SPECIAL FUNCTION ICs AND IC VOLTAGE REGULATORS</b> <b>2.1: SAMPLING AND QUANTIZATION</b>	2
	<b>2.2: A/D CONVERTER</b> Analog to digital conversion using Ramp method – Successive approximation method – Dual slope method – Specifications of A/D converter	3
	<b>2.3: D/A CONVERTER</b> Basic concepts – Weighted Resistor D/A converter – R-2R Ladder D/A converter – Specifications of DAC IC	2
	<b>2.4: SPECIAL FUNCTION ICs</b> 2.4.1: IC 555 Timer – Pin diagram - Functional Block diagram of IC 555 in Astable and Monostable Multivibrator mode - Schmitt trigger using IC 555	3
	2.4.2: IC 565-PLL-Pin Diagram-Functional Block diagram of IC 565 2.4.3: IC 566-VCO-Pin Diagram-Functional Block diagram of IC 566	
	<b>2.5.: IC VOLTAGE REGULATORS</b> Positive IC Voltage Regulators: 78XX - Negative IC Voltage Regulators: 79XX and General-purpose IC Voltage Regulators using LM 723.	3

III	<p><b>BOOLEAN ALGEBRA AND ARITHMETIC OPERATIONS</b></p> <p><b>3.1: NUMBER SYSTEMS</b> Decimal – Binary – Octal – Hexadecimal – BCD – Conversion from one number system to other – Boolean Algebra – Basic laws and Demorgan’s Theorems</p> <p><b>3.2: UNIVERSAL GATES</b> Realization of basic logic gates using universal gates NAND and NOR -Tristate Buffer circuit</p> <p><b>3.3: PROBLEMS USING 2, 3, AND 4 VARIABLES</b> Boolean expression for outputs – Simplification of Boolean expression using Karnaugh map (up to 4 variable)- Constructing logic circuits for the Boolean expressions</p> <p><b>3.4: ARITHMETIC OPERATIONS</b> Binary Addition-Binary Subtraction-1’s compliment and 2’s compliment-Signed binary numbers</p> <p><b>3.5: ARITHMETIC CIRCUITS</b> Half Adder-Full Adder-Half Subtractor-Full Subtractor</p>	2  2  2  2
	<p><b>COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS</b></p> <p><b>4.1: PARITY GENERATOR AND CHECKER</b></p> <p><b>4.2: DECIMAL to BCD ENCODER</b></p> <p><b>4.3: 3 to 8 DECODER</b></p> <p><b>4.4: MULTIPLEXER:</b> 4 to 1 Multiplexer</p> <p><b>4.5: DEMULTIPLEXER :</b>1 to 4 Demultiplexer</p>	1  1  1  1
	<p><b>4.6: FLIP-FLOPS (FF)</b> RS FF– JK FF: Master Slave FF and Edge triggered FF – D and T FF</p> <p><b>4.7: COUNTERS</b> 4 bit Asynchronous Up Counter –Mod N counter – Decade counter – 4 bit Synchronous up counter</p> <p><b>4.8: SHIFT REGISTER</b> 4 bit shift register – Serial in Serial out</p>	1  1  2  3  2



	<b>MEMORIES</b>	
V	<b>5.1: CLASSIFICATION OF MEMORIES</b>	<b>6</b>
	<b>5.2:RAM</b> RAM organization-Address Lines and Memory Size- Read/write operations-Static RAM-Bipolar RAM cell- Dynamic RAM- SD RAM- DDR RAM.	
	<b>5.3:ROM</b> ROM organization-Expanding memory- PROM- EPROM- and EEPROM- Flash memory- Anti Fuse Technologies.	<b>6</b>

**TEXT BOOKS:**

1. Roger L. Tokheim Macmillan – Digital Electronics – McGraw – Hill –1994.
2. D.Roychoudhury & shail. B.Jain- Linear Integrated Circuits -New age International publishers - II Edition -2004.

**REFERENCE BOOKS:**

1. Albert Paul Malvino and Donald P. Leach – Digital Principles and Applications
2. William H.Goth Mann – Digital Electronics – An introduction to theory and practice – PHI 1998.
3. Linear Integrated Circuits by B.Suseela & T.R.Ganesh babu -Scitech publications-2018
4. Integrated circuits by K.R.Botkar-Khanna publisher's-1996.
5. R.P.Jain – Modern Digital Electronics – TMH 2003.

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**

**DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS**

**N-SCHEME**

(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : All branches of Diploma in Engineering and Technology

Subject Code : 4020620

Semester : VI

Subject Title : E - VEHICLE TECHNOLOGY & POLICY

**TEACHING AND SCHEME OF EXAMINATION**

No of Weeks per Semester: 16 Weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
<b>E - VEHICLE TECHNOLOGY AND POLICY</b>	4	64	25	100*	100	3 Hrs.

\* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

**Topics and Allocation of Hours**

Unit No	Topics	Hours
I	Environmental impact and history, Types of Electric vehicles	12
II	Electric vehicle, Electrical Propulsion System	12
III	Energy Storages, Charging System, Effects and Impacts	11
IV	Electric Mobility Policy Frame Work	11
V	Tamilnadu E-Vehicle Policy 2019	11
Test And Revision		7
<b>Total</b>		<b>64</b>

## **RATIONALE**

The world is transitioning to cleaner mobility options with the aim at improving air quality and reducing dependency on fossil fuels. Electric Vehicles (EVs) have emerged a popular clean mobility choice to reduce emissions. EVs are powered fully or partially by batteries, they can help to reduce dependence on fossil fuels also air quality. Tamil Nadu is one of the most advanced states in India. Tamil Nadu has a highly developed industrial eco-system and is very strong in sectors like automobiles and auto-components. Many globally renowned companies have setup their manufacturing facilities in Tamil Nadu. Due the rapid depletion of fossil fuel and increase in fuel cost, environmental pollution, the shift to clean transport is necessary. This subject introduced by keeping all the above factors.

## **OBJECTIVES**

1. To learn the environmental impact and history of Electric Vehicles.
2. To understand the concept of Electric Vehicle and its types.
3. To study the configurations of Electric Vehicles
4. To acquire knowledge about Energy Storages, Charging System, Effects and Impacts
5. To appreciate the Electric Mobility Policy Frame work India and EV Policy Tamil Nadu 2019.

**DETAILED SYLLABUS**

Contents: Theory

Unit	Name of the Topics	Hours
I	<b>Environmental impact and history:</b> Environmental impact of conventional vehicle - Air pollution – Petroleum resources – History of Electric vehicles & Hybrid Electric Vehicles - Conventional drive train system – Rear Wheel, Front Wheel and All wheel - Parts of Drive train system	6
	<b>Types of Electric Vehicles:</b> Introduction to Battery Electric Vehicle (BEV) – Definition BEV – Necessity BEV – Different between BEV and Conventional Vehicle - Advantages of BEV - Block diagram of BEV – Hybrid electric Vehicle (HEV) - Plug-in Hybrid Electric Vehicle (PHEV) – Fuel Cell Electric Vehicle (FCEV) – Description.	6
II	<b>Electric Vehicles:</b> Configurations of Electric Vehicle – Performance of Electric Vehicles – Tractive Effort in Normal Driving – energy consumption. Hybrid Electric Vehicles: Concept of Hybrid electric drive trains – Architecture of Hybrid Electric Drive trains – Series, Parallel and Series & Parallel	6
	<b>Electric Propulsion Systems:</b> Types of EV motors - DC motor drives– Permanent Magnetic Brush Less DC Motor Drives (BLDC) – Principles, Construction and Working – Hub motor Drive system – Merits and Demerits of DC motor drive, BLDC motor drive	6

III	<p><b>Energy Storages:</b> Electrochemical Batteries – Battery Technologies – Construction and working of Lead Acid Batteries, Nickel Based Batteries and Lithium Based Batteries - Role of Battery Management System (BMS)– Battery pack development Technology– Cell Series and Parallel connection to develop battery pack.</p>	5
	<p><b>Charging:</b> Battery Charging techniques - Constant current and Constant voltage, Trickle charging – Battery Swapping Techniques – DC charging – Wireless charging – Maintenance of Battery pack – Latest development in battery chemistry.</p>	4
	<p><b>Effects and Impacts:</b> Effects of EV – Impacts on Power grid – Impacts on Environment – Impacts on Economy.</p>	1
IV	<p><b>Electric Mobility Policy Frame Work</b> Government of India Electric Mobility Policy Frame work – Global Scenario of EV adoption – Electric mobility in India – National Electric Mobility Mission Plan 2020 – Action led by Original Equipment Manufacturers – Need of EV Policy – Advantage of EV Eco system – Scope and Applicability of EV Policy – ARAI Standards for Electric Vehicle – AIS 038, AIS 039 &amp; AIS 123 - Key Performance Indicator - Global impact – Trends and Future Developments</p>	11
V	<p><b>Tamil Nadu E-Vehicle Policy 2019</b> Tamil Nadu E-vehicle Policy 2019: Vehicle Population in Tamil Nadu – Objectives of EV Policy – Policy Measures – Demand side incentives – Supply side incentives to promote EV manufacturing – Revision of Transport Regulation of EV – City building codes – Capacity Building and Skilling – Charging structure – implementing agencies – Research &amp; Development and Business Incubation – Recycling Ecosystem – Battery and EVs</p>	11

**TEXT BOOKS:**

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, CR Press, London, New York.
2. Comparison of Electric and Conventional Vehicles in Indian Market: Total Cost of Ownership, Consumer Preference and Best Segment for Electric Vehicle (IJSR), Akshat Bansal, Akriti Agarwal

**REFERENCE BOOKS:**

1. A Comprehensive Study of Key Electric Vehicle (EV) Components, Technologies, Challenges, Impacts, and Future Direction of Development (MDPI), Fuad Un-Noor, Sanjeevi kumar Padmanaban, Lucian Mihet-Popa, Mohammad NurunnabiMollah and Eklas Hossain.
2. Electric Vehicles: A future Projection CII October 2020 report.
3. Design and analysis of aluminum/air battery system for electric vehicles, Shaohua Yang, Harold Knickle, Elsevier.
4. Propelling Electric Vehicles in India, Technical study of Electric Vehicles and Charging Infrastructure
5. Zero Emission Vehicles (Zevs): Towards A Policy Framework – Niti Aayog.
6. Faster Adoption of Electric Vehicles in India: Perspective of Consumers and Industry, TheEnergy and Resources Institute, New Delhi.
7. India EV Story: Emerging Opportunities by Innovation Norway.
8. Automotive Industry Standards – AIS 038, AIS 039 & AIS 123 – Manual

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**  
**DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS**  
**N-SCHEME**  
**(Implemented from the Academic year 2020 - 2021 onwards)**

Course Name : Diploma in Electrical and Electronics Engineering

Subject Code : 4030450

Semester : IV

Subject Title : Electrical Machines and Instrumentation Practical

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
<b>ELECTRICAL MACHINES AND INSTRUMENTATION PRACTICAL</b>	5	80	25	100*	100	3 Hrs.

\* Examinations will be conducted for 100 marks, and it will be reduced to 75 marks.

**RATIONALE:**

- To impart practical knowledge to the Diploma Students, Practical's are introduced for every corresponding Theory Subject.
- This Practical Subject supports the Aim and Objective of Electrical Machines II and Measurements and Instruments subjects.

**OBJECTIVES:**

On completion of this practical Subject the Students will be able to:

- Understand the characteristics of AC Machines.
- Make various Electrical Measurements.
- Use Transducers in Non-Electrical Quantity Measurement

**DETAILED SYLLABUS**

Contents: Practical

**Name of the Topics:** Electrical Machines and Instrumentation Practical

**Exercise:**

1. Predetermine the Regulation of Alternator.
2. Load test on 3 Phase Alternator.
3. Synchronization of 3 Phase Alternator
4. Load test on Single Phase Induction Motor.
5. Load test on 3 Phase Induction Motor.
6. Determine the Equivalent Circuit Constants of 3 Phase Induction Motor.
7. Predetermine the performance of a 3 Phase Induction Motor.
8. Improvement of Power Factor of an Induction Motor with load.
9. Calibration of given Ammeter and Voltmeter.
10. Calibration of given Wattmeter.
11. Calibration of 3 Phase Energy Meter.
12. Measurement of Alternator Winding Resistance using Wheatstone Bridge
13. Measurement of value of unknown Capacitance using Schering Bridge.
14. Measurement of value of unknown Inductance using Anderson Bridge.
15. Displacement measurement using LVDT.
16. Measurement of earth Resistance by using Megger.



**LIST OF EQUIPMENTS (For a Batch of 30 Students)**

S.NO	NAME OF TH EQUIPMENTS	QUANTITY REQUIRED
1.	Three Phase Squirrel Cage Induction motor 5 HP, 440V, 1440 rpm with starting and loading arrangement	2
2.	Three Phase Squirrel Cage Induction motor 5 HP, 440V, 1440 rpm without starting and loading arrangement	1
3.	Three phase Slip ring Induction motor 5HP, 440V, 940/1450 rpm with starting and loading arrangement	1
4.	Single phase induction motor with starting and loading arrangement 2HP, 250V, 10A, 1440 rpm.	1
5.	Wheatstone bridge.	2
6.	Anderson Bridge.	2
7.	Schering Bridge.	2
8.	1 Phase Energy meter induction type, 250V, 10A.	2
9.	3 Phase Energy meter Induction type 440V, 10/20A.	2
10.	Earth megger with necessary connecting leads and rods.	1
11.	3 phase Alternator with prime mover.	2
12.	Synchronizing panel.	1
13.	PF meter (power factor meter).	2
14.	LVDT trainer.	2
15.	3 phase capacitor bank rating of 1KVAR, 400/440 V.	1

**DETAILED ALLOCATION OF MARKS**

<b>S.NO</b>	<b>NAME OF THE ACTIVITY</b>	<b>MARK ALLOCATION</b>
1	Circuit Diagram	30
2	Connections And Conduction of the Experiment	30
3	Reading/Calculation	20
4	Graph/Result	15
5	Viva Voce	05
	Total	100

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**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU**  
**DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS**

**N-SCHEME**  
**(Implemented from the Academic year 2020 - 2021 onwards)**

Course Name : All Branches of Diploma in Engineering and Technology  
Subject code : 4040460  
Semester : IV  
Subject title : ANALOG AND DIGITAL ELECTRONICS PRACTICAL

**TEACHING AND SCHEME OF EXAMINATION**

No. of weeks/ Semester: 16weeks

Subject	Instruction		Examination			Duration
	Hours /week	Hours /semester	Marks			
			Internal Assessment	Board Examination	Total	
ANALOG AND DIGITAL ELECTRONICS PRACTICAL	5	80	25	100*	100	3 Hours

\* Examination will be conducted for 100 marks and it will be reduced to 75 marks.

**RATIONALE:**

Every Electronic Engineer should have sound knowledge about the ICs used in Electronics Industry. This is vital in R&D Department for Chip level troubleshooting. To meet the industrial needs, diploma holders must be taught about the most fundamental subject, Analog and Digital Electronics Practical. By doing practical experience in this, they will be skilled in handling all types of ICs and able to apply the skill in electronic system design and the designing of PCBs.

**OBJECTIVES:**

On completion of the following experiments, the students must be able to

- Know the Verification of truth table of OR, AND, NOT, NOR, NAND, EX-OR gates
- Know the Realization of basic gates using NAND & NOR gates.
- Know the verification of Half Adder and Full Adder using IC's.
- Know the verification of Half Subtractor and Full Subtractor using IC's.
- Know the Verification of Truth Table for Decoder/Encoder.
- Know the Verification of truth table for RS, D, T & JK flip-flop.

- Test Inverting Amplifier and Non inverting amplifier using Op-amp
- Test Summing Amplifier, Difference Amplifier and Voltage Comparator using Op-amp.
- Test Integrator and Differentiator.
- Test Astable multivibrator using IC 555
- Design IC Voltage Regulator Power Supplies using IC 7805, IC 7912
- Design the PCB of 4- bit ripple counter using FF

**4040460 ANALOG AND DIGITAL ELECTRONICS PRACTICAL**  
**DETAILED SYLLABUS**

Contents: Practical

**Exercises**

**Note: At least 6 experiments should be constructed using breadboard**

1. Realization of basic gates using NAND & NOR gates.
2. Realization of logic circuit for De-Morgans Theorems
3. Test the performance of Half Adder and Full Adder.
4. Test the performance of Half Subtractor and Full Subtractor.
5. Test the performance of Decoder/Encoder.
6. Test the performance of RS, D, T & JK flip-flops.
7. Test the performance of Parity generator and checker using parity checker/  
generator IC's.
8. Test the performance of Multiplexer/De-multiplexer using IC 4051
9. Test the performance of Inverting Amplifier and Non inverting amplifier using Op-amp  
IC 741.
10. Test the performance of Summing Amplifier, Difference Amplifier.
11. Test the performance of Zero Crossing Detector and Voltage Comparator using Op-amp IC  
741.
12. Test the performance of Integrator and Differentiator using Op-amp IC 741.
13. Test the performance of Astable multivibrator using IC 555.
14. Test the performance of IC Voltage Regulator Power Supplies using IC 7805, IC 7912.
15. Design the PCB of 4- bit ripple counter using FF using Software tool Multisim/OrCAD

### DETAILED ALLOCATION OF MARKS

S.No.	NAME OF THE ACTIVITY	MARK ALLOCATION
1	CIRCUIT DIAGRAM	25
2	CONNECTION	30
3	EXECUTION & HANDLING OF EQUIPMENT	20
4	OUTPUT / RESULT	15
5	VIVA – VOCE	10
	TOTAL	100

### LIST OF EQUIPMENTS (For a Batch of 30 Students)

S. NO	Name of the Equipments	Range	Required Nos
1	DC Regulated power supply	0-30V, 1A	5
2	IC Voltage Power Supply	0-5V, 1A 15-0-15V, 1A	5 5
3	Signal Generator	1MHz	4
4	Dual trace CRO	20MHz/ 30MHz	5
5	Digital Trainer	-	10
6	DC Voltmeter (Analog/Digital)	Different Ranges	5
7	DC Ammeter (Analog/Digital)	Different Range	5
8	Desk Top Computer	-	5
9	Simulation Tool	Multisim/OrCAD	1

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU  
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS  
N-SCHEME

(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : Diploma in Electrical and Electronics Engineering

Subject Code : 4030470

Semester : IV

Subject Title : Electrical Circuits and Simulation Practical

**TEACHING AND SCHEME OF EXAMINATION**

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
ELECTRICAL CIRCUITS AND SIMULATION PRACTICAL	4	64	25	100*	100	3 Hrs.

\* Examinations will be conducted for 100 marks, and it will be reduced to 75 marks.

**RATIONALE**

All the Engineering applications are simulated through Computers. They are tested and then built using real components for commercial implementation. Simulation Software is available for all Engineering Fields. Here is an attempt to impart the knowledge of using Simulation Software for realizing some of the Electrical and Electronics Circuits for the Diploma students.

**OBJECTIVES**

On Completion Of This Practical subject, the Students will be able to know :

- ✓ The Various Aspects of Simulation Software
- ✓ Simulate and Test the Simple Electrical and Electronics Circuits
- ✓ Simulate and Test the Wave Generating Circuits

- ✓ Simulate and Prove the Simple Theorems
- ✓ Simulate and Test the Performance Characteristics of Converters
- ✓ Design and Verify the Results of Various Electric Circuits Using Simulation Software

### **DETAILED SYLLABUS**

Contents: Practical

**Name of the Topics:** Electrical Circuits and Simulation Practical

#### **Exercise**

1. Generate the following waveforms
  - (i) Sinusoidal waveform of Fundamental Frequency (50Hz)
  - (ii) 3<sup>rd</sup> Order, 5<sup>th</sup> Order and 7<sup>th</sup> Order Harmonics for the Fundamental frequency.
2. Simulation of RLC series and RLC Parallel Response Circuits.
3. Step Response of RL and RC Series Circuit.
4. Simulation of Mesh and Nodal analysis for DC Circuits.
5. Verification of Superposition Theorem.
6. Verification of Thevenin's and Norton's Theorem.
7. Verification of Maximum Power Transfer Theorem.
8. Simulation of Full Wave Rectifier (Center Tapped and Bridge) with RL load.
9. Simulation of Single-Phase Half Wave Controlled Converter with RL Load and FreeWheeling Diode.
10. Simulation of Single-Phase Full Wave Controlled Converter with RL Load and FreeWheeling Diode.
11. Simulation of Three Phase Star Connected Balanced and Unbalanced Load
12. Simulation of Three Phase Delta Connected Balanced and Unbalanced Load
13. Simulation of Three Phase Non-Linear Star Connected Load with Three Phase 3 Wire System.
14. Simulation of Three Phase Non-Linear Star Connected Load with Three Phase 4 Wire System.
15. Simulation basic Logic Gates, Universal Logic Gates and Realization of Logic Gates using Universal Logic Gates.
16. Simulation of Half Adders and Full Adder.

**LIST OF EQUIPMENTS (FOR A BATCH OF 30 STUDENTS)**

<b>S.No.</b>	<b>LISTOFEQUIPMENTS</b>	<b>QUANTITYREQUIRED</b>
1.	PC with any suitable simulation software	30
2.	UPS 5KVA with half an hour battery backup	1
3.	Printer	1

**DETAILED ALLOCATION OF MARKS**

<b>S.NO</b>	<b>NAME OF THE ACTIVITY</b>	<b>MARK ALLOCATION</b>
1	Circuit Diagram (Manual Diagram)	30
2	Development of circuit diagram	30
3	Simulation Performance & print out	35
4	Viva Voce	05
	<b>Total</b>	100

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