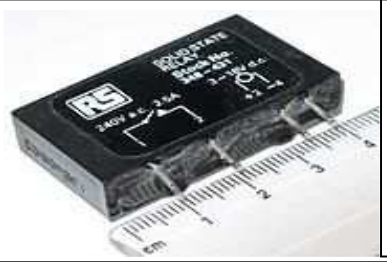
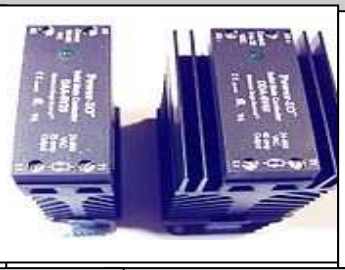
CURRICULUM

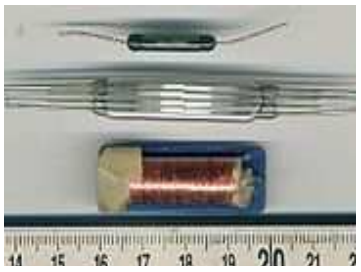
FOR

ELECTROMECHANICAL TECHNICIAN [EMT]

(A Competency Based Short-term Curriculum)







Council for Technical Education and Vocational Training

CURRICULUM DEVELOPMENT DIVISION

Sanothimi, Bhaktapur

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Introduction

This curriculum has been developed with a purpose of preparing Electromechanical technicians as a lower level technical workforce able to get employment in the country. The technical skills incorporated in this curriculum come from the electromechanical technology. Its contents are organized in the form of modules. So it is a tailor made curriculum with a special purpose to be implemented in a modular form.

It is a competency based curriculum. It is also designed to produce lower level technical workforce in the field of electromechanical technology equipped with skills and knowledge related to electromechanical technology in order to meet the demand of such workforce in the country so as to contribute in the national streamline of poverty reduction.

Aims

The main aim of this curricular program is to produce skilled workforce in the field of electromechanical technology by providing training to the potential citizen of the country and link them to employment opportunities in the country. The aims of this curriculum are:

- To produce lower level technical workforce in the area of electromechanical technology
- To produce such technical workforce who will be able to serve the community and household people through the application of the techniques /skills of electromechanical technology being an entrepreneur

Objectives

After the completion or this training program, the trainees will be able:

- To follow safety measures
- To perform Electrical Bench work
- To perform Mechanical Bench work
- To perform Shielded Metal Arc Welding
- To perform Oxy Acetylene Welding
- To be familiar with Electronics
- To be familiar with Current, Voltage & Resistance
- To be familiar with OHM'S Law, Power &Energy
- To be familiar with Series Circuits
- To be familiar with Parallel Circuits
- To be familiar with Series Parallel Circuits
- To be familiar with DC Measuring Instruments
- To be familiar with Industrial Control Devices
- To be familiar with Magnetism
- To be familiar with DC Motors and Control Circuits
- To be familiar with Alternating Voltage &Current
- To be familiar with AC Measuring Instruments
- To be familiar with Capacitance and Capacitors
- To be familiar with Inductance and Inductors
- To be familiar with Transformers
- To be familiar with AC Motors and Drives
- To be familiar with Analog and Digital Transducers
- To be familiar with Industrial Process Control
- To be familiar with Semiconductor Fundamentals
- To be familiar with Transistors and Thyristors
- To be familiar with Amplifier Circuits
- To be familiar with Integrated Circuits
- To be familiar with Digital Electronics
- To be familiar with Programmable Logic Controllers
- To fit electromechanical devices
- To perform relays fittings
- To maintain/repair electrical Fan
- To maintain/repair electric Mixer
- To maintain/repair electric Juicer
- To maintain/repair electric Grinder
- To maintain/repair electric Blender
- To maintain/repair electric Can Opener

- To maintain/repair electric Shaver
- To maintain/repair electric Coffee Maker
- To maintain/repair electric Blower
- To maintain/repair Vacuum cleaner
- To maintain/repair electric Floor polisher
- To maintain/electric repair Hair dryer
- To maintain/repair Refrigerator
- To maintain/repair Washing machine and
- To carryout project works related to electromechanical technology

Description

This curriculum provides skills and knowledge necessary for electromechanical technician as a technical worker. There will be both demonstration by trainers/instructors and opportunity by trainees to carry out the skills/tasks necessary for this level of technical workforce. Trainees will practice and learn skills by using typical tools, materials and equipment necessary for this curricular program.

On successful completion of this training, the trainees will be able to follow safety measures, perform Electrical Bench work, perform Mechanical Bench work, perform Shielded Metal Arc Welding, perform Oxy Acetylene Welding, be familiar with Electronics, be familiar with Current, Voltage & Resistance, be familiar with OHM'S Law, Power &Energy, be familiar with Series Circuits, be familiar with Parallel Circuits, be familiar with Series Parallel Circuits, be familiar with DC Measuring Instruments, be familiar with Industrial Control Devices, be familiar with Magnetism, be familiar with DC Motors and Control Circuits, be familiar with Alternating Voltage &Current, be familiar with AC Measuring Instruments, be familiar with Capacitance and Capacitors, be familiar with Inductance and Inductors, be familiar with Transformers, be familiar with AC Motors and Drives, be familiar with Analog and Digital Transducers, be familiar with Industrial Process Control, be familiar with Semiconductor Fundamentals, be familiar with Transistors and Thyristors, be familiar with Amplifier Circuits, be familiar with Integrated Circuits, be familiar with Digital Electronics, be familiar with Programmable Logic Controllers, fit electromechanical devices, perform relays fittings, maintain/repair electrical Fan, maintain/repair electric Mixer, maintain/repair electric Juicer, maintain/repair electric Grinder, maintain/repair electric Blender, maintain/repair electric Can Opener, maintain/repair electric Shaver, maintain/repair electric Coffee Maker, maintain/repair electric Blower, maintain/repair Vacuum cleaner, maintain/repair electric Floor polisher, maintain/electric repair Hair dryer, maintain/repair Refrigerator, maintain/repair Washing machine and carryout project works related to electromechanical technology.

Course Structure

SN		Modules/Sub modules	Nature	Th.	Pr.	Tot.	Th.	Pr.	Tot.
1.	**Bench work**		**T+P**	**28**	**102**	**130**	**20**	**80**	**100**
	1.	Safety	T+P	4	16	20	0	0	0
	2.	Electrical Bench work	T+P	10	30	40	0	0	0
	3.	Mechanical Bench work	T+P	14	56	70	0	0	0
2.	**Welding**		**T+P**	**21**	**69**	**90**	**15**	**60**	**75**
	1.	Shielded Metal Arc Welding	T+P	9	41	50	0	0	0
	2.	Oxy Acetylene Welding	T+P	12	28	40	0	0	0
3.	**Basic Electro-Mechanics**		**T+P**	**52**	**208**	**260**	**40**	**160**	**200**
	1.	Introduction to Electronics	T+P	2	8	10	0	0	0
	2.	Current, Voltage & Resistance	T+P	2	8	10	0	0	0
	3.	OHM'S Law, Power &Energy	T+P	2	8	10	0	0	0
	4.	Series Circuits	T+P	2	8	10	0	0	0
	5.	Parallel Circuits	T+P	2	8	10	0	0	0
	6.	Series Parallel Circuits	T+P	2	8	10	0	0	0
	7.	DC Measuring Instruments	T+P	2	8	10	0	0	0
	8.	Industrial Control Devices	T+P	2	8	10	0	0	0
	9.	Magnetism	T+P	2	8	10	0	0	0
	10.	DC Motors and Control Circuits	T+P	4	16	20	0	0	0
	11.	Alternating Voltage &Current	T+P	2	8	10	0	0	0
	12.	AC Measuring Instruments	T+P	2	8	10	0	0	0
	13.	Capacitance and Capacitors	T+P	2	8	10	0	0	0
	14.	Inductance and Inductors	T+P	2	8	10	0	0	0
	15.	Transformers	T+P	2	8	10	0	0	0
	16.	AC Motors and Drives	T+P	4	16	20	0	0	0
	17.	Analog and Digital Transducers	T+P	2	8	10	0	0	0
	18.	Industrial Process Control	T+P	2	8	10	0	0	0
	19.	Semiconductor Fundamentals	T+P	2	8	10	0	0	0
	20.	Transistors and Thyristors	T+P	2	8	10	0	0	0
	21.	Amplifier Circuits	T+P	2	8	10	0	0	0
	22.	Integrated Circuits	T+P	2	8	10	0	0	0
	23.	Digital Electronics	T+P	2	8	10	0	0	0
	24.	Programmable Logic Controllers	T+P	2	8	10	0	0	0
4.	**Electromechanical Devices & Relays**		**T+P**	**26**	**104**	**130**	**20**	**80**	**100**
	1.	Electromechanical Devices	T+P	14	56	70	0	0	0
	2.	Electromechanical Relays	T+P	12	48	60	0	0	0
5.	**Motorized Electrical Appliances**		**T+P**	**26**	**104**	**130**	**20**	**80**	**100**
6.	**Project Work**		**P**	**0**	**40**	**40**	**5**	**20**	**25**
		Total:		**153**	**627**	**780**	**120**	**480**	**600**

Duration
The total duration of this curricular program will be **780** hours [six months]

Target group
The target group for this training will be all the interested individuals of the country with academic qualification of grade ten pass

Group size
The group size of this training program will be not more than 20

Target location
The target location of this training program will be all over Nepal.

Medium of Instruction
The medium of instruction for this training program will be Nepali or English or both.

Pattern of attendance
The trainees should have 80% attendance in theory classes and 90% in Practical (Performance) to be eligible for internal assessment and final examinations.

Focus of the program
This is a competency based curriculum. This curriculum emphasizes on competent performance of the task specified in it. Not less than 80% time is allotted to the competencies and not more than 20% to the related technical knowledge. So, the main focus will be on the performance of the specified competencies/tasks /skills included in this curriculum.

Entry criteria
Individuals who meet the following criteria will be allowed to enter in this curricular program:

- Ten grade pass
- Physically and mentally fit
- Age : 16-25 years
- Preference will be given to female, Dalit, Janjati, and Conflict affected people

Follow up suggestion
This is not a training program only for training sake. The ultimate success of this program will rest on the proficiency of the graduates of this training program in providing services in the community either by wage employment or by self-employment.
In other to assess the success of this program and collect feedbacks/inputs for the revision of the program, a schedule of follow up is suggested as follows:-

- First follow up: - Six months after the completion of the training program.
- Second follow up: - Six months after the completion of the first follow up.
- Follow up cycle: - In a cycle of one year after the completion of second follow up for five years

Certificate requirement
The related training institute will provide the certificate of "Electromechanical Technician" to those individuals who successfully complete all the tasks with their related technical knowledge specified in this curriculum

Student evaluation details
- Continuous evaluation of the trainees' performance is to be done by the related instructor/trainer to ensure the proficiency over each competency.
- Related technical knowledge learnt by the trainees will be evaluated through written or oral tests as per the nature of the content
- Trainees must secure minimum marks of 60% in an average of both theory and practical evaluations

Trainers' qualification

- Bachelor's degree in the related field
- Good communicative & instructional skills.
- Experience in the related field.

Trainer: trainee's ratio

- 1:10 for practical classes
- Depends on the nature of subject matter and class room situation for theory classes.

Suggestion for instruction

1. Demonstrate task performance

- Demonstrate task performance in normal speed
- Demonstrate slowly with verbal description of each and every steps in the sequence of activity flow of the task performance using question and answer techniques
- Repeat the above step for the clarification on trainees demand if necessary.
- Perform fast demonstration of the task performance.

2. Provide trainees the opportunity to practice the task performance demonstrated.

- Provide trainees to have guided practice:- create environment for practicing the demonstrated task performance and guide the trainees in each and every step of task performance
- Provide trainees the opportunity to repeat & re-repeat as per the need to be proficient on the given task performance
- Switch to another task demonstration if and only if the trainees developed proficiency in the given task performance

3. Evaluation performance of the trainees/ student

- Perform task analysis
- Develop a detail task performance check list
- Perform continuous performance evaluation of the trainees / students by applying the performance check list.

List of modules and sub-modules

1. Bench work

1. Safety
2. Electrical Bench work
3. Mechanical Bench work

2. Welding

4. Shielded Metal Arc Welding
5. Oxy Acetylene Welding

3. Basic Electro-Mechanics

1. Introduction to Electronics
2. Current, Voltage & Resistance
3. OHM'S Law, Power &Energy
4. Series Circuits
5. Parallel Circuits
6. Series Parallel Circuits
7. DC Measuring Instruments
8. Industrial Control Devices
9. Magnetism
10. DC Motors and Control Circuits
11. Alternating Voltage &Current
12. AC Measuring Instruments
13. Capacitance and Capacitors

14. Inductance and Inductors
15. Transformers
16. AC Motors and Drives
17. Analog and Digital Transducers
18. Industrial Process Control
19. Semiconductor Fundamentals
20. Transistors and Thyristors
21. Amplifier Circuits
22. Integrated Circuits
23. Digital Electronics
24. Programmable Logic Controllers

4. Electromechanical Devices & Relays

1. Electromechanical Devices
2. Electromechanical Relays
3. Motorized Electrical Appliances

5. Project Work

Details of Modules and sub-modules

Module: 1: Bench work

Description: This consists of knowledge and skills related to safety measures to be followed, mechanical bench works and electrical bench works necessary for an electromechanical technician.

Objectives:

- To follow safety measures
- To perform Electrical Bench work
- To perform Mechanical Bench work

Duration: 130 hours

Sub modules:

1. Safety
2. Electrical Bench work
3. Mechanical Bench work

Sub module: 1: Safety

Description: This consists of knowledge and skills related to safety precautions to be followed while performing electromechanical works necessary for an electromechanical technician.

Objectives:

- To identify need for safety precautions
- To enlist safety measures to be followed while performing electromechanical works
- To follow safety measures while performing electromechanical works

Duration: 20 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Electrical bench work		4 hrs. (Th.) + 16 hrs. (Pr,) = 20 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Identify concept of safety	**Concept of safety**: • Definition of safety • Definition of safety precautions • Definition of safety measures • Identifying situations to take safety • Records keeping	1.0	3	
2.	List need for safety precautions	**Need for safety precautions**: • Need of taking safety precautions • Importance of taking safety precautions • Records keeping	0.5	3	
3.	Identify types of safety measures to be taken while performing electromechanical works	**Identification of the types of safety measures to be taken while performing electromechanical works**: • Types of safety measures to be taken while performing electromechanical works • Identification of the types of safety measures to be taken while performing electromechanical works • Records keeping	1.0	3	
4.	Enlist safety measures to be followed while performing electromechanical works	**Enlisting safety measures to be followed while performing electromechanical works**: • Concept of safety measures to be followed while performing electromechanical works • Enlist safety measures to be followed while performing electromechanical works • Records keeping	0.5	3	
5.	Follow safety measures while performing electromechanical works	**Following safety measures while performing electromechanical works:** • Principles and procedures for following safety measures while performing electromechanical works • When and how of taking safety measures while performing electromechanical works • Records keeping	1.0	4	
		Subtotal:	4	16	20

Sub module: 2: Electrical Bench Work

Description: This consists of knowledge and skills related to electrical bench works necessary for an electromechanical technician.

Objectives:

- Make straight joint of solid wire/cable.
- Make "T" joint of solid wire/cable.
- Make Married joint of solid wire/cable.
- Make Britannia joint of solid wire/cable.
- Make wire/cable eyelet.

Duration: 40 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Electrical bench work		10 hrs. (Th.) + 30 hrs. (Pr,) = 40 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
6.	Make straight joint of solid wire/cable.	**<u>Making straight joint of solid wire/cable</u>** : • Concept of: ▪ Wire/cable joint ▪ Parts of cable ▪ Conductor ▪ Insulation covering ▪ Protective covering ▪ Stranded cable ▪ Advantage of stranded cables ▪ Types of joint ▪ Voltage grade of cable ▪ Measurement of joint ▪ Techniques of insulation remove from wire/cable using: o Pliers Skinning o Pencil Skinning o Snake Skinning o Straight Skinning • Uses of straight joint of solid wire/cable • Principe and procedures for making straight joint of solid wire/cable • Making straight joint of solid wire/cable • Safety precautions to be followed while carrying out this task • Keeping records of related activities carried out	2	6	8
7.	Make "T" joint of solid wire/cable	**<u>Make "T" joint of solid wire/cable:</u>** • Concept of "T" joint of solid wire/cable • Uses of "T" joint of solid wire/cable • Principe and procedures for making "T" joint of solid wire/cable • Making "T" joint of solid wire/cable • Safety precautions to be followed while carrying out this task	2	6	8

		• Keeping records of related activities carried out			
8.	Make married joint of solid wire/cable	**Make married joint of solid wire/cable**: • Concept of married joint of solid wire/cable • Uses of married joint of solid wire/cable • Principe and procedures for making Married joint of solid wire/cable • Making married joint of solid wire/cable • Safety precautions to be followed while carrying out this task • Keeping records of related activities carried out	2	6	8
9.	Make Britannia joint of solid wire/cable	**Make Britannia joint of solid wire/cable**: • Concept of Britannia joint of solid wire/cable • Uses of Britannia joint of solid wire/cable • Principe and procedures for making Britannia joint of solid wire/cable • Making Britannia joint of solid wire/cable • Safety precautions to be followed while carrying out this task • Keeping records of related activities carried out	2	6	8
10.	Make wire/cable eyelet	**Make wire/cable eyelet**: • Concept of wire/cable eyelet • Uses of wire/cable eyelet • Principe and procedures for making wire/cable eyelet • Making wire/cable eyelet • Safety precautions to be followed while carrying out this task • Keeping records of related activities carried out	2	6	8
		Subtotal:	10	30	40

Sub module: 3: Mechanical Bench Work

Description: This consists of knowledge and skills related to mechanical bench works necessary for an electromechanical technician.

Objectives:

- To follow safety rule
- To identify/handle mechanical tool/ equipment
- To measure & mark the given W/P
- To file flat surface
- To punch dot / center
- To saw the metal by hand
- To perform chipping groove
- To perform chipping flat
- To drill a hole
- To counter shank a hole
- To counter bore a hole
- To perform internal threads using hand taps
- To perform external threads using die set
- To measure the dimension using vernier caliper/micrometer
- To perform cold riveting

Duration: 70 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Mechanical bench work		14 hrs. (Th.) + 56 hrs. (Pr,) = 70 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Follow safety measures.	**Following safety measures:** • Concept of: ▪ Safety ▪ occupational safety ▪ Workshop hazards ▪ safety rules and regulations: personal and workshop safety rules regulations ▪ Safety sign and notice ▪ Emergency response ▪ First Aid • Principles and procedures for safety • Following safety measures • Keeping records	0.5	3	3.5
2.	Identify/handle mechanical tools/ equipment	**Identifying/handling mechanical tools/ equipment**: • Identification of different tools, devices, instruments and equipments used in mechanical work • Uses, application and functions • Handling procedure • Care and maintenance • Safety precautions • Keeping activity records	1	3	4.0

3.	Measure & mark the given W/P	**Measuring & marking the given W/P**: • Concept and importance of measuring & marking the given W/P • Principles and procedures for measuring & marking the given W/P • Measuring & marking the given W/P • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	3	4.0
4.	File flat surface.	**Filing flat surface**: • Concept and importance of filing flat surface • Principles and procedures for filing flat surface • Function of files & its type. • Methods of filling • Basic material study and selection of metal • Filing flat surface • Workshop safety rules and precautions to be followed • Records keeping of the activities related to this task	1	4	5.0
5.	Punch dot / center.	**Punching dot / center**: • Concept and importance of punching dot / center • Principles and procedures for punching dot / center • Punching dot / center • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
6.	Saw the metal by hand	**Sawing the metal by hand**: • Concept and importance of sawing the metal by hand • Principles and procedures for sawing the metal by hand • Use of hacksaw blade for different metal • Holding of work piece for sawing • Sawing metal by hand • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0

7.	Perform chipping groove	**Performing chipping groove**: • Concept and importance of performing chipping groove • Principles and procedures for performing chipping groove • Chipping process • Types of chisel & their importance and uses • Chipping process. • Performing chipping groove • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
8.	Perform chipping flat	**Performing chipping flat**: • Concept and importance of performing chipping flat • Principles and procedures for performing chipping flat • Performing chipping flat • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
9.	Drill a hole	**Drilling a hole**: • Concept and application of: ▪ Drill machine ▪ Types of drill machine. ▪ Drill bits & its types. ▪ Speed feed R.P.M. ▪ Calculation of R.P.M. • Principles and procedures for drilling a hole • Drilling a hole • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
10.	Counter shank a hole	**Counter shaking a hole** : • Importance, types & uses of counter shank. • Principles and procedures for counter shaking a hole • Counter shaking a hole • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0

11.	Counter bore a hole	**Counter boring a hole**: • Concept, importance, types & uses of counter bore • Principles and procedures for counter boring a hole • Counter boring a hole • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
12.	Perform internal threads using hand taps	**Performing internal threads using hand taps**: • Concept of performing internal threads using hand taps • Principles and procedures for performing internal threads using hand taps • Identification of thread cutting tools and equipment. • Size of threads • Application of threads • Types of taps & dies • Performing internal threads using hand taps • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
13.	Perform external threads using die set	**Performing external threads using die set**: • Concept of performing external threads using die set • Principles and procedures for performing external threads using die set • Concept of threads • Size and number of threads • Threads cutting procedure • Performing external threads using die set • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
14.	Measure the dimension using vernier caliper /micrometer	**Measuring the dimension using vernier caliper /micrometer**: • Introduction & Features of vernier caliper and micrometer • Reading scale & uses of vernier caliper and micrometer • Least count & care of vernier caliper.	0.5	3	3.5

		• Concept of measuring the dimension using vernier caliper /micrometer • Principles and procedures for measuring the dimension using vernier caliper /micrometer • Measuring the dimension using vernier caliper /micrometer • Precautions to be followed while performing this task • Records keeping of the activities related to this task			
15.	Perform cold riveting	**<u>Performing cold riveting</u>**: • Concept of performing cold riveting • Principles and procedures for performing cold riveting • Concept of: ▪ Function of vice & its types. ▪ Principle and function of rivets and its types ▪ Methods of riveting ▪ Workshop safety rules. • Performing cold riveting • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	4	5.0
		Subtotal:	14	56	70

Module: 2: Welding

Description: This consists of knowledge and skills related to Shielded Metal Arc Welding and Oxy Acetylene Welding necessary for an electromechanical technician.

Objectives:
- To perform Shielded Metal Arc Welding
- To perform Oxy Acetylene Welding

Duration: 90 hours

Sub modules:
1. Shielded Metal Arc Welding
2. Oxy Acetylene Welding

Sub module: 1: Shielded Metal Arc Welding

Description: This consists of knowledge and skills related to Shielded Metal Arc Welding necessary for an electromechanical technician.

Objectives:

- Apply welding safety equipments / apparels
- Prepare A/C arc welding machine, tools & equipments.
- Strike/maintain the arc
- Perform Straight bead in flat position
- Grind – off welding surfaces
- Weld Fillet Lap joint in flat position
- Weld Fillet Tee joint in flat position
- Perform straight bead in horizontal vertical position
- Perform straight bead in vertical position (up & down)

Duration: 50 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Mechanical bench work		9 hrs. (Th.) + 41 hrs. (Pr,) = 50 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Apply welding safety equipments / apparels	**Applying welding safety equipments / apparels:** • Concept, need and importance of applying welding safety equipments / apparels • Principles and procedures for applying welding safety equipments / apparels • Applying welding safety equipments / apparels • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	1	2
2.	Prepare A/C arc welding machine, tools & equipments.	**Preprinting A/C arc welding machine, tools & equipments:** • Concept, need and importance of preprinting A/C arc welding machine, tools & equipments. • Principles and procedures for preprinting A/C arc welding machine, tools & equipments. • Preprinting A/C arc welding machine, tools & equipments. • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	5	6
3.	Strike/maintain the arc	**Striking/maintaining the arc**: • Concept, need and importance of	1	5	6

		striking/maintaining the arc • Principles and procedures for striking/maintaining the arc • Striking/maintaining the arc • Precautions to be followed while performing this task • Records keeping of the activities related to this task			
4.	Perform Straight bead in flat position	**Performing straight bead in flat position**: • Concept, need and importance of performing straight bead in flat position • Principles and procedures for performing straight bead in flat position • Performing straight bead in flat position • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	5	6
5.	Grind – off welding surfaces	**Grinding – off welding surfaces**: • Concept, need and importance of grinding – off welding surfaces • Principles and procedures for grinding – off welding surfaces • Grinding – off welding surfaces • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	5	6
6.	Weld Fillet Lap joint in flat position	**Welding Fillet Lap joint in flat position**: • Concept, need and importance of welding Fillet Lap joint in flat position • Principles and procedures for welding Fillet Lap joint in flat position • Welding Fillet Lap joint in flat position • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	5	6
7.	Weld Fillet Tee joint in flat position	**Welding Fillet Tee joint in flat position**: • Concept, need and importance of welding Fillet Tee joint in flat position • Principles and procedures for welding Fillet Tee joint in flat position • Welding Fillet Tee joint in flat position • Precautions to be followed while performing this task • Records keeping of the activities related	1	5	6

		to this task			
8.	Perform straight bead in horizontal vertical position	**Performing straight bead in horizontal vertical position**: • Concept, need and importance of performing straight bead in horizontal vertical position • Principles and procedures for performing straight bead in horizontal vertical position • Performing straight bead in horizontal vertical position • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	5	6
9.	Perform straight bead in vertical position (up & down)	**Performing straight bead in vertical position (up & down)** : • Concept, need and importance of performing straight bead in vertical position (up & down) • Principles and procedures for performing straight bead in vertical position (up & down) • Performing straight bead in vertical position (up & down) • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	5	6
		Subtotal:	9	41	50

Sub module: 2: Oxy Acetylene Welding

Description: This consists of knowledge and skills related to Oxy Acetylene Welding necessary for an electromechanical technician.

Objectives:
Upon completion of this module the student will be able to:

- Prepare Acetylene gas and safety equipment
- Set up Oxygen gas and Rubber hose
- Set up Welding Nozzles
- Run fusion lines without filler rod
- Run fusion lines with filler rod
- Weld Butt joint in flat position
- Weld Butt joint in Vertical position
- Cut straight line in MS plate manually
- Braze brass in Mild steel plate
- Braze Butt joint in Copper plate
- Braze Butt joint in Brass plate
- Braze copper Pipe + pipe in fixed flat position

Duration: 40 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

	Mechanical bench work	12 hrs. (Th.) + 28 hrs. (Pr,) = 40 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Prepare Acetylene gas and safety equipment	**Preparing Acetylene gas and safety equipment**: • Concept, need and importance of preparing Acetylene gas and safety equipment • Principles and procedures for preparing Acetylene gas and safety equipment • Preparing Acetylene gas and safety equipment • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	2	3
2.	Set up Oxygen gas and Rubber hose	**Setting up of Oxygen gas and Rubber hose**: • Concept, need and importance of setting up of Oxygen gas and Rubber hose • setting up of Oxygen gas and Rubber hose • Principles and procedures for • Setting up of Oxygen gas and Rubber hose • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	2	3
3.	Set up Welding Nozzles	**Setting up of Welding Nozzles**: • Concept, need and importance of setting up of Welding Nozzles • Principles and procedures for setting up of Welding Nozzles • Setting up of Welding Nozzles • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	2	3
4.	Run fusion lines without filler rod	**Running fusion lines without filler rod:** • Concept, need and importance of running fusion lines without filler rod	1	2	3

		• Principles and procedures for running fusion lines without filler rod • Running fusion lines without filler rod • Precautions to be followed while performing this task • Records keeping of the activities related to this task			
5.	Run fusion lines with filler rod	**Running fusion lines with filler rod**: • Concept, need and importance of running fusion lines with filler rod • Principles and procedures for running fusion lines with filler rod • Running fusion lines with filler rod • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	2	3
6.	Weld Butt joint in flat position	**Welding Butt joint in flat position:** • Concept, need and importance of welding Butt joint in flat position • Principles and procedures for welding Butt joint in flat position • Welding Butt joint in flat position • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	3	4
7.	Weld Butt joint in Vertical position	**Welding Butt joint in Vertical position:** • Concept, need and importance of welding Butt joint in Vertical position • Principles and procedures for welding Butt joint in Vertical position • Welding Butt joint in Vertical position • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	3	4
8.	Cut straight line in MS plate manually	**Cutting straight line in MS plate manually**: • Concept, need and importance of cutting straight line in MS plate manually • Principles and procedures for cutting straight line in MS plate manually • Cutting straight line in MS plate manually • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	2	3
9.	Braze brass in Mild steel plate	**Brazing brass in Mild steel plate:** • Concept, need and importance of brazing brass in Mild steel plate • Principles and procedures for brazing brass in Mild steel plate	1	2	3

		• Brazing brass in Mild steel plate • Precautions to be followed while performing this task • Records keeping of the activities related to this task			
10.	Braze Butt joint in Copper plate	**Brazing Butt joint in Copper plate**: • Concept, need and importance of brazing Butt joint in Copper plate • Principles and procedures for brazing Butt joint in Copper plate • Brazing Butt joint in Copper plate • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	3	4
11.	Braze Butt joint in Brass plate	**Brazing Butt joint in Brass plate**: • Concept, need and importance of brazing Butt joint in Brass plate • Principles and procedures for brazing Butt joint in Brass plate • Brazing Butt joint in Brass plate • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	3	4
12.	Braze copper Pipe + pipe in fixed flat position	**Brazing copper Pipe + pipe in fixed flat position:** • Concept, need and importance of brazing copper Pipe + pipe in fixed flat position • Principles and procedures for brazing copper Pipe + pipe in fixed flat position • Brazing copper Pipe + pipe in fixed flat position • Precautions to be followed while performing this task • Records keeping of the activities related to this task	1	2	3
		Subtotal:	12	28	40

Module: 3: Basic Electro mechanics

Description: This consists of knowledge and skills related to basic electro mechanics necessary for an electromechanical technician.

Objectives:

- To be familiar with Electronics
- To be familiar with Current, Voltage & Resistance
- To be familiar with OHM'S Law, Power &Energy
- To be familiar with Series Circuits
- To be familiar with Parallel Circuits
- To be familiar with Series Parallel Circuits
- To be familiar with DC Measuring Instruments
- To be familiar with Industrial Control Devices
- To be familiar with Magnetism
- To be familiar with DC Motors and Control Circuits
- To be familiar with Alternating Voltage &Current
- To be familiar with AC Measuring Instruments
- To be familiar with Capacitance and Capacitors
- To be familiar with Inductance and Inductors
- To be familiar with Transformers
- To be familiar with AC Motors and Drives
- To be familiar with Analog and Digital Transducers
- To be familiar with Industrial Process Control
- To be familiar with Semiconductor Fundamentals
- To be familiar with Transistors and Thyristors
- To be familiar with Amplifier Circuits
- To be familiar with Integrated Circuits
- To be familiar with Digital Electronics
- To be familiar with Programmable Logic Controllers

Duration: 260 hours

Sub modules:

1. Introduction to Electronics
2. Current, Voltage & Resistance
3. OHM'S Law, Power &Energy
4. Series Circuits
5. Parallel Circuits
6. Series Parallel Circuits
7. DC Measuring Instruments
8. Industrial Control Devices
9. Magnetism
10. DC Motors and Control Circuits
11. Alternating Voltage &Current
12. AC Measuring Instruments
13. Capacitance and Capacitors
14. Inductance and Inductors
15. Transformers

16. AC Motors and Drives
17. Analog and Digital Transducers
18. Industrial Process Control
19. Semiconductor Fundamentals
20. Transistors and Thyristors
21. Amplifier Circuits
22. Integrated Circuits
23. Digital Electronics
24. Programmable Logic Controllers

Sub module: 1: Introduction to Electronics

Description: This is designed to introduce the student to the fundamental concepts of electronics and describe some basic applications. This module covers units of measure, scientific notation, SI system, and engineering notation. The principles of molecules and atomic structure are also presented in this module as well as an introduction to electric charges.

Objectives:
Upon completion of this module the student will be able to:

- Describe the historical perspective of electricity and electronics.
- Describe some of the important areas where electronics technology is applied.
- List examples of common electronic components.
- Define the basic units of measurement.
- Describe the SI system of measurement.
- Be able to express numbers in scientific notation.
- Convert from one power of 10 to another.
- Define engineering notation.
- Describe basic atomic structure.
- Explain the principle of electric charge.
- Express Coulomb's law.

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

	Introduction to Electronics	2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Describe the historical perspective of electricity and electronics.	**Describing the historical perspective of electricity and electronics**: • Concept and importance of electricity and electronics • Historical perspective of electricity and electronics • Related records keeping	0.1	0.4	0.5
2.	Describe some of the important areas where electronics technology is applied.	**Describing some of the important areas where electronics technology is applied:** • Concept and importance of electronics technology • Important areas where electronics technology is applied. • Related records keeping	0.1	0.4	0.5
3.	List examples of common electronic components	**Listing examples of common electronic components:** • Concept, importance and application of common electronic components • Listing of common electronic components • Related records keeping	0.2	0.8	1.0
4.	Define the basic units of measurement	**Defining the basic units of measurement**: • Concept, importance and application of basic units of measurement • Defining the basic units of measurement • Related records keeping	0.2	0.8	1.0
5.	Describe the SI system of	**Describing the SI system of measurement:**	0.2	0.8	1.0

	measurement	• Concept, importance and application of SI system of measurement • Describing the SI system of measurement • Related records keeping			
6.	Be able to express numbers in scientific notation.	**Being able to express numbers in scientific notation**: • Concept, importance and application of scientific notation • Procedures for expressing numbers in scientific notation • Related precautions to be followed • Related records keeping	0.2	0.8	1.0
7.	Convert from one power of 10 to another.	**Converting from one power of 10 to another**: • Concept, importance and application of converting from one power of 10 to another • Procedures for converting from one power of 10 to another • Converting from one power of 10 to another • Related records keeping	0.2	0.8	1.0
8.	Define engineering notation.	**Defining engineering notation**: • Concept, importance and application of engineering notation • Defining engineering notation • Related records keeping	0.2	0.8	1.0
9.	Describe basic atomic structure	**Describing basic atomic structure**: • Concept and importance of atomic structure • Describing basic atomic structure • Related records keeping	0.2	0.8	1.0
10.	Explain the principle of electric charge	**Explaining the principle of electric charge**: • Concept, importance and application of electric charge • Principle of electric charge • Explaining the principle of electric charge • Related precautions to be followed • Related records keeping	0.2	0.8	1.0
11.	Express Coulomb's law	**Expressing Coulomb's law**: • Concept, importance and application of Coulomb's law • Expressing Coulomb's law • Related records keeping	0.2	0.8	1.0
		Subtotal:	2	8	10

Sub module: 2: Current, voltage, & resistance

Description: This introduces students to the fundamentals of current, voltage and resistance. In addition, the module introduces essential concepts such as the relationship between temperature and resistance, electron velocity, and the direction of current flow. The module also covers wire sizes, the resistor color code, and troubleshooting resistors.

Objectives:

Upon completion of this module the student will be able to:

- Define electric current.
- Describe electron flow and conventional flow.
- Discuss electric potential and voltage.
- List the five main types of voltage sources.
- Differentiate between a voltage source and a current source.
- Explain the difference between a dependent source and independent source.
- Define resistance.
- Describe the relationship between temperature and resistance.
- List various types of resistors.
- Utilize the resistor color code.
- Measure resistance using multimeter/ohmmeter
- Measure current using multimeter/ammeter
- Measure voltage using multimeter/voltmeter
- Identify resistance by colour coding method

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Current, voltage, & resistance		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define electric current	Defining electric current: • Definition and concept of electric current • Application of electric current • Records keeping	0.1	0.5	0.6
2.	Describe electron flow and conventional flow.	Describing electron flow and conventional flow: • Definition and concept of electron flow and conventional flow • Describing electron flow and conventional flow • Records keeping	0.1	0.5	0.6
3.	Discuss electric potential and voltage	Discussing electric potential and voltage: • Definition and concept of electric potential and voltage • Discussing electric potential and voltage • Records keeping	0.1	0.5	0.6
4.	List the five main types of voltage sources.	Listing the five main types of voltage sources: • Definition and concept of voltage sources. • Five main types of voltage sources. • Records keeping	0.1	0.5	0.6

5.	Differentiate between a voltage source and a current source.	Differentiating between a voltage source and a current source: • Definition and concept of voltage source and a current source. • Difference between a voltage source and a current source • Application of voltage source and a current source • Records keeping	0.1	0.5	0.6
6.	Explain the difference between a dependent source and independent source.	**Explaining the difference between a dependent source and independent source**: • Definition and concept of dependent source and independent source. • Explaining the difference between a dependent source and independent source • Application of dependent source and independent source • Records keeping	0.1	0.5	0.6
7.	Define resistance.	**Defining resistance**: • Definition and concept of resistance • Application of resistance • Records keeping	0.1	0.5	0.6
8.	Describe the relationship between temperature and resistance.	**Describing the relationship between temperature and resistance**: • Definition and concept of the relationship between temperature and resistance • Describing the relationship between temperature and resistance • Records keeping	0.1	0.5	0.6
9.	List various types of resistors.	**Listing various types of resistors**: • Definition and concept of resistors • Various types of resistors • Application of resistors • Records keeping	0.2	0.5	0.7
10.	Utilize the resistor color code	**Utilizing the resistor color code**: • Definition and concept of resistor color code • Utilizing the resistor color code • Records keeping	0.2	0.5	0.7
11.	Measure resistance using multimeter/ohmmeter	**Measuring resistance using multimeter/ohmmeter**: • Definition and concept of multimeter/ohmmeter • Operation and handling of multimeter/ohmmeter • Principles and procedures for measuring resistance using multimeter/ohmmeter	0.2	1.0	1.2

		• Measuring resistance using multimeter/ohmmeter • Safety/precautions to be taken • Records keeping			
12.	Measure current using multimeter/ammeter	**Measuring current using multimeter/ammeter**: • Definition and concept of multimeter/ohmmeter • Operation and handling of multimeter/ohmmeter • Principles and procedures for measuring current using multimeter/ammeter • Measuring current using multimeter/ammeter • Safety/precautions to be taken • Records keeping	0.2	1.0	1.2
13.	Measure voltage using multimeter/voltmeter	**Measuring voltage using multimeter/voltmeter**: • Definition and concept of measuring voltage using multimeter/voltmeter • Principles and procedures for measuring voltage using multimeter/voltmeter • Measuring voltage using multimeter/voltmeter • Safety/precautions to be taken • Records keeping	0.2	0.5	0.7
14.	Identify resistance by colour coding method	**Identifying resistance by colour coding method**: • Concept and application of colour coding method • Principles and procedures for colour coding method • Identifying resistance by colour coding method • Records keeping	0.2	0.5	0.7
		Subtotal:	2	8	10

Sub module: 3: Ohm's law, power, & energy

Description: This is designed to cover the fundamentals of Ohm's law, work, energy and power. A discussion of power dissipation and rating of circuit components is presented, as well as efficiency, the kilowatt hour. The theoretical and practical aspects of basic circuit calculations are also presented in this module using a combination of video, animation, and a laboratory projects using Electronics Workbench.

Objectives:

Upon completion of this module the student will be able to:

- Define Ohm's law.
- Utilize Ohm's law to determine current, voltage, or resistance.
- Describe the linear relationship between current and voltage.
- Differentiate between work and energy.
- Define power.
- Determine the efficiency of an electrical device.
- Calculate power consumption in terms of kilowatt hours.
- Apply/verify Ohm's law
- Measure power consumption in kilowatt-hour using energy-meter

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Ohm's law, power, & energy	2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define Ohm's law.	**Defining Ohm's law** : • Concept of Ohm's law • Application of Ohm's law • Records keeping of the activities carried out	0.2	0.5	0.7
2.	Utilize Ohm's law to determine current, voltage, or resistance.	Utilizing Ohm's law to determine current, voltage, or resistance: • Concept of determination of current, voltage, or resistance • Utilizing Ohm's law to determine current, voltage, or resistance. • Precautions to be followed • Records keeping of the activities carried out	0.2	1.0	1.2
3.	Describe the linear relationship between current and voltage	**Describing the linear relationship between current and voltage**: • Concept of linear relationship between current and voltage • Describing the linear relationship between current and voltage • Records keeping of the activities carried out	0.2	1.0	1.2
4.	Differentiate between work and energy.	**Differentiating between work and energy:** • Concept of work and energy. • Differentiating between work and energy • Records keeping of the activities carried out	0.2	0.5	0.7
5.	Define power.	**Defining power**:	0.2	1.0	1.2

		• Concept and definition of power • Application of power • Records keeping of the activities carried out			
6.	Determine the efficiency of an electrical device.	**Determining the efficiency of an electrical device**: • Concept of efficiency of electrical device • Principles and procedures for determining the efficiency of an electrical device • Determining the efficiency of an electrical device • Precautions to be followed • Records keeping of the activities carried out	0.3	1.0	1.3
7.	Calculate power consumption in terms of kilowatt hours.	**Calculating power consumption in terms of kilowatt hours**: • Concept of power consumption and kilowatt hours • Calculating power consumption in terms of kilowatt hours • Precautions to be taken • Records keeping of the activities carried out	0.3	1.0	1.3
8.	Apply/verify Ohm's law	**Applying/verifying Ohm's law**: • Concept of verifying Ohm's law • Procedures for verifying Ohm's law • Application of Ohm's law • Verifying Ohm's law • Precautions to be taken • Records keeping of the activities carried out	0.2	1.0	1.2
9.	Measure power consumption in kilowatt-hour using energy-meter	**Measuring power consumption in kilowatt-hour using energy-meter**: • Concept, handling and application of energy-meter • Procedures for measuring power consumption using energy-meter • Measuring power consumption in kilowatt-hour using energy-meter • Precautions to be taken • Records keeping of the activities carried out	0.2	1.0	1.2
		Subtotal:	2	8	10

Sub module: 4: Series circuits

Description: It covers resistance, current, and voltage in a series circuit, and presents an introduction to the polarity of voltages, voltage dividers, and the concept of internal resistance. The student will learn to apply Kirchhoff's voltage law to solve problems and design voltage dividers. Fuses and switches are also presented with an emphasis on practical applications and troubleshooting.

Objectives:

Upon completion of this module the student will be able to:

- Describe how voltages are distributed around a series circuit.
- Explain the purpose of double subscript notation.
- Define Kirchhoff's voltage law.
- Express the voltage divider rule and determine where it can be applied.
- Determine the polarity of EMFS and voltage drops.
- Explain the meaning of positive ground and negative ground.
- Calculate power in a series circuit.
- Define internal resistance.
- Explain the purpose of fuses and switches.
- Troubleshoot open circuit and short circuit conditions in a series circuit
- Connect three resister having (i) different value and (ii) same value in series and find the equivalent resistance
- Apply/verify Kirchoff's voltage law

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Series circuits		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Describe how voltages are distributed around a series circuit.	**Describing how voltages are distributed around a series circuit**: • Concept of voltage distribution around a series circuit. • How of voltage distribution around a series circuit. • Records keeping	0.2	0.5	0.7
2.	Explain the purpose of double subscript notation.	**Explaining the purpose of double subscript notation**: • Concept of double subscript notation • Application of double subscript notation • Purpose of double subscript notation. • Records keeping	0.2	0.5	0.7
3.	Define Kirchhoff's voltage law.	**Defining Kirchhoff's voltage law**: • Concept of Kirchhoff's voltage law • Application of Kirchhoff's voltage law • Records keeping	0.2	0.5	0.7
4.	Express the voltage divider rule and determine where it can be applied.	**Expressing the voltage divider rule and determining where it can be applied**:	0.2	0.5	0.7

		• Concept of voltage divider rule • Application of voltage divider rule • Expressing the voltage divider rule and determining where it can be applied Records keeping			
5.	Determine the polarity of EMFS and voltage drops.	**Determining the polarity of EMFS and voltage drops**: • Concept of polarity of EMFS and voltage drops. • Procedures for determining the polarity of EMFS and voltage drops • Determining the polarity of EMFS and voltage drops • Precautions to be taken • Records keeping	0.2	0.5	0.7
6.	Explain the meaning of positive ground and negative ground.	**Explaining the meaning of positive ground and negative ground**: • Concept of positive ground and negative ground. • Application of the concept of positive ground and negative ground. • Precautions to be taken • Records keeping	0.2	0.5	0.7
7.	Calculate power in a series circuit.	**Calculating power in a series circuit**: • Concept of power in a series circuit • Procedure for calculating power in a series circuit • Calculating power in a series circuit • Precautions to be taken • Records keeping	0.2	0.5	0.7
8.	Define internal resistance.	**Defining internal resistance**: • Concept of internal resistance • Application of internal resistance • Records keeping	0.2	0.5	0.7
9.	Explain the purpose of fuses and switches.	**Explaining the purpose of fuses and switches**: • Concept of fuses and switches. • Purpose of fuses and switches. • Explaining the purpose of fuses and switches Records keeping	0.1	1.0	1.1
10.	Troubleshoot open circuit and short circuit conditions in a series circuit.	**Troubleshooting open circuit and short circuit conditions in a series circuit**: • Concept of open circuit and short circuit conditions in a series circuit • Application of open circuit and short circuit conditions in a series circuit	0.1	1.0	1.1

		• Principles and procedures for troubleshooting open circuit and short circuit • Troubleshooting open circuit and short circuit • Precautions to be taken • Records keeping			
11.	Connect three resister having (i) different value and (ii) same value in series and find the equivalent resistance	**Connecting three resister having (i) different value and (ii) same value in series and find the equivalent resistance**: • Concept • Principles and procedures • Connecting three resister having (i) different value and (ii) same value in series and find the equivalent resistance • Precautions to be taken • Records keeping	0.1	1.0	1.1
12.	Apply/verify Kirchoff's voltage law	**Applying/verifying Kirchoff's voltage law**: • Concept of Kirchoff's voltage law • Application of Kirchoff's voltage law • Verification of Kirchoff's voltage law • Applying/verifying Kirchoff's voltage law • Precautions to be taken • Records keeping	0.1	1.0	1.1
		Subtotal:	2	8	10

Sub module: 5: Parallel circuits

Description: It will provide the student with an introduction to voltage in parallel circuits and the application of Ohm's law to these circuit configurations. The module is designed to demonstrate the effect of current, voltage, and resistance in parallel circuits and describe how Kirchhoff's current law can be applied to problem solving and troubleshooting techniques.

Objectives:

Upon completion of this module the student will be able to:

- Define a parallel circuit.
- Calculate resistance in parallel.
- Describe the flow of current in a parallel circuit.
- Express Kirchhoff's current law.
- Use the current divider rule.
- Apply Ohm's law for parallel circuit calculations.
- Calculate power in a parallel circuit.
- Describe the effect of connecting voltage sources in parallel.
- List some typical applications for parallel circuits.
- Troubleshoot parallel circuits.
- Connect three resistor having (i) different value and (ii) same value in parallel and find the equivalent resistance
- Apply /verify Kirchoff's current law

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Parallel circuits		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define a parallel circuit.	**Defining a parallel circuit**: Definition and concept of parallel circuit Application of parallel circuit Records keeping	0.2	0.5	0.7
2.	Calculate resistance in parallel.	**Calculating resistance in parallel**: • Concept of resistance in parallel • Procedure for calculating resistance in parallel • Application of calculation of resistance in parallel	0.2	0.5	0.7
3.	Describe the flow of current in a parallel circuit.	**Describing the flow of current in a parallel circuit**: • Concept of flow of current in a parallel circuit • Application of flow of current in a parallel circuit • Describing the flow of current in a parallel circuit • Records keeping	0.2	0.5	0.7
4.	Express Kirchhoff's current law.	**Expressing Kirchhoff's current law**:	0.2	0.5	0.7

		• Concept of Kirchhoff's current law • Application of Kirchhoff's current law • Expressing Kirchhoff's current law • Records keeping			
5.	Use the current divider rule.	**Using the current divider rule** : • Concept of current divider rule • Application of current divider rule • Using the current divider rule • Precautions to be taken • Records keeping	0.2	0.5	0.7
6.	Apply Ohm's law for parallel circuit calculations.	**Applying Ohm's law for parallel circuit calculations**: • Concept of applying Ohm's law for parallel circuit • Applying Ohm's law for parallel circuit • Records keeping	0.2	0.5	0.7
7.	Calculate power in a parallel circuit.	**Calculating power in a parallel circuit**: • Concept of calculating power in a parallel circuit • Application of the calculation of power in a parallel circuit • Calculating power in a parallel circuit • Records keeping	0.2	0.5	0.7
8.	Describe the effect of connecting voltage sources in parallel.	**Describing the effect of connecting voltage sources in parallel**: • Concept of effect of connecting voltage sources in parallel • Application of effect of connecting voltage sources in parallel • Describing the effect of connecting voltage sources in parallel • Records keeping	0.2	0.5	0.7
9.	List some typical applications for parallel circuits.	**Listing some typical applications for parallel circuits**: • Concept of applications for parallel circuits • Listing some typical applications for parallel circuits • Records keeping	0.1	1.0	1.1
10.	Troubleshoot parallel circuits	**Troubleshooting parallel circuits**: • Concept of troubleshooting parallel circuits • Principles and procedures for troubleshooting parallel circuits • Troubleshooting parallel circuits • Safety/precautions to be followed • Records keeping	0.1	1.0	1.1

11.	Connect three resistor having (i) different value and (ii) same value in parallel and find the equivalent resistance	**Connecting three resistor having (i) different value and (ii) same value in parallel and find the equivalent resistance**: • Concept of connecting three resistors • Application of connecting three resistors • Principles and procedures for connecting three resistor having (i) different value and (ii) same value in parallel and find the equivalent resistance • Connecting three resistor having (i) different value and (ii) same value in parallel and find the equivalent resistance • Safety/precautions to be followed • Records keeping	0.1	1.0	1.1
12.	Apply /verify Kirchoff's current law	**Applying /verifying Kirchoff's current law**: • Concept of Kirchoff's current law • Application of Kirchoff's current law • Verification of Kirchoff's current law • Applying /verifying Kirchoff's current law • Safety/precautions to be followed • Records keeping	0.1	1.0	1.1
		Subtotal:	2	8	10

Sub module: 6: Series parallel circuits

Description: It covers resistance, current, and voltage in series parallel circuits. The student will learn to apply Ohm's law to solving for specific quantities in these circuit configurations. The module also covers power, loaded voltage dividers and the Wheatstone Bridge as well as troubleshooting applications and problem solving.

Objectives:

Upon completion of this module the student will be able to:

- Define a series parallel circuit.
- Determine the total resistance in a series parallel circuit.
- Apply Kirchhoff's current and voltage law to a series parallel circuit.
- Calculate voltage drops and power.
- Recognize the various configurations of series parallel networks.
- Explain the purpose of loaded voltage dividers.
- List some applications of series parallel circuits.
- Describe the effects of open and short circuits on series parallel resistor networks.
- Determine the total voltage of series parallel voltage sources.
- Connect a series parallel circuit having three resistors in series and three resistors in parallel and find t6he equivalent resistance

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Series parallel circuits		9 hrs. (Th.) + 41 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define a series parallel circuit.	**Defining a series parallel circuit**: Concept and definition of series parallel circuit Application of series parallel circuit Records keeping	0.2	0.8	1
2.	Determine the total resistance in a series parallel circuit.	**Determining the total resistance in a series parallel circuit**: • Concept of total resistance in a series parallel circuit • Application of total resistance in a series parallel circuit • procedure for determining the total resistance in a series parallel circuit • Determining the total resistance in a series parallel circuit • Precautions to be followed • Records keeping	0.2	0.8	1
3.	Apply Kirchhoff's current and voltage law to a series parallel circuit.	**Applying Kirchhoff's current and voltage law to a series parallel circuit**: • Concept of Kirchhoff's current and voltage law to a series parallel circuit • Application of Kirchhoff's current and voltage law to a series parallel circuit • Procedure for applying Kirchhoff's current and voltage law to a series parallel circuit • Applying Kirchhoff's current and voltage	0.2	0.8	1

		law to a series parallel circuit • Precautions to be followed • Records keeping			
4.	Calculate voltage drops and power.	**Calculating voltage drops and power**: • Concept of voltage drops and power • Application of calculation of voltage drops and power • procedure for calculating voltage drops and power • Calculating voltage drops and power • Precautions to be followed • Records keeping	0.2	0.8	1
5.	Recognize the various configurations of series parallel networks.	**Recognizing the various configurations of series parallel networks**: • Concept of various configurations of series parallel networks • Application of various configurations of series parallel networks • How to recognize various configurations of series parallel networks • Recognizing the various configurations of series parallel networks • Records keeping	0.2	0.8	1
6.	Explain the purpose of loaded voltage dividers.	**Explaining the purpose of loaded voltage dividers**: • Concept of loaded voltage dividers • Application of loaded voltage dividers • Purpose of loaded voltage dividers • Explaining the purpose of loaded voltage dividers • Records keeping	0.2	0.8	1
7.	List some applications of series parallel circuits.	**Listing some applications of series parallel circuits**: • Concept of applications of series parallel circuits • Listing applications of series parallel circuits • Precautions to be followed • Records keeping	0.2	0.8	1
8.	Describe the effects of open and short circuits on series parallel resistor networks.	**Describing the effects of open and short circuits on series parallel resistor networks:** • Concept of effects of open and short circuits on series parallel resistor networks: • Application of effects of open and short circuits on series parallel resistor networks • Describing the effects of open and short	0.2	0.8	1

		circuits on series parallel resistor networks • Records keeping			
9.	Determine the total voltage of series parallel voltage sources.	**Determining the total voltage of series parallel voltage sources**: • Concept of total voltage of series parallel voltage sources • Application of total voltage of series parallel voltage sources • Procedure for determining the total voltage of series parallel voltage sources • Determining the total voltage of series parallel voltage sources • Precautions to be followed • Records keeping	0.2	0.8	1
10.	Connect a series parallel circuit having three resistors in series and three resistors in parallel and find t6he equivalent resistance	**Connecting a series parallel circuit having three resistors in series and three resistors in parallel and find t6he equivalent resistance**: • Concept • Application • Procedure for connecting a series parallel circuit having three resistors in series and three resistors in parallel and find t6he equivalent resistance • Connecting a series parallel circuit having three resistors in series and three resistors in parallel and find t6he equivalent resistance • Precautions to be followed • Records keeping	0.2	0.8	1
		Subtotal:	2	8	10

Sub module: 7: DC measuring instruments

Description: It includes the study of both analogue and digital dc measuring instruments including ammeters, voltmeters, and ohmmeters. Voltmeter loading and sensitivity are presented with an emphasis on practical applications and safe operation of these instruments. This module also covers multimeters, electronic meters, and an introduction to digital measuring instruments.

Objectives:

- Upon completion of this module the student will be able to:
- Explain the necessity of a shunt resistor in a dc ammeter circuit.
- Describe the effects of ammeter and voltmeter loading.
- Explain the basic operation of a multi range ammeter.
- Discuss the purpose of a multiplier resistor in a dc voltmeter.
- Define voltmeter sensitivity.
- Describe the operating characteristics of the dc wattmeter.
- Describe the operation of the ohmmeter.
- Discuss the basic principles of electronic and digital multimeters.
- Measure DC voltage using multimeter/voltmeter
- Measure DC current using multimeter/ammeter
- Measure power using DC wattmeter

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

DC measuring instruments		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Explain the necessity of a shunt resistor in a dc ammeter circuit.	**Explaining the necessity of a shunt resistor in a dc ammeter circuit**: • concept of shunt resistor in a dc ammeter circuit • Application of shunt resistor in a dc ammeter circuit • Explaining the necessity of a shunt resistor in a dc ammeter circuit • Record keeping	0.1	0.4	0.5
2.	Describe the effects of ammeter and voltmeter loading.	**Describing the effects of ammeter and voltmeter loading**: • Concept of effects of ammeter and voltmeter loading • Application of effects of ammeter and voltmeter loading • Describing the effects of ammeter and voltmeter loading • Record keeping	0.1	0.4	0.5
3.	Explain the basic operation of a multi range ammeter.	**Explaining the basic operation of a multi range ammeter**: • Concept of basic operation of a multi range ammeter	0.2	0.8	1.0

		• Application of basic operation of a multi range ammeter • Explaining the basic operation of a multi range ammeter • Record keeping			
4.	Discuss the purpose of a multiplier resistor in a dc voltmeter.	**Discussing the purpose of a multiplier resistor in a dc voltmeter:** • Concept of multiplier resistor in a dc voltmeter • Application of multiplier resistor in a dc voltmeter • Purpose of a multiplier resistor in a dc voltmeter • Discussing the purpose of a multiplier resistor in a dc voltmeter • Record keeping	0.2	0.8	1.0
5.	Define voltmeter sensitivity.	**Defining voltmeter sensitivity**: • Concept of voltmeter sensitivity • Application of voltmeter sensitivity • Defining voltmeter sensitivity • Record keeping	0.2	0.8	1.0
6.	Describe the operating characteristics of the dc wattmeter.	**Describing the operating characteristics of the dc wattmeter**: • Concept of dc wattmeter • Application/ handling of dc wattmeter • Operating characteristics of the dc wattmeter • Describing the operating characteristics of the dc wattmeter • Record keeping	0.2	0.8	1.0
7.	Describe the operation of the ohmmeter.	**Describing the operation of the ohmmeter**: • Concept of operation of ohmmeter • Application / handling of ohmmeter • Describing the operation of the ohmmeter • Safety/precautions to be taken • Record keeping	0.2	0.8	1.0
8.	Discuss the basic principles of electronic and digital multimeters.	**Discussing the basic principles of electronic and digital multimeters**: • Concept of electronic and digital multimeters • Application of electronic and digital multimeters • Basic principles of electronic and digital multimeters • Discussing the basic principles of electronic and digital multimeters	0.2	0.8	1.0

		• Record keeping			
9.	Measure DC voltage using multimeter/voltmeter	**Measuring DC voltage using multimeter/voltmeter**: • Concept of DC voltage • Application of DC voltage • Principles and procedures for measuring DC voltage using multimeter/voltmeter • Handling of multimeter/voltmeter • Measuring DC voltage using multimeter/voltmeter • Safety/precautions to be taken • Record keeping	0.2	0.8	1.0
10.	Measure DC current using multimeter/ammeter	**Measuring DC current using multimeter/ammeter**: • Concept of DC current • Application of DC current • Principles and procedures for measuring DC current using multimeter/ammeter • Handling of multimeter/ammeter • Measuring DC current using multimeter/ammeter • Safety/precautions to be taken • Record keeping	0.2	0.8	1.0
11.	Measure power using DC wattmeter	**Measuring power using DC wattmeter**: • Concept of measuring power using DC wattmeter • Application of measuring power using DC wattmeter • Principles and procedures for measuring power using DC wattmeter • Handling DC wattmeter • Measuring power using DC wattmeter • Safety/precautions to be taken • Record keeping	0.2	0.8	1.0
		Subtotal:	2	8	10

Sub module: 8: Industrial control devices

Description: Industrial Control Devices provides an overview of devices such as switches, actuators and relays and their industrial applications. The student will learn troubleshooting techniques and the principles of relay and ladder logic. This module also covers solenoids and control valves with an emphasis on practical applications.

Objectives:

Upon completion of this module the student will be able to:

- Define inductive arcing and explain how it can be prevented.
- Name three types of mechanical switches.
- Describe the basic operating principle of a control relay.
- Explain the purpose of overload relays.
- Define the term holding contract and its application in control circuits.
- Explain the difference between a control relay and a solenoid.
- List three applications of rotary actuators.
- Name three types of time-delay relays.
- Identify Normally Open (NO) and Normally Closed (NC) contact6s of push switches

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Industrial control devices		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define inductive arcing and explain how it can be prevented.	**Defining inductive arcing and explain how it can be prevented**: • Concept and definition of inductive arcing • Prevention of inductive arcing • Explaining how inductive arcing can be prevented • Records keeping	0.2	0.5	0.7
2.	Name three types of mechanical switches.	**Naming three types of mechanical switches**: • Concept and definition of mechanical switches • Three types of mechanical switches • Application of mechanical switches • Records keeping	0.2	1.0	1.2
3.	Describe the basic operating principle of a control relay.	**Describing the basic operating principle of a control relay**: • Concept of control relay • Application of control relay • Basic operating principle of a control relay • Describing the basic operating principle of a control relay • Records keeping	0.2	1.0	1.2
4.	Explain the purpose of overload relays.	**Explaining the purpose of overload relays:** • Concept of overload relays	0.2	0.5	0.7

		• Application of overload relays • Purpose of overload relays • Explaining the purpose of overload relays • Records keeping			
5.	Define the term holding contract and its application in control circuits	**Defining the term holding contract and its application in control circuits**: • Concept and definition of holding contract and control circuits • Application of holding contract in control circuits • Records keeping	0.2	1.0	1.2
6.	Explain the difference between a control relay and a solenoid.	**Explaining the difference between a control relay and a solenoid**: • Concept of control relay and solenoid • Application of control relay and solenoid • Difference between a control relay and a solenoid • Explaining the difference between a control relay and a solenoid • Records keeping	0.3	1.0	1.3
7.	List three applications of rotary actuators.	**Listing three applications of rotary actuators:** • Concept of rotary actuators • Application of rotary actuators • Listing three applications of rotary actuators • Records keeping	0.3	1.0	1.3
8.	Name three types of time-delay relays.	**Naming three types of time-delay relays**: • Concept of time-delay relays • Application of time-delay relays • Naming three types of time-delay relays • Records keeping	0.2	1.0	1.2
9.	Identify Normally Open (NO) and Normally Closed (NC) contacts of push switches	**Identify Normally Open (NO) and Normally Closed (NC) contacts of push switches**: • Concept of Normally Open (NO) and Normally Closed (NC) contacts of push switches • Application of Normally Open (NO) and Normally Closed (NC) contacts of push switches • Identification of Normally Open (NO) and Normally Closed (NC) contacts of push switches • Records keeping	0.2	1.0	1.2
		Subtotal:	2	8	10

Sub module: 9: Magnetism

Description: It provides an introduction to magnetism including the nature of magnetism, magnetic fields, and magnetic materials. Electromagnets and permanent magnets are also presented using a combination of video and animation allowing the student to gain a better understanding of magnetic field theory. The Hall effect sensor is also introduced in this module.

Objectives:

Upon completion of this module the student will be able to:

- Explain Weber's theory.
- Define the term domain.
- Describe the principle of the magnetic field.
- List four characteristics of magnetic lines of force.
- List the three laws of magnetic attraction and repulsion.
- Name the three classifications of magnetic materials.
- Describe the field around a current carrying conductor.
- Define the right hand rule.
- List the three factors affecting the strength of an electromagnetic field.
- Explain how magnetic fields are used to store audio and video signals.
- Name two types of permanent magnets.
- Describe the Hall Effect.
- List four characteristics of magnetic lines of force.
- List the three laws of magnetic attraction and repulsion.
- Name two types of permanent magnets.

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Magnetism		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Explain Weber's theory.	**Explaining Weber's theory:** • Concept of Weber's theory • Application of Weber's theory • Explaining Weber's theory • Keeping records	0.2	0.5	0.7
2.	Define the term domain.	**Defining the term domain**: • Concept and definition of domain • Application of domain • Keeping records	0.2	0.5	0.7
3.	Describe the principle of the magnetic field.	**Describing the principle of the magnetic field**: • Concept of magnetic field • Principle of the magnetic field • Describing the principle of the magnetic field • Application of the principle of the magnetic field • Keeping records	0.2	0.5	0.7

4.	List four characteristics of magnetic lines of force.	**Listing four characteristics of magnetic lines of force**: • Concept of magnetic lines of force • Application of magnetic lines of force • Characteristics of magnetic lines of force • Listing four characteristics of magnetic lines of force • Keeping records	0.2	0.5	0.7
5.	List the three laws of magnetic attraction and repulsion.	**Listing the three laws of magnetic attraction and repulsion**: • Concept of magnetic attraction and repulsion • Three laws of magnetic attraction and repulsion • Application of the three laws of magnetic attraction and repulsion • Keeping records	0.2	0.5	0.7
6.	Name the three classifications of magnetic materials.	**Naming the three classifications of magnetic materials**: • Concept of magnetic materials • Application of magnetic materials • Classification of magnetic materials • Naming the three classifications of magnetic materials • Keeping records	0.1	0.5	0.6
7.	Describe the field around a current carrying conductor.	**Describing the field around a current carrying conductor**: • Concept of field around a current carrying conductor • Application of field around a current carrying conductor • Describing the field around a current carrying conductor • Keeping records	0.1	0.5	0.6
8.	Define the right hand rule.	**Defining the right hand rule**: • Concept and definition of right hand rule • Application of right hand rule • Keeping records	0.1	0.5	0.6
9.	List the three factors affecting the strength of an electromagnetic field.	**Listing the three factors affecting the strength of an electromagnetic field**: • Concept of electromagnetic field and strength of an electromagnetic field • Application of electromagnetic field and strength of an electromagnetic field • Factors affecting the strength of an electromagnetic field • Listing the three factors affecting the	0.1	0.5	0.6

		strength of an electromagnetic field • Keeping records			
10.	Explain how magnetic fields are used to store audio and video signals.	**Explaining how magnetic fields are used to store audio and video signals**: • Concept of audio and video signals • Application of audio and video signals • Use of magnetic fields to store audio and video signals • Explaining how magnetic fields are used to store audio and video signals • Keeping records	0.1	0.5	0.6
11.	Name two types of permanent magnets.	**Naming two types of permanent magnets**: • Concept of permanent magnets • Application of permanent magnets • Naming two types of permanent magnets • Keeping records	0.1	0.5	0.6
12.	Describe the Hall Effect.	**Describing the Hall Effect**: • Concept of Hall Effect • Application of Hall Effect • Describing the Hall Effect • Keeping records	0.1	0.5	0.6
13.	List four characteristics of magnetic lines of force.	**Listing four characteristics of magnetic lines of force**: • Concept of magnetic lines of force • Application of magnetic lines of force • Characteristics of magnetic lines of force • Listing four characteristics of magnetic lines of force • Keeping records	0.1	0.5	0.6
14.	List the three laws of magnetic attraction and repulsion.	**Listing the three laws of magnetic attraction and repulsion**: • Concept of laws of magnetic attraction and repulsion • Application of laws of magnetic attraction and repulsion • Listing the three laws of magnetic attraction and repulsion • Keeping records	0.1	0.5	0.6
15.	Name two types of permanent magnets	**Naming two types of permanent magnets**: • Concept of permanent magnets • Application of permanent magnets • Naming two types of permanent magnets • Keeping records	0.1	1.0	1.1
		Subtotal:	2	8	10

Sub module: 10: DC motors and control circuits

Description: It will focus on the principles of DC motors and the various types used in industry. The student will learn the fundamentals of speed control including dynamic and regenerative braking. Servo-, Stepper- and Brushless DC motors are discussed as well as basic dynamo configurations. This module also introduces the student to electronic speed control of DC motors

Objectives:

Upon completion of this module the student will be able to:

- Explain the purpose of a commutator in DC motors.
- Differentiate between a stator and an armature.
- Describe the basic components of a dynamo
- Define torque and counter EMF.
- Name three typical dynamo configurations.
- List two types of compound motors.
- Explain the basic operating principle of servomotors.
- Describe what is meant by overshoot and damping in motor circuits.
- List three applications for stepper motors.
- Name two advantages of using brushless DC motors.
- Explain how pulse-width modulation is applied to DC motor speed control.
- Define the terms dynamic and regenerative braking.
- Identify DC motor parts
- Dismantle DC motor parts
- Assemble DC motor parts
- Control speed of DC shunt motor by Armature control method (keeping field current constant)
- Control speed of DC shunt motor by Field control method (keeping armature voltage constant

Duration: 20 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

DC motors and control circuits		4 hrs. (Th.) + 16 hrs. (Pr,) = 20 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Explain the purpose of a commutator in DC motors.	**Explaining the purpose of a commutator in DC motors**: • Concept of commutator and DC motors • Application of commutator and DC motors • Purpose of commutator in DC motors • Explaining the purpose of a commutator in DC motors • Keeping records	0.3	0.7	1.0
2.	Differentiate between a stator and an armature.	**Differentiating between a stator and an armature**: • Concept of a stator and an armature • Application of a stator and an armature • Difference between a stator and an armature • Keeping records	0.3	0.6	0.9
3.	Describe the basic components of a dynamo.	**Describing the basic components of a dynamo**: • Concept of dynamo • Application of dynamo • Basic components of a dynamo • Describing the basic components of a dynamo • Keeping records	0.2	0.7	0.9

4.	Define torque and counter EMF.	**Defining torque and counter EMF**: • Concept of torque and counter EMF • Application of torque and counter EMF • Defining torque and counter EMF • Keeping records	0.2	1.0	1.2
5.	Name three typical dynamo configurations.	**Naming three typical dynamo configurations:** • Concept of dynamo configurations • Application of dynamo configurations • Three typical dynamo configurations • Keeping records	0.2	1.0	1.2
6.	List two types of compound motors	**Listing two types of compound motors:** • Concept of compound motors • Application of compound motors • Two types of compound motors • Keeping records	0.2	1.0	1.2
7.	Explain the basic operating principle of servomotors.	**Explaining the basic operating principle of servomotors**: • Concept of servomotors • Application of servomotors • Basic operating principle of servomotors • Explaining the basic operating principle of servomotors • Keeping records	0.2	1.0	1.2
8.	Describe what is meant by overshoot and damping in motor circuits.	**Describing what is meant by overshoot and damping in motor circuits**: • Concept of overshoot and damping in motor circuits • Describing what is meant by overshoot and damping in motor circuits • Keeping records	0.2	1.0	1.2
9.	List three applications for stepper motors.	**Listing three applications for stepper motors**: • Concept of stepper motors • Application of stepper motors • Listing three applications for stepper motors • Keeping records	0.2	1.0	1.2
10.	Name two advantages of using brushless DC motors.	**Naming two advantages of using brushless DC motors**: • Concept of brushless DC motors • Application of brushless DC motors • Advantages of using brushless DC motors • Keeping records	0.2	1.0	1.2
11.	Explain how pulse-width modulation is applied to DC motor speed control	**Explaining how pulse-width modulation is applied to DC motor speed control**: • Concept of pulse-width modulation and DC motor speed control • Application of pulse-width modulation in DC motor speed control • Keeping records	0.2	1.0	1.2
12.	Define the terms dynamic and regenerative braking.	**Defining the terms dynamic and regenerative braking**:	0.2	1.0	1.2

		• Concept of dynamic and regenerative braking • Application of dynamic and regenerative braking • Keeping records			
13.	Identify DC motor parts	**Identifying DC motor parts**: • Concept of DC motor parts • Applications and functions of DC motor parts • Identification of DC motor parts • Keeping records	0.2	1.0	1.2
14.	Dismantle DC motor parts	**Dismantling DC motor parts**: • Concept of dismantling DC motor parts • Principles and procedures for dismantling DC motor parts • Dismantling DC motor parts • Safety/precautions to be taken • Keeping records	0.3	1.0	1.3
15.	Assemble DC motor parts	**Assembling DC motor parts**: • Concept of assembling DC motor parts • Principles and procedures for assembling DC motor parts • Assembling DC motor parts • Safety/precautions to be taken • Keeping records	0.3	1.0	1.3
16.	Control speed of DC shunt motor by Armature control method (keeping field current constant)	**Controlling speed of DC shunt motor by Armature control method (keeping field current constant):** • Concept of controlling speed, DC shunt motor and Armature control method • Application of Armature control method • Principles and procedures for controlling speed of DC shunt motor by Armature control method (keeping field current constant) • Safety/precautions to be taken • Keeping records	0.3	1.0	1.3
17.	Control speed of DC shunt motor by Field control method (keeping armature voltage constant)	**Controlling speed of DC shunt motor by Field control method (keeping armature voltage constant):** • Concept of controlling speed, DC shunt motor and Field control method • Application of Field control method • Principles and procedures for controlling speed of DC shunt motor by Field control method (keeping field current constant) • Safety/precautions to be taken • Keeping records	0.3	1.0	1.3
		Subtotal:	4	16	20

Sub module: 11: Alternating voltages & currents

Description: It introduces the student to the fundamentals of alternating voltages and currents. In addition to sine waves, the module also covers non sinusoidal waveforms and harmonic frequencies. The principles of frequency, period, and wavelength are presented emphasizing practical applications and troubleshooting techniques. Theoretical areas of study include instantaneous, RMS and average values of sine waves.

Objectives:

Upon completion of this module the student will be able to:

- Identify sine waves.
- Explain the instantaneous value of a sine wave.
- Convert radians to electrical degrees and vice versa.
- Define frequency, period and wavelength.
- Determine the average and RMS values of a sine wave.
- Explain the phase relationships between alternating current and voltage.
- Differentiate between a sinusoidal wave and a non sinusoidal wave.
- Name three types of non sinusoidal waves.
- Define harmonics.
- Convert radians to electrical degrees and vice versa.
- Determine the average and RMS values of a sine wave.
- Explain the phase relationships between alternating current and voltage.
- Differentiate between a sinusoidal wave and a non sinusoidal wave.
- Name three types of non sinusoidal waves.

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Alternating voltages & currents		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Identify sine waves.	**Identifying sine waves**: Concept of sine waves Application of sine waves Identification of sine waves Keeping records	0.1	0.5	0.6
2.	Explain the instantaneous value of a sine wave.	**Explaining the instantaneous value of a sine wave**: • Concept of instantaneous value of a sine wave • Application of instantaneous value of a sine wave • Explaining the instantaneous value of a sine wave • Keeping records	0.1	0.5	0.6
3.	Convert radians to electrical degrees and vice versa.	**Converting radians to electrical degrees and vice versa**: • Concept of radians and electrical degrees • Converting radians to electrical degrees and vice versa • Converting electrical degrees to radians • Keeping records	0.1	0.5	0.6
4.	Define frequency, period and wavelength.	**Defining frequency, period and wavelength**: • Concept and definition of frequency, period and wavelength • Application of frequency, period and	0.1	0.5	0.6

		wavelength • Keeping records			
5.	Determine the average and RMS values of a sine wave.	**Determining the average and RMS values of a sine wave**: • Concept of average and RMS values of a sine wave • Application of average and RMS values of a sine wave • Determining the average values of a sine wave • Determining the RMS values of a sine wave • Precautions to be taken • Keeping records	0.1	0.5	0.6
6.	Explain the phase relationships between alternating current and voltage.	**Explaining the phase relationships between alternating current and voltage**: • Concept of phase relationships, alternating current and voltage • Phase relationships between alternating current and voltage Application of phase relationships between alternating current and voltage • Explaining the phase relationships between alternating current and voltage • Precautions to be taken • Keeping records	0.1	0.5	0.6
7.	Differentiate between a sinusoidal wave and a non sinusoidal wave.	**Differentiating between a sinusoidal wave and a non sinusoidal wave**: • Concept of sinusoidal wave and non sinusoidal wave • Application of sinusoidal wave and non sinusoidal wave • Difference between a sinusoidal wave and a non sinusoidal wave • Keeping records •	0.1	0.5	0.6
8.	Name three types of non sinusoidal waves.	**Naming three types of non sinusoidal waves**: • Types of non sinusoidal waves • Naming three types of non sinusoidal waves • Keeping records	0.1	0.5	0.6
9.	Define harmonics.	**Defining harmonics**: • Concept and definition of harmonics • Keeping records	0.2	0.5	0.7
10.	Convert radians to electrical degrees and vice versa.	**Converting radians to electrical degrees and vice versa**: • Concept of converting radians to electrical degrees and vice versa • Converting radians to electrical degrees • Converting electrical degrees to radians • Precautions to be taken • Keeping records	0.2	1.0	1.2
11.	Determine the average and RMS values of a sine wave.	**Determining the average and RMS values of a sine wave:** • Concept of average and RMS values of a sine	0.2	1.0	1.2

		wave • Application of average and RMS values of a sine wave • Principles and procedures for determining the average and RMS values of a sine wave • Determining the average and RMS values of a sine wave • Precautions to be taken while carrying out this task • Keeping records of the related activities			
12.	Explain the phase relationships between alternating current and voltage	**Explaining the phase relationships between alternating current and voltage**: • Concept of phase relationships, alternating current and voltage • Application of phase relationships, alternating current and voltage • Relationships between alternating current and voltage • Explaining the phase relationships between alternating current and voltage • Keeping records of the related activities	0.2	0.5	0.7
13.	Differentiate between a sinusoidal wave and a non sinusoidal wave.	**Differentiating between a sinusoidal wave and a non sinusoidal wave:** • Concept of sinusoidal wave and a non sinusoidal wave • Application of sinusoidal wave and a non sinusoidal wave • Difference between a sinusoidal wave and a non sinusoidal wave • Differentiating between a sinusoidal wave and a non sinusoidal wave • Precautions to be taken while carrying out this task • Keeping records of the related activities	0.2	0.5	0.7
14.	Name three types of non sinusoidal waves.	**Naming three types of non sinusoidal waves:** • Concept of non sinusoidal waves • Application of non sinusoidal waves • Types of non sinusoidal waves • Naming three types of non sinusoidal waves • Precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
		Subtotal:	2	8	10

Sub module: 12: AC measuring instruments

Description: It includes the study of both analogue and digital AC measuring instruments including ammeters, voltmeters and ohmmeters. Oscilloscopes, signal generators, and frequency counters are presented with an emphasis on practical applications and safe operation of these instruments. This module is designed to reinforce troubleshooting techniques using AC meters.

Objectives: Upon completion of this module the student will be able to:

- Name two methods of frequency measurement.
- Describe the basic operating characteristics of an oscilloscope.
- Determine voltage and frequency values from oscilloscope displays.
- List two applications of signal generators.
- Define a function generator.
- Define harmonics.
- Measure AC voltage using multimeter/voltmeter
- Measure AC current using multimeter/ammeter
- Verify frequencies and signals using function generator
- Trace different wave forms ((sinusoidal, triangular and square) in the oscilloscope

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

	AC measuring instruments	2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Name two methods of frequency measurement.	**Naming two methods of frequency measurement**: • Concept of frequency measurement • Methods of frequency measurement • Naming two methods of frequency measurement • Application of frequency measurement • Keeping records	0.2	0.8	1
2.	Describe the basic operating characteristics of an oscilloscope	**Describing the basic operating characteristics of an oscilloscope**: • Concept of oscilloscope • Application of oscilloscope • Basic operating characteristics of an oscilloscope • Handling of oscilloscope • Precautions to be taken • Keeping records	0.2	0.8	1
3.	Determine voltage and frequency values from oscilloscope displays	**Determining voltage and frequency values from oscilloscope displays**: • Concept of determining voltage and frequency values from oscilloscope displays • Application of voltage and frequency values • Determining voltage and frequency values from oscilloscope displays • Precautions to be taken • Keeping records	0.2	0.8	1
4.	List two applications of signal generators.	**Listing two applications of signal generators**: • Concept of signal generators • Applications of signal generators • Keeping records	0.2	0.8	1
5.	Define a function generator.	**Defining a function generator**:	0.2	0.8	1

		• Concept/definition of functions of generator • Application of the functions of generator • Keeping records			
6.	Define harmonics.	**Defining harmonics**: • Concept of harmonics • Application of harmonics • Keeping records	0.2	0.8	1
7.	Measure AC voltage using multimeter/voltmeter	**Measuring AC voltage using multimeter/voltmeter**: • Concept of AC voltage • Application of AC voltage • Measuring AC voltage using multimeter/voltmeter • Keeping records	0.2	0.8	1
8.	Measure AC current using multimeter/ammeter	**Measuring AC current using multimeter/ammeter**: • Concept of AC current, multimeter/ammeter • Application of AC current • Measuring AC current using multimeter/ammeter • Keeping records	0.2	0.8	1
9.	Verify frequencies and signals using function generator	**Verifying frequencies and signals using function generator**: • Concept of function generator and verifying frequencies and signals using function generator • Application of function generator • Verifying frequencies and signals using function generator • Keeping records	0.2	0.8	1
10.	Trace different wave forms ((sinusoidal, triangular and square) in the oscilloscope	**Tracing different wave forms ((sinusoidal, triangular and square) in the oscilloscope**: • Concept of tracing different in the oscilloscope • Wave forms - sinusoidal, triangular and square • Application of tracing different in the oscilloscope • Tracing different wave forms ((sinusoidal, triangular and square) in the oscilloscope • Keeping records	0.2	0.8	1
		Subtotal:	2	8	10

Sub module: 13: Capacitance and capacitors

Description: It covers the principles of capacitance including relative permittivity, dielectric strength and leakage current. The types of capacitors covered in this module include electrolytic, ceramic, mylar and tantalum. Series and parallel configurations of capacitor circuits are included in the module as well as an introduction to bypass and coupling capacitors.

Objectives:

Upon completion of this module the student will be able to:

- Describe the electrostatic field between two charged surfaces.
- Determine the flux density of a capacitor.
- Define relative permittivity and dielectric strength.
- Express the capacitance of a device in terms of charge and potential difference.
- List three factors that determine the capacitance of a capacitor.
- Define the terms leakage current and leakage resistance.
- Describe various types of capacitors used in electronic circuits.
- Utilize the capacitor color code.
- Explain transients in RC circuits.
- Describe the universal time constant curve.
- Discuss the relationship between capacitors connected in series and in parallel.
- Define coupling capacitors and bypass capacitors.
- Troubleshoot capacitors.
- Identify capacitance by color coding method
- Connect three capacitance having (i) different value and (ii) same value in series and find the equivalent capacitance
- Connect three capacitors having (i) different value and (ii) same value in parallel and find the equivalent capacitance
- Trace transients of RC series circuit using function generator and oscilloscope

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Capacitance and capacitors		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Describe the electrostatic field between two charged surfaces.	**Describing the electrostatic field between two charged surfaces**: • Concept of electrostatic field & charged surfaces • Describing the electrostatic field between two charged surfaces • Records keeping	0.1	0.4	0.5
2.	Determine the flux density of a capacitor.	**Determining the flux density of a capacitor**: • Concept of capacitor & flux density of a capacitor • Handling of a capacitor • Process of determining the flux density of a capacitor • Determining the flux density of a capacitor • Precautions to be taken	0.1	0.4	0.5

		• Records keeping			
3.	Define relative permittivity and dielectric strength.	**Defining relative permittivity and dielectric strength**: • Concept of relative permittivity and dielectric strength • Application of relative permittivity and dielectric strength • Records keeping	0.1	0.4	0.5
4.	Express the capacitance of a device in terms of charge and potential difference.	**Expressing the capacitance of a device in terms of charge and potential difference**: • Concept of capacitance, charge and potential difference • Expressing the capacitance of a device in terms of charge and potential difference • Records keeping	0.1	0.4	0.5
5.	List three factors that determine the capacitance of a capacitor.	**Listing three factors that determine the capacitance of a capacitor**: • Concept of factors that determine the capacitance of a capacitor • Listing factors that determine the capacitance of a capacitor • Records keeping	0.1	0.4	0.5
6.	Define the terms leakage current and leakage resistance.	**Defining the terms leakage current and leakage resistance**: • Concept & definition of leakage current • Concept & definition of leakage current leakage resistance • Records keeping	0.1	0.5	0.6
7.	Describe various types of capacitors used in electronic circuits.	**Describing various types of capacitors used in electronic circuits**: • Concept of capacitors & electronic circuits • Types of capacitors used in electronic circuits • Describing various types of capacitors used in electronic circuits • Records keeping	0.1	0.5	0.6
8.	Utilize the capacitor color code.	**Utilizing the capacitor color code**: • Concept of capacitor color code • Application of capacitor color code • Utilizing the capacitor color code • Records keeping	0.1	0.5	0.6
9.	Explain transients in RC circuits.	**Explaining transients in RC circuits**: • Concept of transients & RC circuits • Explaining transients in RC circuits • Records keeping	0.1	0.5	0.6
10.	Describe the universal time constant curve.	**Describing the universal time constant curve:**	0.1	0.5	0.6

		• Concept of universal time constant curve • Application of universal time constant curve • Describing the universal time constant curve • Records keeping			
11.	Discuss the relationship between capacitors connected in series and in parallel.	**Discussing the relationship between capacitors connected in series and in parallel**: • Concept of capacitors connected in series and in parallel • Concept of the relationship between capacitors connected in series and in parallel • Discussing the relationship between capacitors connected in series and in parallel • Records keeping	0.1	0.5	0.6
12.	Define coupling capacitors and bypass capacitors.	**Defining coupling capacitors and bypass capacitors**: • Concept & definition of coupling capacitors and bypass capacitors • Application of coupling capacitors and bypass capacitors • Handling of coupling capacitors and bypass capacitors • Precautions to be taken • Records keeping	0.1	0.5	0.6
13.	Troubleshoot capacitors.	**Troubleshooting capacitors**: • Concept of troubleshooting • Principle & procedures for troubleshooting capacitors • Troubleshooting capacitors • Precautions to be taken • Records keeping	0.1	0.5	0.6
14.	Identify capacitance by color coding method	**Identifying capacitance by color coding method**: • Concept of capacitance & color coding method • Principle and procedure of color coding method • Determining capacitance by color coding method • Identifying capacitance by color coding method • Precautions to be followed • Records keeping	0.1	0.5	0.6

15.	Connect three capacitance having (i) different value and (ii) same value in series and find the equivalent capacitance	**Connecting three capacitance having (i) different value and (ii) same value in series and find the equivalent capacitance**: • Concept of connecting three capacitance • Application of connecting three capacitance • Principle & procedures for Connecting three capacitance having (i) different value and (ii) same value in series and find the equivalent capacitance • Connecting three capacitance having (i) different value and (ii) same value in series and find the equivalent capacitance • Precautions to be taken • Records keeping	0.2	0.5	0.7
16.	Connect three capacitors having (i) different value and (ii) same value in parallel and find the equivalent capacitance	**Connecting three capacitors having (i) different value and (ii) same value in parallel and find the equivalent capacitance**: • Concept of Connecting three capacitors having (i) different value and (ii) same value in parallel and find the equivalent capacitance • Connecting three capacitors having (i) different value and (ii) same value in parallel and find the equivalent capacitance • Precautions to be taken • Records keeping	0.2	0.5	0.7
17.	Trace transients	**Tracing transients**: • Concept of transients • Principle & procedures for tracing transients • Tracing transients • Precautions to be taken • Records keeping	0.2	0.5	0.7
		Subtotal:	2	8	10

Sub module: 14: Inductance and inductors

Description: It introduces the student to electromagnetic induction, Faraday's law and Lenz's law. Various types of inductors are described and the student will learn to calculate the values of transients in RL circuits. This module also covers inductors in series and parallel, and the effect on current, voltage and inductive reactance in these circuits.

Objectives:

Upon completion of this module the student will be able to:

- Describe the principle of electromagnetic induction and flux linkages.
- List the four basic factors that determine the magnitude of an induced EMF.
- Explain Lenz's law and the principle of counter EMF.
- Define self inductance and mutual inductance.
- List various types of inductors used in electrical and electronic circuits.
- Discuss the differences between inductors connected in series and in parallel.
- Explain inductive time constants and transients in RL circuits.
- Discuss energy stored in a magnetic field.
- Troubleshoot inductors.
- Connect three inductors having (i) different value and (ii) same value in series and find the equivalent inductance
- Connect three inductors having (i) different value and (ii) same value in parallel and the equivalent inductance
- Trace the transients of RL series circuit using function generator and oscilloscope

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Inductance and inductors		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Describe the principle of electromagnetic induction and flux linkages	**Describing the principle of electromagnetic induction and flux linkages**: • Concept of electromagnetic induction and flux linkages • Application of electromagnetic induction and flux linkages • Principle of electromagnetic induction and flux linkages • Describing the principle of electromagnetic induction and flux linkages • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
2.	List the four basic factors that determine the magnitude of an induced EMF.	**Listing the four basic factors that determine the magnitude of an induced EMF**: • Concept of magnitude of an induced EMF • Application of magnitude of an induced EMF • Basic factors that determine the magnitude of an induced EMF	0.2	0.5	0.7

		• Listing the four basic factors that determine the magnitude of an induced EMF • Related precautions to be taken • Keeping records of the related activities			
3.	Explain Lenz's law and the principle of counter EMF.	**Explaining Lenz's law and the principle of counter EMF**: • Concept of Lenz's law and counter EMF • Application of Lenz's law and the principle of counter EMF • Lenz's law and the principle of counter EMF • Explaining Lenz's law and the principle of counter EMF • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
4.	Define self inductance and mutual inductance.	**Defining self inductance and mutual inductance**: • Concept of self inductance and mutual inductance • Application of self inductance and mutual inductance • Defining self inductance and mutual inductance • Concept of self inductance and mutual inductance • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
5.	List various types of inductors used in electrical and electronic circuits.	**Listing various types of inductors used in electrical and electronic circuits**: • Concept of inductors, electrical and electronic circuits • Application of inductors, electrical and electronic • Types of inductors used in electrical and electronic circuits • Listing various types of inductors used in electrical and electronic circuits • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
6.	Discuss the differences between inductors connected in series and in parallel	**Discussing the differences between inductors connected in series and in parallel**: • Concept of inductors connected in series and in parallel • Application of inductors connected in series and in parallel • Differences between inductors connected	0.2	0.5	0.7

		in series and in parallel • Discussing the differences between inductors connected in series and in parallel • Related precautions to be taken • Keeping records of the related activities			
7.	Explain inductive time constants and transients in RL circuits.	**Explaining inductive time constants and transients in RL circuits**: • Concept of inductive time constants and transients in RL circuits • Application of inductive time constants and transients in RL circuits • Explaining inductive time constants and transients in RL circuits • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
8.	Discuss energy stored in a magnetic field.	**Discussing energy stored in a magnetic field**: • Concept of energy stored in a magnetic field • Application of energy stored in a magnetic field • Discussing energy stored in a magnetic field • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
9.	Troubleshoot inductors.	**Troubleshooting inductors**: • Concept of troubleshooting inductors • Application of troubleshooting inductors • Principles and procedures for troubleshooting inductors • Troubleshooting inductors • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
10.	Connect three inductors having (i) different value and (ii) same value in series and find the equivalent inductance	**Connecting three inductors having (i) different value and (ii) same value in series and find the equivalent inductance**: • Concept of connecting inductors • Application of connecting inductors • Principles and procedures for connecting three inductors having (i) different value and (ii) same value in series and find the equivalent inductance • Connecting three inductors having (i) different value and (ii) same value in series and find the equivalent inductance • Related safety/precautions to be taken • Keeping records of the related activities	0.1	1.5	1.6
11.	Connect three inductors having (i)	**Connecting three inductors having (i)**	0.1	1.5	1.6

	different value and (ii) same value in parallel and the equivalent inductance	**different value and (ii) same value in parallel and the equivalent inductance**: • Principles and procedures for connecting three inductors having (i) different value and (ii) same value in parallel and the equivalent inductance • Connecting three inductors having (i) different value and (ii) same value in parallel and the equivalent inductance • Related safety/precautions to be taken • Keeping records of the related activities			
12.	Trace the transients of RL series circuit using function generator and oscilloscope	**Tracing the transients of RL series circuit using function generator and oscilloscope**: • Concept of transients, RL series circuit, function generator, and oscilloscope • Application of transients, RL series circuit, function generator, and oscilloscope • Principles and procedures for tracing the transients of RL series circuit using function generator and oscilloscope • Tracing the transients of RL series circuit using function generator and oscilloscope • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
		Subtotal:	2	8	10

Sub module: 15: Transformers

Description: This is designed to present an overview of transformers and their applications in electronic circuits. Module work will be primarily based on transformer principles, design considerations and reinforcement of key concepts such as reflected load and maximum power transfer. Transformer types such as pulse, center tap, multiple winding and auto transformers are also discussed.

Objectives:

Upon completion of this module the student will be able to:

- Explain the basic operating principles of the transformer.
- Draw the schematic symbols for iron and air core transformers.
- Explain the standard markings used to identify transformer windings.
- Discuss the principles of reflected loads and impedance matching.
- List the various losses associated with transformers.
- Express the significance of transformer polarity.
- Differentiate between isolation transformers and auto transformers.
- Troubleshoot transformers.
- Identify different parts of single phase transformer
- Check voltage of step-up and step-down transformer
- Perform the polarity test on transformer
- Calculate the iron loss of transformer using Open-circuit test
- Calculate the copper loss of transformer using Short- circuit test
- Calculate efficiency of transformer
- Calculate voltage regulation of transformer

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Transformers		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Explain the basic operating principles of the transformer.	**Explaining the basic operating principles of the transformer**: • Concept of transformer • Application of transformer • Basic operating principles of the transformer • Explaining the basic operating principles of the transformer • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
2.	Draw the schematic symbols for iron and air core transformers.	**Drawing the schematic symbols for iron and air core transformers**: • Concept of schematic symbols, iron and air core transformers • Application of schematic symbols, iron and air core transformers • Schematic symbols for iron and air core transformers • Principle and procedures for drawing schematic symbols for iron and air core transformers • Drawing the schematic symbols for iron and air core transformers • Related precautions to be taken	0.2	0.5	0.7

		• Keeping records of the related activities			
3.	Explain the standard markings used to identify transformer windings.	**Explaining the standard markings used to identify transformer windings**: • Concept of standard markings & transformer windings • Application of standard markings & transformer windings • Standard markings used to identify transformer windings • Explaining the standard markings used to identify transformer windings • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
4.	Discuss the principles of reflected loads and impedance matching.	**Discussing the principles of reflected loads and impedance matching**: • Concept of reflected loads and impedance matching • Application of reflected loads and impedance matching • Principles of reflected loads and impedance matching • Discussing the principles of reflected loads and impedance matching • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
5.	List the various losses associated with transformers.	**Listing the various losses associated with transformers**: • Concept of losses associated with transformers • Application of losses associated with transformers • Various losses associated with transformers • Listing the various losses associated with transformers • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
6.	Express the significance of transformer polarity.	**Expressing the significance of transformer polarity**: • Concept of transformer polarity • Application of transformer polarity • Significance of transformer polarity • Expressing the significance of transformer polarity • Related precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
7.	Differentiate between isolation transformers and auto transformers	**Differentiating between isolation transformers and auto transformers**: • Concept of isolation transformers and auto transformers • Application of isolation transformers and auto transformers • Difference between isolation transformers and	0.1	0.5	0.6

		auto transformers • Related precautions to be taken • Keeping records of the related activities			
8.	Troubleshoot transformers.	**Troubleshooting transformers**: • Concept of transformers & troubleshooting • Application of transformers • Principles and procedures for troubleshooting of transformers • Troubleshooting of transformers • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
9.	Identify different parts of single phase transformer	**Identifying different parts of single phase transformer**: • Concept of single phase transformer & parts of single phase transformer • Application of single phase transformer • Identification of different parts of single phase transformer • Related precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
10.	Check voltage of step-up and step-down transformer	**Checking voltage of step-up and step-down transformer**: • Concept of voltage of step-up and step-down transformer • Application of voltage of step-up and step-down transformer • Principles and procedures for checking voltage of step-up and step-down transformer • Checking voltage of step-up and step-down transformer • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
11.	Perform the polarity test on transformer	**Performing the polarity test on transformer**: • Concept of polarity test on transformer • Application of polarity test on transformer • Principles and procedures for performing the polarity test on transformer • Performing the polarity test on transformer • Related safety/precautions to be taken • Keeping records of the related activities	0.1	1.0	1.1
12.	Calculate the iron loss of transformer using Open-circuit test	**Calculating the iron loss of transformer using Open-circuit test**: • Concept of iron loss of transformer & Open-circuit test • Application of iron loss of transformer & Open-circuit test • Principles and procedures for calculating the iron loss of transformer using Open-circuit test • Calculating the iron loss of transformer using Open-circuit test • Related safety/precautions to be taken	0.1	0.5	0.6

		• Keeping records of the related activities			
13.	Calculate the copper loss of transformer using Short- circuit test	**Calculating the copper loss of transformer using Short- circuit test:** • Concept of copper loss of transformer & Short-circuit test • Application of copper loss of transformer & Short- circuit test • Principles and procedures for calculating the copper loss of transformer using Short- circuit test • Calculating the copper loss of transformer using Short- circuit test • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
14.	Calculate efficiency of transformer	**Calculating efficiency of transformer:** • Concept of efficiency of transformer • Application of efficiency of transformer • Principles and procedures for calculating efficiency of transformer • Calculating efficiency of transformer • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
15.	Calculate voltage regulation of transformer	**Calculating voltage regulation of transformer:** • Concept of voltage regulation of transformer • Application of voltage regulation of transformer • Principles and procedures for calculating voltage regulation of transformer • Calculating voltage regulation of transformer • Related safety/precautions to be taken • Keeping records of the related activities	0.1	0.5	0.6
		Subtotal:	2	8	10

Sub module: 16: AC motors and drives

Description: It introduces the student to the fundamentals of alternating current motors and AC variable speed control systems. In addition to the basic introduction motor, the module also covers servo-, universal and synchronous motors. The principles of variable frequency drives and their control circuits are presented emphasizing practical applications and troubleshooting techniques. Theoretical areas of study include single-phase and shaded-pole induction motors.

Objectives:

Upon completion of this module the student will be able to:

- List the three classifications of single-phase motors.
- Explain the basic operating principle of the induction motor.
- Define synchronous speed and slip.
- Describe the difference between starting torque and breakdown torque.
- Name the three types of induction motors.
- List three advantages of universal motors over induction motors.
- Define speed regulation.
- Describe the difference between pulse-width modulation, pulse-amplitude modulation and pulse width control.
- Explain the difference between a cycloconverter and an inverter.
- List the three classifications of single-phase motors.
- Name the three types of induction motors.
- Identify different parts of single phase motor

Duration: 20 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

AC motors and drives		4 hrs. (Th.) + 16 hrs. (Pr,) = 20 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	List the three classifications of single-phase motors.	**Listing the three classifications of single-phase motors:** • Concept of single-phase motors • Application of single-phase motors • Classifications of single-phase motors • Keeping records of the related activities	0.4	1.0	1.4
2.	Explain the basic operating principle of the induction motor.	**Explaining the basic operating principle of the induction motor:** • Concept of induction motor • Application of induction motor • Basic operating principle of the induction motor • Explaining the basic operating principle of the induction motor • Keeping records of the related activities	0.4	2.0	2.4
3.	Define synchronous speed and slip.	**Defining synchronous speed and slip** • Concept of synchronous speed and slip • Application of synchronous speed and slip • Defining synchronous speed and slip • Keeping records of the related activities:	0.4	1.0	1.4

4.	Describe the difference between starting torque and breakdown torque	**Describing the difference between starting torque and breakdown torque:** • Concept of starting torque and breakdown torque • Application of starting torque and breakdown torque • Difference between starting torque and breakdown torque • Describing the difference between starting torque and breakdown torque • Keeping records of the related activities	0.4	1.0	1.4
5.	Name the three types of induction motors.	**Name the three types of induction motors:** • Concept of induction motors • Application of induction motors • Types of induction motors • Name the three types of induction motors • Keeping records of the related activities	0.3	1.0	1.3
6.	List three advantages of universal motors over induction motors	**Listing three advantages of universal motors over induction motors:** • Concept of universal motors over induction motors • Application of universal motors over induction motors • Advantages of universal motors over induction motors • Listing three advantages of universal motors over induction motors • Keeping records of the related activities	0.3	1.0	1.3
7.	Define speed regulation.	**Defining speed regulation:** • Concept of speed regulation • Application of speed regulation • Defining speed regulation • Keeping records of the related activities	0.3	1.0	1.3
8.	Describe the difference between pulse-width modulation, pulse-amplitude modulation and pulse width control.	**Describing the difference between pulse-width modulation, pulse-amplitude modulation and pulse width control:** • Concept of pulse-width modulation, pulse-amplitude modulation and pulse width control • Application of pulse-width modulation, pulse-amplitude modulation and pulse width control • Difference between pulse-width modulation, pulse-amplitude modulation and pulse width control • Describing the difference between pulse-width modulation, pulse-amplitude	0.3	1.0	1.3

		modulation and pulse width control • Related precautions to be taken • Keeping records of the related activities			
9.	Explain the difference between a cycloconverter and an inverter	**Explaining the difference between a cycloconverter and inverter:** • Concept of cycloconverter and inverter • Application of cycloconverter and inverter • Difference between a cycloconverter and inverter • Explaining the difference between a cycloconverter and inverter • Keeping records of the related activities	0.3	1.0	1.3
10.	List the three classifications of single-phase motors.	Listing the three classifications of single-phase motors	0.3	2.0	2.3
11.	Name the three types of induction motors.	Naming the three types of induction motors	0.3	2.0	2.3
12.	Identify different parts of single phase motor	**Identifying different parts of single phase motor:** • Concept of different parts of single phase motor • Application of different parts of single phase motor • Identifying different parts of single phase moto • Related precautions to be taken • Keeping records of the related activities	0.3	2.0	2.3
		Subtotal:	4	16	20

Sub module: 17: Analog and digital transducers

Description: It will build on previous topics by presenting an introduction to transducers used in both analog and digital applications. The module also covers temperature, pressure and flow transducers as well as other detection devices such as optical encoders and Hall-effect sensors. Capacitive, ultrasonic and thickness sensors are also presented using practical and theoretical examples of industrial applications of these devices.

Objectives:

Upon completion of this module the student will be able to:

- Differentiate between a thermocouple and a thermopile.
- Explain the advantages of using pyrometers for temperature measurement.
- Define the terms RTD and thermistor.
- Name two types of pressure transducers.
- Describe how load cells are used for flow measurement.
- Name three types of photoelectric devices.
- Briefly describe the components used in fiber optic systems.
- Define lasers and explain why they are used in industrial electronic controls.
- Explain the basic operating principle of an optical shaft encoder.
- Measure temperature of thermistor using boiled water thermistor and thermometer
- Control electrical device using LDR, Photo diode, Opto- coupler
- Identify properties of fiber optic system

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Analog and digital transducers		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Differentiate between a thermocouple and a thermopile	**Differentiating between a thermocouple and a thermopile**: • Concept of thermocouple and a thermopile • Application of thermocouple and a thermopile • Difference between a thermocouple and a thermopile • Keeping records of the related activities	0.2	0.5	0.7
2.	Explain the advantages of using pyrometers for temperature measurement.	**Explaining the advantages of using pyrometers for temperature measurement**: • Concept of pyrometers for temperature measurement • Application of pyrometers for temperature measurement • Advantages of using pyrometers for temperature measurement • Keeping records of the related activities	0.2	0.5	0.7
3.	Define the terms RTD and thermistor.	**Defining the terms RTD and thermistor** : • Concept of RTD and thermistor • Application of RTD and thermistor • Defining the terms RTD and thermistor • Keeping records of the related activities	0.2	0.5	0.7

4.	Name two types of pressure transducers.	**Naming two types of pressure transducers**: • Concept of pressure transducers • Application of pressure transducers • Types of pressure transducers • Related precautions to be taken • Naming two types of pressure transducers • Keeping records of the related activities	0.2	0.5	0.7
5.	Describe how load cells are used for flow measurement.	**Describing how load cells are used for flow measurement**: • Concept of load cells & flow measurement • Application of load cells & flow measurement • How load cells are used for flow measurement • Describing how load cells are used for flow measurement • Keeping records of the related activities	0.2	0.5	0.7
6.	Name three types of photoelectric devices.	**Naming three types of photoelectric devices**: • Concept of photoelectric devices • Application of photoelectric devices • Types of photoelectric devices • Naming three types of photoelectric devices • Keeping records of the related activities	0.2	0.5	0.7
7.	Briefly describe the components used in fiber optic systems.	**Describing the components used in fiber optic systems**: • Concept of fiber optic systems • Application of fiber optic systems • Components used in fiber optic systems • Describing the components used in fiber optic systems • Related precautions to be taken • Keeping records of the related activities	0.2	0.5	0.7
8.	Define lasers and explain why they are used in industrial electronic controls.	**Defining lasers and explaining why they are used in industrial electronic controls:** • Concept of lasers and industrial electronic controls • Application of lasers and industrial electronic controls • Defining lasers • explaining why they are used in industrial electronic controls • Keeping records of the related activities	0.2	0.5	0.7
9.	Explain the basic operating principle of an optical shaft encoder.	**Explaining the basic operating principle of an optical shaft encoder**: • Concept of optical shaft encoder	0.1	1.0	1.1

		• Application of optical shaft encoder • Basic operating principle of an optical shaft encoder • Explaining the basic operating principle of an optical shaft encoder • Keeping records of the related activities			
10.	Measure temperature of thermistor using boiled water thermistor and thermometer	**Measuring temperature of thermistor using boiled water thermistor and thermometer**: • Concept of temperature of thermistor, boiled water thermistor and thermometer • Application of temperature of thermistor, boiled water thermistor and thermometer • Principles and procedures for measuring temperature of thermistor using boiled water thermistor and thermometer • Measuring temperature of thermistor using boiled water thermistor and thermometer • Related safety/precautions to be taken • Keeping records of the related activities	0.1	1.0	1.1
11.	Control electrical device using LDR, Photo diode, Opto- coupler	**Controlling electrical device using LDR, Photo diode, Opto- couple**: • Concept of electrical device, LDR, Photo diode, & Opto- coupler • Application of electrical device, LDR, Photo diode, & Opto- coupler • Principles and procedures for controlling electrical device using LDR, Photo diode, Opto- coupler • Controlling electrical device using LDR, Photo diode, Opto- coupler • Related safety/precautions to be taken • Keeping records of the related activities	0.1	1.0	1.1
12.	Identify properties of fiber optic system	**Identifying properties of fiber optic system Concept of optic system**: • Application of optic system • Identifying properties of fiber optic system • Keeping records of the related activities	0.1	1.0	1.1
		Subtotal:	2	8	10

Sub module: 18: Industrial process control

Description: It is in this module that the student learns the principles of industrial control systems including open- and closed-loop control. Proportional, Integral and Derivative control are covered with an emphasis on practical application and design. An introduction to algorithms, flow charts and fuzzy logic is also presented in this module.

Objectives:

Upon completion of this module the student will be able to:

- Define the terms process, process variable and controlled variable.
- Name four applications for control systems.
- Explain the advantage of using block diagrams.
- Describe the relationship between the set point, error signal and measured value.
- Differentiate between open-loop control and closed-loop control.
- List the five basic components in a closed-loop control system.
- Name the four variables that are generally used to evaluate the performance of a closed-loop control system.
- Define dead time.
- Explain the basic operating principles of on off, proportional, integral, and derivative and PID control.
- Describe the purpose of feed forward control in process systems.
- Identify open loop and close loop control system
- Find the process of proportional integral, derivative and PID control
- Find out out relationship between set point, error signal and measured value

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Industrial process control		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define the terms process, process variable and controlled variable.	**Defining the terms process, process variable and controlled variable**: • Concept of process, process variable and controlled variable • Application of process, process variable and controlled variable • Defining the terms process, process variable and controlled variable • Records keeping of the activities	0.2	0.5	0.7
2.	Name four applications for control systems.	**Naming four applications for control systems** • Concept of control systems • Application of control systems • Naming four applications for control systems • Concept of control systems • Records keeping of the activities	0.2	0.5	0.7
3.	Explain the advantage of using block diagrams.	**Explaining the advantage of using block diagrams**: • concept of block diagrams • Application of block diagrams • Advantage of using block diagrams • Explaining the advantage of using block diagrams • Records keeping of the activities	0.2	0.5	0.7
4.	Describe the relationship between the set point, error signal and measured value.	**Describing the relationship between the set point, error signal and measured value**:	0.2	0.5	0.7

		• Concept of set point, error signal and measured value • Application of set point, error signal and measured value • Relationship between the set point, error signal and measured value • Describing the relationship between the set point, error signal and measured value • Records keeping of the activities			
5.	Differentiate between open-loop control and closed-loop control.	**Differentiating between open-loop control and closed-loop control**: • Concept of open-loop control and closed-loop control • Application of open-loop control and closed-loop control • Difference between open-loop control and closed-loop control • Records keeping of the activities	0.2	0.5	0.7
6.	List the five basic components in a closed-loop control system.	**Listing the five basic components in a closed-loop control system** • Concept of components in a closed-loop control system • Application of components in a closed-loop control system • Five basic components in a closed-loop control system • Records keeping of the activities	0.2	0.5	0.7
7.	Name the four variables that are generally used to evaluate the performance of a closed-loop control system.	**Naming the four variables that are generally used to evaluate the performance of a closed-loop control system**: • Concept of variables & evaluation of performance of a closed-loop control system • Application of variables & evaluation of performance of a closed-loop control system • Four variables that are generally used to evaluate the performance of a closed-loop control system • Records keeping of the activities	0.2	0.5	0.7
8.	Define dead time.	**Defining dead time**: • Concept of dead time • Application of dead time • Defining dead time • Records keeping of the activities	0.1	0.5	0.6
9.	Explain the basic operating principles of on off, proportional, integral, and derivative and PID control.	**Explaining the basic operating principles of on off, proportional, integral, and derivative and PID control**: • Concept of off, proportional, integral, and derivative and PID control • Application of off, proportional, integral, and derivative and PID control • Basic operating principles of on off,	0.1	0.5	0.6

		proportional, integral, and derivative and PID control • Explaining the basic operating principles of on off, proportional, integral, and derivative and PID control • Records keeping of the activities			
10.	Describe the purpose of feed forward control in process systems.	**Describing the purpose of feed forward control in process systems**: • Concept of feed forward control in process systems • Application of feed forward control in process systems • Purpose of feed forward control in process systems • Describing the purpose of feed forward control in process systems • Records keeping of the activities	0.1	0.5	0.6
11.	Identify open loop and close loop control system	**Identifying open loop and close loop control system**: • Concept of open loop and close loop control system • Application of open loop and close loop control system • Identification of open loop and close loop control system • Records keeping of the activities	0.1	1.0	1.1
12.	Find the process of proportional integral, derivative and PID control	**Finding the process of proportional integral, derivative and PID control**: • Concept of process of proportional integral, derivative and PID control • Application of process of proportional integral, derivative and PID control • Finding the process of proportional integral, derivative and PID control • Records keeping of the activities	0.1	1.0	1.1
13.	Find out relationship between set point, error signal and measured value	**Finding out relationship between set point, error signal and measured value**: • Concept of set point, error signal and measured value • Application of set point, error signal and measured value • Relationship between set point, error signal and measured value • Finding out relationship between set point, error signal and measured value • Records keeping of the activities	0.1	1.0	1.1
		Subtotal:	2	8	10

Sub module: 19: Semiconductor fundamentals

Description: It introduces the student to the PN junction and i application in modern electronic circuits. Semiconductor diodes and configurations such as half wave and full wave rectifiers are presented using both theoretical and practical examples which are reinforced by laboratory experiments. Other diodes such as Zener, Varactor, and Light Emitting Diodes (LEDs) are also introduced in this module.

Objectives:

Upon completion of this module the student will be able to:

- Explain the atomic structure of semiconductors.
- Differentiate between P type and N type semiconductors.
- Describe how a PN junction is forward biased and reverse biased.
- Name the two leads of a semiconductor diode.
- Explain the purpose of diode ratings.
- Troubleshoot diodes and rectifier circuits.
- Discuss the basic operation of half wave and full-wave rectifiers.
- Describe the operating characteristics of zener diodes.
- Name two types of optoelectronic devices and describe their operation.
- Identify characteristic of forward and reverse bias of a PN junction diode
- Identify and calculate DC AVG voltage, RMS voltage of AC input voltage in half & full wave rectifier
- Filter the half wave and full wave with simple capacitor and Π- filter
- Find voltage stabilization using zener diode

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Semiconductor fundamentals		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Explain the atomic structure of semiconductors.	**Explaining the atomic structure of semiconductors**: • Concept of atomic structure & semiconductors • Application of atomic structure • Atomic structure of semiconductors • Explaining the atomic structure of semiconductors • Records keeping of the activities	0.2	0.5	0.7
2.	Differentiate between P type and N type semiconductors.	**Differentiating between P type and N type semiconductors**: • Concept of P type and N type semiconductors • Application of P type and N type semiconductors • Difference between P type and N type semiconductors • Records keeping of the activities	0.2	0.5	0.7
3.	Describe how a PN junction is forward biased and reverse biased.	**Describing how a PN junction is forward biased and reverse biased**: • Concept of PN junction, forward biased and reverse biased • Application of PN junction, forward biased and reverse biased • How a PN junction is forward biased and reverse biased	0.2	0.5	0.7

		• Describing how a PN junction is forward biased and reverse biased • Records keeping of the activities			
4.	Name the two leads of a semiconductor diode.	**Naming the two leads of a semiconductor diode:** • Concept of leads & semiconductor diode • Application of leads & semiconductor diode • Naming the two leads of a semiconductor diode • Records keeping of the activities	0.1	0.5	0.6
5.	Explain the purpose of diode ratings.	**Explaining the purpose of diode ratings : Concept of diode ratings** • Application of diode ratings • Purpose of diode ratings • Explaining the purpose of diode ratings • Records keeping of the activities	0.2	0.5	0.7
6.	Troubleshoot diodes and rectifier circuits.	**Troubleshooting diodes and rectifier circuits**: • Concept of troubleshooting diodes, rectifier circuits • Application of troubleshooting diodes, rectifier circuits • Principles and procedures of troubleshooting diodes and rectifier circuits • Safety/precautions to be taken • Records keeping of the activities	0.2	0.5	0.7
7.	Discuss the basic operation of half wave and full-wave rectifiers.	**Discussing the basic operation of half wave and full-wave rectifiers**: • Concept of half wave and full-wave rectifiers • Application of half wave and full-wave rectifiers • Basic operation of half wave and full-wave rectifiers • Discussing the basic operation of half wave and full-wave rectifiers • Records keeping of the activities	0.2	0.5	0.7
8.	Describe the operating characteristics of zener diodes.	**Describing the operating characteristics of zener diodes**: • Concept of zener diodes • Application of zener diodes • operating characteristics of zener diodes • Describing the operating characteristics of zener diodes • Records keeping of the activities	0.2	0.5	0.7
9.	Name two types of optoelectronic devices and describe their operation	**Naming two types of optoelectronic devices and describe their operation**: • Concept of optoelectronic devices • Application of optoelectronic devices • Types of optoelectronic devices • Operation of optoelectronic devices • Records keeping of the activities	0.1	0.5	0.6
10.	Identify characteristic of forward and reverse bias of a PN junction diode	**Identifying characteristic of forward and reverse bias of a PN junction diode**	0.1	0.5	0.6

		• Concept of forward and reverse bias of a PN junction diode • Application of forward and reverse bias of a PN junction diode • Characteristic of forward and reverse bias of a PN junction diode • Identification of characteristic of forward and reverse bias of a PN junction diode • Records keeping of the activities			
11.	Identify and calculate DC AVG voltage, RMS voltage of AC input voltage in half & full wave rectifier	**Identifying and calculating DC AVG voltage, RMS voltage of AC input voltage in half & full wave rectifier**: • Concept of DC AVG voltage, RMS voltage of AC input voltage in half & full wave rectifier • Application of DC AVG voltage, RMS voltage of AC input voltage in half & full wave rectifier • Identification and calculation of DC AVG voltage, RMS voltage of AC input voltage in half & full wave rectifier • Records keeping of the activities	0.1	1.0	1.1
12.	Filter the half wave and full wave with simple capacitor and Π- filter	**Filtering the half wave and full wave with simple capacitor and Π- filter:** • Concept of half wave, full wave, simple capacitor, and Π- filter: • Application of wave, full wave, simple capacitor, and Π- filter • Principle and procedures for filtering the half wave and full wave with simple capacitor and Π- filter: • Filtering the half wave and full wave with simple capacitor and Π- filter: • Precautions to be taken • Records keeping of the activities	0.1	1.0	1.1
13.	Find voltage stabilization using zener diode	**Finding voltage stabilization using zener diode**: • Concept of voltage stabilization & zener diode • Application of voltage stabilization & zener diode • Principles and procedures of finding voltage stabilization using zener diode • Finding voltage stabilization using zener diode • Safety/precautions to be taken • Records keeping of the activities	0.1	1.0	1.1
		Subtotal:	2	8	10

Sub module: 20: Transistors and thyristors

Description: Bipolar Junction Transistors (BJTs) are covered in this and their application in amplifier and switching circuits is also presented. This module also introduces Field Effects Transistors (FETs), and thyristors such as Silicon Controlled Rectifiers (SCRs) and Triacs. In addition the module also includes transistor troubleshooting problems and assignments as well as laboratory experiments for transistor circuits.

Objectives:
Upon completion of this module the student will be able to:

- Describe the basic operation of a transistor.
- Explain how transistors are biased.
- List three types of transistors.
- Explain the relationship between current, voltage and power in a transistor.
- Discuss the purpose of voltage divider biasing.
- Exam bipolar transistors.
- Differentiate between FETs and BJTs.
- Define transconductance.
- Exam FETs and thyristors.
- Explain how SCRs and triacs are used for phase angle control.
- Describe the basic principles of a relaxation oscillator.
- Find the relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor
- Find stability of base,/voltage divider biasing /collector biasing of a transistor
- Find gain of FET, MOSFET transistor
- Control voltage and current using SCR, TRIAC by phase angle control
- Verify the frequency generation of relaxation oscillator using UJT

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Transistors and thyristors		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Describe the basic operation of a transistor.	**Describing the basic operation of a transistor**: • Concept of transistor • Application of transistor • Basic operation of a transistor • Describing the basic operation of a transistor • Records keeping of the activities	0.2	0.5	0.7
2.	Explain how transistors are biased	**Explaining how transistors are biased**: Concept of how transistors are biased Explaining how transistors are biased Records keeping of the activities	0.2	0.5	0.7
3.	List three types of transistors.	**Listing three types of transistors**: • Types of transistors • Listing three types of transistors • Records keeping of the activities	0.2	0.5	0.7
4.	Explain the relationship between	**Explaining the relationship between**	0.2	0.5	0.7

	current, voltage and power in a transistor.	**current, voltage and power in a transistor**: • Concept of the relationship between current, voltage and power in a transistor • Application of the relationship between current, voltage and power in a transistor • Explaining the relationship between current, voltage and power in a transistor • Records keeping of the activities			
5.	Discuss the purpose of voltage divider biasing.	**Discussing the purpose of voltage divider biasing**: • Concept of voltage divider biasing • Application of voltage divider biasing • Purpose of voltage divider biasing • Discussing the purpose of voltage divider biasing • Records keeping of the activities	0.1	0.5	0.6
6.	Exam bipolar transistors.	**Examination of bipolar transistors** : • Concept of bipolar transistors • Application of bipolar transistors • Principles and procedures for the examination of bipolar transistors • Examination of bipolar transistors • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
7.	Differentiate between FETs and BJTs.	**Differentiating between FETs and BJTs**: • Concept of FETs and BJTs • Application of FETs and BJTs • Difference between FETs and BJTs • Records keeping of the activities	0.1	0.5	0.6
8.	Define transconductance.	**Defining transconductance**: • Concept & definition of transconductance • Application of transconductance • Records keeping of the activities	0.1	0.5	0.6
9.	Exam FETs and thyristors.	**Examination of FETs and thyristors**: • Concept of FETs and thyristors • Application of FETs and thyristors • Principles and procedures for the examination of FETs and thyristors • Examination of FETs and thyristors • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
10.	Explain how SCRs and triacs are used for phase angle control.	**Explaining how SCRs and triacs are used for phase angle control**: • Concept of SCRs, triacs and phase angle control • Application of SCRs, triacs and phase angle	0.1	0.5	0.6

		control • Explaining how SCRs and triacs are used for phase angle control • Records keeping of the activities			
11.	Describe the basic principles of a relaxation oscillator.	**Describing the basic principles of a relaxation oscillator**: • Concept of relaxation oscillator • Application of relaxation oscillator • Basic principles of a relaxation oscillator • Describing the basic principles of a relaxation oscillator • Records keeping of the activities	0.1	0.5	0.6
12.	Find the relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor	**Finding the relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor**: • Concept of relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor • Application of relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor • Principles and procedures of finding out the relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor • Finding the relative voltage/current gain impedance of a CE, CB, CC configuration of a transistor • Safety/precautions to be taken • Records keeping of the activities •	0.1	0.5	0.6
13.	Find stability of base/voltage divider biasing /collector biasing of a transistor	**Finding stability of base/voltage divider biasing /collector biasing of a transistor**: • Concept of stability of base/voltage divider biasing /collector biasing of a transistor • Application of stability of base/voltage divider biasing /collector biasing of a transistor • Principles and procedures for finding out stability of base/ voltage divider biasing /collector biasing of a transistor • Finding stability of base/voltage divider biasing/ collector biasing of a transistor • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
14.	Find gain of FET, MOSFET transistor	**Finding gain of FET, MOSFET transistor**: • Concept of FET, MOSFET transistor	0.1	0.5	0.6

		• Application of FET, MOSFET transistor • Principles and procedures of finding out the gain of FET, MOSFET transistor • Finding gain of FET, MOSFET transistor • Safety/precautions to be taken • Records keeping of the activities			
15.	Control voltage and current using SCR, TRLAC by phase angle control	**Controlling voltage and current using SCR, TRLAC by phase angle control:** • Concept of controlling voltage and current using SCR, TRLAC by phase angle control • Application of controlling voltage and current using SCR, TRLAC by phase angle control • Principles and procedures for controlling voltage and current using SCR, TRLAC by phase angle control • Controlling voltage and current using SCR, TRLAC by phase angle control • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
16.	Verify the frequency generation of relaxation oscillator using UJT	**Verifying the frequency generation of relaxation oscillator using UJT**: • Concept of frequency generation, relaxation oscillator & UJT • Application of frequency generation, relaxation oscillator & UJT • Principles and procedures for verifying the frequency generation of relaxation oscillator using UJT • Verifying the frequency generation of relaxation oscillator using UJT • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
		Subtotal:	2	8	10

Sub module: 21: Amplifier circuits

Description: It covers common base, common collector and common-emitter amplifiers. In addition, the student is introduced to the effect of AC signals on amplifiers, FET amplifiers and multistage amplifiers. The student will also learn the differences between Class A, B, and C amplifiers and their applications in industry. Emphasis is placed on design, problem solving, and troubleshooting of amplifier circuits.

Objectives:

Upon completion of this module the student will be able to:

- List three main characteristics of linear amplifiers.
- Describe the effect of AC signals on an amplifier.
- Name three configurations for BJT amplifiers.
- Explain why coupling capacitors and bypass capacitors are used in amplifier circuits.
- List three configurations for FET amplifiers.
- Discuss the advantages and disadvantages of direct coupling, capacitor coupling and transformer coupling.
- Differentiate between classes A, B and C amplifiers.
- Define crossover distortion.
- Troubleshoot amplifier circuits.
- Find switching action of transistor
- Identify the effect of coupling/ decoupling capacitor/transformer coupling/ direct coupling in an amplifier
- Find gain of power amplifier
- Troubleshoot of different amplifier faults

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Amplifier circuits		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	List three main characteristics of linear amplifiers.	**Listing three main characteristics of linear amplifiers:** • Concept of linear amplifiers • Application of linear amplifiers • Characteristics of linear amplifiers • Listing three main characteristics of linear amplifiers • Records keeping of the activities	0.1	0.5	0.6
2.	Describe the effect of AC signals on an amplifier.	**Describing the effect of AC signals on an amplifier:** • Concept of AC signals, amplifier & effect of AC signals on an amplifier • Application of AC signals, amplifier & effect of AC signals on an amplifier • Effect of AC signals on an amplifier • Describing the effect of AC signals on an amplifier • Records keeping of the activities	0.1	0.5	0.6
3.	Name three configurations for BJT amplifiers.	**Naming three configurations for BJT amplifiers:** • Concept of configurations for BJT amplifiers • Application of configurations for BJT amplifiers • Naming three configurations for BJT amplifiers • Records keeping of the activities	0.1	0.5	0.6

4.	Explain why coupling capacitors and bypass capacitors are used in amplifier circuits.	**Explaining why coupling capacitors and bypass capacitors are used in amplifier circuits:** • Concept of coupling capacitors, bypass capacitors and amplifier circuits • Application of coupling capacitors, bypass capacitors and amplifier circuits • Explaining why coupling capacitors and bypass capacitors are used in amplifier circuits • Records keeping of the activities	0.1	0.5	0.6
5.	List three configurations for FET amplifiers.	**Listing three configurations for FET amplifiers:** • Concept of configurations & FET amplifiers • Application of configurations & FET amplifiers • Listing three configurations for FET amplifiers • Records keeping of the activities	0.1	0.5	0.6
6.	Discuss the advantages and disadvantages of direct coupling, capacitor coupling and transformer coupling.	**Discussing the advantages and disadvantages of direct coupling, capacitor coupling and transformer coupling**: • Concept of direct coupling, capacitor coupling and transformer coupling • Application of direct coupling, capacitor coupling and transformer coupling • Advantages of direct coupling, capacitor coupling and transformer coupling • Disadvantages of direct coupling, capacitor coupling and transformer coupling • Records keeping of the activities	0.1	0.5	0.6
7.	Differentiate between classes A, B and C amplifiers.	**Differentiating between class A, B and C amplifiers**: • Concept of class A, B and C amplifiers • Application of class A, B and C amplifiers • Difference between class A, B and C amplifiers • Records keeping of the activities	0.1	0.5	0.6
8.	Define crossover distortion.	**Defining crossover distortion**: • Concept of crossover distortion • Application of crossover distortion • Defining crossover distortion • Records keeping of the activities	0.1	0.5	0.6
9.	Troubleshoot amplifier circuits.	**Troubleshooting amplifier circuits**: • Concept of troubleshooting & amplifier circuits • Application of troubleshooting & amplifier circuits • Principles and procedures for troubleshooting amplifier circuits • Troubleshooting amplifier circuits • Safety/precautions to be taken • Records keeping of the activities	0.2	0.5	0.7
10.	Find switching action of transistor	**Finding switching action of transistor:** • Concept of switching action of transistor • Application of switching action of transistor • Principles and procedures for finding switching action of transistor	0.3	0.7	1.0

		• Finding switching action of transistor • Safety/precautions to be taken • Records keeping of the activities			
11.	Identify the effect of coupling/ decoupling capacitor/ transformer coupling/direct coupling in an amplifier	**Identifying the effect of coupling/ decoupling capacitor/ transformer coupling/direct coupling in an amplifier:** • Concept of coupling/ decoupling capacitor/ transformer coupling/direct coupling in an amplifier • Application of the effect of coupling/ decoupling capacitor/ transformer coupling/direct coupling in an amplifier • Identifying the effect of coupling/ decoupling capacitor/ transformer coupling/direct coupling in an amplifier • Records keeping of the activities	0.3	0.8	1.1
12.	Find gain of power amplifier	**Finding gain of power amplifier**: • Concept of gain of power amplifier • Application of gain of power amplifier • Principles and procedures for finding out gain of power amplifier • Finding gain of power amplifier • Safety/precautions to be taken • Records keeping of the activities	0.2	1.0	1.2
13.	Troubleshoot of different amplifier faults	**Troubleshooting of different amplifier faults**: • Concept of troubleshooting & amplifier • Application of amplifier faults • Principles and procedures for troubleshooting of different amplifier faults • Troubleshooting of different amplifier faults • Safety/precautions to be taken • Records keeping of the activities	0.2	1.0	1.2
		Subtotal:	2	8	10

Sub module: 22: Integrated circuits

Description: It will provide the student with an overview of operational amplifiers and their characteristics. The student will learn basic op amp configurations such as inverting and non inverting amplifiers, as well as summing amplifiers and comparators. An introduction to analogue to digital converters is also presented in this module. Integrators, differentiators, oscillators and active filters are included emphasizing real world control applications.

Objectives:

Upon completion of this module the student will be able to:

- List three characteristics of an ideal op amp.
- Define slew rate.
- Describe the purpose of feedback in op amp circuits.
- Determine the voltage gain of inverting and non inverting amplifiers.
- Explain the purpose of voltage followers.
- Name two applications of summing amplifiers.
- Describe the basic operation of a comparator.
- List two types of op amp voltage regulators.
- Determine resonant frequency of an oscillator.
- Name three types of multi vibrators.
- Determine voltage gain of inverting/non inverting Op-amp(Operational amplifier)
- Identify the different signal out put in Op-amp by providing different signal using integrating, differentiating Op-amp CKT
- Find the mathematical action of summing/ subtracting/ comparator action of Op-amp
- Find voltage regulation action using operational amplifier
- Generate frequency using operational amplifier as multi vibrators

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Integrated circuits		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	List three characteristics of an ideal op amp.	**Listing three characteristics of an ideal op amp**: • Concept of ideal op amp • Application of op amp • Characteristics of an ideal op amp • Listing three characteristics of an ideal op amp • Records keeping of the activities	0.2	0.5	0.7
2.	Define slew rate.	**Defining slew rate**: • Concept of slew rate • Application of slew rate • Defining slew rate • Records keeping of the activities	0.2	0.5	0.7
3.	Describe the purpose of feedback in op amp circuits.	**Describing the purpose of feedback in op amp circuits**:	0.2	0.5	0.7

		• Concept of op amp circuits • Application of op amp circuits • Purpose of feedback in op amp circuits • Describing the purpose of feedback in op amp circuits • Records keeping of the activities			
4.	Determine the voltage gain of inverting and non inverting amplifiers.	**Determining the voltage gain of inverting and non inverting amplifiers** : • Concept of voltage gain, inverting and non inverting amplifiers • Application of voltage gain of inverting and non inverting amplifiers • Principles and procedures for determining the voltage gain of inverting and non inverting amplifiers • Determining the voltage gain of inverting and non inverting amplifiers • Safety/precautions to be taken • Records keeping of the activities	0.2	0.5	0.7
5.	Explain the purpose of voltage followers.	**Explaining the purpose of voltage followers**: • Concept of voltage followers • Application of voltage followers • Purpose of voltage followers • Explaining the purpose of voltage followers • Records keeping of the activities	0.2	0.5	0.7
6.	Name two applications of summing amplifiers.	**Naming two applications of summing amplifiers**: • Concept of summing amplifiers • Applications of summing amplifiers • Records keeping of the activities	0.1	0.5	0.6
7.	Describe the basic operation of a comparator.	**Describing the basic operation of a comparator**: • Concept of comparator • Application of comparator • Basic operation of a comparator • Describing the basic operation of a comparator • Records keeping of the activities •	0.1	0.5	0.6
8.	List two types of op amp voltage regulators.	**Listing two types of op amp voltage regulators**: • Concept of op amp voltage regulators • Application of op amp voltage regulators • Types of op amp voltage regulators • Records keeping of the activities	0.1	0.5	0.6
9.	Determine resonant frequency of an	**Determining resonant frequency of an**	0.1	0.5	0.6

	oscillator.	**oscillator:** • Concept of resonant frequency of an oscillator • Application of resonant frequency of an oscillator • Principles and procedures for determining resonant frequency of an oscillator • Determining resonant frequency of an oscillator • Records keeping of the activities			
10.	Name three types of multi vibrators	**Naming three types of multi vibrators**: • Concept of multi vibrators • Application of multi vibrators • Types of multi vibrators • Records keeping of the activities	0.1	0.5	0.6
11.	Determine voltage gain of inverting/non inverting Op-amp(Operational amplifier)	**Determining voltage gain of inverting/non inverting Op-amp(Operational amplifier):** • Concept of voltage gain , inverting Op-amp and non inverting Op-amp(Operational amplifier): • Application of voltage gain , inverting Op-amp and non inverting Op-amp(Operational amplifier): • Principles and procedures for determining voltage gain of inverting/non inverting Op-amp(Operational amplifier): • Determining voltage gain of inverting/non inverting Op-amp(Operational amplifier): • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
12.	Identify the different signal out put in Op-amp by providing different signal using integrating, differentiating Op-amp CKT	**Identifying the different signal out put in Op-amp by providing different signal using integrating, differentiating Op-amp CKT:** • Concept of signal out put in Op-amp by providing different signal using integrating, differentiating Op-amp CKT • Application of signal out put in Op-amp by providing different signal using integrating, differentiating Op-amp CKT • Identifying the different signal out put in Op-amp by providing different signal using integrating, differentiating Op-amp CKT • Records keeping of the activities	0.1	0.5	0.6
13.	Find the mathematical action of summing/ subtracting/ comparator action of Op-amp	**Finding the mathematical action of summing/ subtracting/ comparator action of Op-amp**: • Concept of mathematical action of	0.1	0.5	0.6

		summing/subtracting/ comparator action of Op-amp • Application of mathematical action of summing/ subtracting,/comparator action of Op-amp • Principles and procedures for finding out the mathematical action of summing/ subtracting/comparator action of Op-amp • Finding the mathematical action of summing/ subtracting/ comparator action of Op-amp • Safety/precautions to be taken • Records keeping of the activities			
14.	Find voltage regulation action using operational amplifier	**Finding voltage regulation action using operational amplifier**: • Concept of voltage regulation action • Application of voltage regulation action using operational amplifier • Principles and procedures for finding out voltage regulation action using operational amplifier • Finding voltage regulation action using operational amplifier • Safety/precautions to be taken • Records keeping of the activities	0.1	1.0	1.1
15.	Generate frequency using operational amplifier as multi vibrators	**Generating frequency using operational amplifier as multi vibrators**: • Concept of frequency & operational amplifier as multi vibrators • Application of generating frequency using operational amplifier as multi vibrators • Principles and procedures for generating frequency using operational amplifier as multi vibrators • Generating frequency using operational amplifier as multi vibrators • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
		Subtotal:	2	8	10

Sub module: 23: Digital electronics

Description: It covers a wide variety of topics relating to digital electronics including number systems, logic gates, flip flops and counters. Boolean algebra and DeMorgan's theorem is also introduced as well as troubleshooting and problem solving techniques for digital logic circuits. The logic gates presented in the module include AND, OR, NOR, NAND and inverters.

Objectives:

Upon completion of this module the student will be able to:

- Explain the binary number system.
- Convert binary numbers to decimal and decimal numbers to binary.
- Explain the hexadecimal number system.
- Convert hexadecimal numbers to binary and binary numbers to hexadecimal.
- Differentiate between natural binary and Binary Coded Decimal (BCD).
- Understand the ASCII code.
- Apply truth tables to troubleshooting digital circuits.
- List five logic gates.
- Describe the basic operation of an inverter.
- Explain the purpose of Boolean algebra.
- Understand logic gate combinations.
- Name eight Boolean theorems.
- Apply basic troubleshooting techniques to digital circuits.
- Identify the logic action of basic logic gate
- Verify AE Morgan's theorem
- Verify BCD coding, decoding
- Troubleshot the faults of digital circuits

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Digital electronics		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Explain the binary number system	**Explaining the binary number system:** • Concept of binary number system • Application of binary number system • Explaining the binary number system • Records keeping of the activities	0.2	0.4	0.6
2.	Convert binary numbers to decimal and decimal numbers to binary.	**Converting binary numbers to decimal and decimal numbers to binary**: • Concept of binary numbers & decimal numbers Application of binary numbers & decimal numbers • Converting binary numbers to decimal numbers • Converting decimal numbers to binary numbers • Records keeping of the activities	0.2	0.4	0.6
3.	Explain the hexadecimal number system.	**Explaining the hexadecimal number system**: • Concept of hexadecimal number system • Application of hexadecimal number system • Explaining the hexadecimal number system • Records keeping of the activities	0.2	0.4	0.6
4.	Convert hexadecimal numbers to binary and binary numbers to hexadecimal.	**Converting hexadecimal numbers to binary and binary numbers to hexadecimal**:	0.1	0.4	0.5

		• Converting hexadecimal numbers to binary numbers • Converting binary numbers to hexadecimal numbers • Records keeping of the activities			
5.	Differentiate between natural binary and Binary Coded Decimal (BCD).	**Differentiating between natural binary and Binary Coded Decimal (BCD):** • Concept of natural binary and Binary Coded Decimal (BCD) • Application of natural binary and Binary Coded Decimal (BCD) • Difference between natural binary and Binary Coded Decimal (BCD • Records keeping of the activities	0.1	0.4	0.5
6.	Understand the ASCII code.	**Understanding the ASCII code**: • Concept of ASCII code • Application of ASCII code • The ASCII code • Records keeping of the activities	0.1	0.5	0.6
7.	Apply truth tables to troubleshooting digital circuits.	**Applying truth tables to troubleshooting digital circuits**: • Concept of truth tables & troubleshooting digital circuits • Application of truth tables to troubleshooting digital circuits • Applying truth tables to troubleshooting digital circuits • Records keeping of the activities	0.1	0.5	0.6
8.	List five logic gates.	**Listing five logic gates**: • Concept of five logic gates • Application of five logic gates • Listing five logic gates • Records keeping of the activities	0.1	0.5	0.6
9.	Describe the basic operation of an inverter.	**Describing the basic operation of an inverter**: • Concept of inverter • Application of inverter • Basic operation of an inverter • Describing the basic operation of an inverter • Records keeping of the activities	0.1	0.5	0.6
10.	Explain the purpose of Boolean algebra.	**Explaining the purpose of Boolean algebra**: • Concept of Boolean algebra • Application of Boolean algebra • Purpose of Boolean algebra • Explaining the purpose of Boolean algebra • Records keeping of the activities	0.1	0.5	0.6
11.	Understand logic gate combinations	**Understanding logic gate combinations**: • Concept of logic gate combinations • Application of logic gate combinations • Records keeping of the activities	0.1	0.5	0.6
12.	Name eight Boolean theorems.	**Naming eight Boolean theorems**:	0.1	0.5	0.6

		• Concept of eight Boolean theorems • Application of eight Boolean theorems • Naming eight Boolean theorems • Records keeping of the activities			
13.	Apply basic troubleshooting techniques to digital circuits	**Applying basic troubleshooting techniques to digital circuits:** • Concept of basic troubleshooting techniques & digital circuits • Application of basic troubleshooting techniques to digital circuits • Records keeping of the activities	0.1	0.5	0.6
14.	Identify the logic action of basic logic gate	**Identifying the logic action of basic logic gate**: • Concept of logic action & basic logic gate • Application of logic action of basic logic gate • Identifying the logic action of basic logic gate • Records keeping of the activities	0.1	0.5	0.6
15.	Verify AE Morgan's theorem	**Verifying AE Morgan's theorem**: • Concept of AE Morgan's theorem • Application of AE Morgan's theorem • Principles and procedures for verifying AE Morgan's theorem • Verifying AE Morgan's theorem • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
16.	Verify BCD coding, decoding	**Verifying BCD coding, decoding**: • Concept of BCD coding & decoding • Application of BCD coding & decoding • Principles and procedures for verifying BCD coding, decoding • Verifying BCD coding, decoding • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
17.	Troubleshoot the faults of digital circuits	**Troubleshooting the faults of digital circuits:** • Concept of faults of digital circuits • Application troubleshooting of faults of digital circuits • Principles and procedures for troubleshooting of faults of digital circuits • Troubleshoot the faults of digital circuits • Safety/precautions to be taken • Records keeping of the activities	0.1	0.5	0.6
		Subtotal:	2	8	10

Sub module: 24: Programmable logic controllers

Description: It includes the study of basic principles of programmable logic controllers (PLCs) and focuses on Allen-Bradley and AEG Modicon systems. PLC timers, counters and sequencers are presented with an emphasis on practical applications and safe operation of PLC systems. This module also covers data transfer, math functions and installation, maintenance and troubleshooting of PLCs.

Objectives:

- Define a programmable logic controller.
- Explain the purpose of the PLC scan function.
- Describe the basic function of I/O system.
- Define ladder logic.
- Name the two basic types of PLC counters.
- Describe the operating principles of a sequencer.
- Explain how data transfer is accomplished using a PLC.
- Name four PLC math functions.
- List six safety considerations for PLC systems.
- Describe the basic troubleshooting procedure for PLC systems.
- Verify the PLC controlling using ladder
- Verify PLC controlling for kneumatic system/hydraulic system

Objectives:
Upon completion of this module the student will be able to:

Duration: 10 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Programmable logic controllers		2 hrs. (Th.) + 8 hrs. (Pr,) = 10 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Define a programmable logic controller.	**Defining a programmable logic controller**: • Concept of programmable logic controller • Application of programmable logic controller • Defining a programmable logic controller • Records keeping of the activities	0.2	0.5	0.7
2.	Explain the purpose of the PLC scan function.	**Explaining the purpose of the PLC scan function:** • Concept of PLC scan function • Application of PLC scan function • Purpose of the PLC scan function • Explaining the purpose of the PLC scan function • Records keeping of the activities	0.2	0.5	0.7
3.	Describe the basic function of I/O system.	**Describing the basic function of I/O system**: • Concept of I/O system • Application of I/O system • Basic function of I/O system • Describing the basic function of I/O	0.2	0.5	0.7

		system • Records keeping of the activities			
4.	Define ladder logic.	**Defining ladder logic :** • Concept of ladder logic • Application of ladder logic • Defining ladder logic • Records keeping of the activities	0.2	0.5	0.7
5.	Name the two basic types of PLC counters.	**Naming the two basic types of PLC counters**: • Concept of PLC counters • Application of PLC counters • Types of PLC counters • Naming the two basic types of PLC counters • Records keeping of the activities	0.2	0.5	0.7
6.	Describe the operating principles of a sequencer.	**Describing the operating principles of a sequencer**: • Concept of sequencer • Application of sequencer • Operating principles of a sequencer • Describing the operating principles of a sequencer • Records keeping of the activities	0.2	0.5	0.7
7.	Explain how data transfer is accomplished using a PLC.	**Explaining how data transfer is accomplished using a PLC** : • Concept of data transfer • Application of data transfer • How data transfer is accomplished using a PLC • Explaining how data transfer is accomplished using a PLC Records keeping of the activities	0.2	0.5	0.7
8.	Name four PLC math functions	**Naming four PLC math functions**: • Concept of PLC math functions • Application of PLC math functions • Four PLC math functions • Records keeping of the activities	0.2	0.5	0.7
9.	List six safety considerations for PLC systems.	**Listing six safety considerations for PLC systems**: • Concept of safety considerations for PLC systems • Application of safety considerations for PLC systems • Six safety considerations for PLC systems • Records keeping of the activities	0.1	1.0	1.1
10.	Describe the basic troubleshooting	**Describing the basic troubleshooting**	0.1	1.0	1.1

	procedure for PLC systems.	**<u>procedure for PLC systems</u>**: • Basic troubleshooting procedure for PLC systems • Application of basic troubleshooting procedure for PLC systems • Describing the basic troubleshooting procedure for PLC systems • Records keeping of the activities			
11.	Verify the PLC controlling using ladder	**<u>Verifying the PLC controlling using ladder</u>**: • Concept of PLC controlling using ladder • Application of PLC controlling using ladder • Principles and procedures for verifying the PLC controlling using ladder • Verifying the PLC controlling using ladder • Safety/precautions to be taken • Records keeping of the activities	0.1	1.0	1.1
12.	Verify PLC controlling for kneumatic system /hydraulic system	**<u>Verifying PLC controlling for kneumatic system / hydraulic system</u>**: • Concept of PLC controlling for kneumatic system / hydraulic system • Application of PLC controlling for kneumatic system /hydraulic system • Principles and procedures for verifying PLC controlling for kneumatic system /hydraulic system • Records keeping of the activities	0.1	1.0	1.1
		Subtotal:	2	8	10

Module: 4: Electromechanical Devices & Relays

Description: This consists of knowledge and skills related to electromechanical devices and relays fitting works necessary for an electromechanical technician.

Objectives:

- To fit electromechanical devices
- To perform relays fittings

Duration: 130 hours

Sub modules:

1. Electromechanical Devices
2. Electromechanical Relays

Sub module: 1: Electromechanical Devices

Description: This consists of knowledge and skills related to fittings of electromechanical devices necessary for an electromechanical technician.

Objectives:

- To identify electromechanical devices
- To perform fittings of electromechanical devices
- To repair/maintain AC transformers
- To repair/maintain DC transformers
- To repair/maintain electrical motors
- To repair/maintain generators
- To repair/maintain turbine
- To repair/maintain furnace
- To repair/maintain contractor
- To repair/maintain switches
- To repair/maintain relay
- To repair/maintain water pump
- To repair/maintain boiler
- To repair/maintain heating appliances
- To repair/maintain compressor
- To maintain pneumatic equipment
- To maintain hydraulic equipment

Duration: 70 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Electromechanical Devices		14 hrs. (Th.) + 56 hrs. (Pr,) = 70 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Identify electromechanical devices	**Identifying electromechanical devices**: • Concept, function/use/application of electromechanical devices • Identification of electromechanical devices • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	2	2.5
2.	Identify /be familiar with electromechanical Components	**Identifying electromechanical Components** : The Electromechanical Components • Connectors • Relays • KVM Switches • Keyboards/Pointing Devices • Thermal Printers • Thermal Printers • Resistive Touch Panels • Optical Modules	1.0	3	4.0

		• DC/DC Converters			
3.	Perform fittings of electromechanical devices	**Perform fittings of electromechanical devices**: • Concept of fittings electromechanical devices • Principles and procedures for fittings electromechanical devices • Fittings of electromechanical devices • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
4.	Repair/maintain AC transformers	**Repairing/maintaining AC transformers**: • Concept of AC transformers • Principles and procedures for repairing and maintaining AC transformers • Repairing and maintaining AC transformers • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
5.	Repair/maintain DC transformers	**Repairing/maintaining DC transformers**: • Concept of DC transformers • Principles and procedures for repairing and maintaining DC transformers • Repairing and maintaining DC transformers • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
6.	Repair/maintain electrical motors	**Repairing/maintaining electrical motors**: • Concept of electrical motors • Principles and procedures for repairing and maintaining electrical motors • Repairing and maintaining electrical motors • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
7.	Repair/maintain generators	**Repairing/maintaining generators**: • Concept of generators • Principles and procedures for repairing and maintaining generators • Repairing and maintaining generators • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5

8.	Repair/maintain turbine	**Repairing/maintaining turbine**: • Concept of turbine • Principles and procedures for repairing and maintaining turbine • Repairing and maintaining turbine • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
9.	Repair/maintain furnace	**Repairing/maintaining furnace**: • Concept of furnace • Principles and procedures for repairing and maintaining furnace • Repairing and maintaining furnace • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
10.	Repair/maintain contractor	**Repairing/maintaining contractor**: • Concept of contractor • Principles and procedures for repairing and maintaining contractor • Repairing and maintaining contractor • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
11.	Repair/maintain switches	**Repairing/maintaining switches**: • Concept of switches • Principles and procedures for repairing and maintaining switches • Repairing and maintaining switches • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
12.	Repair/maintain water pump	**Repairing/maintaining water pump**: • Concept of water pump • Principles and procedures for repairing and maintaining water pump • Repairing and maintaining water pump • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
13.	Repair/maintain boiler	**Repairing/maintaining boiler**: • Concept of boiler • Principles and procedures for repairing and maintaining boiler • Repairing and maintaining boiler	0.5	3	3.5

		• Safety /precautions to be followed while carrying out this task • Keeping records of the related activities			
14.	Repair/maintain heating appliances	**Repairing/maintaining heating appliances**: • Concept of heating appliances • Principles and procedures for repairing and maintaining heating appliances • Repairing and maintaining heating appliances • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
15.	Repair/maintain compressor	**Repairing/maintaining compressor**: • Concept of compressor • Principles and procedures for repairing and maintaining compressor • Repairing and maintaining compressor • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
16.	Maintain pneumatic equipment	**Maintaining pneumatic equipment**: • Concept of pneumatic equipment • Principles and procedures for repairing and maintaining pneumatic equipment • Repairing and maintaining pneumatic equipment • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
17.	Maintain hydraulic equipment	**Maintaining hydraulic equipment**: • Concept of hydraulic equipment • Principles and procedures for repairing and maintaining hydraulic equipment • Repairing and maintaining hydraulic equipment • Safety /precautions to be followed while carrying out this task • Keeping records of the related activities	0.5	3	3.5
18.	Be familiar with the installation/operation/repair/maintenance of electromechanical actuators/positioning devices/systems	**Being familiar with the Installation/operation/repair/maintenance of the following electromechanical actuators/positioning devices/systems**: • Valve actuation • Door openers & closers	2.5	3	5.5

		• Optical alignment actuators • Material punching & cutting • Antenna positioning actuators • Medical bed positioning actuators • X-ray, laser, & sensor positioning actuators • Liquid pumping & dispensing • Height adjustment actuators • Seat positioners • Automated machinery • Robotics • Lift elevators • Pick & place machine actuators • Throttle control & transmission shifter • Conveyor diverters • Special effects industry actuators • Chip & wafer handling actuators • Grinding feed actuators • Parts feeding actuators • Aircraft video monitor lift • Structural test actuators			
19.	Be familiar with the installation/operation/repair/maintenance of electromechanical devices	**Being familiar with installation/operation/repair/maintenance of the following electromechanical devices**: • Switching ▪ Acceleration Switches ▪ Electromechanical Relays ▪ Float Switches ▪ Microswitches ▪ Proximity Switches ▪ Reed Switches ▪ Shock Switches ▪ Switches ▪ Tilt Switches ▪ Tip Over Switches • Sensing ▪ Bimetal Temperature Switches ▪ Capacitive Sensors ▪ Inductive Sensors ▪ Liquid level Sensors ▪ Motion Sensors ▪ NTC Thermistors ▪ Proximity Sensors ▪ Thermal Cutoffs ▪ Thermistor Probes ▪ Vibration Sensors	2.5	3	5.5

		• Motion control ▪ Absolute Encoders ▪ AC Motors ▪ Actuators ▪ Brushless DC Motors ▪ DC Motors ▪ Gearboxes & Driver Boards ▪ Incremental Encoders ▪ Linear Encoder Systems ▪ Solenoids ▪ Stepper Motors ▪ Synchronous Motors • Connector solutions ▪ High Temp Connectors ▪ High Density Connectors ▪ Male Card Edge Connectors ▪ Headers			
		Subtotal:	14	56	70

Sub module: 2: Electromechanical Relays

Description: This consists of knowledge and skills related to fittings of electromechanical relays necessary for an electromechanical technician.

Objectives:

- To identify electromechanical relays
- To perform fittings of electromechanical relays
- To install/operate/repair/maintain electromechanical relays

Duration: 60 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Electromechanical Relays		12 hrs. (Th.) + 48 hrs. (Pr,) = 60 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Be familiar with relays	**Relays**: • Concept of relays • Basic design and operation of relays • Types of relays • Concept of Pole and throw • Applications • Relay application considerations • Railway signaling(General, Double switching, Proving)	0.8	3	3.8
2.	Install/operate/repair/maintain latching relay	**Installing/operating/repairing/maintaining latching relay**: • Concept and application of latching relay • Principles and procedures for installing, operating, repairing and maintaining latching relay • Installing, operating, repairing and maintaining latching relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.8	3	3.8
3.	Install/operate/repair/maintain reed relay	**Installing/operating/repairing/maintaining reed relay**: • Concept and application of reed relay • Principles and procedures for installing, operating, repairing and maintaining reed relay • Installing, operating, repairing and maintaining reed relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.8	3	3.8
4.	Install/operate/repair/maintain mercury-wetted relay	**Installing/operating/repairing/maintaining mercury-wetted relay**: • Concept and application of mercury-wetted relay • Principles and procedures for installing, operating, repairing and maintaining mercury-wetted relay	0.8	3	3.8

		• Installing, operating, repairing and maintaining mercury-wetted relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities			
5.	Install/operate/repair/maintain polarized relay	**Installing/operating/repairing/maintaining polarized relay**: • Concept and application of polarized relay • Principles and procedures for installing, operating, repairing and maintaining polarized relay • Installing, operating, repairing and maintaining polarized relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.8	3	3.8
6.	Install/operate/repair/maintain machine tool relay	**Installing/operating/repairing/maintaining machine tool relay**: • Concept and application of machine tool relay • Principles and procedures for installing, operating, repairing and maintaining machine tool relay • Installing, operating, repairing and maintaining machine tool relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.8	3	3.8
7.	Install/operate/repair/maintain contactor relay	**Installing/operating/repairing/maintaining contactor relay**: • Concept and application of contactor relay • Principles and procedures for installing, operating, repairing and maintaining contactor relay • Installing, operating, repairing and maintaining contactor relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.8	3	3.8
8.	Install/operate/repair/maintain solid-state relay	**Installing/operating/repairing/maintaining solid-state relay**: • Concept and application of solid-state relay • Principles and procedures for installing, operating, repairing and maintaining solid-state relay • Installing, operating, repairing and maintaining solid-state relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.8	3	3.8
9.	Install/operate/repair/maintain solid state contactor relay	**Installing/operating/repairing/maintaining solid state contactor relay**: • Concept and application of solid state	0.7	3	3.7

		contactor relay • Principles and procedures for installing, operating, repairing and maintaining solid state contactor relay • Installing, operating, repairing and maintaining solid state contactor relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities			
10.	Install/operate/repair/maintain buchholz relay	**Installing/operating/repairing/maintaining buchholz relay**: • Concept and application of buchholz relay • Principles and procedures for installing, operating, repairing and maintaining buchholz relay • Installing, operating, repairing and maintaining buchholz relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.7	3	3.7
11.	Install/operate/repair/maintain forced-guided contacts relay	**Installing/operating/repairing/maintaining forced-guided contacts relay forced-guided contacts relay**: • Concept and application of forced-guided contacts relay • Principles and procedures for installing, operating, repairing and maintaining forced-guided contacts relay • Installing, operating, repairing and maintaining forced-guided contacts relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.7	3	3.7
12.	Install/operate/repair/maintain overload protection relay	**Installing/operating/repairing/maintaining overload protection relay**: • Concept and application of overload protection relay • Principles and procedures for installing, operating, repairing and maintaining overload protection relay • Installing, operating, repairing and maintaining overload protection relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.7	3	3.7
13.	Install/operate/repair/maintain overcurrent protective relay	**Installing/operating/repairing/maintaining overcurrent protective relay**: • Concept and application of overcurrent protective relay • Principles and procedures for installing, operating, repairing and maintaining overcurrent protective relay • Installing, operating, repairing and	0.7	3	3.7

		maintaining overcurrent protective relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities			
14.	Install/operate/repair/maintain induction disc overcurrent protective relay	**Installing/operating/repairing/maintaining induction disc overcurrent protective relay**: • Concept and application of induction disc overcurrent protective relay • Principles and procedures for installing, operating, repairing and maintaining induction disc overcurrent protective relay • Installing, operating, repairing and maintaining induction disc overcurrent protective relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.7	3	3.7
15.	Install/operate/repair/maintain distance relay	**Installing/operating/repairing/maintaining distance relay**: • Concept and application of distance relay • Principles and procedures for installing, operating, repairing and maintaining distance relay • Installing, operating, repairing and maintaining distance relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.7	3	3.7
16.	Install/operate/repair/maintain motor protection relay	**Installing/operating/repairing/maintaining motor protection relay:** • Concept and application of motor protection relay • Principles and procedures for installing, operating, repairing and maintaining motor protection relay • Installing, operating, repairing and maintaining motor protection relay • Safety precautions to be taken while carrying out this task • Keeping records of the related activities	0.7	3	3.7
		Subtotal:	12	48	60

Module: 5: Motorized Electrical Appliances

Description: This consists of knowledge and skills related to repair and maintenance of motorized electrical appliances necessary for an electromechanical technician.

Objectives:

- To maintain/repair electrical Fan
- To maintain/repair electric Mixer
- To maintain/repair electric Juicer
- To maintain/repair electric Grinder
- To maintain/repair electric Blender
- To maintain/repair electric Can Opener
- To maintain/repair electric Shaver
- To maintain/repair electric Coffee Maker
- To maintain/repair electric Blower
- To maintain/repair Vacuum cleaner
- To maintain/repair electric Floor polisher
- To maintain/electric repair Hair dryer
- To maintain/repair Refrigerator
- To maintain/repair Washing machine

Duration: 130 hours

Tasks: Each task consists of a task statement, related technical knowledge necessary to perform the task and time necessary for both the theory and practical aspects of the task.

Motorized Electrical Appliances		26 hrs. (Th.) + 104 hrs. (Pr,) = 130 hrs. (Tot.)	Time		
SN	Tasks	Related technical knowledge	Th.	Pr.	Tot.
1.	Maintain/repair electrical Fan.	**Repairing/maintaining electrical Fan**: • Concept and functions of electrical Fan and its parts • Identification of each part/component of electrical Fan • Principles and procedures for repairing and maintaining electrical Fan • Repairing and maintaining electrical Fan • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	1	7	8
2.	Maintain/repair electric Mixer.	**Repairing/maintaining electric Mixer**: • Concept and functions of electric Mixer and its parts • Identification of each part/component of electric Mixer • Principles and procedures for repairing and maintaining electric Mixer • Repairing and maintaining electric Mixer • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	1	7	8
3.	Maintain/repair electric Juicer.	**Repairing/maintaining electric Juicer**: • Concept and functions of electric Juicer • and its parts	2	7	9

		• Identification of each part/component of electric Juicer • Principles and procedures for repairing and maintaining electric Juicer • Repairing and maintaining electric Juicer • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task			
4.	Maintain/repair electric Grinder.	**Repairing/maintaining electric Grinder**: • Concept and functions of electric Grinder • and its parts • Identification of each part/component of electric Grinder • Principles and procedures for repairing and maintaining electric Grinder • Repairing and maintaining electric Grinder • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	7	9
5.	Maintain/repair electric Blender.	**Repairing/maintaining electric Blender**: • Concept and functions of electric Blender • and its parts • Identification of each part/component of electric Blender • Principles and procedures for repairing and maintaining electric Blender • Repairing and maintaining electric Blender • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	7	9
6.	Maintain/repair electric Can Opener	**Repairing/maintaining electric Can Opener**: • Concept and functions of electric Can Opener and its parts • Identification of each part/component of electric Can Opener • Principles and procedures for repairing and maintaining electric Can Opener • Repairing and maintaining electric Can Opener • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	7	9
7.	Maintain/repair electric Shaver.	**Repairing/maintaining electric Shaver**: • Concept and functions of electric Shaver and its parts • Identification of each part/component of electric Shaver • Principles and procedures for repairing and	2	7	9

		maintaining electric Shaver • Repairing and maintaining electric Shaver • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task			
8.	Maintain/repair electric Coffee Maker	**Repairing/maintaining electric Coffee Maker**: • Concept and functions of electric Coffee Maker and its parts • Identification of each part/component of electric Coffee Maker • Principles and procedures for repairing and maintaining electric Coffee Maker • Repairing and maintaining electric Coffee Maker • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	7	9
9.	Maintain/repair electric Blower	**Repairing/maintaining electric Blower**: • Concept and functions of electric Blower and its parts • Identification of each part/component of electric Blower • Principles and procedures for repairing and maintaining electric Blower • Repairing and maintaining electric Blower • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	8	10
10.	Maintain/repair Vacuum cleaner	**Repairing/maintaining Vacuum cleaner**: • Concept and functions of Vacuum cleaner and its parts • Identification of each part/component of Vacuum cleaner • Principles and procedures for repairing and maintaining Vacuum cleaner • Repairing and maintaining Vacuum cleaner • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	8	10
11.	Maintain/repair electric Floor polisher	**Repairing/maintaining electric Floor polisher**: • Concept and functions of electric Floor polisher and its parts • Identification of each part/component of electric Floor polisher • Principles and procedures for repairing and maintaining electric Floor polisher • Repairing and maintaining electric Floor	2	8	10

		polisher • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task			
12.	Maintain/ repair electric Hair dryer	**Repairing/maintaining electric Hair dryer**: • Concept and functions of electric Hair dryer and its parts • Identification of each part/component of electric Hair dryer • Principles and procedures for repairing and maintaining electric Hair dryer • Repairing and maintaining electric Hair dryer • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	8	10
13.	Maintain/repair Refrigerator.	**Repairing/maintaining Refrigerator:** • Concept and functions of Refrigerator and its parts • Identification of each part/component of Refrigerator • Principles and procedures for repairing and maintaining Refrigerator • Repairing and maintaining Refrigerator • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	8	10
14.	Maintain/repair Washing machine.	**Repairing/maintaining Washing machine:** • Concept and functions of Washing machine • and its parts • Identification of each part/component of Washing machine • Principles and procedures for repairing and maintaining Washing machine • Repairing and maintaining Washing machine • Precautions/safety to be followed while performing this task • Keeping records of activities carried out while carrying out this task	2	8	10
		Subtotal:	26	104	130

Module: 6: Project Work

Each student will complete the followings under the guidance of related instructor(s):

I. Electricity:

Assemble/manufacture low voltage dc sources

- Wind the primary and secondary winding of transformer to design a 220/12 V step down multi wind transformer..
- Design iron core of transformer by stacking alter5nate layers of E & I sheets
- Apply concept of selector switch and connect terminals of multi winding secondary of transformer to each contact point using soldering technique.
- Make rectifier circuit in order4 to convert low voltage ac to low voltage dc using diodes.
- Apply capacitor as fitting device and connect it at the load terminal to filter out the pulsated dc to obtain fuse dc voltage.
- Assemble the whole parameter to obtain low voltage multiple dc voltage sources.

II. Electronics:

1. Construct street light with the help of LDR and transistor
2. Design close loop control system for simple dc motor
3. (a) Design voltage stabilization at 3.1 v, 5.1 v, 5.2 v, 6.1 v, 7.2 v, 8.2 v etc with the help of respective zener diodes
   (b)Design dc voltage supply using regulator IC 7808 & 7809.
   4. Design Ac motor speed control using SCR and TRIACS
4. Design a switching of transistor using thermister
5. Design Operational amplifier using comparator to change the direction of motor
6. Design logic action for motor 'ON' & 'OFF' in condition of high heat & high speed.
7. Design ladder programme for movements as given ways

Facilities

1. Well equipped enough class rooms
2. Well equipped electromechanical workshop
3. Well equipped library
4. Teaching learning materials
5. Computer and multimedia
6. Electricity facility
7. Water supply facility
8. Vehicle (available to use)
9. Canteen
10. Hostel(available to use)

List of tools/equipment

Electrical hand tools/equipment/devices

1. Combination pliers
2. Long nose pliers
3. Wire cutter
4. Wire stripper
5. Side cutter
6. Knife
7. Soldering iron
8. Multimeter
9. Set of drill
10. Set of screwdrivers
11. Set of hammers
12. Set of spirit level
13. Set of micrometer
14. Wire gauge
15. Set of L & N keys
16. Set of spanners

Mechanical hand tools/machine, machine tools/equipment/measuring instrument and gauges

Hand tools:

1. Workbench with bench vice
2. Steel rule
3. Steel square
4. Scribers (soft and hard)
5. Bench files (different shapes, sizes and grades)
6. Hand hacksaw
7. Chisel (flat, cross and profiles)
8. Punches (different sizes)
9. Dividers
10. Bevel protractor
11. Straight edge
12. Steel hammer (cross, straight and ball)
13. Center punch
14. Hand vice
15. Bench shears
16. Pliers (combination, cutting)
17. Wrenches
18. Spanners

Machine and machine tools:

1. Power hacksaw
2. Bench drilling machine
3. Pillar drilling machine
4. Pedestal grinder
5. Lathe machine
6. Shaping machine
7. Milling machine

Equipment:

1. Surface plate
2. Surface gauge
3. Anvil
4. Cevillative
5. Bending machine
6. Rolling machine
7. Soldering gun
8. Forging equipment
9. Measuring instrument and gauges:
10. Vernier caliper
11. Micrometer
12. Standard wire gauge/thickness gauge
13. Feeler gauge
14. Radius gauge
15. Screw pitch gauge
16. Telescopic gauge

Reading materials:

1. Code of Practice for Electrical Wiring Installation, CTEVT.
2. S.K.Malice, Electric Trade Theory and Practical.
3. Skill Standard Level (Building Electrician) 1 & 2 CTEVT.
4. श्रेष्ठ जीवनहरि तथा साथीहरु, *प्रारम्भिक विद्युत*, पाठ्यक्रम विकास केन्द्र त्रि. वि.वि. इ.स .१९८१
5. Tricomi Ernest, How to Repair Mojor Appliances.
6. Gershon J Wheeler, How to Repair Electrical Appliances.
7. Rayer, F.G. Repair of Domestic Electrical Appliance.
8. www.fixitclub.com/electrical
9. Instructor selected books/manuals/references
10. Instructor prepared manuals/books/notes

Mechanical

1. *Workshop technology I – R.S Khurmi*
2. *Workshop technology II – R.S Khurmi*
3. *All about mechanical tools –Gerling (Germany-Indian print)*
4. *Metal tool book- Westermann (Germany-Indian print)*
5. *Engineering drawing*

Electronics

1. *Principals of electronics*
2. *Digital electronics-Floyd*
3. *Control system*

From Thapathali meetings

Repair/maintain washing machine
Repair/maintain power hacksaw
Repair/maintain distribution board
Repair/maintain panel board
Repair/maintain lathe machine
Repair/maintain milling machine
Repair/maintain shaping machine

Basic fitting works
(Perform basic fitting works)
Perform measuring
Perform marking
Perform laying out
Perform scrapping
Perform filing
Perform hammering
Perform sawing
Perform chiseling
Perform drilling
Perform threading
Perform reaming
Perform shearing
Perform punching
Perform soldering
Perform bending
Perform riveting
Perform counter sinking
Perform counter boring
Lathe machine
(Operate lathe machine)
Turning
(Carry out turning)
Carry out surface turning
Carry out facing
Carry out grooving
Carry out taper turning
Carry out eccentric turning
Knurling
Carry out knurling
Thread cutting
(Carry out thread cutting)
Carry out v-thread cutting
Carry out square thread cutting
Carry out acme thread cutting
Carry out buttress thread cutting
Carry out round thread cutting
Carry out internal thread cutting

Carry out external thread cutting
Carry out boring
Carry out forming/turning
Carry out drilling
Carry out reaming

Welding, fabrication and Brazing

Welding (Perform welding)
Perform flat arc welding
Perform horizontal-vertical arc welding
Perform flat oxy-acetylene welding
Perform vertical oxy-acetylene welding
Perform flat TIG welding
Perform flat MIG welding

Fabrication (Perform fabrication)
Fabricate housings
Fabricate fittings
Fabricate jigs
Fabricate fixtures
Fabricate accelerometers
Fabricate altimeters
Fabricate gyroscope
Fabricate temperature probes
Fabricate washing machine
Fabricate power hacksaw
Fabricate distribution board
Fabricate panel board
Fabricate lathe machine
Fabricate milling machine
Fabricate shaping machine

Brazing
(Perform blazing)
Perform soft blazing
Perform hard blazing

Steel metal works
(Perform steel metal works)
Perform rolling
Perform folding
Perform bending
Perform swaging
Perform flanging
Make edges
Make seams
Perform slinging/lifting
Grinding
(Perform grinding)

Operate off hand grinding machine
Grind/sharpen scriber
Grind/sharpen chisel
Grind/sharpen drill bit
Grind/sharpen single point turning tool
Perform wheel mounting for care/maintenance of grinding machine
Perform wheel balancing for care/maintenance of grinding machine
Perform wheel dressing for care/maintenance of grinding machine

Forging
(Perform forging)
Perform drawing outs
Perform upsetting
Perform fullering
Perform bending
Perform smoothening
Forge flat chisel
Forge center punch
Forge hammer
Forge square point
Forge dice
Forge tongs

Repair/maintain simple machine
Receive instruction
Read drawings
Determine work sequence/operation plan
Ascertain work procedures
Select appropriate tools and equipment
Carry out diagnosis and troubleshooting
Perform repair works as per the requirement
Check up machine condition
Dismantle components/parts
Identify replacement of genuine parts
Test run (free load)
Test run and operate with load
Carry out final test and carry out necessary adjustment

Project work
Carry out repair work on a simple lathe machine

Repair/maintain electromechanical devices:

1. Repair/maintain AC transformers
2. Repair/maintain DC transformers
3. Repair/maintain electrical motors
4. Repair/maintain generators
5. Repair/maintain turbine
6. Repair/maintain furnace
7. Repair/maintain blower

8. Repair/maintain contractor
9. Repair/maintain switches
10. Repair/maintain relay
11. Repair/maintain water pump
12. Repair/maintain boiler
13. Repair/maintain heating appliances
14. Repair/maintain compressor
15. Maintain pneumatic equipment
16. Maintain hydraulic equipment

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Fabrication:

1. Blower
2. Washing machine
3. Power hacksaw
4. Distribution/panel board
5. Switch boxes

List of tools/equipment

Electrical hand tools/equipment/devices

17. Combination pliers
18. Long nose pliers
19. Wire cutter
20. Wire stripper
21. Side cutter
22. Knife
23. Soldering iron
24. Multimeter
25. Set of drill
26. Set of screwdrivers
27. Set of hammers
28. Set of spirit level
29. Set of micrometer
30. Wire gauge
31. Set of L & N keys
32. Set of spanners

Mechanical hand tools/machine, machine tools/equipment/measuring instrument and gauges

Hand tools:

19. Workbench with bench vice
20. Steel rule
21. Steel square
22. Scribers (soft and hard)
23. Bench files (different shapes, sizes and grades)
24. Hand hacksaw
25. Chisel (flat, cross and profiles)
26. Punches (different sizes)
27. Dividers
28. Bevel protractor
29. Straight edge

30. Steel hammer (cross, straight and ball)
31. Center punch
32. Hand vice
33. Bench shears
34. Pliers (combination, cutting)
35. Wrenches
36. Spanners

Machine and machine tools:

8. Power hacksaw
9. Bench drilling machine
10. Pillar drilling machine
11. Pedestal grinder
12. Lathe machine
13. Shaping machine
14. Milling machine

Equipment:

17. Surface plate
18. Surface gauge
19. Anvil
20. Cevillative
21. Bending machine
22. Rolling machine
23. Soldering gun
24. Forging equipment
25. Measuring instrument and gauges:
26. Vernier caliper
27. Micrometer
28. Standard wire gauge/thickness gauge
29. Feeler gauge
30. Radius gauge
31. Screw pitch gauge
32. Telescopic gauge

Program: Electro mechanical Technician

Module: Electrical
Sub module: Fundamental of Electricity

Explain the concept of electricity
Follow safety measures
Identify/enumerate/handle tools and instruments
Identify /draw electrical symbols and codes
Apply /Verify Ohm's law
Calculate current/voltage/resistance
Identify resistant by colour coding method
Measure DC voltage using multimeter/ Voltmeter
Measure AC voltage using multimeter/Voltmeter
Measure DC current using multimeter/Ampermeter
Measure AC current using multimeter/ Ampermeter
Measure resistant using multimeter/ Ohmmeter
Calculate current/voltage/resistance
Apply /Verify Kirchof's current law in a given circuit
Apply /Verify Kirchof's voltage law of a closed loop circuit

Sub module: DC Motor:
Identify DC motor parts
Identify AC motor parts
Dismantle DC motor parts
Dismantle AC motor parts
Assemble DC motor parts
Assemble DC motor parts
Control speed of DC shunt motor by Armature voltage regulation (Keeping field current constant)
Control speed of DC shunt motor by flux regulation (Keeping Armature voltage constant: Rheostat method)

Sub module: Motorized Operated Appliances (Home)

1. **Repair ceiling fan:**

- Carryout preliminary test
  - Check continuity of coil (field, armature)
  - Check Capacitor
- Dismantle parts of fan
  - Find resistant of coil
  - Check body leakage
- Troubleshoot:
  - Repair /rewind field/armature winding
  - Replace regulating resistor
  - Replace capacitor
  - Replace brush
- Assemble dismantled parts

2. **Repair water pump**
3. **Repair grinder**
4. **Repair electric Mixer**
5. **Repair electric Juicer**
6. **Repair electric Blender**

7. **Repair Vacuum cleaner**
8. **Repair electric Hair dryer**
9. **Repair Refrigerator**
10. **Repair Washing machine**

Sub module: Motorized Operated Appliances (Industry)

1. **Repair AC/DC single phase motor**
2. **Repair AC/DC three phase motor**
3. **Repair AC generator**
4. **Repair Compressor**
5. **Repair Boiler**
6. **Repair Furnace**
7. **Repair transformer**

- Identify parts
- Check voltage of step up and step-down
- Check DC voltage

Sub module: Micro hydro

Repair turbine

- Align base frame
- Install turbine & generator
- Align pulley & belts
- Align couplings
- Install ELC control panel
- Erect ballast tank

Sample of Breakdown:

Task: Repair ceiling fan:

- Carryout preliminary test
- Disassemble the object
- Draw layout and wiring diagram of the object
- Diagnose problem/Troubleshoot
- Locate fault
- Service and repair
- Replace worn and defective parts
- Adjusting the faulty parts
- Reassembling
- Checking the performance of the object