

CURRICULUM

Technical School Leaving Certificate

Electronics Engineering

(18 months program)



Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

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Introduction:

Nepal Government, Ministry of Education implemented the letter grading system in SLC from 2072 B.S. The door of TSLC programme is open for those students who have appeared in SLC exam and achieved any GPA and any grade in each subject. Focusing on such students the curriculum of TSLC of 29 months and 15 months have been converted into 18 months to create uniformity among different TSLC programme.

This curriculum is designed to produce basic level human resources in the field of Electronics engineering equipped with knowledge, skills and attitude necessary for this level of technicians so as to meet the demand of such technician in the country.

Title:

The title of the programme is TSLC in Electronics Engineering.

Aim:

The aim of the programme is to produce competent human resources in the field of Electronics Engineering who can work in rapid growing electronics items manufacturing industries as well as can provide service in electronics and communication fields.

Objectives:

After completing this curricular program, the students will be able to:

- Perform basic mechanical fitting practices
- Perform basic electrical installation
- Perform basic electronics and computer works
- Assist to install telecommunication system
- Repair and maintain radio and television devices and equipment
- Repair and maintain electronic devices, solar components, and household appliances
- Install and maintain audio video and multimedia system
- Create self-employment opportunity to reduce the unemployment problems and poverty in the country.

Programme Description:

This programme is based on the job required to be performed by the Junior Electronics Technicians (Sub-overseer) in electronics goods manufacturing and service sectors. The manufacturing sector includes electronic items production and service sector includes electronics and communication system installation and maintenance. Therefore, this curriculum is designed to provide knowledge and skills focusing on Electronics Engineering related to the occupation. The curricular program consists of one year in house course and six months on the Job Training.

Similarly, the On-the-Job Training (OJT) for 6 months insists on the application of learned skills and knowledge in formal setting as well as the provision of OJT is also included to establish a linkage with employers and provides hands on work experience to students and promotes employability of graduates. Moreover, OJT takes place immediately after completing yearly final examination.

Course Duration:

This course will be completed within 18 months (40 hrs./week X 39 weeks a year = 1560 hrs.) class plus 6 months (40 hrs./week X 24 weeks = 960 hrs.) on the job training (OJT).

Entry criteria:

Individuals with following criteria will be eligible for this program:

- SLC with any grade and any GPA (Since 2072 SLC).
- SLC appeared (Before 2072 SLC)
- Pass entrance examination administered by CTEVT

Group size:

The group size will be maximum 40 (forty) in a batch.

Medium of Instruction:

The medium of instruction will be in English and/or Nepali language.

Pattern of Attendance:

The students should have minimum 90% attendance in theory classes and practical/performance to be eligible for internal assessments and final examinations.

Instructors' Qualification:

- Instructors should have Bachelor Degree in Electronics Engineering.
- Assistant Instructors should have Diploma in Electronics Engineering
- Practical Assistant/Teaching Aid should have TSLC in Electronics Engineering with 3 years' experience
- Good communicative/instructional skills

Teacher and Student Ratio:

- Overall at institutional level: 1:10
- Theory: 1:40
- Practical: 1:10
- Minimum 75% of the teachers must be fulltime

Instructional Media and Materials:

The following instructional media and materials are suggested for the effective instruction, demonstration and practical.

- Printed media materials (assignment sheets, handouts, information sheets, procedure sheets, performance check lists, textbooks, newspaper etc.).
- Non-projected media materials (display, models, photographs, flip chart, poster, writing board etc.).
- Projected media materials (multimedia/overhead transparencies, slides etc.).
- Audio-visual materials (films, videodiscs, videotapes etc.).
- Computer-based instructional materials (computer-based training, interactive video etc.)

Teaching Learning Methodologies:

The methods of teaching for this curricular program will be a combination of several approaches such as;

- Theory: lecture, discussion, assignment, group work, question-answer.
- Practical: demonstration, observation, simulation, role play, guided practice and self-practice.

Evaluation Details:

- The marks distribution for theory and practical tests will be as per the marks given in the course structure of this curriculum for each subject. Ratio of internal and final evaluation is as follows:

S.N.	Particulars	Internal Assessment	Final Exam	Pass %
1.	Theory	50%	50%	40%
2.	Practical	50%	50%	60%

- There will be three internal assessments and one final examination in each subject. Moreover, the mode of assessment and examination includes both theory and practical or as per the nature of instruction as mentioned in the course structure.
- Every student must pass in each internal assessment to appear the final exam.
- Continuous evaluation of the students' performance is to be done by the related instructor/trainer to ensure the proficiency over each competency under each area of a subject specified in the curriculum.
- The on-the-job training is evaluated in 500 full marks. The evaluation of the performance of the student is to be carried out by the three agencies; the concerned institute, OJT provider industry/organization and the CTEVT Office of the Controller of Examinations. The student has to score minimum 60% for successful completion of the OJT.

Grading System:

The grading system will be as follows:

Grading

Distinction
First division
Second division
Third division

Overall marks

80% or above
75% to below 80%
65% to below 75%
Pass aggregate to below 65%

Certificate Awarded:

The council for technical education and vocational training will award certificate in “**Technical School Leaving Certificate in Electronics Engineering**” to those graduates who successfully complete the requirements as prescribed by the curriculum.

Job Opportunity:

The graduate will be eligible for the position equivalent to Non-gazetted 2nd class/level 4 (technical) as Junior Electronics (Sub-Overseers) or as prescribed by the Public Service Commission.

Course Structure

TSLC in Electronics Engineering (18 months Programme)

SN	Course Title	Nature	Class/Week		Total Class/Year			Full Marks		
			T	P	T	P	Total	T	P	Total
1	Applied Math	T	2	0	78	0	78	50	0	50
2	Technical Drawing	T	2	0	78	0	78	50	0	50
3	Entrepreneurship Development	T	1	1	30	48	78	20	30	50
4	Electrical Installation	T	1	2	39	78	117	30	50	80
5	Mechanical Workshop Practice	P	0	2	0	78	78	0	50	50
6	Electronics Fundamental <ul style="list-style-type: none"> • Basic Electronics • Digital Electronics 	T+P	2	4	78	156	234	50	100	150
7	Electronics Technology <ul style="list-style-type: none"> • Radio Receiver (AM/FM) • TV Receiver (CRT/LCD/LED) 	T+P	2	6	78	234	312	50	150	200
8	Repair & Maintenance of Electronics Appliances	T+P	2	4	78	156	234	50	100	150
9	Computer Application & Computer Aided Drafting (CAD)	P	0	2	0	78	78	0	50	50
10	Computer Hardware & Networking	T+P	1	2	39	78	117	20	50	70
11	Telecommunication	T+P	1	3	39	117	156	20	80	100
Sub Total			14	26	546	1014	1560	340	660	1000
On-the-Job Training (6 Months)							960			500
Gran Total							2520			1500

Applied Mathematics

Total:	2 hrs/wk
Theory:	2 hrs/wk
Practical:	0 hrs/wk

Course Description:

This course is designed to help students to calculate and apply the mathematics in a standard applied manner. This course fulfills the basic knowledge required for engineering and technical students.

Course Objectives:

After completion of this course students will be able to:

- Develop the skill needed for the calculation of electronics engineering mathematics
- Communicate Mathematical calculation fluently and accurately with Nepali

Course Objectives:

After completion of this course students will be able to:

- Develop skill of simple mathematic calculation.
- Acquire knowledge on mensuration as well as volume and density.
- Develop the skill needed for the calculation of electronic engineering mathematics
- Communicate Mathematical calculation fluently and accurately with Nepali

Contents

Chapter 1: Permutation, Combination & Binomial Theorem 8 hrs

- Introduction and expansion of $(a+x)^n$ where $n=3,4,5$ basic
- Basic Binomial Theorem and some simple examples
- Laws of Permutation and Combinations
- Meanings of np_r , np_n , nc_r and nc_n
- Some simple exercises

Chapter 2: Laws of Indices 4 hrs

- Introduction
- Four Laws of Indices
- Solve simple problems

Chapter 3: Complex Quantities 7 hrs

- Introduction
- Real and imaginary numbers and meaning of "j"
- Laws of complex quantities and the basic properties
- Some simple exercises

Chapter 4: Quadratic Equations 8 hrs

- Introduction
- Description of $ax^2+bx+c=0$ and $x^2+bx+c=0$

- Methods of solving quadratic equations
 - Method of factorization
 - Method of completing square
 - Converting given equation into $ax^2+bx+c=0$ form
- Simultaneous equations
 - Basic two unknown equations
 - Basic three unknown equations
- Cramers rule
- Some simple exercises

Chapter 5: Matrix and Determinants **7 hrs**

- Introduction: types, some properties
- Matrix addition and subtraction up to 3 by 3 matrix
- Matrix multiplication and division up to 3 by 3 matrix
- Determinants of matrix up to 3 by 3 matrix
- Inverse of matrix
- Minor and cofactors and some properties
- Solve system of linear equations – 2 variables, 3 variables (Cramer's Rule)

Chapter 6: Logarithms & Anti-Logarithms **7 hrs**

- Definition of logarithms: logarithmic functions of base 10 and "e"
- Properties of logarithms and exponential value "e"
- Characteristics and Mantissa
- Method of finding Characteristics and Mantissa
- Definition Antilogarithms
- Method of finding Antilog of logarithm number
- Uses of logarithms & Antilogarithms table
- Some simple exercises

Chapter 7: Trigonometry **9 hrs**

- Introduction and Pythagoras Theorem
- Explain Trigonometric ratios and their relationship – $\sin\theta$, $\cos\theta$, $\tan\theta$, $\cot\theta$ etc.
- Addition and Subtraction formulas
- Some standard formulas
- Read Trigonometric table
- Some simple exercises

Chapter 8: The Limits **8 hrs**

- Introduction and meaning of $x \rightarrow a$
- Some limit theorems and its importance
- Some limits of algebraic and trigonometric functions
- Some simple exercises

Chapter 9: Derivatives **10 hrs**

- Introduction and derivative as slope of tangent of a Curve.
- Derivatives as speed and acceleration of motion

- Derivative of simple algebraic functions from First principle or definition.
- Techniques of differentiation (Derivations are not required)
- The sum rule
- The product rule
- The power rule
- The chain rule
- Derivatives of simple algebraic, trigonometric and logarithmic functions
- Some simple exercises

Chapter 10: Integration & Anti-derivatives

10 hrs

- Introduction and some formulas
- Indefinite integrals of simple algebraic functions
- Techniques of integration: substitution and "by part" methods
- Integrals of simple algebraic, trigonometric and logarithmic functions
- Some simple exercises

Technical Drawing & Auto CAD

Total:	3 hrs/wk
Theory:	0 hrs/wk
Practical:	3 hrs/wk

Course description:

This course is designed to help the students to provide skills on handling of drawing instruments and materials and drawing free hand lettering, lines, and different geometrical shapes, isometric and orthographic drawings. This course also provides comprehensive knowledge and skills on designing electrical and electronic circuits with circuit maker. It also deals with drawing circuits manually, with the help of Auto CAD ® Electrical and simulation of drawn circuits.

Course Objectives:

After completion of this course students will be able to:

1. Project point, line, plane and other geometrical shapes
2. Understand and draw isometric and orthographic drawing
3. Represent three dimensional objects
4. Use freehand techniques to sketch different shapes.
5. Draw basic electronic symbols
6. Draw simple circuit diagram using circuit maker.
7. Explain drawing of Electrical and Electronic circuit (Block diagram).
8. Explain assembling and /or manufacturing drawing.
9. Be familiar with Auto CAD®Electrical.
10. Explain Electrical and Electronic circuit simulation.

List of Tasks:

1. Draw simple engineering drawing in prescribed scale
2. Draw various geometrical shapes
3. Draw isometric drawing
4. Draw orthographic views
5. Draw various electronic components/devices symbols and circuits
6. Interpret assembling and manufacturing drawing
7. Draw block diagram of different Electrical/Electronic circuits
8. Draw circuit with computer aided simulation software.

Task Analysis

Time:- 17 hrs
Theory:- 2 hrs
Practical:- 15 hrs

Task: 1 Draw simple engineering drawing in prescribed scale

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect Drawing paper and instrument. 2. Receive instruction and/or sketches to be drawn. 3. Cut drawing sheet in to required size 4. Fix drawing sheet/paper on drawing board. 5. Draw boarder lines and Name plate. 6. Select scale to be use. 7. Plan the layout in the drawing sheet. 8. Draw the object or the part of object according to layout planned with fin line. 9. Complete main drawing. 10. Project dimensional lines. 11. Provide required dimensions and Title in drawing by free hand. 12. Make / draw required Table and schedules. 13. Detach and store drawing in safe place. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Drawing board and instruments. • Drawing paper • paper cutter • Cello / masking tape • Complete sketches of simple engineering drawing • scale • Drawing Tool and instrument <p>Tasks (What):</p> <ul style="list-style-type: none"> • Draw simple engineering drawing in prescribed scale. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Common drawing instruments properly handled and used. • Drawing sheet laid in standard format • Common symbols draw and interpreted correctly. • Draw and interpreted and deferent types of lines correctly. • Engineering scale used and interpreted correctly. • Draw and interpreted simple engineering drawing with required free hand lettering and numbering cleanly and neatly. 	<p>Drawing</p> <ul style="list-style-type: none"> • Introduction, types, use, importance, advantages and sizes of drawing sheet... • Types, uses and importance of plan views and sections • Importance, uses and advantages of sketches and drawing symbols. • Importance of proper layout and cleanliness in drawing and drawing sheet. • Types of lines, uses and its importance. • Methods of dimensioning and its importance <p>Instruments</p> <ul style="list-style-type: none"> • Introduction, types, uses importance, advantages and methods of handling. • Types of pencils and it uses • Importance, uses, and methods of interpreting engineering scale (Life, reduce and enlarge size) • Importance and use of free hand lettering and numbering.

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape.

Safety:-

Task: 2 Draw various geometrical shapes

Time:- 14 hrs
Theory:- 2 hrs
Practical:- 12 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect Drawing paper and instrument. 2. Receive instruction and/or sketches to be drawn. 3. Cut drawing sheet in to required size 4. Fix drawing sheet/paper on drawing board. 5. Draw boarder lines and Name plate. 6. Select scale to be used. 7. Plan the layout in the drawing sheet. 8. Draw specified / various geometrical shapes in drawing sheet with fin and clear lines according to layout planning. 9. Construct specified / various geometrical shapes in drawing sheet. 10. Project dimensional lines. 11. Provide required dimensions and Title in drawing by free hand. 12. Detach and store drawing in safe place. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Drawing board and instruments. • Drawing paper • paper cutter • Cello / masking tape • Shape specified • scale • Drawing Tool and instrument • Geometrical shape specified <p>Tasks (What):</p> <ul style="list-style-type: none"> • Draw various geometrical shapes. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Neat and clean Specified /various geometrical shapes drawn with correct procedures. 	<p>Geometrical shape</p> <ul style="list-style-type: none"> • Introduction, types, uses and importance of various shapes • Lines • Angles • Arcs of circle • Regular polygon • Tangent line of circle • Ellipse • Cube • Prism • Parabola • Hyperbola • Cycloid • Helix (Cylindrical) • Circular Involute • Procedure and methods of Using Drawing instruments • Procedure and methods of constructing various geometrical shape

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape

Safety:-

Task: 3 Draw isometric Drawing

Time:- 17 hrs
 Theory:- 2 hrs
 Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect Drawing paper and instruments. 2. Receive instruction object and/or sketches to be drawn. 3. Cut drawing sheet in to required size 4. Fix drawing sheet/paper on drawing board. 5. Draw boarder lines and Name plate. 6. Select scale to be use. 7. Plan the layout in the drawing sheet. 8. Project required lines with proper pencils and instruments as per planed layout. 9. Complete main drawing. 10. Project dimensional lines. 11. Provide required dimensions and Title in drawing by free hand. 12. Detach and store drawing in safe place. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Drawing board and instruments. • Drawing paper • paper cutter • Cello / masking tape • Two dimensional/ isometric sketches and/or real object. • Scale mention e.g. 1:2 or 1/4 size etc. • Drawing Tool and instrument <p>Tasks (What):</p> <ul style="list-style-type: none"> • Draw isometric drawing. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Draw neat and clean required isometric view in mention scale correctly with right procedure. 	<ul style="list-style-type: none"> • Introduction, uses and importance of 2-D and 3-D Drawing. • FPS and metric system • Introduction to Axonometric projection • Introduction, uses and importance of isometric drawing • Procedure and methods of drawing isometric drawing.

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape

Safety:-

Time:- 15 hrs
 Theory:- 2 hrs
 Practical:- 13 hrs

Task: 4 Draw orthographic views

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect Drawing paper and instruments. 2. Receive instruction object and/or sketches to be drawn. 3. Cut drawing sheet in to required size 4. Fix drawing sheet/paper on drawing board. 5. Draw boarder lines and Name plate. 6. Select scale to be use. 7. Plan the layout in the drawing sheet. 8. Project required lines with proper pencils and instruments as per planed layout. 9. Complete main drawing. 10. Project dimensional lines. 11. Provide required dimensions and Title in drawing by free hand. 12. Detach and store drawing in safe place. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Drawing board and instruments. • Drawing paper • paper cutter • Cello / masking tape • Two dimensional/ isometric sketches and/or real object. • Scale mention e.g. 1:2 or 1/4 size etc. • Drawing Tool and instrument <p>Tasks (What):</p> <ul style="list-style-type: none"> • Draw orthographic Drawing <p>Standard (How well):</p> <ul style="list-style-type: none"> • Draw neat and clean orthographic drawing in mention scale correctly with right procedure 	<ul style="list-style-type: none"> • Introduction, types, uses and importance of orthographic drawing • Procedure and methods of drawing orthographic drawing. • Systems of Orthographic Projection: First Angle and Third Angle

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape

Safety:-

Task: 5 Draw various electronic components/ devices symbols and circuits

Time:- 12 hrs
Theory:- 2 hrs
Practical:-10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect Drawing paper and instruments. 2. Receive instruction object and/or sketches to be drawn. 3. Cut drawing sheet in to required size 4. Fix drawing sheet/paper on drawing board. 5. Draw boarder lines and Name plate. 6. Select scale to be use. 7. Plan the layout in the drawing sheet. 8. Project required lines with proper pencils and instruments as per planed layout. 9. Complete main drawing. 10. Project dimensional lines. 11. Provide required dimensions and Title in drawing by free hand. 12. Detach and store drawing in safe place. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Drawing board and instruments. • Drawing paper • paper cutter • Cello / masking tape • Two dimensional/ isometric sketches and/or real object. • Scale mention e.g. 1:2 or 1/4 size etc. • Drawing Tool and instrument <p>Tasks (What):</p> <ul style="list-style-type: none"> • Draw various electronic components/devices symbols and circuits <p>Standard (How well):</p> <ul style="list-style-type: none"> • Draw neat and clean drawing of various electronic components/devices symbols and circuits correctly with right procedure 	<ul style="list-style-type: none"> • Draw basic symbols for active components such as transistors PNP/NPN, diodes, SCR, MOSFET, CMOS, JFET, FET and thyristers. • Draw symbols for Logic Gates (AND,OR,NOT, NAND, NOR, XOR, XNOR and Flip-Flops) • Draw circuit diagram of simple measuring instruments (Voltmeter, Ammeter and Ohmmeter)

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape

Safety:-

Task: 6 Interpret assembling and manufacturing drawing

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect assembling and/or manufacturing drawing. 2. Study assembling and/or manufacturing drawing. 3. Flow instructions provided in assembling and/or manufacturing drawing. 4. Identify /distinguish and /or explain the meaning of common Electrical and Electronic symbols 5. Assemble the Electronic unit /object according to assembling drawing. Or 6. Explain the assembling line according to assembling drawing. 7. Compare / verify manufacturing drawing (diagram) with PCB Board. 8. Identify defects of installed PCB Board of unit by verifying manufacturing drawing 9. Prepare block drawing/ Sketches according to the manufacturing drawing. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Assembling and manufacturing drawing • Tool/Equipment and materials. • Required Component • PCB board • List of electrical and electronic symbols • Symbolic representation of electrical and electronic symbols <p>Tasks (What):</p> <ul style="list-style-type: none"> • Interpret assembling and/or manufacturing drawing. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Various electrical and electronic symbols identified, distinguish and interpreted correctly • Electronic unit /object assembled or explain assembling process according to assembling drawing. • Manufacturing drawing compared /verified with PCB board correctly 	<p>Assembling and manufacturing drawing</p> <ul style="list-style-type: none"> • Introduction • Importance, advantages and application • Importance, advantages and application of Electrical and Electronic symbols

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape

Safety:-

Task: 7 Draw block diagram of different Electrical/Electronic circuits

Time:- 16 hrs
Theory:- 4 hrs
Practical: 12 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Create basic boarder. 2. Insert attributes: a) Sheet name b) Text height c) width factor d) Title e) drawing value 3. Save file. 4. Create drawing 5. Insert wire and Electrical / Electronic components 6. Print circuit drawn.	<p>Condition (Given): A PC with AutoCAD®Electrical software installed.</p> <p>Tasks (What):</p> <ul style="list-style-type: none"> • Draw block diagram of different Electronic circuits. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Number of section determined • Blocks connected according to the signal flow from one to another stage as per the given Electrical/Electronic circuit. • Printed the circuit diagram. 	<ul style="list-style-type: none"> • What is AutoCAD®Electrical software? • How to draw circuit using AutoCAD®Electrical. • Menu bars. • Tool bars. • Symbols of different Electrical and Electronic circuit components. • Function commands of AutoCAD®Electrical.

Tools and Materials:- Drawing board, Mini-drafter, Set Square, Scale, Pencil, Eraser, Drawing Paper, Masking Tape

Safety:-

Task: 8 Draw circuit with computer aided simulation software / working with circuit maker.

Time:- 20 hrs
Theory:- 5 hrs
Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Load Electrical/ Electronic circuit simulation program. 2. Exit from circuit simulation program. 3. Plan to draw circuits: <ol style="list-style-type: none"> a) Basic Electronics b) Digital Electronics c) Basic Electrical Installation 4. Select Electrical/ Electronic components from drop down list. 5. Connect terminals of components. 6. Connect voltmeter, Ammeter, Oscilloscope across the components where appropriate 7. Add Power supply & ground to circuit. 8. Simulate drawn circuit. 9. Measure voltage, current, frequency 10. Convert circuit into PCB compatible. 11. Justify the simulated circuit. 12. Print circuit & PCB layout. 	<p>Condition (Given): A PC with circuit simulation software installed. (Preferred software: 1. Electronic workbench circuit simulator 2. SPICE (Simulation Program with Integrated Circuit Emphasis)</p> <p>Tasks (What): Draw circuit with computer aided simulation software.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Draw circuit. • Simulated the circuit. • Justified simulated result. • Converted circuit into PCB compatible. • Printed circuit & PCB layout. 	<ul style="list-style-type: none"> • What is Electrical /Electronic circuit simulation software? • How it works? • Menu bars. • Tool bars. • Symbols. • Defining basic Electronic circuits. • Defining Digital Electronic Circuits. • Defining Basic Electrical Installation circuits.

Tools and Materials:- PC, CKT maker software

Safety:-

References:

1. Luzadder, W.J., **Fundamental of Engineering Drawing**, Prentice-Hall of India Pvt-Ltd., New Delhi, Latest edition.
2. Bhatt N. D. and Panchal V.M., **Engineering Drawing**, Charotar Publishing House, 2001.
3. Gill P.S, **Engineering Drawing**, S. K. Kataria & Sons, New Delhi, 2004/2005
4. Surjit Singh, **General Electrical Drawing**, S.K. Kataria and sons

Entrepreneurship Development

Total: 78 hrs
Theory: 30 hrs
Practical: 48 hrs

Course description

This course is designed to impart the knowledge and skills on formulating business plan and managing small business in general. This course intends to deal with exploring, acquiring and developing enterprising competencies, identification of suitable business idea and developing of business plan.

Course objectives

After completion of this course students will be able to:

1. Understand the concept of business and entrepreneurship
2. Explore entrepreneurial competencies
3. Analyze business ideas and viability
4. Formulate business plan
5. Learn to manage small business

S.N.	Task statements	Related technical knowledge	Time (hrs)		
			T	P	Total
Unit 1: Introduction to Entrepreneurship			5.75	4.08	9.83
1	Introduce business	<u>Introduction of business:</u> Definition of business/enterprise Types of business Classification of business Overview of MSMEs(Micro, Small and Medium Enterprises) in Nepal	1.5		1.5
2	Define entrepreneur/entrepreneurship	<u>Definition of entrepreneur:</u> Definition of entrepreneur Definition of entrepreneurship Entrepreneurship development process	0.5	0.5	1.0
3	Describe entrepreneur's characteristics	<u>Entrepreneur's characteristics:</u> Characteristics of entrepreneurs Nature of entrepreneurs	0.67	0.83	1.5
4	Assess entrepreneur's characteristics	<u>Assessment of entrepreneur's characteristics:</u> List of human characteristics Assessment of entrepreneurial characteristics	0.5	1.0	1.5
5	Compare entrepreneur with other occupations	<u>Entrepreneur and other occupations:</u> Comparison of entrepreneur with other occupations Types and styles of entrepreneurs	1.0		1.0
6	Differentiate between entrepreneur and employee	<u>Entrepreneur and employee:</u> Difference between entrepreneur and employee Benefit of doing own business	0.5	0.5	1.0
7	Assess "Self"	<u>"Self" assessment:</u> Understanding "self" Self-disclosure and feedback taking	0.6	0.4	1.0

8	Entrepreneurial personality test: Assess “Self” inclination to business	<u>Entrepreneurial personality test:</u> Concept of entrepreneurial personality test Assessing self-entrepreneurial inclination	0.67	0.83	1.5
Unit 2: Creativity and Assessment			6.5	4.0	10.5
9	Create viable business idea	<u>Creativity:</u> Concept of creativity Barriers to creative thinking	1.67	0.33	2.0
10	Innovate business idea	<u>Innovation:</u> Concept of innovation SCAMPER Method of innovation	0.83	0.67	1.5
11	Transfer ideas into action	<u>Transformation of idea into action:</u> Concept of transferring idea into action Self-assessment of creative style	1.0	0.5	1.5
12	Assess personal entrepreneurial competencies	<u>Personal entrepreneurial competencies:</u> Concept of entrepreneurial competencies Assessing personal entrepreneurial competencies	0.5	1.0	1.5
13	Assess personal risk taking attitude	<u>Risk taking attitude:</u> Concept of risk Personal risk taking attitude Do and don’t do while taking risk	1.5	1.0	2.5
14	Make decision	<u>Decision making:</u> Concept of decision making Personal decision making attitude Do and don’t do while making decision	1.0	0.5	1.5
Unit 3: Identification and Selection of Viable Business Ideas			0.83	3.42	4.25
15	Identify/ select potential business idea Analyze strength, Weakness, Opportunity and Threat (SWOT) of business idea	<u>Identification and selection of potential business:</u> Sources of business ideas Points to be considered while selecting business idea Business selection process Potential business selection among different businesses Strength, Weakness, Opportunity and Threats (SWOT) analysis of business idea Selection of viable business idea matching to “self”	0.83	3.42	4.25
Unit 4: Business Plan			16.67	36.58	53.25
16	Assess market and marketing	<u>Market and marketing:</u> Concept of market and marketing Marketing and selling Market forces 4 Ps of marketing Marketing strategies	1.33	0.75	2.08
17	Business exercise: Explore small business	<u>Business exercise:</u> Business exercise rules Concept of small business management	1.58	1.67	3.25

	management concept	Elements of business management Planning Organizing Executing Controlling			
18	Prepare market plan	<u>Business plan/Market plan</u> Concept of business plan Concept of market plan Steps of market plan	2.0	2.0	4.0
19	Prepare production plan	<u>Business plan/Production plan:</u> Concept of production plan Steps of production plan	1.25	1.5	2.75
20	Prepare business operation plan	<u>Business plan/Business operation plan:</u> Concept of business operation plan Steps of business operation plan Cost price determination	2.5	2.67	5.17
21	Prepare financial plan	<u>Business pan/Financial plan:</u> Concept of financial plan Steps of financial plan Working capital estimation Pricing strategy Profit/loss calculation BEP and ROI analysis Cash flow calculation	4.5	7.5	12.0
22	Collect market information /prepare business plan	<u>Information collection and preparing business plan:</u> Introduction Market survey Precaution to be taken while collecting information Sample questions for market survey Questions to be asked to the customers Questions to be asked to the retailer Questions to be asked to the stockiest/suppliers Preparing business plan	2.0	13.0	15.0
23	Appraise business plan	<u>Business plan appraisal:</u> Return on investment Breakeven analysis Cash flow Risk factors	0.5	5.5	6.0
24	Maintain basic book keeping	<u>Basic book keeping:</u> Concept and need of book keeping Methods and types of book keeping Keeping and maintaining of day book and sales records	1.0	2.0	3.0
		Total:	30	48	78.0

Text book:

क) प्रशिक्षकहरुका लागि निर्मित निर्देशिका तथा प्रशिक्षण सामग्री, प्राविधिक शिक्षा तथा व्यावसायिक तालीम परिषद्, २०६९

ख) प्रशिक्षार्थीहरुका लागि निर्मित पाठ्यसामग्री तथा कार्यपुस्तिका, प्राविधिक शिक्षा तथा व्यावसायिक तालीम परिषद् (अप्रकाशित), २०६९

Reference book:

Entrepreneur's Handbook, Technonet Asia, 1981.

Electrical Installation

Total: 3 hrs/wk
Theory: 1 hr/wk
Practical: 2 hrs/wk

Course Description:

This course provides knowledge and skills related on basic electrical installation techniques. It also covers classification of wiring, selection of materials, simple design and installation of domestic electrification.

Course Objectives:

After completing this course students will be able to:

1. Apply Electrical Safety rules.
2. Identify tools, Equipment, machines and materials used in electrical system.
3. Familiarize with electrical components related with electrical system.
4. Interpret layout and wiring diagram.
5. Perform basic electrical installation and board wiring.
6. Repair and maintain faults of electrical system.
7. Perform wiring system and electrical safety test.

List of Tasks:

1. Interpret schematic Diagram
2. Interpret layout Diagram
3. Interpret wiring Diagram
4. Perform one bulb control by one way switch on the exercise board
5. Perform two bulb control by one way switch in series condition
6. Perform two bulb control by one way switch in parallel condition
7. Perform one bulb control by one way switch with 2pin Socket and indicator
8. Perform one bulb control by one way switch with push button switch controlled by buzzer
9. Perform one bulb control by 2 way switch with 3pin switch combined power socket
10. Perform one bell control by one way switch and other bulb control by two way switch with 3pin switch combined power socket
11. Perform one bulb control by 3 places using 2 ways switches and one cross way switch
12. Read and handle multi meter
13. Perform call bell system on board
14. Perform go down circuit on board
15. Install MCB electrical supply system
16. Install energy meter in electrical supply system
17. Control one bulb, one Tube light set and one fan by three one way switch and dimmer.

Task Analysis

Task 1: Interpret Schematic Diagram

Time : 3 hrs

Theory : 1 hrs

Practical: 2 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction. 2. Prepare the drawing instruments. 3. Prepare the drawing sheet. 4. Draw Schematic diagram of one bulb control by one way switch. 5. Wipe off unnecessary drawing Lines. 6. Submit the drawing to instrument for Evaluation. 	<p>Condition (Given): Fully Equipped Drawing classroom with drawing Instrument.</p> <p>Task (What): Interpret Schematic Diagram</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Read and follow schematic diagram • Draw simple diagram of one bulb control by one way switch. 	<p>Interpret Schematic Diagram:</p> <ul style="list-style-type: none"> • Introduce AC & DC. • Introduction of Electrical Symbols. • Electrical schematic, wiring and layout diagram.

Tools/Equipment: Drawing instruments.

Safety Precaution: Follow the safety precaution of engineering drawing.

Task 2: Interpret Layout Diagram

Time : 3 hrs

Theory : 1 hrs

Practical : 2 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
1. Obtain instruction. 2. Obtain the layout diagram 3. Prepare electrical accessories as per layout diagram.	<p>Condition (Given): Fully Equipped electrical workshop with different accessories.</p> <p>Task (What): Interpret Layout Diagram</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Interpret layout diagram • Identify different electrical accessories. 	<p>Interpret Layout Diagram:</p> <ul style="list-style-type: none"> • Introduction of layout diagram. • Introduction of Electrical accessories.

Tools/Equipment: Tools set.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pulls the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Task 3: Interpret Wiring Diagram

Time : 3 hrs

Theory : 1 hrs

Practical : 2 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
1. Obtain instruction. 2. Obtain the layout diagram 3. Prepare electrical accessories as per layout diagram.	<p>Condition (Given): Fully Equipped electrical workshop with different accessories.</p> <p>Task (What): Interpret Wiring Diagram</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Interpret wiring diagram • Use different electrical accessories. 	<p>Interpret Wiring Diagram:</p> <ul style="list-style-type: none"> • Introduction of wiring diagram. • Use of Electrical accessories. • Introduction to conductors and insulators.

Tools/Equipment: Tools set.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pulls the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Task 4: Perform one bulb control by one way switch on the Exercise board.

Time : 7 hrs
Theory : 1.5 hrs
Practical : 5.5 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction Layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Collect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform one bulb control by one way switch.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Perform one bulb control by one way switch. 	<p>Perform one bulb control by one way switch.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Identify tools and materials. • Electrical Terminology and Ohm’s law. • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammar, Wire Striper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pulls the flexible cable or wire to disconnect the plug.
Never place bear wire seen on plugs & socket.

Task 5: Perform two bulb control by one way switch in series.

Time : 7 hrs
 Theory : 1.5 hrs
 Practical : 5.5 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform two bulb control by one way switch in series condition.</p> <p>Standard (How well): Perform two bulb control by one way switch in series condition.</p>	<p>Two bulb control by one way switch in series condition.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Electrical circuit and its condition. • Series parallel circuit. • Related numerical. • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pull the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Task 6: Perform two bulb control by one way switch in Parallel.

Time : 7 hrs
Theory : 1.5 hrs
Practical : 5.5 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Con 11. Nect power supply. 12. Check circuit operation. 13. Dismantle circuit. 14. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with tools & materials.</p> <p>Task (What): Perform two bulb control by one way switch in parallel condition.</p> <p>Standard (How well): Perform two bulb control by one way switch in parallel condition.</p>	<p>Two bulb control by one way switch in Parallel condition.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Numerical on ohms law. • Working procedure. <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammar, Wire Striper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pulls the flexible cable or wire to disconnect the plug.
Never place bear wire seen on plugs & socket.

Task 7: Perform one bulb control by one way switch with 2pin Socket and indicator

Time : 7 hrs
Theory : 1.5 hrs
Practical : 5.5 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and Layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform one bulb control by one way switch with 2pin Socket.</p> <p>Standard (How well): Perform one bulb control by one way switch with 2pin Socket</p>	<p>One bulb control by one way switch with 2 pin Socket.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammar, Wire Striper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pulls the flexible cable or wire to disconnect the plug.
Never place bare wire seen on plugs & socket.

Task 8: Perform one bulb control by one way switch with push button switch controlled by buzzer.

Time : 10 hrs
Theory : 2 hrs
Practical : 8 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform one bulb control by one way switch with push button switch controlled by buzzer.</p> <p>Standard (How well): Perform one bulb control by one way switch with push button switch controlled by buzzer.</p>	<p>One bulb control by one way switch with push button switch controlled by buzzer.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pull the flexible cable or wire to disconnect the plug.
Never place bare wire seen on plugs & socket.

Task 9: Perform one bulb control by Two way switch with 3 pin switch combined power socket.

Time : 8 hrs
Theory : 2 hrs
Practical : 6 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform one bulb control by Two way switch with 3pin switch combined power socket</p> <p>Standard (How well): Oone bulb is controlled by two way switch with 3pin switch combined power socket</p>	<p>One bulb control by Two way switch with 3pin switch combined power socket.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools &Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammar, Wire Striper, Wiring Board, Scale,

Safety Precaution: Handle all electrical apparatus &Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pulls the flexible cable or wire to disconnect the plug.
Never place bear wire seen on plugs & socket.

Task 10: Perform one bulb control by one way switch and other bulb control by two way switch and switch combined power socket.

Time : 8 hrs
Theory : 2 hrs
Practical : 6 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform one bell control by Push bottom switch and other bulb control by Two way switch with 3pin switch power socket.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • The bell is controlled by push bottom switch. • The bulb control by two way switch with 3pin switch power socket. 	<p>One bell control by Push bottom switch and other bulb control by Two way switch with 3pin switch power socket.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Earthing, its type and process. • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pull the flexible cable or wire to disconnect the plug.
Never place bare wire seen on plugs & socket.

Task 11: Perform one bulb control by 3 places using 2 two way switch and one cross way switch.

Time : 8 hrs
 Theory : 2 hrs
 Practical : 6 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform one bulb control by 3 places using 2 two switch and one cross way switch.</p> <p>Standard (How well): The bulb is controlled by 3 places using 2 two switch and one cross way switch.</p>	<p>One bulb control by 3 places using 2 two switch and one cross way switch.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale,

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pulls the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Task 12: Read and Handle Multi meter.

Time : 4 hrs

Theory : 1 hrs

Practical : 3 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain multi meter 2. Insert Probe (jack) into positive terminal and negative terminal. 3. Connect multi meter probe in respective supply. 4. Read measure voltage. 5. Note down the measurement. 6. Follow the steps from 3 to 5 for adjusting selector switch to Ampere. 7. Follow the steps from 3 to 6 for adjusting selector switch to Resistance. 8. Clean and store the meter in safe and sound place. 	<p>Condition (Given): Well-equipped electrical workshop with Multi meter.</p> <p>Task (What): Read and Handle Multi meter.</p> <p>Standard (How well): Read and Handle Multi meter.</p>	<p>Multi meter</p> <ul style="list-style-type: none"> • Introduction and types of multi meter • Advantage of using multi meter • Process of reading and handling multi meter • Handle and care of multi meter <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pull the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Time : 10 hrs
 Theory : 2 hrs
 Practical : 8 hrs

Task 13: Perform call bell system on board.

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram by Multi Meter. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform Call bell system on board.</p> <p>Standard (How well): Perform call bell system on board.</p>	<p>Call bell system on board.</p> <p>Introduction</p> <ul style="list-style-type: none"> • Uses • Importance • Advantage • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pulls the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Task 14: Perform go down circuit on board.

Time : 10 hrs

Theory : 2 hrs

Practical : 8 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary accessories as per measurement. 6. Install the main & auxiliary accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram by Multi Meter. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Perform go down circuit on board.</p> <p>Standard (How well): Perform go down circuit on board.</p>	<p>Go down circuit on board.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Working procedure <p>Safety Rules.</p> <ul style="list-style-type: none"> • Electrical safety • Tools & Equipment safety. • Personal safety.

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale.

Safety Precaution: Handle all electrical apparatus & Equipment carefully.

Replace broken Switches and Plugs immediately.

Never pull the flexible cable or wire to disconnect the plug.

Never place bare wire seen on plugs & socket.

Time : 6 hrs
 Theory : 2 hrs
 Practical : 4 hrs

Task 15: Install MCB electrical supply system

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction 2. Collect required tools & materials 3. Identify main supply of electrical system 4. Identify suitable place to install MCB 5. Mark on location of energy meter 6. Drill hole on wall 7. Insert grip in hole 8. Fix base bar of MCB with fastness 9. Connect input and output supply through MCB 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Install MCB electrical supply system</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed MCB following proper procedure • Safety precautions were taken while performing the tasks 	<p>MCB electrical supply system</p> <ul style="list-style-type: none"> • Definition • Types • Component installing procedure • Input and output supply • Input supply connecting procedure • output supply distribution procedure

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale.

Safety: Handle all electrical apparatus & Equipment carefully.

Replace broken Switches and Plugs immediately.

Never pull the flexible cable or wire to disconnect the plug.

Never place bare wire seen on plugs & socket.

Task 16: Install energy meter in electrical supply system

Time : 4 hrs
 Theory : 1 hrs
 Practical : 3 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction 2. Collect required tools & materials 3. Identify main supply of electrical system 4. Identify suitable place to install Energy meter 5. Mark on location of energy meter 6. Drill hole on wall 7. Insert grip in hole 8. Fix Energy meter 9. Connect input and output supply through Energy meter 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Install Energy meter in electrical supply system</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed Energy meter following proper procedure • Safety precautions were taken while performing the tasks 	<p>Energy meter</p> <ul style="list-style-type: none"> • Definition • Types • Component installing procedure • Input and output supply • Input supply connecting procedure • output supply distribution procedure

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale.

Safety: Handle all electrical apparatus & Equipment carefully.
 Replace broken Switches and Plugs immediately.
 Never pull the flexible cable or wire to disconnect the plug.
 Never place bare wire seen on plugs & socket.

Task 17: Control one bulb, one tube light set and one fan by two one way switch and dimmer (fan regulator).

Time : 12 hrs
Theory : 2 hrs
Practical: 10 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and layout diagram. 2. Prepare wiring diagram. 3. Collect required tools & materials 4. Mark the layout on board as per diagram. 5. Prepare the main & auxiliary Electrical accessories as per measurement. 6. Install the main & auxiliary Electrical accessories on the board. 7. Lay wire according to the wiring diagram. 8. Connect all electrical accessories according to the wiring diagram. 9. Recheck circuit diagram according to the wiring diagram by multi meter. 10. Connect power supply. 11. Check circuit operation. 12. Dismantle circuit. 13. Clean and store the electrical accessories. 	<p>Condition (Given): Well-equipped electrical workshop with Tools & Materials.</p> <p>Task (What): Control one bulb, one Tube light set and one fan by three one way switch and dimmer.</p> <p>Standard (How well): Control one bulb, one Tube light set and one fan by three one way switch and dimmer.</p>	<p>One bulb, one Tube light set and one fan by three one way switch and dimmer.</p> <ul style="list-style-type: none"> • Introduction • Uses • Importance • Advantage • Working procedure <p>Safety Rules. Electrical safety Tools & Equipment safety. Personal safety.</p>

Tools/Equipment: Tools box, Screw driver, Nose Plier, Wire Cutter, Line Tester, Multimeter, Hammer, Wire Stripper, Wiring Board, Scale

Safety Precaution: Handle all electrical apparatus & Equipment carefully.
Replace broken Switches and Plugs immediately.
Never pull the flexible cable or wire to disconnect the plug.

References:

- Electrical Engineering, Vol I & II, P.S. Dhogal.
- Basic Electrical Engineering, M.L. Anwani.

Mechanical Workshop Practice

Total:	3 hrs/wk
Theory:	0 hrs/wk
Practical:	3 hrs/wk

Course Description:

This course provides basic skills and knowledge related to mechanical workshop practice. It imparts skills to use, care and maintain basic hand tools for metal work. Mechanical workshop practice undertakes shaping jobs of all basic mechanical fittings carry out on bench work.

Course Objectives:

After completion of this course students will be able to:

1. Explain and follow and follow general safety rules.
2. Perform measuring, marking and Punching.
3. Perform cutting, sawing and filing.
4. Perform drilling, countersinking, tapping and dieng.
5. Perform sheet metal works.
6. Perform soldering and riveting.
7. Perform sheet metal project work.

List of tasks:

1. Familiarize with mechanical tools, materials and equipment.
2. File flat surface.
3. Measure and mark on the work piece (Right angle & dimensions).
4. File external radius.
5. Punch dot and center on the object.
6. Stamp letters and numbers on metal plate.
7. Saw metal by hand hack –saw.
8. Drill a hole
9. Countersink hole
10. Cut internal thread using hand taps
11. Cut external thread using threading dies
12. Cut metal sheet with snip
13. Fold metal sheet
14. Perform riveting joints
15. Perform soldering
16. Perform project (Sheet metal Project)

Task Analysis

Task: 1 Familiarize with mechanical tools, materials and equipment

Time:- 3 hrs
Theory:- 0.5 hrs
Practical:- 2.5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain tools / materials and equipment as per list. 2. Introduce tools / materials and equipment. 3. Explain objectives. 4. Explain working principle 5. Explain safety precaution. 6. Explain care and maintenance. 7. State using proper tools / material/ equipment. 8. Store the tools. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Tool/ materials and Equipment as per given list. • Well-equipped workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Familiarize with mechanical tools, materials and Equipment. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Tools, equipment and material should be identified as per given list. • Applied different tools equipment and materials safely • Explained the functions of different tools equipment and materials 	<p>Mechanical tools, materials and equipment</p> <ul style="list-style-type: none"> • Bench work tools and equipment • Definition • Objective • Working principle • Uses • Importance • Handling and caring • Safety precaution

Tools and Equipment:- Steel scale, Different types of file, Back square, Marking scriber, Center punch, Hammers, Hand hack saw,

Materials: Mild steel, Carbon steel, Tool steel

Safety:-

1. Handle the tools carefully.
2. Store the tools and material systematically.

Task: 2 File flat surface

Time:- 14 hrs
 Theory:- 1 hrs
 Practical:- 13 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain required drawing. 2. Read drawing thoroughly. 3. Obtain rough flat file. 4. Obtain material as per drawing. 5. Clean up the vice and working surroundings. 6. Obtain steel scale, marking scriber and back square. 7. Mark on the work piece as per drawing. 8. Clamp the work-piece centrally on Bench vice so that the flat file can be file down the surface of w/p. 9. Hold the file by one hand with gripping the file handle so that the end of the handle presses against the ball of the thumb. 10. Press the tip file blade with the ball of the thumb by the other hand. 11. Position the feet to safe distance during filling. 12. Position the body to speedy and regular movements of the body. 13. Put the file on top of the work-piece pressing and pushing from one hand and pressing only from other hand. 14. Return the file without pressure. 15. Apply the same motion to produces even removal of filling surface. 16. Apply full length of file. 17. Check the flatness in cross and diagonally with back square 18. Check measurement by steel scale 19. Repeat the same motion of filling across and diagonally until produce even surface. 20. Check right angle of W/P 21. De-burr the work piece. 22. Punch the roll no on work piece. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): File flat surface</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Filing work piece should be match given check list. • Tolerances of filing work piece is within the ± 0.1 mm • Tolerance of right angle $\pm 1^0$ 	<ul style="list-style-type: none"> • Material of w/p • Material of files and introduction • w/p clamping devices • care and safety features of files, bench vices, steel rule, try square • Type of file • Proper way of holding file while filing • Position of feet and body while filing • Measuring and marking tools. • State basic units of length, measurements and its multiples • Techniques of flat filing i.e. straight, cross and draw filing • Techniques of checking right angle of W/P <p>Safety: General, personal, machine, tool and equipment, workshop</p>

23. Oil the surface of the work piece.		
24. Store the work piece and tools.		
25. Clean the vice and work shop.		

Tools and Equipment:- Flat files, steel scale, Back square (try square), Marking scriber, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Flat, Oil

Safety:-

1. Follow safety rule.
2. The height of bench vice should be set before filing.
3. The handle of file should be fixed tightly.
4. Avoid using broken files on files without handle
5. Do not leave the files above work pieces on bench vice

Time:- 4 hrs
 Theory:- 0.5 hrs
 Practical:- 3.5 hrs

Task: 3 Measure and Mark on the work piece.

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain required drawing. 2. Study the drawing thoroughly. 3. Obtain required tools and materials. 4. Measure the work piece according to given drawing. 5. Mark the work piece according to drawing. 6. Punch the roll no on work piece. 7. Oil the surface of the work piece. 8. Store the work piece and tools. 9. Clean the vice and work shop. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Working bench and Bench vice with fully equipped workshop. • Drawing <p>Tasks (What): Measure and mark on the work piece.</p> <p>Standard (How well): The measured and marked work piece should be within the given check list.</p>	<p>Measuring and Marking</p> <ul style="list-style-type: none"> • Definition • Importance • Tool and equipment • Method • Safety

Tools and Equipment:- Steel scale, Steel Protractor, Marking scribe, Center punch, Oil can, Back Square, Number punch, Bench cleaning brush, File brush, Hammer

Materials: MS Sheet, Oil

Safety:- Hold marking tools carefully because of sharpen tip of marking tools may injured.

Time:- 4 hrs
 Theory:- 0.5 hrs
 Practical:- 3.5 hrs

Task: 4 File external radius

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain required drawing. 2. Read drawing thoroughly. 3. Obtain rough, medium and fine flat files. 4. Obtain work-piece material. 5. Obtain a radius gauge of the required size. 6. Obtain a centre punch and hammer. 7. Obtain a steel Scale/rule. 8. Obtain a divider/compass. 9. Clean up the bench vice and surrounding. 10. Mark the centre point of the radius by center punch. 11. Make the radius by divider. 12. Clamp the w/p projecting the corner part which has to be made radius. 13. File down to make flat surface close to the marked radius line using rough file. 14. Change medium flat file and start filling in SEE SAW motion along the curved line until all marked line touches. 15. Check periodically with radius gauge. 16. Remove the w/p and check the measurement 17. File down further in see saw motion with fine flat file until required radius is obtained 18. Remove the w/p and check the final measurement. 19. Punch the roll no on work piece. 20. Oil the surface of the work piece. 21. Store the work piece and tools. 22. Clean the vice and work shop. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): File external radius.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Filing work piece should be match given check list. • Tolerances of filing work piece is within the ± 0.1 mm 	<ul style="list-style-type: none"> • Introduction of making and layout using steel rule, compass. • Radius gauge. • Method of filing radius surface. • State the feature of compass. • Radius filing procedure

Tools and Equipment:- Flat files (Rough, medium, fine), radius gauge, Marking scriber, Center punch, Number punch, Steel scale Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Square, Oil

Safety: - Refer the same safety precautions of the task "File flat surface."

Time:- 3 hrs
 Theory:- 0.5 hr
 Practical:- 2.5 hrs

Task: 5 Punch dot and center on the workpiece

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the w/p drawing. 2. Read drawing thoroughly. 3. Obtain steel rule, marking scribe, steel hammer, centre or dot punch. 4. Prepare the w/p material in flat position as per required dimension. 5. Mark the symmetrical lines as per drawing using steel rule (scale) and marking scribe. 6. Place the w/p on flat anvil. 7. Hold the dot/centre punch by three fingers of one hand and the hammer on other hand. 8. Place the tip of the centre punch at the cross of symmetrical lines of w/p. 9. Apply trial stroke on the punch by hammer. 10. Assess that the punch is at the correct centre. 11. Align if required. 12. Punch further stroke to get good impression. 13. Take next cross line and punch the centre. 14. Move center from self-ward while punching numerous dotted in same line. 15. Repeat the same steps for other cross lines until finished. 16. Punch the roll no on work piece. 17. Oil the surface of the work piece. 18. Store the work piece and tools. 19. Clean the vice and work shop. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Punch dot and centre on the object.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Check trial stroke. • Punching work piece should be match with given check list. • Tolerances of marking line is within the ± 0.1 mm 	<ul style="list-style-type: none"> • Dot punch, its included angle and its uses. • Dots punch material. • Centre punch, its included angles and its uses. • Centre punches material for center punch.

Tools and Equipment:- Steel rule, marking scribe, steel hammer, centre punch or dot punch, anvil, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan
Materials: MS Sheet, Oil

Safety:-

1. Ascertain the head of the punch is flat .i.e. avoid mushroom head punch.
2. Wipe off oily substance, if any, from the face of the hammer.
3. Look at the punch tip, not at the head of the punch while punching.
4. While punching remove bangles and wrist watches.

Time:- 4 hrs
 Theory:- 1 hr
 Practical:- 3 hrs

Task: 6 Stamp letters and numbers on metal plate

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the w/p drawing. 2. Read drawing thoroughly. 3. Obtain w/p material. 4. Obtain letter and number punch of required size. 5. Prepare the material in flat and in required dimensions. 6. Layout the base lines as per drawing. 7. Make the centre line to locate the position of the middle letter. 8. Place the work piece on anvil block facing up the surface to be stamped. 9. Check and Select the number or letter to be stamped. 10. Stamp the middle letter on the centre column line by holding the punch with three fingers of one hand and striking the hammer on head of punch by other hand. 11. Check the impressions. 12. Stamp the remaining letters to the right of centre and then to the left of centre. 13. Punch the roll no on work piece. 14. Oil the surface of the work piece. 15. Store the work piece and tools. 16. Clean the vice and work shop. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Stamp letters and numbers on metal plate.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Stamping work piece should be match with given check list. • Tolerances of marking line is within the ± 0.1 mm 	<ul style="list-style-type: none"> • Letter and number punches. • Stamping process. • Three step stroking procedure

Tools and Equipment:- Steel rule, Steel hammer, Marking scribe, Letter & number punch, Flat anvil, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Sheet, Oil

Safety:-

1. Ascertain the head of the punch in flat.
2. Avoid mushroom head punch.
3. Wipe off oily substance, if any from the face of the hammer.
4. Make sure that the face of the hammer strikes on punch head, use on fingers.
5. While punching remove bangles and wrist watches.

Task: 7 Saw metal by hand hack-saw

Time:- 7 hrs
Theory:- 1 hr
Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the w/p drawing. 2. Read drawing thoroughly. 3. Obtain the w/p material. 4. Obtain steel rule. 5. Obtain marking scriber. 6. Obtain dot punch, hammer. 7. Obtain hand hacksaw frame with blade. 8. Make symmetrical line. 9. Punch dotted on marked line. 10. Clamp the work piece so that the marked line must be outside the vice. 11. Set the hand hack saw blade on hacksaw frame making teeth pointing towards forward. 12. Check the tightness of the blade in frame. 13. Take a small triangular file. 14. Mark a small Vee-notch by triangular file on start point. 15. Hold the hacksaw frame firmly as per file handling. 16. Start cutting slowly moving the blade forward. 17. Apply pressure only during the forward stroke. 18. Release pressure during the return stroke. 19. Repeat the strokes. 20. Check the cutting line to be straight. 21. Move slowly while finishing the cut. 22. Apply cutting on the blade frequently while sawing. 23. Check the part that has been sawed. 24. Punch the roll no on work piece. 25. Oil the surface of the work piece. 26. Store the work piece and tools. 27. Clean the vice and work shop. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Saw the metal by hand hack saw.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Sawing work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.1 mm 	<ul style="list-style-type: none"> • Introduction of hacksaw. • Types of hacksaw. • Parts of hack saw. • Hacksaw blades and their types and material. • Selecting blade for different materials and sections. • Holding different sections of w/p for hack sawing. • Procedure of sawing the metal by hand.

Tools and Equipment:- Hand Hacksaw frame, Hacksaw blade, steel rule, marking scriber, steel hammer, flat anvil, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Triangular file, Finishing file

Materials: MS Flat or MS Angle, Oil

Safety:-

1. Hold the job so as to cut on flat side rather than edge.
2. The teeth of the hacksaw blade should point towards the forwards direction.
3. The cutting movement should be steady and straight.
4. The full length of the blade should be engaged per stroke.
5. Avoid moving the blade too fast; slow down while finishing the cut.
6. The blades too much neither tighten nor loose.
7. Avoid clamping the w/p over hang.

Task: 8 Drill a hole

Time:- 2.5 hrs
Theory:- 0.5 hr
Practical:- 2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the w/s drawing. 2. Read drawing. 3. Obtain pre-finished w/p material. 4. Obtain drill bit as per the required size. 5. Mark layout line on the w/p. 6. Punch the centre. 7. Clamp the w/p on m/c vice of m/c table. 8. Clamp the drill bit on drill chuck by drill chuck key. 9. Set the RPM as per the drill bit size and the w/p material. 10. Start the machine. 11. Set the coolant housing pipe. 12. Give hand feed. 13. Apply the coolant on the rotating drill bit. 14. Reduce the feeding pressure at the bottom to the end. 15. Make sure the drill passes through. 16. Stop the machine. 17. Remove the w/p from m/c vice. 18. De-burr the drilled hole. 19. Clean oil and chips. 20. Punch the roll no on work piece. 21. Oil the surface of the work piece. 22. Store the work piece and tools. 23. Clean the vice and work shop. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Drill a hole.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Drilling work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.1 mm except drill hole 	<ul style="list-style-type: none"> • Introduction of drill m/c. • Types of drill m/c • Parts of drill machine • Twist drills and its types. • Parts of drill bit • Cutting speed, feed and RPM. • RPM calculation according to the drill size and w/p material. • Handling of drill m/c (Operation and changing of belt) • Safety

Tools and Equipment:- Drill m/c with drill chuck key and drill bits, centre punch, steel hammer, Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: MS Flat, Oil, Coolant

Safety:-

1. Tighten the table lock to avoid dislocation of the w/p.
2. Use parallel block to prevent drilling on m/c vice or table.
3. Check the cutting edge of drill before drilling.
4. Mount the drill shank to its maximum length inside the drill chuck.
5. Check the drill centre alignment to avoid breading of drill.
6. Apply coolant fluently.
7. Use cleaning brush to clean out the chips.

Task: 9 Countersink a hole

Time:- 1.5 hrs
Theory:- 0.5 hr
Practical:- 1 hr

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain workshop drawing. 2. Read drawing thoroughly. 3. Obtain previously drilled w/p material. 4. Obtain countersink as per the required size. 5. Mount the same size of twist drill on drill spindle on drill chuck. 6. Clamp the w/p in drill vice or hold by hand placing at the m/c table. 7. Align the centre of m/c spindle with the drilled hole to cut uniform angle. 8. Change countersink on drill machine chuck. 9. Set the RPM 10. Start machine. 11. Check the alignment giving feed by hand. 12. Re-align if necessary. 13. Give feed as per depth required. 14. Stop the machine. 15. Remove the w/p 16. Chamfer (De-burr) if necessary. 17. Check the final measurement. 24. Clean oil and chips. 25. Punch the roll no on work piece. 26. Oil the surface of the work piece. 27. Store the work piece and tools. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Countersink a hole.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Countersinked work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.1 mm 	<ul style="list-style-type: none"> • Introduction to countersink. • Types of countersink. • Importance of countersinking. • Safety

Tools and Equipment:- countersink 60° and 90°, Drill m/c with drill chuck key and drill bits, centre punch, steel hammer, Drill vice, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: MS Flat, Oil

Safety:-

1. Check the cutting edge of the countersink.
2. Use drift to remove taper shank from drill spindle.
3. Use cleaning brush to clear out the chips.
4. Refer to the safety precaution of task "drill a hole"

Task: 10 Cut internal thread using hand taps (Tapping)

Time:- 4 hrs
Theory:- 0.5 hr
Practical:- 3.5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain w/s drawing. 2. Read drawing thoroughly. 3. Obtain pre-machined work material. 4. Obtain drill size & required tools for internal threads. 5. Obtain sets of taps and tap handle/wrench. 6. Mark and punch on centre to drill hole. 7. Drill hole of required tap drill size. 8. Countersink the hole. 9. De-burr the hole. 10. Re-clamp the w/p on bench vice in horizontal position slightly above the vice jaws. 11. Fix the first tap in the tap handle/wrench. 12. Position the tap (90° with horizontal surface) in the countersinked hole. 13. Hold the tap handle closer to the centre. 14. Exert steady downward pressure and turn the tap handle in clockwise direction to start the thread. 15. Ensure the thread as well as check the tap alignment removing the tap handle. 16. Check the tap alignment with Back Square to ensure the tap being 90 ° with the w/p surface. 17. Make corrections, if necessary by exerting slightly more pressure downward in the side having angle greater than 90° 18. Fit the tap handle without disturbing the tap alignment. 19. Make 1-2 clockwise turn and re-check the alignment. 20. Turn the tap handle lightly without exerting any downward pressure. 21. Turn anticlockwise quarterly after every clockwise full turn. 22. Apply cutting oil frequently. 23. Cut thread until the tap is fully inside the hole being threaded. 24. Remove the first tap. 25. Repeat the steps (18) to (23) for intermediate 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Cut internal thread using hand taps (Tapping).</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Tapping work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.1 mm 	<ul style="list-style-type: none"> • Introduction thread and its types • Introduction of tap and tapping • Types of tap • Thread nomenclature • Selection of drill bit for required tapping

<p>(Tap no 2) and bottoming tap (Tap no 3).</p> <p>26. Remove the chips from thread.</p> <p>27. Clean oil and chips.</p> <p>28. Punch the roll no on work piece.</p> <p>29. Oil the surface of the work piece.</p> <p>30. Store the work piece and tools.</p>		
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Tools and Equipment:- Drill m/c, Sets of twist drills, Bench vice, Set of hand tap, Cutting oil can, Countersink 60° and 90°, Centre punch, Steel hammer, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: MS Flat, Oil

Safety:-

1. Use cutting fluid while cutting threads to avoid heat.
2. Avoid applying side pressure without giving turning motion to tap.
3. Tap alignment should be correct since starting of thread to avoid breaking of taps.
4. Tap handle should be chosen as per tap size.
5. Chips after cutting threads must be cleaned out from the hole and vice.

Task: 11 Cut external thread using threading dies(Dieing)

Time:- 4 hrs
Theory:- 0.5 hr
Practical:- 3.5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain w/p drawing. 2. Read drawing thoroughly. 3. Obtain w/p material. 4. Obtain set of files. 5. Obtain caliper, threading die, die handle, check nut and hole gauge. 6. Mark square at the end face as per thread diameter. 7. File roughly using the procedure of filing a square block. 8. File round bar of black using the steps of taste "File external radius". 9. Check the blank size with hole gauge. 10. Re-file until the blank diameter is obtained. 11. Chamfer 45° at the end of the blank. 12. Fix the die in die handle 13. Re-clamp the w/p on vice projecting the blank upward above the vice in 90° with the horizontal. 14. Place the leading side of the die on the chamfer of the w/p 15. Ensure the die is fully open by tightening the centre screw. 16. Hold the die handle close to the centre. 17. Apply pressure on die handle evenly and turn clockwise to advance the die on the bolt blank. 18. Ensure the thread starts by the time reverse frequently at about every quarter turn. 19. Cut thread until the die is fully down the length to be threaded. 20. Increase the depth of cut gradually by adjusting the outer screw and 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Cut external thread using threading dies.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Dieing work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.1 mm 	<ul style="list-style-type: none"> • Introduction of Dies and Dieing. • Required blank size for external thread. •

<p>repeat above steps (16-19).</p> <ol style="list-style-type: none"> 21. Check the thread with check nut. 22. Clear the die and the bench vice. 23. Clean oil and chips. 24. Punch the roll no on work piece. 25. Oil the surface of the work piece. 26. Store the work piece and tools. 		
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Tools and Equipment:- Set of files, hole gauge, Check nut, caliper, Set of threading dies, Die handle, oil can with cutting oil, Bench vice, Centre punch, Steel hammer, Number punch, Bench cleaning brush, File brush, Dust pan

Materials: MS Flat, Oil

Safety:-

1. Check screws on the die handle before starting.
2. Check the depth of cut too much depth can damage die and threads.
3. Apply cutting fluid frequently to reduce heat and wash out the chips avoid clogging.
4. Keep the die handle at right angle to the job.

Task: 12 Cut metal sheet with snip.

Time:- 4 hrs
 Theory:- 1 hr
 Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the work piece drawing. 2. Study the drawing thoroughly. 3. Obtain the piece of sheet metal as per drawing size. 4. Obtain required tools. 5. Straighten and de-burr the sheet metal. 6. Layout (Measure and mark) the notches and line for cutting. 7. Check the layout for accuracy. 8. Put the work piece on the table. 9. Place the snip on the edge of marking line. 10. Cut the metal slowly at beginning and proceeding it for required cutting. 11. Straighten and de-burr the sheet metal. 12. Check dimension of the complete job. 13. Punch the roll no on work piece. 14. Oil the surface of the work piece. 15. Store the work piece and tools. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Cut metal sheet with snip.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Cutting work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.5 mm 	<ul style="list-style-type: none"> • Sheet and its types • Size and gauges of sheet metal available in marked. • Importance and use of sheet • Introduction of snips and their types i.e. straight and curve. • Marking and layout. • Hand tools, equipment and machine used in sheet metal works. • Notching • Sheet metal operation

Tools and Equipment:- Steel rule, Snips, Back square, marking scriber, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Oil

Safety:-

- Place snips and material on bench.
- De-burr the metal sheet edges.
- Avoid carrying scriber in pockets.

Task: 13 Fold metal sheet

Time:- 4 hrs
 Theory:- 0.5 hr
 Practical:- 3.5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the work piece drawing. 2. Read drawing thoroughly. 3. Obtain the metal sheet of required size and required sheet metal tools. 4. Straighten and de-burr the sheet metal. 5. Layout the pattern. 6. Layout the folding lines by marking with marking scriber. 7. Check the layout for accuracy. 8. Notch and cut the unnecessary part. 9. Bend the open folds by mallet and hardies. 10. Check dimensions of the completed job. 11. Punch the roll no on work piece. 12. Oil the surface of the work piece. 13. Store the work piece and tools. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Fold metal sheet.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Folding work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.5 mm 	<ul style="list-style-type: none"> • Hand tools (Hardies) used in folding metal sheets. • Mallet and types. • Folding m/c and application • Pattern

Tools and Equipment:- Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Oil

Safety:-

- Take care of marked lines; folds must not be collecting together.
- Use only mallet hammer to bend sheet.
- To avoid damage on surface of sheet insert a protecting jaw of aluminum or vice jaw cover.

Task: 14 Perform riveting joints

Time:- 6 hrs
Theory:- 1 hr
Practical:- 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the w/p drawing. 2. Study the drawing thoroughly. 3. Obtain the required number of sheet metal of required size. 4. Obtain required hand tools. 5. Straighten and de-burr the sheet metal. 6. Layout the sheet metal. 7. Cut the sheet metal accordingly if necessary. 8. Punch the centre by centre punch where holes are to be drilled. 9. Bunch the sheet metal in layer so that the holes to be drilled are aligned on above another. 10. Clamp the bunch of sheet metal with c-clamp. 11. Drill holes on every centre punched marks. 12. Remove and de-burr the pieces individually. 13. Place the drilled sheet together for riveting as per drawing. 14. Calculate rivet length and select rivet. 15. Insert the rivet. 16. Insert rivet head set for aligning on the tail of rivet. 17. Punch slightly on the rivet head until align. 18. Remove the rivet head set. 19. Strike on the tail of rivet to make mushroom head by ball pin hammer. 20. Insert rivet head cap on the tail of rivet. 21. Punch the rivet head until the required head forms and the pieces join together. 22. Repeat the same steps for 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Perform riveting work.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Riveting work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.5 mm 	<ul style="list-style-type: none"> • Introduction of Rivet and types. • Different riveting joint. • Calculation of reverting length. • Calculation of Rivet hole. • Rivets available in market. • Rivet material • Causes of riveting defects

<p>next riveting.</p> <p>23. Check dimensions of the completed job.</p> <p>24. Punch the roll no on work piece.</p> <p>25. Oil the surface of the work piece.</p> <p>26. Store the work piece and tools.</p>		
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Tools and Equipment:- Rivet head set, Ball pin hammer, Steel rule, marking scriber, try square, snips, hardies, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: GI Sheet, Rivet (Aluminum or MS), Oil

Safety:-

- Take care of your hand while striking tail of riveting and riveting the head.
- Take care while you bushing out the sheet metal.
- The length of the rivet should be carefully calculated.
- Avoid mushroom head rivet head set.

Time:- 3 hrs
Theory:- 1 hr
Practical:- 2 hrs

Task: 15 Perform soldering

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain the w/p drawing. 2. Study the drawing thoroughly. 3. Obtain the sheet metal as per required size. 4. Obtain required tools. 5. Heat the soldering iron. 6. Clean up the soldering areas with zinc chloride. 7. Apply flux in all areas to be soldered. 8. Join the areas together and support them. 9. Hold soldering lead in one hand and soldering iron in other hand. 10. Touch the lead by soldering iron until it melts and apply in the joining areas. 11. Use the soldering iron frequently to spread melted lead in all joining areas. 12. Repeat spreading lead until it covers and joins the pieces. 13. Allow the soldered area to be cool for solid deposition. 14. Clean soldered area and tools after completing. 15. Check dimensions of the completed job. 16. Punch the roll no on work piece. 17. Oil the surface of the work piece. 18. Store the work piece and tools. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Perform soldering.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Soldering work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.5 mm 	<ul style="list-style-type: none"> • Introduction of soldering joints. • Characteristics of soldering lead. • Soldering method. • Characteristics of soldering flux. • Causes of soldering defects.

Tools and Equipment:- Soldering iron, Soldering iron stand, Steel rule, marking scribe, try square, snips, steel hammer, Mallet, Oil can, Number punch, Bench cleaning brush, File brush, Dust pan, Finishing file

Materials: Zinc chloride, soldering lead, flux, Oil

Safety:-

- Take care while using zinc chloride.
- Take care while heating the soldering iron.
- Flux should be applied in whole joining areas.
- Avoid overheating of soldering iron.
- Make proper ventilation and well lighted working areas.
- Beware from toxic fumes generated while soldering.
- Use safety goggles.
- Work safety to avoid burn.

Task: 16 Perform Project work
Bench work : Steel Hammer 500gm, Center punch, Back square

Time:- 14 hrs
 Theory:- 1 hr
 Practical:- 13 hrs

Sheet Metal: Rectangular Fabricate Box, Dust pan, Junction box, Adaptor box, Stabilizer box

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain project drawing. 2. Study the drawing thoroughly. 3. Obtain material for project. 4. Obtain required tools. 5. Perform bench work's tasks for bench work's project. 6. Perform sheet metal's tasks for sheet metal's project. 7. Clean oil, sharp edges, de-burr from project and working area. 8. Punch the roll no on project. 9. Oil the surface of the bench work's project. 10. Store the project and tools. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Well-equipped workshop with set of hand tools in tool box. • Drawing instruction and work piece. <p>Tasks (What): Perform project work.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Project work piece should be match with given check list. • Tolerances of dimensions are within the ± 0.5 mm 	<ul style="list-style-type: none"> • Preparing group for project • Uses of project. • Instruction for Working • Project guide line

Tools and Equipment:- All tool, equipment and machine which are used in above task

Materials: As per project

Safety:-

1. Follow safety related bench work task and sheet metal task
2. De-burr the edges of project.
3. Use safety equipment.

References:

- Raghuwanshi, B. S., **A Course in Workshop Technology Vol 1**, Dhanpat Rai and Company, India
- Chaudhary, S. K. Hajra, **Workshop Technology (Vol. 1)**, Media promoter and publishers, India
- Henp Fort, **Shop Theory (Vol. 1)**, Trade School
- Chapman, **Workshop Technology (Vol. 1)**,

Electronics Fundamentals

Total:	6 hrs/wk
Theory:	2 hrs/wk
Practical:	4 hrs/wk

Course description:

This course is designed to provide knowledge and skills on essential modern components particularly on linear circuits. It is imparted with view that the use of electronics, specially the semiconductors has expanded in recent years has made a strong need of knowledge. This course also deals with the principles and applications of digital electronics. This course imparts knowledge and skills on number system, basic gates, logic circuits, Boolean algebra, combinational circuits and sequential circuits.

Unit I: Analog/Linear Electronics

Course Objectives:

After completion of this course students will be able to:

1. Describe various electronics components such as resistor, inductors, capacitors, diode, transistor, Zener diode, FET, MOSFET, JFET, SCR, DIAC, TRIAC, UJT and various ICs interpret their characteristics and applications.
2. Provide essential theoretical and practical knowledge on transistor amplifier.
3. Design electronics power supply using diodes, Zener diode and regulator ics: 78**, 79**, LM317 and LM 337 series etc.

List of Tasks

1. Maintain safe electronics workshop/lab.
2. Familiarize with electronics devices, tools, equipment.
3. Perform first aid treatment.
4. Apply passive components.
5. Familiarize with electronics.
6. Apply practical electronics equipment and circuits.
7. Apply different types of Diodes
8. Draw V-I characteristics curve of rectifier and zenor diode.
9. Introduce different power supply circuits and filter circuits.
10. Apply Zener diode as voltage stabilizer.
11. Operate Oscilloscope/Function Generator.
12. Identify different types of Transistors.
13. Study CB, CE, CC configuration of Bipolar Junction Transistors.
14. Use Transistors as a switch.
15. Study the characteristics of JFET & MOSFET.
16. Identify Power Diode, Power Transistor, SCR, DIAC, TRIAC and UJT.
17. Study the characteristics of SCR, DIAC and TRIAC.
18. Familiarize with ICs.
19. Introduce oscillator & operational amplifiers.

Task Analysis

Task: 1 Maintain safe electronics workshop/lab

Total: 6 hrs
Theory: 2 hrs
Practical: 4 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Install necessary equipment and maintain appropriate (25-30) degree temperature. 2. Manage dust free workshop. 3. Apply insulated tools to work with voltage and current. 4. Install two pin, three pin sockets to each table. 5. Install TV coaxial cable to each room. 6. Apply cable splitter to get individual terminals. 7. Place soldering iron stand to each table. 8. Install drawer in each table to store tools. 9. Install fire extinguisher. 10. Place flexible table lamp 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Physical Facilities <p>Tasks (What):</p> <ul style="list-style-type: none"> • Maintain safe Electronics Workshop/Lab <p>Standard (How Well):</p> <ul style="list-style-type: none"> • Maintain dust free workshop • Installed sockets to proper location. • Installed TV coaxial cable. • Adequate illumination. • Maintained appropriate room temperature. 	<p>Safety materials</p> <ul style="list-style-type: none"> • Introduction • Use • Importance • Fuse <p>Safety precautions and first aid fundamentals Circuit breaker, MCB</p> <p>Coaxial cable</p> <p>Power sockets- different types</p> <p>Temperature</p> <p>Tools and equipment used in lab</p> <p>Operational manual of fire extinguisher</p> <p>Know how to use fire extinguisher and alarm system. Extension power socket board and cable</p>

Tools and Materials:- Well equipped electronics lab.

Safety:-

Task: 2 Familiarize with electronics devices, tools, equipment

Total: 4 hrs
Theory: 2 hrs
Practical: 2 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Maintain appropriate temperature (25-30 degree) in electronics devices. 2. Avoid High tension line near to the electronics devices. 3. Maintain dust free store of electronics devices. 4. Apply tool box to store electronics tools and equipment. 5. Remove battery from electronics equipment to store it long time. 6. Keep room humidity properly. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • An electronic store room. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Familiarize with electronics devices, tools, equipment . <p>Standard (How Well):</p> <ul style="list-style-type: none"> • Dust free store room maintained. • Maintained in electronics devices. • Battery removed from electronics equipment before storing it for long time. • Tool box used for storing tools and equipment. 	<p>Concept of</p> <ul style="list-style-type: none"> • HT (High Tension Line) • LT line • Tool Box • Battery and its types. • Use of battery chemicals. • Power and amperage VA characteristics of batteries.

Tools and Materials:- Multimeter, Oscilloscope, Signal Generator, Pattern Generator, Screw Driver, Nose Plier, Wire Cutter, Soldering Iron, Soldering Wire, Paste.

Safety:-

Task: 3 Perform first aid treatment

Total: 6 hrs
Theory: 4 hrs
Practical: 2 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect first aid materials. 2. Use first aid box to store first aid materials. 3. Avoid first aid box from direct sun light. 4. Place the first aid box to eye sight and within reach location. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • First Aid Box. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Perform first aid treatment. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Place/keep First Aid Box at eye sight and within reach location. • Avoid First Aid Box from direct sun lights. 	<p>➤ First Aid.</p> <ul style="list-style-type: none"> • Definition • Importance • Uses • First Aid Materials <p>➤ Medicine</p> <p>➤ Adhesive Tapes</p> <p>➤ Bandages</p> <ul style="list-style-type: none"> • Procedure • First Aid Treatment • Hazards <p>➤ Wound/ Cut</p> <p>➤ Fracture/ Sprain</p> <p>➤ Burn</p> <p>➤ Temperature</p>

Tools and Materials:- First Aid Box.

Safety:-

Task: 4 Apply passive components.

Total: 10 hrs
Theory: 6 hrs
Practical: 4 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect passive components. 2. Identify resistors. 3. Identify capacitors. 4. Identify inductors. 5. Calculate the resistance value using color code. 6. Test passive components. 7. List the types of resistors, capacitors & inductors. 8. Connect passive components in series & parallel. 	<p>Condition (Given): Workshop, components, multi meter.</p> <p>Tasks (What): Apply passive components.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified passive component and tested. • Found values of passive components. • Connected in series & parallel. 	<p>Resistors</p> <ul style="list-style-type: none"> • Definition • Types • Color codes & value markings. • Series, parallel connections. • Equivalent values. <p>Inductors</p> <ul style="list-style-type: none"> • Definition • Types • Color codes & value markings. • Series, parallel connections. • Equivalent values. <p>Capacitors</p> <ul style="list-style-type: none"> • Definition • Types • Color codes & value markings. • Series, parallel connections. • Equivalent values. <p>Parameters of R,C</p> <ul style="list-style-type: none"> • Working voltage & leakage current. • Tolerance, stability factor and power rating.

Tools and Materials:- Multimeter, Resistor, Capacitor, Inductor.

Safety:-

Total: 6 hrs
 Theory: 2 hrs
 Practical: 4 hrs

Task: 5 Familiarize with electronics

Steps	Terminal Performance Objectives	Related Technical Knowledge
1. Define electronics. 2. Define electronics components, circuits and system. 3. Differentiate linear and digital circuits.	<p>Condition (Given): Clearly stated problem/ question.</p> <p>Tasks (What): Familiarize with electronics.</p> <p>Standard (How well): Learners should be able to</p> <ul style="list-style-type: none"> • Define electronics, electronic components, circuit and systems. • Distinguish between linear and digital circuits. 	1. Definition <ul style="list-style-type: none"> • Electronics • Electronics Components • Electronic Circuits systems • Linear & digital Circuits. 2. Distinguish between linear & digital circuits. 3. Applications of electronics in modern technology. 4. Passive and active devices.

Tools and Materials:- Multimeter, Resistor, Capacitor, Inductor.

Safety:-

Task: 6 Apply practical electronics equipment and circuits.

Total: 8 hrs
Theory: 2 hrs
Practical: 6 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Identify basic test equipment (Ammeter, Voltmeter, Ohm meter) 2. Identify Multimeter. 3. Locate selector switch of multi-meter. 4. Measure AC, DC values of current & voltage using multi-meter. 5. Measure resistance. 6. Distinguish conductor & insulator using multi-meter. 7. Identify closed & open circuit using multi-meter. 8. Identify oscilloscope. 9. Verify Ohm's law, Kirchhoff's law. 10. Draw practical circuits. 	<p>Condition (Given): Workshop, multi-meter, operation manuals and electronics components</p> <p>Tasks (What): Apply practical electronic equipment & circuits.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified test equipment. • Performed ohm's & Kirchhoff's law. • Draw simple practical circuits. (voltage divider, current divider) • Used multimeters 	<ol style="list-style-type: none"> 1. Test Equipment <ul style="list-style-type: none"> • Definition • Types • Operation manual 2. Oscilloscope, function generator & soldering iron, de-soldering pump & analog and digital multimeters <ul style="list-style-type: none"> • Definition • Working Principle • Applications • Operation manual. 3. Ohm's law & Kirchhoff's law <ul style="list-style-type: none"> • Statements. • Demonstration circuits. • Applications. 4. Voltage divider circuit 5. Current divider circuit.

Tools and Materials:-

Multi meter, Oscilloscope, Soldering iron, power supply connecting leads, De-soldering Pump.

Safety:-

Task: 7 Apply different types of Diodes.

Total: 8 hrs
Theory: 3 hrs
Practical: 5 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. List semiconductors (Si, Ge) from conductors, insulators & semiconductors. 2. Identify PN junction diodes. 3. Identify Cathode and anode terminals. 4. Demonstrate unbiased, forward biased and reverse biased PN junctions. 5. Perform rectification using diodes. (Rectifier). 6. Perform zener diode in reverse bias condition.. 7. Test diode. 8. Voltage at different points. 9. Perform LED in forward bias condition. 10. Perform photo diode in reverse bias condition. 	<p>Condition (Given): Workshop, multi-meter.</p> <p>Tasks (What): Use different types of diodes.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Listed semiconductors. • Demonstrated unbiased, FB, RB. • Performed rectification. • Made regulated power supply circuits. • Deserved light illumination. • Tested diodes. • Found characteristics. • Found TV characteristics. 	<ol style="list-style-type: none"> 1. Semiconductors <ul style="list-style-type: none"> • Definition • Types • Define extrinsic & intrinsic semiconductor • Define N- type & P- type semiconductors. 2. PN Junction 3. Biasing of PN Junction. 4. Operation Symbol & characteristics of <ul style="list-style-type: none"> • Rectifier Diode • Zener Diode • Photo Diode 5. Application of above mention diodes.

Tools and Materials:- Multi meter, Diodes, Power Supply (DC & AC).

Safety:-

Task: 8 Draw V-I characteristics curve of rectifier and zener diode.

Total: 8 hrs
Theory: 2 hrs
Practical: 6 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. List semiconductors (Si, Ge) from conductors, insulators & semiconductors. 2. Identify PN junction diodes. 3. Identify cathode and anode terminals. 4. Demonstrate unbiased, forward biased and reverse biased PN junctions. 5. Find out characteristics of rectifier and zener diodes. 6. Test diodes. 7. Perform operation for DC voltage output using zener diode in RB condition. 	<p>Condition (Given): Workshop, multi-meter. rectifier, zener diode, Bread Board, Jumper wires</p> <p>Tasks (What): Draw V-I characteristics curve of rectifier and zener diode.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Listed semiconductors. • Demonstrated unbiased, FB, RB. • Performed V-I characteristics. • Tested diodes. • Found characteristics. 	<ol style="list-style-type: none"> 1. PN Junction 2. Biasing of PN Junction. 3. V- I Characteristics of rectifier and zener diode 4. Application of rectifier Diode 5. Application of zener diode

Tools and Materials:-Multi meter, Diodes, Power Supply (DC)

Safety:-

Task: 9. Introduce different power supply circuits and filter circuits.

Total: 9 hrs
Theory: 3 hrs
Practical: 6 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Demonstrate rectifier circuits. <ol style="list-style-type: none"> a. Half Wave Rectifier with wave form b. Full Wave Rectifier with wave form c. Full Wave Bridge Rectifier with wave form 2. Build smoothing circuits. 3. Build regulating circuits. 4. Build Power supply circuits. 5. Apply filter circuits. 	<p>Condition (Given): Simulated lab, multi-meter.</p> <p>Tasks (What): Introduce different power supply circuits & filters.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Rectified AC in to DC. • Build smoothing Circuits. • Build stabilizing circuits. • Build Power supply circuits. • Applied filter circuits. 	<ol style="list-style-type: none"> 1. Rectifier <ul style="list-style-type: none"> • Definition • Types (HW,FW,FW Bridge) • Applications 2. Working principle of <ul style="list-style-type: none"> • Smoothing circuits • Stabilizing Circuits • Power supply circuits 3. Filters <ul style="list-style-type: none"> • Definition • Types (High pass, Low pass, Band pass, Band stop) • Applications • Regulator ICs

Tools and Materials: - Multi meter, Diodes, Power Supply transformer, passive components, connecting leads, regulator ICs.

Safety:-

Task: 10 Apply Zener diode as voltage regulator.

Total: 6 hrs
Theory: 2 hrs
Practical: 4 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none">1. List semiconductors (Si, Ge) from conductors, insulators & semiconductors.2. Identify PN junction diodes.3. Construct voltage regulator using zener diode.4. Find out characteristics of the regulator.5. Construct indicator circuit using LED.6. Construct using LED circuit.	<p>Condition (Given): Workshop, multi-meter. Zener Diode, Resistor, Bread Board, Jumper wires, variable resistor</p> <p>Tasks (What): Apply Zener Diode as Voltage regulator.</p> <p>Standard (How well):</p> <ul style="list-style-type: none">• Listed semiconductors.• Made regulator circuits.• Tested diodes.• Found characteristics for all the diodes.	<ul style="list-style-type: none">• Operation Symbol & voltage regulator of Zener Diode.• Operating principle of voltage regulator.• Application of Zener diodes as DCV regulator.• Application of LED as indicator and torchlight.

Tools and Materials:- Multi meter, Diodes, Power Supply (DC), Resistor.

Safety:-

Task: 11 Operate Oscilloscope/Function Generator.

Total: 9 hrs
Theory: 4 hrs
Practical: 5 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain operating/user's manual. 2. Study operating /user's manual. 3. Turn on power switch of Oscilloscope/pattern generator. 4. Select proper functional button for operation of Oscilloscope. 5. Select desired range of Volt/division and time/ division by the selector switch. 6. Select desired channel by selector switch. 7. Create reference line on screen by pushing ground button. 8. Check the desired frequency using probes. 9. Check the performance of various operations. 10. Read just output performance of Oscilloscope as per requirement. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Oscilloscope with probe • Signal generator • Operational manual • Pattern generator <p>Tasks (What): Operate Oscilloscope/ Function Generator.</p> <p>Standard(How Well)</p> <ul style="list-style-type: none"> • Desired frequency checked and recorded correctly using Oscilloscope's probe. • Oscilloscope operated with correct procedures or as instructed in manual and signal output displayed accurately with correct frequency. 	<p>Oscilloscope</p> <ul style="list-style-type: none"> • Definition • Operating Procedure • Tuning • Advantages • Application • Safety Precautions <p>Function Generator</p> <ul style="list-style-type: none"> • Definition • Operating Procedure • Advantages • Application • Safety Precautions

Tools and Materials:- Oscilloscope (Digital & Analog), Function Generator, Connecting Leads.

Safety:-

Task: 12 Identify different types of Transistors

Total: 10 hrs
Theory: 4 hrs
Practical: 6 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect bipolar junction transistors(NPN or PNP) 2. Test transistors for their types and identification of leads. 3. Apply Data Book. 4. Collect Field effect Transistor. 5. Test field effect trans 6. Bias BJT and FET. 	<p>Condition (Given): Workshop, multi-meter.</p> <p>Tasks (What): Identify different types of transistors.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified NPN, PNP and NFET, PFET. • Tested junction and FET transistor. • Biased transistors. 	<ol style="list-style-type: none"> 1. Bipolar junction transistor <ul style="list-style-type: none"> • Definition • Operation • Types (NPN, PNP) • Biasing • As an amplifier • Applications 2. Field Effect Transistors. <ul style="list-style-type: none"> • Definition • Operation • Types: JFET, MOSFET • Biasing • As an amplifier • Applications 3. Comparison between junction & FET transistors.

Tools and Materials:- Multi meter, Transistors, Data Book.

Safety:-

Task: 13 Study CB, CE, CC configuration of Bipolar Junction Transistors

Total: 14 hrs
Theory: 4 hrs
Practical: 10 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect BJT. 2. Identify bipolar junction transistors (NPN or PNP) 3. Test transistors. 4. Apply Data Book. 5. Construct transistor circuits. 6. Connect & check different configuration (CB, CE, and CC). 	<p>Condition (Given): Workshop, multi-meter.</p> <p>Tasks (What): Study CB, CE, CC configuration of bipolar transistor.</p> <p>Standard (How Well): Measured DCV terminals demonstrate the proper amplification.</p>	<p>Bipolar Junction transistor</p> <ul style="list-style-type: none"> • Characteristics of (CB, CE, CC) in bipolar transistors. • Applications of them. • Voltage gain, Current gain and dc biasing of the amplifiers.

Tools and Materials:-Multi meter, Transistors, Data Book.

Safety:-

Task: 14. Use Transistors as switch

Total: 3 hrs
 Theory: 1 hrs
 Practical: 2 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Identify bipolar junction transistors (NPN or PNP) 2. Test transistors. 3. Apply Data Book. 4. Wire inverter amplifier circuit using BJT. 	<p>Condition (Given): Workshop, multi-meter, variable regulated power supply</p> <p>Tasks (What): Use Transistors as a switch.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified NPN, PNP transistor. • Check the transistors as a switch/inverter. 	<p>Bipolar Junction transistor</p> <ul style="list-style-type: none"> • Transistor as a switch. • Applications

Tools and Materials:- Multi meter, Transistors, Data Book, Bread Board, Jumpers wire, Power supply.

Safety:-

Task: 15 Study the characteristics of JFET & MOSFET

Total: 9 hrs
Theory: 4 hrs
Practical: 5 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect multimeter. 2. Test JFET & MOSFET. 3. Apply Data Book. 4. Identify JFET& MOSFET. 5. Bias JFET and MOSFET. 6. Characteristics of JFET & MOSFET. 7. Constuct inverter amplifier circuit using JFET or and MOSFET (N-Channel). 	<p>Condition (Given): Workshop, multi-meter.</p> <p>Tasks (What): Study the characteristics of JFET & MOSFET.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Biased FET & MOSFET. • Characteristics of JFET & MOSFET. • Check transistors as a NOT-gate or inverter. 	<ol style="list-style-type: none"> 1. JFET <ul style="list-style-type: none"> • Characteristics of JFET • Effect of gate to source voltage on drain characteristics. • Transfer characteristics. 2. MOSFET <ul style="list-style-type: none"> • Characteristics of MOSFET. • Gain characteristics of Depletion Type MOSFET. • Transfer characteristics of Depletion type MOSFET. • Drain characteristics of Enhancement type MOSFET. • Transfer characteristics of Enhancement type MOSFET.

Tools and Materials:- Multi meter, JFET, MOSFET, Data Book.

Safety:-

Task: 16 Identify Power Diode, Power Transistor, SCR, DIAC, TRIAC and UJT.

**Total: 11 hrs
Theory: 5 hrs
Practical: 6 hrs**

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Identify Power Diode. 2. Identify Power Transistor. 3. Identify SCR. 4. Identify DIAC. 5. Identify TRIAC. 6. Identify UJT. 7. Test Power Diode, Power transistor, SCR, DIAC, TRIAC & UJT. 8. Apply Data Book. 	<p>Condition (Given): Workshop, multi-meter.</p> <p>Tasks (What): Use power diode, power transistor, SCR, DIAC, TRIAC and UJT</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified Power diode, power transistor, SCR, DIAC, TRIAC & UJT. • Tested Power diode, power transistor, SCR, DIAC, TRIAC and UJT 	<ol style="list-style-type: none"> 1. Power Diode <ul style="list-style-type: none"> • Definition • Operation • Types • Advantages • Applications 2. Power Transistor& SCR <ul style="list-style-type: none"> • Definition • Operation • Types • Advantages • Applications 3. DIAC& TRIAC <ul style="list-style-type: none"> • Definition • Operation • Types • Advantages • Applications 4. UJT <ul style="list-style-type: none"> • Definition • Operation • Types • Advantages • Applications

Tools and Materials:- Multi meter, Power diode, power transistor, SCR, DIAC, TRIAC, UJT, Data Book.

Safety:-

Task: 17 Study the characteristics of SCR, DIAC and TRIAC

**Total: 9 hrs
Theory: 2 hrs
Practical: 7 hrs**

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect multimeter. 2. Test SCR, DIAC & TRIAC. 3. Apply Data Book to identify SCR, DIAC & TRIAC. 4. Construct circuits using SCR, DIAC and TRIAC. 5. Note Characteristics of SCR, DIAC & TRIAC. 6. Construct SCR (or and triac) circuit as construed power supply. 	<p>Condition (Given): Workshop, multi-meter.</p> <p>Tasks (What): Study the characteristics of SCR, DIAC & TRIAC.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified SCR, DIAC, & TRIAC. • Tested SCR, DIAC, & TRIAC. • Identified the characteristics of SCR, DIAC & TRIAC. • Output power observed. 	<ol style="list-style-type: none"> 1. SCR <ul style="list-style-type: none"> • V-I Characteristics of SCR. • Turn On characteristics of SCR. • Turn Off characteristics of SCR. 2. DIAC <ul style="list-style-type: none"> • V-I Characteristics of DIAC. 3. TRIAC <ul style="list-style-type: none"> • V-I characteristics of TRIAC. • Operating mode of TRIAC.

Tools and Materials:- Multi meter, SCR, DIAC, TRIAC, Data Book.

Safety:-

Task: 18 Familiarize with ICs.

Total: 7 hrs
Theory: 2 hrs
Practical: 5 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect ICs Tester. 2. Identify ICs. 3. Test ICs. 4. Apply Data Book. 5. Perform 741 as comparator. 6. Perform 555 as oscillator. 	<p>Condition (Given): Simulated lab with ICs.</p> <p>Tasks (What): Familiarize with ICs.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identify ICs. • Test different ICs. • 741 and 555. 	<p>ICs</p> <ul style="list-style-type: none"> • Definition • What does do it? • Types • Working principle 741 and 555. • Advantages. • Applications. • Importance.

Tools and Materials:- ICs Tester, ICs, Data Book.

Safety:-

References:

- V.K. Metha, Electronics Principles, Khanna publishers
- J. B. Gupta, Basic Electronics Principle
- हरि बहादुर पौडेल, (टाई जी), सरल बेसिक इलेक्ट्रॉनिक्स

Task: 19 Introduce oscillator & operational amplifiers.

Total: 13 hrs
Theory: 5 hrs
Practical: 8 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Know operating frequency of oscillator. 2. Operate UJT blocking oscillator. 3. Explain characteristics and properties of operational amplifier. 4. Explain following operational amplifier circuits. <ol style="list-style-type: none"> a. Summing amplifier b. Non-inverting/ inverting amplifiers. c. OP-AMP circuits using single power supply. d. Voltage comparator. 5. Wire construct, Colpitt, square wave oscillator, wien bridge oscillator using OP-AMP. 6. Application of 555 IC as oscillator. 	<p>Condition (Given): Simulated lab with trainer kits.</p> <p>Tasks (What): Introduce Oscillator & Operational amplifiers.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Found operating frequency of oscillators. • Operated UJT blocking oscillator. • Explained characteristics of operational amplifier. • Observed output frequency and wave forms of the oscillators. 	<ol style="list-style-type: none"> 1. Oscillator <ul style="list-style-type: none"> • Definition • What does it do? • Operating frequency • Types with working principle. • RF oscillator • LC oscillator • Hartley oscillator • Colpitts oscillator • Crystal Oscillator 2. OP-Amps. <ul style="list-style-type: none"> • Introduction • What does it do? • Characteristics. 3. Circuit diagram & mathematical equation of <ul style="list-style-type: none"> • Summing amplifier • Inverting/Non-inverting amplifier • Op-amp circuit with single power supply. • Voltage comparator

Tools and Materials:- Trainer kit, UJT blocking oscillator, Oscilloscope, operational amplifiers

Safety:-

Unit II: Digital Electronics

Course Objectives:

After the completion of this course students will be able to:

1. Represent numerical values in various number systems and perform number conversions between different number systems.
2. Provide the knowledge of:
 - a. Operation of logic gates (AND, OR, NOT, NAND, NOR, XOR and XNOR).
 - b. Boolean algebra including algebraic simplification, and application of De Morgan's theorems
3. Impart the knowledge of operation of basic types of flip-flops, decoders, encoders, multiplexers, and de-multiplexers, counter
4. Analyze and design digital combinational circuits including arithmetic circuits (half adder and full adder).

List of Tasks

1. Verify truth table of OR, AND & NOT gates.
2. Verify truth table of NOR and NAND gate.
3. Verify universal property of NOR and NAND gates.
4. Verify truth table of Exclusive OR and Exclusive NOR gates
5. Verify Decimal to Binary Number System Conversion.
6. Verify truth table of half and full adder
7. Verify Boolean Algebra
8. Verify simplification of logic expressions using Boolean algebra.
9. Verify De Morgan's Theorems.
10. Verify truth table of encoder/decoder.
11. Verify truth table of multiplexer and de-multiplexer.
12. Verify the flip flops
13. Verify Seven Segment display decoder
14. Verify truth table of counter.

Task 1. Verify truth table of NOR and NAND gate.

Time:- 6 hrs
Theory:- 1 hrs
Practical:- 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required components 2. Identify logic gates. 3. Take a specific logic gate. 4. Connect the gate as per logic diagram. 5. Set the inputs to possible logic states. 6. Observe the output logic. 7. Repeat step 4 through 6 for remaining gates. 8. Disconnect the components. 9. Restore the components safely. 	<p>Condition (Given): Well-equipped laboratory, IC trainer kit, jumpers, 7402 IC, 7400 IC, bread board, regulated variable power supply 0-32 V DC,</p> <p>Tasks (What): Verify truth table of</p> <ul style="list-style-type: none"> • NOR gate and • NAND gate. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Verified T.T. of NOR and NAND gates must be correct. • Insertion and detachment must be without damage. • Circuit must be connected securely and correctly as per given diagram. 	<p>NOR gate</p> <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram <p>NAND gate</p> <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram. <ul style="list-style-type: none"> • Know use of trainer kit to give inputs and observe outputs. • Safety precautions.

Tools and Materials: - IC trainer kit, Jumpers, 7402 IC, 7400 IC, Tweezer, AC cord, Bread board

Safety: - Proper insertion of IC.

Task 2. Verify truth table of OR, AND & NOT gates.

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required components 2. Identify logic gates. 3. Take a specific logic gate. 4. Connect the gate as per logic diagram. 5. Set the inputs to possible logic states. 6. Observe the output logic. 7. Repeat step 4 through 6 for remaining gates. 8. Disconnect the components. 9. Restore the components safely. 	<p>Condition (Given): Given digital ICs, logic diagram and IC trainer kit, bread board, jumper, regulated variable pointer</p> <p>Tasks (What): Verify the Truth Table of</p> <ul style="list-style-type: none"> • OR gate • AND gate and • NOT gate <p>Standard (How well):</p> <ul style="list-style-type: none"> • Verified truth table of basic logic gates must be correct. • Insert and detach ICs without damage. 	<p>Truth table.</p> <ul style="list-style-type: none"> • Explanation of logic gates. • OR gate <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram • AND gate. <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram • NOT gate <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram • Know use of trainer kit to give inputs and observe outputs. • Know the internal connection of bread board • Safety precautions.

Tools and Materials: - IC trainer kit, 7432 IC (OR gate), 7408 IC (AND gate), 7404 IC (NOT gate), Jumpers, Tweezer, AC cord, I.C. extractor, Regulated variable power supply 0.32 V DC

Safety: - Insertion and detachment of ICs must be without damage.

Task 3. Verify universal property of NOR and NAND gates.

Time:- 4 hrs
Theory:- 1 hrs
Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect necessary components. 2. Take a NOR gate. 3. Connect NOR gate to perform as NOT gate. 4. Set the inputs to possible logic states. 5. Observe the outputs. 6. Connect NOR gate to perform as OR gate. 7. Repeat steps 4 through 5. 8. Connect NOR gate to perform AND gate. 9. Repeat step 7. 10. Disconnect the components. 11. Restore the components. 12. Repeat steps 2 through 11 for NAND gate. 	<p>Condition (Given): Well-equipped lab, IC trainer kit, 7402 IC, 7400 IC, jumpers and tweezer.</p> <p>Tasks (What): Verify universal property of NOR and NAND gates.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Verified truth table must be correct. • Insertion and detachment must be without damage. • Circuit must be connected securely and correctly as per given diagram. 	<p>Universal property</p> <ul style="list-style-type: none"> • Know NOR and NAND gate function. • Know conversion of NOR and NAND gate to NOT, OR and NAND gate. • Use of trainer kit to give inputs and observe outputs • Safety precautions.

Tools and Materials:- IC trainer kit, Jumpers, 7402 IC, 7400 IC, Tweezer, AC cord., I.C. extractor

Safety: - Take safety precaution.

Task 4. Verify truth table of Exclusive OR and Exclusive NOR gates

Time:- 3 hrs
Theory:- 1 hrs
Practical:- 2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required components. 2. Take EX-OR (7486 IC) gate. 3. Insert EX-OR gate in IC socket of trainer kit. 4. Connect inputs to input pin of IC. 5. Connect output pin of IC to output LEDs. 6. Set the inputs to possible logic states. 7. Observe the outputs. 8. Repeat steps 2 through 7 for EX-NOR (74266) gate. 9. Disconnect the components. 10. Restore components safely. 	<p>Condition (Given): Well-equipped lab with required components.</p> <p>Tasks (What): Verify T.T of</p> <ul style="list-style-type: none"> • EX-OR gate. • EX-NOR gate. <p>Standard (How well): Verified T.T. of EX-OR and EX-NOR gates must be correct.</p>	<p>EX-OR gate</p> <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram. <p>EX-NOR gate</p> <ul style="list-style-type: none"> ➤ Definition. ➤ Circuit diagram. ➤ Logic function. ➤ Truth table. ➤ IC pin diagram. <ul style="list-style-type: none"> • Use of trainer kit to give inputs and observe outputs. • Safety precautions.

Tools and Materials:- IC trainer kit, Jumpers, 7486 IC, 74266 IC, Tweezer, AC cord.

Safety: -

- Proper insertion/extraction of ICs.
- Apply proper power supply to IC (refer data book)

Task 5. Verify Decimal to Binary Number System Conversion.

Time:- 5 hrs
Theory:- 2 hrs
Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required components. 2. Connect the trainer kit to ac main supply. 3. Connect the circuit as per diagram. 4. Turn on the power supply 5. Set inputs 0 to 9 respectively. 6. Observe the corresponding outputs. 7. Turn off the power supply. 8. Disconnect the components. 9. Store the components safely. 	<p>Condition (Given) Given a digital IC trainer kit set and jumpers/jack</p> <p>Tasks (What): Verify Decimal to Binary Number System Conversion.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Circuit must be connected securely and correctly as per given diagram. • Verified converted output must be according to Truth Table. 	<p>Number system</p> <ul style="list-style-type: none"> • Explanation of number systems. • Types: <ul style="list-style-type: none"> ▪ Binary. ▪ Decimal. ▪ Octal. ▪ Hexadecimal. • Method of decimal to binary number system conversion. • Introduction to digital trainer kit. • Truth table.

Tools and Materials: - Digital IC trainer kit, AC Cord, Jumpers/jack

Safety:-

- Turn off supply before disconnecting component.
- Connection should be made properly.

Task 6. Verify truth table of half and full adder.

Time:- 6 hrs
 Theory:- 2 hrs
 Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect necessary tools and materials. 2. Take required logic gates for verifying half adder. 3. Connect the gates as per logic diagram. 4. Set the possible input logic states. 5. Observe the corresponding outputs 6. Repeat the operation for full adder. 7. Disconnect the components. 8. Restore components safely. 	<p>Condition (Given): Well-equipped lab with required tools and materials.</p> <p>Tasks (What): Verify truth table of half and full adder.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Verified truth table of half adder and full adder must be correct. 	<p>Binary addition.</p> <p>Half adder.</p> <ul style="list-style-type: none"> ➤ Explanation. ➤ Circuit diagram. ➤ Truth Table. <p>Full adder</p> <ul style="list-style-type: none"> ➤ Explanation. ➤ Circuit diagram. ➤ Truth Table. <p>Use of trainer kit to give inputs and observe outputs.</p> <p>Safety precautions.</p>

Tools and Materials: - IC trainer kit, 7408 IC, 7486 IC, Jumpers, Tweezer, AC cord.

Safety: - Proper insertion of ICs.

Task 7. Verify Boolean Algebra

Time:- 4 hrs
 Theory:- 1 hrs
 Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Collect required tools and materials. 2. Take a required logic gate for corresponding law. 3. Connect the gate as per logic diagram. 4. Set the inputs to possible logic states. 5. Observe the outputs of corresponding inputs. 6. Repeat steps 2 through 5 for other laws. 7. Disconnect the components. 8. Store components safely.	<p>Condition (Given): Well-equipped lab with required tools and materials.</p> <p>Tasks (What): Verify Boolean algebra.</p> <p>Standard (How well): Verification of Boolean algebra must be correct. Components must be disconnected without damage.</p>	<p>Boolean Algebra</p> <ul style="list-style-type: none"> • Laws. • Explanation. • Application. <p>Use of trainer kit to give inputs and observe outputs. IC data sheet</p> <p>Safety precautions.</p>

Tools and Materials: - IC trainer kit, ICs, Jumpers, Tweezer, AC cord.

Safety: - Proper insertion of ICs.

Task 8. Verify simplification of logic expressions using Boolean algebra.

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Take required logic gates for verifying T.T. of given logic expression. 3. Connect the logic gate as per given logic diagram. 4. Set the input for possible logic states. 5. Observe the output for corresponding input. 6. Repeat steps 2 through 5 for verifying T.T. of simplified logic expression. 7. Disconnect the components. 8. Store components safely. 	<p>Condition (Given): Well-equipped lab with required tools and materials.</p> <p>Tasks (What): Verify simplification of given logic expression using Boolean algebra.</p> <p>Standard (How well): Verification of simplification of logic expressions using Boolean algebra must be correct.</p>	<p>Boolean algebra.</p> <p>Use of trainer kit to give inputs and observe outputs.</p> <p>Safety precautions.</p> <p>De Morgans Theorems</p> <p>Duality Theorem</p>

Tools and Materials: - IC trainer kit, ICs, Jumpers, Tweezer, AC cord.

Safety: - Proper insertion of ICs.

Task 9. **Verify De Morgan's Theorems.**

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Take required logic gates for verification of one of the theorem. 3. Connect the gate as per logic diagram. 4. Set the inputs to possible logic states. 5. Observe the corresponding output for given inputs. 6. Repeat steps 2 through 5 for another theorem. 7. Disconnect the components. 8. Store components safely. 	<p>Condition (Given): Well-equipped lab with required tools and materials.</p> <p>Tasks (What): Verify De Morgan's Theorems.</p> <p>Standard (How well): Verification of De Morgan's Theorems must be correct. The components must be disconnected without damage.</p>	<p>De Morgan's Theorem</p> <ul style="list-style-type: none"> • First theorem. • Second theorem. • Truth table. • Application. <p>Use of trainer kit to give inputs and observe outputs.</p> <p>Safety precautions.</p> <p>Duality Theorem</p>

Tools and Materials: - IC trainer kit, ICs, Jumpers, Tweezer , AC cord.

Safety: - Proper insertion of ICs.

Task 10. Verify truth table of encoder/decoder.

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Take required logic gates for verifying T.T. of encoder. 3. Connect the gates as per logic diagram. 4. Set the possible input logic states. 5. Observe the outputs for corresponding inputs. 6. Repeat steps 2 through 5 for decoder. 7. Disconnect the components. 8. Store components safely. 	<p>Condition (Given): Well-equipped lab with required tools and materials.</p> <p>Tasks (What): Verify truth table of encoder/decoder.</p> <p>Standard (How well): Verified truth table of encoder/decoder must be correct.</p>	<p>Combinational logic Definition Implementation.</p> <p>Decoder/encoder.</p> <ul style="list-style-type: none"> • Definition. • Truth table (T.T.) • Logic symbol. • Application. <p>Use of trainer kit to give inputs and observe outputs.</p> <p>Safety precautions.</p>

Tools and Materials: - IC trainer kit, ICs, Jumpers, Tweezer, AC cord.

Safety: - Proper insertion of ICs.

Task 11. Verify truth table of multiplexer and de-multiplexer.

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Take required logic gates for verifying multiplexer. 3. Connect the gates as per logic diagram. 4. Set the possible input states. 5. Observe the corresponding outputs. 6. Repeat steps 2 through 5 for de-multiplexer. 7. Disconnect the components. 8. Store components safely. 	<p>Condition (Given): Well-equipped lab with required tools and materials.</p> <p>Tasks (What): Verify truth table of multiplexer and demultiplexer.</p> <p>Standard (How well): Verified multiplexer and demultiplexer truth table must be correct.</p>	<p>Multiplexer.</p> <ul style="list-style-type: none"> • Definition • Operation • T.T. • Application. <p>De-multiplexer</p> <ul style="list-style-type: none"> • Definition • Operation • T.T. • Application. <p>Use of trainer kit to give inputs and observe outputs.</p> <p>Safety precautions.</p>

Tools and Materials:- IC trainer kit, ICs, Jumpers, Tweezer, AC cord.

Safety:- Proper insertion of ICs.

Task 12. Verify the flip flops

Time:- 6 hrs
 Theory:- 2 hrs
 Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Prepare list of necessary components. 2. Take required f.f. (gates) (IC) 3. Connect the ff as per logic diagram 4. Observe the output without giving any inputs. 5. Set the possible input logic states. 6. Observe the corresponding outputs. 7. Repeat the operations for remaining flip flops. 8. Disconnect the components. 9. Store safely 10. Take safety precaution. 	<p>Condition (Given): Perform in lab with given components. T.T.s, logic diagrams and specification.</p> <p>Tasks (What): Verify flip flops.</p> <p>Standard (How well): Verified different kinds of flip-flop with logic diagram correctly and disconnected components with undamaging connected as per logic diagram correctly.</p>	<p>Flip flops.</p> <ul style="list-style-type: none"> • Definition • Types • Logic operations. • T.T.s • Clocking signals and timing <p>Use of trainer kit to give inputs and observe outputs. Safety precautions.</p>

Tools and Materials: - IC trainer kit, ICs, Jumpers, Tweezer, AC cord.

Safety: - Connections must be made properly.
 Output must be observed carefully.
 Clock signal should be applied properly.

Task 13. Verify Seven Segment display decoder

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and components. 2. Identify display common (anode /cathode). 3. Connect the wires as per diagram. 4. Check the connections properly. 5. Switch on the power supply. 6. Sequentially connect all the terminals one by one. 7. Check that the display segments are lighted according to the order given on the table. 8. Connect the terminals either to ground or to supply voltage so that binary pattern are generated to light the segment. 9. Check that the display displays the ten decimal digits according to binary pattern. 10. Disconnect the components. 11. Store components safely. 	<p>Condition (Given): Fully equipped lab with necessary component. Required data to identify display segments. Table of binary pattern. Circuit diagram.</p> <p>Tasks (What): Verify seven segment display decoder.</p> <p>Standard (How well): Seven segment display must be according to display pattern.</p>	<ul style="list-style-type: none"> • LED • 7 segment display. • Binary number system.

Tools and Materials: - IC trainer kit, Seven segment display IC, Jumpers, AC Cord, Tweezer

Safety:- Seven segment display IC must be inserted without damage.

TASK 14. Verify truth table of counter

Time:- 8 hrs
 Theory:- 2 hrs
 Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and components. 2. Identify display common (anode /cathode). 3. Connect the wires as per diagram. 4. Check the connections properly. 5. Switch on the power supply. 6. Sequentially connect all the terminals one by one. 7. Check that the display segments are lighted according to the order given on the table. 8. Connect the terminals either to ground or to supply voltage so that binary pattern are generated to light the segment. 9. Check that the display displays the ten decimal digits according to binary pattern. 10. Disconnect the components. 11. Store components safely. 	<p>Condition (Given): Fully equipped lab with necessary component. Required data to identify display segments. Table of binary pattern. Circuit diagram.</p> <p>Tasks (What): Verify seven segment display decoder.</p> <p>Standard (How well): Seven segment display must be according to display pattern.</p>	<ul style="list-style-type: none"> • LED • 7 segment display. • Binary number system.

Tools and Materials: - IC trainer kit, Seven segment display IC, Jumpers, AC Cord, Tweezer

Safety:- Seven segment display IC must be inserted without damage.

References:

P. Malvino, Digital Electronics

Electronics Technology

Total:	8 hrs/wk
Theory:	2 hrs/wk
Practical:	6 hrs/wk

Course Description:

This course intends to provide knowledge and skills on repairing and maintenance of power supply, amplifier and AM-FM radio set. This course is also designed to provide knowledge and skills on repairing and maintenance of B/W TV, SMPS, Antenna, color, LCD, LED TV.

Unit I : Repair and Maintenance of Radio Set

Total:	3 hrs/wk
Theory:	1 hrs/wk
Practical:	2 hrs/wk

Course Objectives:

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

1. Operate multi-meter, signal generator, signal tracer,
2. Assemble variable voltage power supply
3. Repair variable voltage power supply
4. Repair AM/FM radio receiver set
5. Repair radio with USB pen-drive player

Theory

Contents:

- 1. Signal generator - 2 hrs**
 - a. RF(radio frequency) signal generator
 - b. IF(Intermediate frequency) signal generator
 - c. AF(Audio frequency) signal generator
- 2. Power supply – 4 hrs**
 - a. Need of dc power supply
 - b. Function of transformer in power supply
 - c. Function of rectifier circuits, filter circuits and regular circuits
 - d. Function of safety fuse and indicator in power supply
 - e. Basic faults and fault finding methods
- 3. AM Radio - 6 hrs**
 - a. AM modulation/Demodulation
 - b. Simple AM radio transmitter block diagram and explanation
 - c. Simple AM radio receiver block diagram and explanation
 - d. Basic faults and fault finding methods

4. FM Radio - 4 hrs

- a. FM modulation/Demodulation
- b. Simple FM radio transmitter block diagram and explanation
- c. Simple FM radio receiver block diagram and explanation
- d. Basic faults and fault finding methods

5. Memory device and types - 5 hrs

- a. Pen-drive memory, flash memory chips functions
- b. Basic faults and fault finding methods
- c. I.C. Tester
- d. Pattern Generator

Practical

List of Tasks:

- 1. Operate multi-meter, signal generator, signal tracer, oscilloscope - 8 hrs
- 2. Assemble variable voltage power supply (with/without using IC) - 12 hrs
- 3. Repair variable voltage power supply(with/without using IC) - 10 hrs
- 4. Repair AM/FM radio receiver set - 56 hrs
- 5. Repair radio with USB pen-drive player - 10 hrs

Task Analysis

Time:- 8 hrs
Theory:- 2 hrs
Practical:- 6 hrs

Task: 1 Operate signal generator (RF+IF+AF)

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain operating / user's manual. 2. Study operating / user's manual. 3. Turn on power switch of generator and Oscilloscope. 4. Select the functional button for proper operation of signal generator. 5. Set desired frequency pattern (Sine /square) 6. Check the selected frequency using Oscilloscope. 7. Readjust output performance as per requirement. 8. Check the performance of various operations. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Signal generator • Oscilloscope • Operational manual <p>Tasks (What):</p> <ul style="list-style-type: none"> • Operate single generator <p>Standard (How well):</p> <ul style="list-style-type: none"> • Desired frequency pattern set in Single generator and operated it correctly as instructed by manual and frequency produced as set when checked by Oscilloscope. 	<p>Signal generator</p> <ul style="list-style-type: none"> • Introduction • Types • Frequency range • Operating procedure • Advantage • Application • Safety precautions.

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket.

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 2 Assemble simple variable voltage dc voltage power supply

Time:- 12 hrs
Theory:- 2 hrs
Practical:- 10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required components as per circuit diagram 2. Collect required tools and equipment 3. Check all the components 4. Arrange the connections of components as in circuit 5. Solder all the connections 6. Fit or cover all possible high voltage with two pin and insulating tapes 7. Check output voltages with dc voltage meter by supplying ac mains in input 8. Fix the circuit device in enclosure box 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Required components as in circuit • Complete circuit diagram • Soldering iron with paste, soldering wire and all other instruments for workshop <p>Tasks (What):</p> <ul style="list-style-type: none"> • Assemble dc multi voltage power supply adaptor) <p>Standard (How well):</p> <ul style="list-style-type: none"> • The wires cable & components neatly soldered in the PCB • The connectors plugged into the socket • The set assembled as per circuit diagram and checked for normal operation mode 	<p>Simple multi voltage adaptor</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Operating procedure • Advantages • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 3 Repair simple variable voltage dc voltage power supply

Time:- 10 hrs
Theory:- 2 hrs
Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Measure test pin voltage of unit 4. Identify faulty components. 5. Replace faulty components by right one. 6. Measure and record output voltage 7. Assemble unit in the enclosure. 8. Perform final test for particular unit. 9. Perform required adjustment 10. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty simple multi voltage adaptor 2. Circuit diagram 3. Assortment of the component used in simple multi voltage adaptor <ul style="list-style-type: none"> • Tool set • Fully equipped electronic workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain simple multi voltage adaptor <p>Standard (How well):</p> <ul style="list-style-type: none"> • Dismantle the unit without further damage • Replaced components correctly • Simple multi voltage adaptor repaired correctly and functioned normally 	<p>Simple multi voltage adaptor</p> <ul style="list-style-type: none"> • Trouble shooting procedure • Operating procedure • Advantages • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 4 Repair and maintain AM/FM radio receiver

Time:- 56 hrs
Theory:- 6 hrs
Practical:- 50 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of component 4. Check voltage of the test pins. 5. Observe the condition of Mechanical unit. 6. Identify the faulty components. 7. Replace the faulty components. 8. Test the unit for normal operation. 9. Assemble the unit in the enclosure. 10. Perform the final test of unit. 11. Perform required adjustment 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • A faulty Radio receiver set, soldering iron, de-soldering pump, soldering lead, Assortment of components used in radio, radio signal generator, tweezers, jumper wire, circuit diagram and power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain radio receiver. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Replaced Faulty component with proper value and rating component without damaging adjacent part. • Unit repaired correctly with proper connection and gained normal operational function. 	<ul style="list-style-type: none"> • Circuit diagram of modern radio • Trouble shooting procedure. • Use of single generator • Advantage of repairing and maintaining radio • Application.

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 5 Repair and maintain radio with USB pen-drive memory players

Time:- 10 hrs
Theory:- 2 hrs
Practical:-8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of component 4. Check voltage of the test pins. 5. Observe the condition of Mechanical unit. 6. Identify the faulty components. 7. Replace the faulty components. 8. Test the unit for normal operation. 9. Assemble the unit in the enclosure. 10. Perform the final test of unit. 11. Perform required adjustment 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • A faulty Radio receiver set, soldering iron, de-soldering pump, soldering lead, Assortment of components used in radio, radio signal generator, tweezers, jumper wire, circuit diagram and power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain radio receiver. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Replaced Faulty component with proper value and rating component without damaging adjacent part. • Unit repaired correctly with proper connection and gained normal operational function. 	<ul style="list-style-type: none"> • Circuit diagram of radio with USB pen-drive memory • Trouble shooting procedure. • Use of single generator • Advantage of repairing and maintaining radio • Application.

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Unit II: Repair and Maintenance of Television

Total:	5 hrs/wk
Theory:	2 hrs/wk
Practical:	3 hrs/wk

Course Objectives:

After completion of this course students will be able to:

1. Connect Cable TV Network
2. Familiar with black and white TV
3. Repair SMPS power supply
4. Repair and maintain CRT color TV
5. Repair and maintain LCD TV
6. Repair and maintain LED TV
7. Repair TV remote control.
8. Apply safety precautions.

Theory

Course Contents:

1. **Cable Network –introduction-4 hrs**
2. **Television –introduction-4 hrs**
 - a. History, concept, latest development trend
 - b. Applications and advantages of TV
 - c. Image formation, pixel, scanning
3. **Black /White CRT TV- 15 hrs**
 - a. Simple TV modulation and demodulation
 - b. Block diagram of simple TV and functions of each blocks
 - c. Circuit diagram of TV and it's working principle
 - d. Basic faults symptoms and diagnosis methods
 - e. Safety precautions and technique for TV repairing
4. **Antenna - 6 hrs**
 - a. Simple dipole, yagi, dish antenna concept
 - b. Method of installation of dish antenna, yagi antenna
 - c. Basic faults symptoms and diagnosis methods
5. **SMPS power supply - 4 hrs**
 - a. Concept of SMPS and advantages, application
 - b. Block diagram of simple SMPS and functions of each blocks
 - c. Basic circuit diagram of simple SMPS and simple working principle
 - d. Basic faults symptoms and diagnosis methods
6. **Color TV (CRT Type) - 20 hrs**
 - a. Simple color combination concept
 - b. Color video signal concept
 - c. Color encoder/decoder systems, concepts of PAL,SECAM,NTSC
 - d. Block diagram color TV and explanation of each blocks
 - e. Circuit diagram and it's working principle
 - f. Faults symptoms and diagnosis methods
7. **LCD TV - 4 hrs**

- a. CCD concept
- b. LCD concept
- c. Block diagram of LCD TV and its explanation
- d. Circuit diagram and working principle
- e. Faults symptoms and diagnosis methods

8. LED TV - 4 hrs

- a. Concept, application and advantage
- b. Block diagram of LED TV and its explanation
- c. Circuit diagram and working principle
- d. Faults symptoms and diagnosis methods

9. Remote controls - 2 hrs

- a. Concept, application, advantage of remote control
- b. Block diagram and its explanation
- c. Circuit diagram and working principle
- d. Faults symptoms and diagnosis methods

Practical

List of Tasks:

1. Install Cable TV Network - 5 hrs
2. Familiar with black and white television - 5 hrs
3. Repair black and white television - 20 hrs
4. Repair SMPS power supply - 5 hrs
5. Repair and maintain color TV – 42 hrs
6. Repair and maintain LCD TV - 25 hrs
7. Repair and maintain LED TV - 25 hrs
8. Repair TV remote controls - 5 hrs

Task Analysis

Task: 1 Install cable TV network

Time:- 5 hrs
Theory:- 1 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect different items of cable television system 2. Select appropriate location and install dish antenna. 3. Select appropriate location and install receiver unit. 4. Install power driver mixer and amplifier on appropriate location 5. Install and distribute proper station cable with F connector and connect to different TVs. 6. Test operational function of the system. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Cable networking materials • Dish antenna, receivers, mixer and amplifier (LNB) • Connection and layout diagrams • Tool and equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install TV cable network system. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit installed correctly and gain normal operational function with best reception. 	<p>Cable network</p> <ul style="list-style-type: none"> • Definition • Principle of operation • Principle of installation • Types • Installation techniques • Advantage • Application • Safety precaution

Tools and Materials:- :- Flat pliers, Adjustable slide wrench, Nose pliers, wire cutter and screw driver set, signal strength meter, pattern generator, multimeter

Safety:-

Task: 2 Assemble black and white (BW) Television

Time:- 5 hrs
Theory:- 3 hrs
Practical:- 2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required materials, tools & manuals 2. Check the normal operation of Black & white television 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • BW TV kit, picture tube ,V hold, contrast, volume control • circuit diagram • Pattern generator • Basic tools • Well-equipped electronics work shop <p>Tasks (What):</p> <ul style="list-style-type: none"> • Familiar with black & white Television. <p>Standard (How well):</p> <ul style="list-style-type: none"> • The wire cables components of BW/TV solder neatly and safety in the TV kit • The connectors plugged in to power socket safely • The set assembled correctly and checked for normal operation mode. 	<ul style="list-style-type: none"> • Introduction of BWTV • Advantage • Block diagram of black and white television • Function of each block • Importance of black & white Television. • Circuit diagram • Working principle of circuit diagram • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 3 Repair and maintain black and white (BW) Television

Time:- 10 hrs
Theory:- 2 hrs
Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of the unit. 4. Check voltage of the test pins of unit. 5. Identify the faulty components. 6. Replace the faulty components by right one. 7. Test the unit for normal operation. 8. Assemble the unit in the enclosure. 9. Perform the final test of unit. 10. Perform required adjustment 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • BW TV kit, picture tube, V hold, contrast, volume control • Cabinet, • Step down transformer • circuit diagram and service manual • Pattern generator • Basic tools • Well-equipped electronics work shop <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair black & white Television. <p>Standard (How well):</p> <ul style="list-style-type: none"> • The wire cables components of BW/TV solder neatly and safety in the TV kit • The connectors plugged in to power socket safely • The set assembled correctly and checked for normal operation mode. 	<ul style="list-style-type: none"> • Symptoms and faults • Fault finding method for TV • Block diagram and circuit diagram

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 4 Repair and maintain SMPS power supply

Time:- 5 hrs
Theory:- 1 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the SMPS 2. Dismantle SMPS 3. Identify faulty components. 4. Check voltage of test pins 5. Replace faulty components 6. Test SMPS for normal operation. 7. Measure and record different output voltage 8. Assemble unit in the enclosure. 9. Perform final test of particular unit. 10. Perform required adjustment 11. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty SMPS unit 2. Circuit diagram and service manual 3. Assortment of the component used in SMPS <ul style="list-style-type: none"> • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain SMPS power supply <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit repaired correctly and functioned normally with multiple output voltage correctly 	<p>SMPS</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Disadvantages • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 5 Assemble and repair Color TV

Time:- 42 hrs
 Theory:- 10 hrs
 Practical:- 32 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of the unit. 4. Check voltage of the test pins of unit. 5. Identify the faulty components. 6. Replace the faulty components by right one. 7. Test the unit for normal operation. 8. Assemble the unit in the enclosure. 9. Perform the final test of unit. 10. Perform required adjustment 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty Color TV <ul style="list-style-type: none"> • Assortment components used in C TV set, • circuit diagram, • Service manual • Pattern generator • Fully equipped electronics workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain Color TV <p>Standard (How well):</p> <ul style="list-style-type: none"> • Replaced Faulty component with proper value and rating component without damaging adjacent part. • Unit repaired correctly with proper connection and gained normal operational functions 	<p>Television</p> <ul style="list-style-type: none"> • Concept • CTV signal Transmission • Block diagram • Function of each block • Circuit diagram • Working principle of circuit • Types • Advantage • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket, pattern generators, oscilloscope, signal generator, high voltage probe, heat sink paste, EMT paste

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 6 Repair and maintain LCD TV

Time:- 25 hrs
Theory:- 5 hrs
Practical:- 20 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of the unit. 4. Check voltage of the test pins of unit. 5. Identify the faulty components. 6. Replace the faulty components by right one. 7. Test the unit for normal operation. 8. Assemble the unit in the enclosure. 9. Perform the final test of unit. 10. Perform required adjustment 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty LCD TV <ul style="list-style-type: none"> • Assortment components used in LCD TV set, • circuit diagram, • Service manual • Pattern generator • Fully equipped electronics workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain LCD TV <p>Standard (How well):</p> <ul style="list-style-type: none"> • Replaced Faulty component with proper value and rating component without damaging adjacent part. • Unit repaired correctly with proper connection and gained normal operational functions 	<p>Television</p> <ul style="list-style-type: none"> • Concept • Block diagram • Function of each block • Circuit diagram • Working principle of circuit • Types • Advantage • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket, pattern generator, signal generator and oscilloscope, IC net

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Task: 7 Repair LED TV

Time:- 20 hrs
Theory:-5 hrs
Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of the unit. 4. Check voltage of the test pins of unit. 5. Identify the faulty components. 6. Replace the faulty components by right one. 7. Test the unit for normal operation. 8. Assemble the unit in the enclosure. 9. Perform the final test of unit. 10. Perform required adjustment 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty LED TV <ul style="list-style-type: none"> • Assortment components used in LED TV set, • circuit diagram, • AC power supply • Pattern generator • Fully equipped electronics workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain LED TV <p>Standard (How well):</p> <ul style="list-style-type: none"> • Replaced Faulty component with proper value and rating component without damaging adjacent part. • Unit repaired correctly with proper connection and gained normal operational functions 	<p>Television</p> <ul style="list-style-type: none"> • Concept • Block diagram • Function of each block • Circuit diagram • Working principle of circuit • Types • Advantage • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Time:- 5 hrs
 Theory:- 0 hrs
 Practical:- 5 hrs

Task: 8 Repair TV remote controls.

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Check battery 3. Dismantle the unit. 4. Identify faulty card 5. Identify faulty components. 6. Replace faulty card / components by right one. 7. Test unit for normal operation. 8. Assemble unit in enclosure 9. Perform final test of particular unit. 10. Perform required adjustment 11. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty remote control set 2. Circuit diagram 3. Assortment of the component used in remote control 4. Tool set 5. Service manual 6. Fully equipped electronic workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain remote control system <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit repaired correctly and functioned normally 	<p>Remote control</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Application • Types of meter • Concept of sensor • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket, pattern generator, signal generator, oscilloscope

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazards before starting to work

Repair and Maintenance of Electronics Appliances

Total:	6 hrs/wk
Theory:	1 hrs/wk
Practical:	5 hrs/wk

Course Description:

This course intends to provide comprehensive knowledge and skills on repairing and maintenance of electronics appliances. It also deals with operation, installation and troubleshooting of electronic appliances.

Course Objectives:

After completion of this course students will be able to:

1. Familiar with circuit diagram of electronic appliance
2. Installation of electronic appliances
3. Install solar power system
4. Troubleshooting of electronic appliances

List of Tasks

1. Interpret manufacturing and troubleshooting manuals
2. Connect load with solar power system
3. Install Solar panels
4. Install Charge controller
5. Install Solar battery
6. Repair and maintain solar charge controller
7. Repair AC/ DC lights
8. Design PCB
9. Lay circuit diagram in plain PCB
10. Perform computer aided PCB design
11. Prepare solution for etching
12. Immerse PCB in solution
13. Drill holes in PCB
14. Install components in PCB
15. Assemble water level controller with indicator
16. Assemble/ Repair volt guard
17. Assemble/ Repair fridge guard
18. Assemble/ Repair voltage stabilizer
19. Repair and Maintain battery charger
20. Installation and Troubleshoot of Inverter system
21. Repair and maintain inverter
22. Installation and troubleshoot of CCTV system
23. Repair and maintain emergency light
24. Install PA system
25. Install and repair photocopy machine

Task Analysis

Task: 1 Interpret manufacturing and troubleshooting manuals

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect manufacturing manual. 2. Study manufacturing manual. 3. Follow instructions. 4. Compare manufacturing diagram with PCB Board. 5. Identify defects of installed PCB Board of unit by verifying with manufacturing circuit diagram. 6. Replace/ repair components according to manufacturing diagram. 7. Perform the final test of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • A faulty Unit • Manufacturing manual. • Tool/equipment and materials. • Required Component <p>Tasks (What):</p> <ul style="list-style-type: none"> • Interpret manufacturing manuals. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Identified and diagnosed the faults defects consulting manufacturing manual. • Components replaced/ repaired as specified in manufacturing manual. • Unit repaired correctly and gain normal function by interpreting manufacturing manual. 	<p>Manufacturing manual</p> <ul style="list-style-type: none"> • Introduction • Definition • Importance, uses and advantages of Manufacturing manual • Electrical and electronic symbols • Importance, uses and advantages of circuit diagram • Importance, uses and advantages of Layout diagram • Importance, uses and advantages of Installation diagram • Working principle of unit • Importance, uses and advantages of Block diagram • Manual handling procedures

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, AC mains socket, soldering lead, soldering flux, wire cutter, screw driver set nose plier and tweezers

Safety:-

Task 2 Connect load with solar power system

Time:- 6 hrs
 Theory:- 2 hrs
 Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select the appropriate location for the load. 2. Collect materials for solar cabling with accessories. 3. Install proper required color cabling with socket. 4. Install required load in the proper socket. 5. Connect the system with charge controller. 6. Check the operational function of unit 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Cable (7/22, 3/20, 3/22) (1, 1.5, 2 & 2.5mm) • UV cables • Load • Holder • Switch • 3 pin socket • PVC tape • Junction with connecter • Screws • Tool set. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Connect load with solar system <p>Standard (How well):</p> <ul style="list-style-type: none"> • Load allocated in appropriate location and connected properly with solar power system and function normally. 	<ul style="list-style-type: none"> • Wiring concept • Design solar power system and • Calculation • Differences in normal solar wiring. • Types and uses of cables • Colored code of cable • Load calculation • Advantages • Application • Safety precautions.

Tools and Materials:- Nose pliers, Flat pliers, Screw driver set, wire cutter and Multi meter.

Safety:-

Task 3. Install Solar panels

Time:- 4 hrs
Theory:- 1 hrs
Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select the appropriate location for the unit 2. Collect element of solar panel. 3. Select the appropriate location for unit. 4. Install main supporting stand in proper location. 5. Install and fasten the unit to supporting stand. 6. Adjust solar panel the right direction and correct angle. 7. Check the operational function of unit. 8. Connect element of solar panel. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Solar panel and installation manual • Clamps and supporting stand • Screws, Nut and bolts • Adjustable wrench and • Screw driver set. • UV cable <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install Solar panels <p>Standard (How well):</p> <ul style="list-style-type: none"> • Solar panels installed and fastened in proper location facing south in appropriate angle illuminating shadow area and accruing standard DC output voltage 	<ul style="list-style-type: none"> • Definition of photovoltaic effect • Function of PV • Concept of solar cell • Panel specification and its standard output voltage. • Importance and use of installation diagram • Procedure and technique of Panel installation • Advantages • Application • Safety precautions.

Tools and Materials:- Nose pliers, Cutter pliers, Screw driver set, Slide wrench and Multi meter.

Safety:-

Task 4 Install Charge controller

Time:- 4 hrs
Theory:- 1 hrs
Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for unit 2. Mount and fasten the unit to eye sight stable base. 3. Connect the unit with battery with proper cable. 4. Connect the unit and panel with UV cable. 5. Connect the unit and load with proper cable. 6. Check the operational function of unit 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Charger controller • Connecting wires • Connecting diagram • Tools and equipment. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install Change controller <p>Standard (How well):</p> <ul style="list-style-type: none"> • Charger controller mounted and fastens to eye sight stable base at appropriate location, battery panel and load connected correctly in right sequence indicating best performance by blinking /lighting bulb. 	<p>Charge controller</p> <ul style="list-style-type: none"> • Introduction • Function • Working principle • Circuit diagram • Procedure and techniques of installation • Procedure of voltage measurement • Types of cable use in solar power system • Advantages • Application • Safety precautions.

Tools and Materials:- Multi meter, screw driver set, and wire cutter.

Safety:-

Task 5 Install Solar battery

Time:- 4 hrs
Theory:- 1 hrs
Practical:- 3 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select the appropriate location for the load. 2. Place battery to appropriate location on stable flat base. 3. Connect cable according to polarity / color code of battery. 4. Check the operational function of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • New deep cycle battery • Hydrometer • Distilled water • Battery cable and • Cable shoe • Electrolyte • Tools and equipment • Petroleum jelly <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install battery <p>Standard (How well):</p> <ul style="list-style-type: none"> • Battery installed in stable base at appropriate and safe location, cable connected in correct polarity and regulate standard DC voltage • Apply petroleum jelly to battery terminals 	<p>Battery</p> <ul style="list-style-type: none"> • Definition • types • Specific gravity • Chemical reaction • Color code and battery polarity • Principle of operation • Introduction, uses and method of using hydrometer • Petroleum jelly • Advantages • Application • Safety precautions

Tools and Materials: - Multi meter, Hydrometer, screw driver set, Nose pliers and wire cutter

Safety: - Hazard involved in handling acid

Task: 6 Repair and maintain solar charge controller

Time:- 6 hrs
Theory:- 1 hrs
Practical:- 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Identify faulty components. 4. Check battery 5. Measure test pin voltage of unit 6. Replace faulty components by right one. 7. Test unit for normal operation. 8. Assemble unit in the enclosure. 9. Perform final test of particular unit. 10. Perform required adjustment 11. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Faulty solar charge controller • Circuit diagram • Assortment of the component used in solar charge controller • Tool set • Fully equipped electronic workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain solar charge controller <p>Standard (How well):</p> <ul style="list-style-type: none"> • Dismantle the unit without further damage • Replaced components correctly • Solar charge controller repaired correctly and functioned normally • Supply received from panels and charger indicator indicated charging 	<p>Solar charge controller</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Concept of sensor • Trouble shooting procedure • Operating procedure • Advantages • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

Task: 7 Repair AC/ DC lights

Time:- 11 hrs
 Theory:- 2 hrs
 Practical:- 9 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Collect the electronic components 2. Collect the appropriate Repairing Tools 3. Collect AC/ DC LED , TUBE and CFL lights 4. Check the function of DC lights	<p>Condition (Given):</p> <ul style="list-style-type: none"> • AC/DC LED, TUBE and CFL lights • Required electronic components • Circuit Diagram • Table lamp • Multi meter • Tools and equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair different AC/ DC lights types <p>Standard (How well):</p> <ul style="list-style-type: none"> • Repair properly and check the function of AC/DC lights 	<p>Battery</p> <ul style="list-style-type: none"> • Definition • types • Principle of operation • Circuit diagram • Operating principle of driver circuit • Advantages • Application • Safety precautions •

Tools and Materials: - Multi meter, screw driver set, Nose pliers and wire cutter
 Soldering Iron, De-soldering pump, Variable power supply etc.

Safety:-

Task: 8 Design Printed Circuit Board (PCB)

Time:- 10 hrs
 Theory:- 2 hrs
 Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtained tested circuit diagram and white paper 2. Reduce tested circuit and PCB layout 3. Reduce crossing by rerouting connecting lines / relocating components 4. Provide jumper where crossing cannot be avoided 5. Minimize jumper where possible 6. Draw PCB configuration of components and connect as per circuit diagram 7. Increase thickness of supply line track 8. Check final PCB with tested circuit diagram for operation/ function 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Fully equipped workshop with related tools, equipment and materials <p>Tasks (What):</p> <ul style="list-style-type: none"> • Design PCB <p>Standard (How well):</p> <ul style="list-style-type: none"> • Tested circuit and PCB layout resized correctly without varying operational function of tested circuit diagram with no jumper or minimum jumper 	<p>PCB</p> <ul style="list-style-type: none"> • Designing concept • Types • Importance • Function • Circuit diagram • Application • Advantages <p>Complex circuitry</p> <ul style="list-style-type: none"> • Application • Advantages <p>Defects of many jumpers</p>

Tools and Materials:- Hacksaw frame with blade, white paper and drawing tools / equipment

Safety:-

Task: 9 Lay circuit diagram in plain PCB

Time:- 8 hrs
 Theory:- 2 hrs
 Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtained plain PCB and PCB diagram 2. Cut plain PCB to required size and clean its surface 3. Copy tracks of PCB diagram to copper side of plain PCB with pencil 4. Cover tracks with permanent marker (enamel, Nail polish etc.) 5. Remove unwanted excess enamel from the track 6. Check for short circuit between enamel paint of the adjacent track 7. Verify interconnection with PCB diagram 8. Leave PCB for at least 3 hrs in dry place 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Fully equipped workshop with related tools, equipment and materials <p>Tasks (What):</p> <ul style="list-style-type: none"> • Lay circuit diagram in plain PCB <p>Standard (How well):</p> <ul style="list-style-type: none"> • Copied PCB diagram in plain PCB clearly and neatly without short circuit and excess part in plain PCB 	<ol style="list-style-type: none"> 1. Enamel paintings <ul style="list-style-type: none"> • Definition • Types • Functions • Importance • Application • Advantages 2. Disadvantages of running paints in PCB Board 3. Importance of Plain PCB board making

Tools and Materials:- Plain PCB, White paper, Drawing tools, Permanent marker (enamel / nail polish etc.) Hacksaw frame with blade and file

Safety:-

Task: 10 Perform computer added PCB design

Time:- 10 hrs
 Theory:- 2 hrs
 Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtained PCB software 2. Install the software 3. Run the computer 4. Design PCB of the circuit diagram 5. save the PCB design 6. Print the PCB design 7. Check the PCB design. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • PCB Design software • Computer and printer <p>Tasks (What):</p> <ul style="list-style-type: none"> • Perform computer added PCB design. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Printed well using tracing paper. 	<p>PCB software design</p> <ul style="list-style-type: none"> • Definition • Types • Functions • Importance • Application • Advantages

Tools and Materials:- computer, software, printer, tracing paper

Safety:-

Task: 11 Prepare solution for etching

Time:- 6 hrs
Theory:- 1 hrs
Practical:- 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
1. Take required chemicals 2. Prepare ferric chloride solution in Luke warm water in non-corrosive flatbed vassal 3. Apply liquid ready to use solution 4. Stir solution vigorously	Condition (Given): <ul style="list-style-type: none">Fully equipped workshop with related tools, equipment and materials Tasks (What): <ul style="list-style-type: none">Prepare solution for etching. Standard (How well): <ul style="list-style-type: none">Solution prepared with correct method and proportion	1. Chemicals <ul style="list-style-type: none">DefinitionTypesFunctionsImportance 2. ACID <ul style="list-style-type: none">DefinitionTypesFunctionsImportanceApplicationAdvantages 3. Safety precautions

Tools and Materials:- Ferric chloride, Luck warm water, Flat bed vassal, plastic tweezers and glove

Safety:-

Task: 12 Immerse PCB in solution

Time:- 6 hrs
 Theory:- 1 hrs
 Practical:- 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Prepare required chemicals tools as per requirement 2. Immerse PCB in solution 3. Wait for 30 minute 4. Remove PCB from solution using tweezers 5. Wash PCB with fresh water thrice 6. Dry PCB for one hour 7. Gently wash enamel from the track 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Fully equipped workshop with related tools, equipment and materials <p>Tasks (What):</p> <ul style="list-style-type: none"> • Immerse laid PCB in solution. <p>Standard (How well):</p> <ul style="list-style-type: none"> • PCB etched with right solution to appropriate time without damaging any copper track 	<ol style="list-style-type: none"> 1. Baric chloride <ul style="list-style-type: none"> • Definition • Types • Functions • Importance • Application • Advantages • Experiments 2. Etching process of PCB

Tools and Materials:- Plastic twizzer, PCB cleaner

Safety:-

Task: 13 Drill holes in PCB.

Time:- 5 hrs
 Theory:- 1 hrs
 Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select and collect appropriate drilling machine 2. Select and collect required size drill bit. 3. Install required size drill bit into drill machine. 4. Drill all holes for small resister, capacitor and transistor 5. Replace drill bits as required 6. Drill large size holes as per requirement 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Fully equipped workshop with related tools, equipment and materials <p>Tasks (What):</p> <ul style="list-style-type: none"> • Drill holes in PCB <p>Standard (How well):</p> <ul style="list-style-type: none"> • Required size and number of holes drilled in PCB with correct procedures without breaking drill bits and damaging PCB 	<p>Drilling machine</p> <ul style="list-style-type: none"> • Definition • Types • Functions • Importance • Application • Advantages • Experiments • Operation <p>Drill bits</p> <ul style="list-style-type: none"> • Definition • Types • Size • Functions • Importance • Application • Advantages • Experiments • Operation • Process and techniques of drilling hole • Size of component

Tools and Materials:- Portable drilling machine and drill bit set

Safety:-

Task: 14 Install components in PCB.

Time:- 7 hrs
 Theory:- 1 hrs
 Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Take designed require PCB with components 2. Clean PCB with PCB cleaner 3. Place components in proper location 4. Solder the components 5. Check for short circuits between soldered joints 6. Assemble PCB in suitable place 7. Test set for normal operational function 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Fully equipped workshop with related tools, equipment and materials <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install PCB components <p>Standard (How well):</p> <ul style="list-style-type: none"> • Components installed correctly and neatly with required outputs 	<p>Soldering/ de-soldering</p> <ul style="list-style-type: none"> • Definition • Types • Functions • Importance • Application • Advantages • Experiments • Operation <p>PCB Layout</p> <ul style="list-style-type: none"> • Definition • Importance • Application • Advantages • Operation

Tools and Materials:- Soldering iron, soldering lead, de-soldering pump, twizzer, wire cutter and required components

Safety:-

Task: 15 Assemble water level controller with indicator.

Time: 17 hrs
 Practical: 2 hrs
 Theory: 15 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required PCB components as per circuit diagram 2. Collect tools equipment 3. Check all the components 4. Clean the required PCB Spider components for leads 5. Solder the components in PCB 6. Check for short circuits of soldering, polarity of component and open circuit in PCB track. 7. Check operational function of the circuit by taking measurement at the test points. 8. Assemble the complete circuit in the enclosure 9. Check tearing water level controller with indicator. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • PCB • Circuit diagram • Basic tools • Well-equipped electronics work shop /lab <p>Task(What):</p> <p>Assemble water level controller with indicator.</p> <p>Standard(How well):</p> <ul style="list-style-type: none"> • Water level controller with Indicator set assembled neatly and safety. And receive normal function 	<p><u>Safety belt :</u></p> <ul style="list-style-type: none"> • Operating principle • Basic concept of water level controller with indicator • Exploitation of water level controller with indicator • Definition • Type • Functions • Advantages

Tools/Equipment: : Multi-meter, soldering iron with stand, soldering lead, de-soldering pump, soldering paste / flux, Nose-pliers, Tweezers, screw driver set, wire cutter and wire snipers

Safety:

Task: 16 Assemble/ Repair volt guard

Time:- 17 hrs
Theory:- 2 hrs
Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Take inventory of the components requires as per circuit diagram 2. Check all the components 3. Clean the required PCB and the leads of all components 4. Solder the components in PCB 5. Check for short circuit, dry soldering, polarity of components and open circuit in PVB track 6. Check the function by taking measurement at the test points 7. Fix the high & low voltage cut off using variable AC power supply 8. Assemble the complete circuit in the enclosure 9. Perform the final testing of volt guard unit 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • PCB ,components enclosure, • circuit diagram • basic tools • Well-equipped electronics work shop • Variable AC power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Assemble volt guard <p>Standard (How well):</p> <ul style="list-style-type: none"> • Fridge guard set assembled neatly and the function of set as expected • Cut-off high and low voltage accurately 	<ul style="list-style-type: none"> • Operating principle • Basic concept of AC control device and its application • Explanation of volt guard • Circuit diagram • Definition • Type • Function • Advantage • Safety precautions

Tools and Materials:-Multi-meter, soldering iron with stand, soldering lead, de-soldering pump, soldering paste / flux, Nose-pliers, cutter pliers, Tweezers, screw driver set wire cutter and wire snipers

Safety: - Proper use of tools and components

Task: 17 Assemble/ Repair fridge guard

Time:- 17 hrs
Theory:- 2 hrs
Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. collected required components as per circuit diagram 2. Collect required tools & equipment 3. Check all the components 4. Clean the surface of required PCB and the leads of all components 5. Solder the components on the PCB 6. Check for short circuit diagram solder polarity of components and open circuit in PCB track 7. Check for operational functioning of the circuit by taking measurement at the test points 8. Check the trimming function of fridge guard 9. Fix the high and low voltage cut off with timer by variable AC power supply 10. Assemble the PCB board in the enclosure 11. Check/ test fridge guard unit for operational and functional 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • PCB , component enclosure • circuit diagram • Tools set • Well-equipped electronics work shop • Variable AC power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Assemble fridge guard <p>Standard (How well):</p> <ul style="list-style-type: none"> • Fridge guard security assembled neatly with accurate timing function • Checked and replace defective components without damaging other parts • Cut-off high and low voltage accurately with timer. 	<ul style="list-style-type: none"> • Operating principle • Basic concept of fridge guard and its application • Circuit diagram and it's explanation • Definition • Type • Function • Advantages • Safety precautions

Tools and Materials:-Multi-meter, soldering iron with stand, soldering lead, de-soldering pump, soldering paste / flux, Nose-pliers, cutter pliers, Tweezers and screw driver set.

Safety: - Paper use of tools & components

Task: 18 Assemble/Repair voltage stabilizer

Time:- 17 hrs
 Theory:- 2 hrs
 Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Take Inventory of the components required as per circuit diagram 2. Check all the components 3. Clean the required PCB and the lead of all components 4. Solder the components in proper terminals or joints 5. Check for short circuit dry soldering, polarity of components and open circuit in PCB track 6. Check the functioning of the circuit by taking measurement at the test point. 7. Fix high voltages cut off using variable Ac power supply 8. Assemble the components circuit in the enclosure 9. Perform the final testing of voltage stabilizer unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • PCB, required components • Cabinet • Circuit diagram • Basic tools • Well-equipped electronics work shop • Variable AC power supply <p>Tasks (What):</p> <ul style="list-style-type: none"> • Assemble voltage stabilizer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Voltage stabilizer set assembled neatly and function as expected. • Stabilizer function with 220 V output and cut off high voltage. 	<ul style="list-style-type: none"> • Definition • Function • Advantage • application • Operating principle • Basic components of voltage stabilizer • Circuit diagram and it's explanation • Safety precautions

Tools and Materials:- Multi-meter, soldering iron with stand, soldering lead, de-soldering pump, soldering paste / flux, Nose-pliers, Tweezers, screw driver set wire cutter and wire snipers

Safety:-

Task: 19 Repair and Maintain battery charger

Time: 12 hrs
 Practical: 2 hrs
 Theory: 10 hrs

Task Steps	Training Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Take Inventory of the component as per circuit diagram 2. Check all the components 3. Clean the surface of required PCB and the leads of all components 4. Solder the components on the PCB 5. Check for short circuit dry solder polarity of components and open circuit. in PCB track 6. Check the functioning of the circuit by taking measurement at the test points 7. Assemble the component circuit in the enclosure 8. Perform the final testing 	<p>Condition(Given):</p> <ul style="list-style-type: none"> • PCB, components, enclosure, • Circuit diagram • Battery • basic tools • Well-equipped electronics work shop / lab <p>Task (What): Assemble battery charger</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Battery charger set assembled neatly and functioned as expected 	<p><u>Safety belt :</u></p> <ul style="list-style-type: none"> • Basic concept of Battery charger • Operating principle • Circuit diagram and it's explanation • Types • Advantages • Application

Tools/Equipment: Multi-meter, soldering iron with stand, soldering lead, de-soldering pump, soldering paste / flux, Nose-pliers, Tweezers, screw driver set, wire cutter and wire snipers

Safety:

Task: 20 Install and troubleshoot inverter system

Time:- 12 hrs
Theory:- 2 hrs
Practical:- 10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select the appropriate location for the unit 2. Collect element of inverter system 3. Install the proper cabling for inverter system. 4. Install main Inverter System in safe place. 5. Install the Backup Battery appropriate location. 6. Connect each element to main system. 7. Set normal function for main system 8. Adjust the Inverter main system if necessary. 9. Check the operational function of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Inverter System • Battery. • Layout diagram • Operational manual of Inverter • Electric cables. • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Installation and troubleshooting of Inverter system <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed system works properly and gained normal & backup power supply. • Passed test of backup as well as normal supply with minimum time delay. 	<p>Inverter System</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Layout diagram • Trouble shooting procedure • Advantages • Application

Tools and Materials:- Normal tool set, coaxial cable, AC / DC power cable, drill machine, multimeter etc.

Safety:- Connect battery safely without damaging circuit.

Task: 21 Repair and maintain inverter

Time:- 17 hrs
Theory:- 2 hrs
Practical:- 15 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of component. 4. Check voltage of test pins 5. Identify faulty components of unit 6. Replace faulty components by right one. 7. Test set for normal operation. 8. Assemble unit in the enclosure. 9. Perform final test of particular unit. 10. Perform required adjustment 11. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Faulty inverter • Circuit diagram • Assortment of the component used in inverter • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain inverter <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit repaired correctly and gained normal AC output Voltage of unit • Passed test of backup system 	<p>Inverter</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Application

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper nose pliers, screw driver set, tweezers and AC mains socket with power supply

Safety:- Connect battery safely without damaging circuit

Task: 22 Install and troubleshoot CCTV system

Time:- 15 hrs
Theory:- 5 hrs
Practical:- 10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select the appropriate location for the unit 2. Collect element of CCTV system. 3. Select the appropriate location for unit. 4. Install the proper cabling for video and power supply. 5. Install main CCTV camera in each location. 6. Install and fasten the main in appropriate location. 7. Connect each element to main system. 8. Set normal function for main system 9. Adjust the CCTV camera and main system if necessary. 10. Check the operational function of unit. 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. CCTV camera 2. Hub/ DVR 3. Layout diagram 4. Operational manual of DVR 5. BNC connector <ul style="list-style-type: none"> • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Installation and troubleshooting of CCTV system <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed system works properly and gained normal video display • Passed test of recording and playback system of obtained video 	<p>CCTV System</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Application

Tools and Materials:- Normal tool set, coaxial cable, AC / DC power cable, drill machine, multimeter etc.

Safety:- Connect CCTV system safely without damaging each element

Task: 23 Repair and maintain emergency light

Time:- 5 hrs
Theory:- 1 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Measure battery voltages 4. Measure test pin voltage 5. Identify faulty components. 6. Check battery 7. Replace faulty components 8. Test unit for normal operation. 9. Assemble unit in the enclosure. 10. Perform final test of particular unit. <ol style="list-style-type: none"> i. Perform required adjustment ii. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Faulty emergency light • Circuit diagram • Assortment of the component used in emergency light • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain emergency light <p>Standard (How well):</p> <ul style="list-style-type: none"> • Dismantle the unit without further damage • Replaced components correctly • Emergency light repaired correctly and functioned normally with glaring lamp 	<p>Emergency light</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Application • Types of meter • Concept of sensor • Battery voltage • Safety precautions

Tools and Materials:- :- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers and tweezers

Safety:-

Task: 24 Install PA System

Time:- 5 hrs
Theory:- 1 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required materials. 2. Select appropriate location for sound mixer and amplifier units. 3. Select appropriate location for speakers and microphones. 4. Install speakers and microphones with stand. 5. Install mixer unit on a stable table with sufficient illuminated light. 6. Wire all the audio gadgets eg: mixer, amplifier, mikes, speakers, sound effect gadgets, recording and playback units. 7. Install a\AC extension power to AC mains sockets. 8. Check operational functions of all units with the help of built in signal generator or playback unit. 9. Finally check again using microphones and sound effect units. 10. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. PA system gadgets 2. AC mains power and extension units. 3. Connection or wiring diagram 4. Tools and equipment 5. Fully equipped electronic workshop. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install PA System <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed PA system functioning alright with mikes and playback units and volume of sound at speakers appropriate and adequate. 	<p>PA System</p> <ul style="list-style-type: none"> • Definition • Principle of operation • Components • Circuit diagram • Trouble shooting procedure • Application • Components value and rating • Safety precautions • Instruction or operation manuals of the gadgets and their specifications, especially of mixer, main power amplifier units and speakers. • Principles of power amplifier units and speakers • Proper handling of AC mains power line: Proper functioning and safety precautions • Repairing techniques: replacements of fuses and non-functioning gadgets with good ones.

Tools and Materials:- :- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

Task: 25 Install and repair photocopier machine

Time:- 7 hrs
 Theory:- 1 hrs
 Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for the unit. 2. Install devices on flat stable base in proper location. 3. Install AC power cable with socket. 4. Feed proper tray with paper 5. Connect AC cord of Photocopy cord with AC mains socket. 6. Plug AC power in AC socket 7. Check operational function of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Photocopy machine • Line • Remote control • Ac main socket with power • Connection diagram • Tool and equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install Photocopy machine. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed photocopy machine correctly and gain normal operational function with best reception. 	<p>Photocopy machine</p> <ul style="list-style-type: none"> • Definition • Principle of operation • Types • Installation procedures • Advantage • Application • Safety precaution

Tools and Materials:-**Safety:-****References:**

- Lab manual
- Circuit diagrams
- Internet explore

Computer application, computer hardware & Networking

Total:	4 hrs/wk
Theory:	1 hr/wk
Practical:	3 hrs/wk

Course Description:

This course deals with the fundamental of the Microsoft windows based computer operating and application software. It also imparts knowledge and skills on internet and email handling. Moreover, it intends to provide skills on computer virus cleaning. This also intends to impart knowledge and skills on computer hardware components and networking system. It also deals with installation of operating system, applications and utility software. Moreover, computer hardware components repairing and maintenance are included.

Unit I: Computer application

Total:	2 hrs/wk
Theory:	0.5 hr/wk
Practical:	1.5 hrs/wk

Course Objectives:

After completion of this course students will be able to:

1. Explain Microsoft windows operating system.
2. Explain disk operating system.
3. Explain typing and key board format.
4. Explain MS word processing application program.
5. Explain MS Excel application program.
6. Explain MS Power point application program.
7. Explain Media player application program.
8. Explain Internet, E-mail.

List of Tasks

1. Operate windows system
2. Perform typing work.
3. Operate MS Office word.
4. Operate MS Excel.
5. Operate MS Power Point.
6. Use Multimedia (Media player in PC)
7. Perform e-mail, internet, and virus cleaning.

Task 1. Operate windows system

Time:- 8 hrs
Theory:- 2 hrs
Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Start programs. 2. Quit programs 3. Switch between programs. 4. Open a document 5. Open a document by using a program. 6. Familiar with following commands. (Programs, Documents, settings, find, help, control panel, run, shut down.) 7. Add icons to the desktop. 8. Delete files & folders to recycle bin. 9. View what's on your computer explore computers. 10. Customize the explorer file display. 11. Create file & folders. 12. Save a document. (Create shortcut icons) 13. Perform windows system tools 14. Setup printer 15. Execute DOS commands in windows command prompt. 16. Apply external & internal commands. <ul style="list-style-type: none"> • Create directory • Change directory • Switch back rood directory • Switch parent directory • Display list of files sub-directory using DIR 17. Perform following commands. <ol style="list-style-type: none"> a. EDIT, CHKDSK, Copy Con, REN, DEL, TYPE b. COPY, XCOPY, MOVE 18. Introduce wild card characters*? 	<p>Condition (Given): Personal computer</p> <p>Tasks (What): Operate windows system.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Used windows commands. • Customized files & folders. • Created files & folders. • Operated windows system tools • Executed DOS commands in windows command prompt. 	<ol style="list-style-type: none"> 1. Familiarization with <ul style="list-style-type: none"> ▪ Task bar ▪ Start button ▪ Recycle bin ▪ My document ▪ My computer 2. Use of tool bar, menu bar. 3. Familiar with icons. 4. Different program used in computer. 5. Task bar 6. Creating & defining process. <ul style="list-style-type: none"> ▪ Maximize ▪ Minimize ▪ Close. 7 Disk cleaning and disk defragment 8 System information and system restore 10 Defining printer connection and other devices 11 Familiarization of Windows help and support

Task Analysis

Tools and Materials:-

Safety:- Resolution.

Task 2. Perform typing work.

Time:-6 hrs
Theory:- 2 hrs
Practical:-4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none">1. Load a typing program.2. Exit from a typing program.3. Use basic level typing that is letters from same middle row.4. Use high level typing that is letters/words from all the three rows.5. Play typing game to score.6. Use all the 10 fingers.7. Use advanced level typing that is letters/words and symbols from all four rows.	<p>Condition (Given): A pc with typing program installed.</p> <p>Tasks (What): Perform typing work.</p> <p>Standard (How well):</p> <ul style="list-style-type: none">• Loaded & quit the program.• Used basic, high & advanced level typing.• Using all fingers.	<ol style="list-style-type: none">1. Commands to load & quit the typing program.2. Use of menu bar.3. Use tool bar.4. Switching among basic, high & advanced level typing.5. Methods of using fingers & hand placement.

Tools and Materials:-

Safety:-

Task 3. Operate MS Office word.

Time:-25 hrs
Theory:- 5 hrs
Practical:-20 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Load MS-Word program. 2. Exit MS-Word program. 3. Create word document. 4. Save word document. 5. Perform cursor movement. 6. Apply all menu bars. 7. Apply templates. 8. Protect document with password. 9. Perform page setup. <ol style="list-style-type: none"> a. Change margins. b. Change page orientation. c. Format document. d. Format alignment. e. Format selling f. Paragraph selling g. Edit document. h. Apply tool menu (cut, copy, pest) 10. Review document <ol style="list-style-type: none"> a. Check spelling b. Check grammar c. Count word 11. Create table 12. Create picture, shapes 13. Create chart 14. Apply equation tool 15. Insert header, footer, page number, date & time, end note. 16. Create a page border. 17. Perform scaling 18. Perform section break. 19. Print a document. 	<p>Condition (Given): A PC with latest version MS-Office installed.</p> <p>Tasks (What): Operate MS-Office word</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Created word document. • Used templates. • Protected document with password. • Printed a document according to given layout. • Created a table, picture, and chart. • Created equations • Inserted header, footer, page number, date, time. • Created a page border. 	<ol style="list-style-type: none"> 1. MS-Word. <ul style="list-style-type: none"> ▪ What does it do? ▪ Menu bar ▪ Tool bar ▪ Screen 2. Concept of templates. 3. Asking the office assistant for help. 4. Rows & column in table creation. 5. Inserting picture and shapes 6. Defining chart 7. Concept of header, footer, page 8. Defining mathematical equations and standard symbols (Summation, different brackets, trigonometric symbols) 9. Printer setting concept

Tools and Materials:-

Safety:-

Task 4. Operate MS Excel.

Time:- 13 hrs
Theory:- 3 hrs
Practical:- 10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Load excel program. 2. Exit excel program. 3. Create worksheet. 4. Layout (design) worksheet. 5. Move through a worksheet. 6. Scroll through a worksheet. 7. Enter data in worksheet cells. 8. Copy data in worksheet. 9. Edit cell contents: <ol style="list-style-type: none"> a) Merge cell b) Warp text c) Format cell (number, currency, row height, width and so on) d) cell styles 10. Sort cell contents or data. <ol style="list-style-type: none"> a) ascending b) descending 12. Enter formula or equations <ol style="list-style-type: none"> a) Trigonometric functions b) Sum, Average c) Count numbers d) Maximum and minimum 13. Draw charts: <ol style="list-style-type: none"> a) Bar b) Pie c) Line 14. Print layout 	<p>Condition (Given): Computer with latest MS-Office package installed.</p> <p>Tasks (What): Operate excel.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Created worksheet, work book, chart sheet • Entered data, formula, numbers. • Saved the entered data. • Printed layout. 	<ol style="list-style-type: none"> 1. Feature of excel. 2. Components of excel worksheet & work book. <ul style="list-style-type: none"> ▪ Menu bar ▪ Tool bar ▪ Font ▪ Name box ▪ Formula box. ▪ Tab scrolling button ▪ Active sheet tab. ▪ Inactive sheet tab. ▪ Split box. 3. Sorting data 4. Mathematical equations 5. Excel defined functions 6. Defining charts : Bar, Pie, line

Tools and Materials: - Latest version computer, printer, photocopy papers.

Safety:-

Task 5. Operate MS Power Point.

Time:- 10 hrs
 Theory:- 2 hrs
 Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Load Power point program. 2. Exit Power point program. 3. Creat Power point slide <ol style="list-style-type: none"> a. Add title, sub title. b. Add new slide for Presentation. c. Layout slide: <ul style="list-style-type: none"> • Title and content • Two contents • Content with caption • Picture with caption 4. Set font for title and content 5. Design slides: <ol style="list-style-type: none"> a) Set slide orientation b) Set background, color c) Set slide themes 6. Insert audio and video clips in the presentation slides 7. Apply transition effect 8. Apply animation effect 9. Present slide 10. Print slide 	<p>Condition (Given): Computer with MS-Office package installed.</p> <p>Tasks (What): Operate Power point.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Created Power point slides • Entered title, sub title, contents. • Saved the presentation slides. • Presented slides. • Printed slides. 	<ol style="list-style-type: none"> 1. Feature of MS Power point. 2. Components of MS power point. <ol style="list-style-type: none"> i. Menu bar ii. Tool bar iii. Font, color , background styles iv. Design template v. Text box. vi. Slide transition effect vii. Slide animation. viii. Slide show features. 3. Audio and video files 4.

Tools and Materials: - Latest version computer, printer, photocopy papers.

Safety:-

Task 6. Use Multimedia (Media player in PC)

Time:- 6 hrs
 Theory:- 2 hrs
 Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Load media player. 2. Exit from media player. 3. Store Audio/Video files in media library. 4. Identify play lists for Audio /Video. 5. Play media files. 6. Identify media files from list of all files. 7. Adjust volume, bass treble of the media player. 8. Copy media files from CD, DVD etc. 9. Save media files. 	<p>Condition (Given): A PC with media player.</p> <p>Tasks (What): Use multimedia</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Stored music in media library. • Played media files. • Adjusted volume, bass, treble. • Copied media files from CD, DVD. 	<ol style="list-style-type: none"> 1. What is multimedia? 2. What does it do? 3. Music folders. 4. Media library. 5. Menu bars. 6. Tool bars. 7. Drag & drop operation. 8. Copying procedure. 9. Saving techniques from CD, DVD while playing.

Tools and Materials:- PC, Media player software

Safety:-

Task 7. Perform e-mail, internet, and virus cleaning.

Time:-10 hrs
Theory:- 2 hrs
Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Load Internet browser. <ol style="list-style-type: none"> a) Google chrome b) Internet explorer c) Mozilla Firefox 2. Create new internet based E-mail account (G-mail, yahoo mail). 3. Sign in E-mail account. 4. Send E-mail message. 5. Receive E-mail message. 6. Attach files to messages. 7. Sign out E-mail account. 8. Create new E-mail account in MS Outlook. 9. Send message via Outlook. 10. Receive message via Outlook. 11. Open search engines (Google, Yahoo) 12. Browse electronics related web sites. 13. Book mark useful web sites 14. Save files from internet, websites. 15. Exit from internet browser. 16. Check Computer virus for websites, internet based files. 17. Clean virus, if found. 18. Run real time virus protection software. 	<p>Condition (Given): A PC with internet connected, Computer virus cleaning software.</p> <p>Tasks (What): Perform e-mail, internet, and virus checking.</p> <p>Standard (How well):</p> <ul style="list-style-type: none"> • Signed up a new account. • Sent & received e-mails. • Attached files. • Browsed internet • Saved files form internet. • Checked computer virus for internet files 	<ol style="list-style-type: none"> 1. Definition of Internet browser Search engines Internet based e-mail system (G-mail, Yahoo mail) Websites 2. Outlook express Creating New account/adding a mail. Working with address book. 3. Computer virus: Types of virus. Effects caused by virus. The preventive measures from virus. 4. Concept of Networking LAN MAN WAN

Tools and Materials:- PC having internet connection

Safety:-

Unit II: Computer Hardware and Networking

Total: 2 hrs/wk
Theory: 0.5 hr/wk
Practical: 1.5 hrs/wk

Course Objectives:

After the completion of this course students will be able to:

1. Familiar with safety precautions and applying the same in practice
2. Develop computer system configuration
3. Conduct diagnostics - testing and inspection
4. Acquire knowledge of hardware components and latest development in the field
5. Conduct repair and maintenance of computer.
6. Carry out installation of operating system, applications and utility software
7. Perform computer networking and system connectivity.

Contents:

1. Introduction and Concepts: 5 hrs

- Block diagram of computer, Hardware and Software, System Software, Application Software,
- Utility Software, Firmware, CMOS/BIOS setup, Partitioning, Formatting, Operating Systems,
- Program, Flow Charts, Loader, assembler, Compiler, Linker, Editor, Simulator, Emulator,
- Debugger, Device Drivers, Software Packages and Introduction to Programming Language,
- Computer virus.

2. Operating System: Types and Functions – 3 hrs

- DOS – Introduction, Versions, DOS Commands, Internal, External, Root Directory.
- Windows Operating System – Introduction, Working with desktop, Control Panel settings.
- Introduction to System tools.

3. Microprocessor Study: 2 hrs

8086 – Architecture, Instruction set, 80286, 80386, 80486. Introduction to advanced Processors - i series.

4. Interfaces & Drives: 6 hrs

- Type of interface, HDC, CRT Controller, Serial and Parallel Interface, USB,
- Introduction to Bluetooth and IR device, Wifi, Port, Slot, Mini USB, Micro USB. Drives- Floppy Disk Drive, Hard Disk Drive, Optical Disk Drive: Types (ROM, R/W, DVDROM, DVD Drive Components (Connectors, Motors, Back up Drive: Pen Drive U3 format, Zip Drive, Tape Drive,

5. Multimedia, Networking and Internet: 4 hrs

- Networking: Concepts, Need, Types, Topologies, Protocols, Introduction to Network
- Interface Card and Network Operating Systems, Thick and Thin PC's, Virtual PC.
- Multimedia: Medium concept, Types, Multimedia Computer Systems.
- Internet: Concept, Different Connection types, Applications.

List of Tasks:

1. Install Computer
2. Dismantle the computer
3. Assemble computer
4. Install Software
5. Repair and maintain of computer.
6. Repair and maintain SMPS power supply
7. Install DSL/ADSL Router
8. Perform computer networking
9. Install Printer
10. Repair printer
11. Repair and maintain UPS

Task: 1 Install Computer

Time:- 1 hrs
Theory:- 0 hrs
Practical:- 1 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for the unit to be installed 2. Place the computer on Computer table. 3. Install the AC power cable with socket. 4. Plug AC power cord of UPS to the mains AC outlets. 5. Connect AC power cord of the computer to the outlets of UPS. 6. Connect Input and output device of computer system to corresponding CPU port. 7. Check operational function of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • CPU • Monitor • Keyboard • Mouse • UPS • Computer table • Connection diagram • Ac main Socket with power • Tools and Equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install Computer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed computer as per the specification without damaging and loosening the parts • Tasted installed computer for 24 hours • Computer functioned normally. 	<p>Computer</p> <ul style="list-style-type: none"> • Definition • Block diagram of computer • Connection diagram • Types • Parts • Function • Installation procedures • Advantage • Application • Safety precaution

Tools and Materials:- Screw driver set, Computer set.

Safety:-

Task: 2 Dismantle Computer

Time:- 3 hrs
Theory:- 1 hrs
Practical:- 2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate tools for dismantle the PC 2. Place the computer on Computer table. 3. Unplug AC power cord of UPS to the mains AC outlets. 4. Unscrew the casing of CPU 5. Dismantle UPS unit. 6. Dismantle memory unit. 7. Dismantle hard disk, CD-ROM, 8. Disconnect front panel connector. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • CPU • Monitor • Keyboard • Mouse • UPS • Computer table • Connection diagram • Ac main Socket with power • Tools and Equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Dismantle Computer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Dismantled computer as per the normal requirement without damaging computer parts 	<p>Computer</p> <ul style="list-style-type: none"> • Definition • Block diagram of computer • Connection diagram • Types • Parts • Function • Advantage • Application • Safety precaution

Tools and Materials:- Screw driver set.

Safety:-

Task: 3 Assemble Computer

Time:- 6 hrs
 Theory:- 1 hrs
 Practical:- 5 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required materials, tools & components 2. Fix motherboard in computer casing with proper screw 3. Install CD-ROM, Hard disk, SMPS, memory in computer casing 4. Connect proper cable in proper place 5. Fix back side cabinet and fasten screws. 6. Install input and output devices 7. Plug in A.C. main cord of the set/power and switch to ON position. 8. Check the normal operation of computer 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Motherboard, RAM, CD-ROM, Hard disk • casing • SMPS power supply • User manual • Input and output devices • Well-equipped computer workshop <p>Tasks (What):</p> <ul style="list-style-type: none"> • Assemble computer. <p>Standard (How well):</p> <ul style="list-style-type: none"> • The wire cables components of computer connected neatly and safely • The connectors plugged in to power socket safely • The set assembled correctly and checked for normal operation mode. 	<ul style="list-style-type: none"> • Introduction of computer • Advantage • Assembling procedure of computer • Layout diagram of computer • Importance of computer hardware • Safety precautions

Tools and Materials:- Multi meter, screw driver set, AC cord, monitor, keyboard, mouse, computer parts and its accessories

Safety:-

1. Use safety rubber shoe
2. Check electric lines and possible hazards before starting to work
3. Jumper setting for mother board

Task: 4 Install Software

Time:- 8 hrs
 Theory:- 2 hrs
 Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect main bootable operating and application software CD 2. Place the computer on Computer table. 3. Install the AC power cable with socket. 4. Adjust bios setup for booting CD 5. Insert the main CD in CD ROM trolley. 6. Follow the instructions and readjust if necessary 7. Install application software 8. Install driver software 9. Check for normal operation 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • CPU • Monitor • Keyboard • Mouse • UPS • Computer table <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install Software <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed software as per requirement without error • Installed software work function properly • Computer functioned normally. 	<p>Software</p> <ul style="list-style-type: none"> • Definition • Types • Function • Installation procedures • Advantage • Application

Tools and Materials:- Main Operating CD, application software CD, driver CD

Safety:-

Task: 5 Repair and maintain computer

Time:- 9 hrs
 Theory:- 1 hrs
 Practical:- 8 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Check the fault symptoms 3. Open the casing 4. Identify the faulty parts/ software 5. Reinstall the required software 6. Replace the faulty parts by right one. 7. Test the unit for normal operation 8. Assemble the unit in the enclosure. 9. Perform the final test of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • CPU • Monitor • Keyboard • Mouse • UPS • Computer table • Connection diagram • Tools and Equipment • Software CDs • Assortment of the parts used in computer <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain personal Computer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Repaired computer function properly. • Tested repaired computer for normal condition 	<p>Repair and maintain personal Computer</p> <ul style="list-style-type: none"> • Definition • Repairing procedures • Advantage • Application • Safety precaution

Tools and Materials:- Main Operating CD, application software CD, driver CD, Screw driver set.

Safety:-

Task: 6 Repair and maintain SMPS power supply

Time:- 3 hrs
Theory: 1 hrs
Practical:- 2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the SMPS 2. Dismantle SMPS 3. Identify faulty components. 4. Check voltage of test pins 5. Replace faulty components 6. Test SMPS for normal operation. 7. Measure and record different output voltage 8. Assemble unit in the enclosure. 9. Perform final test of particular unit. 10. Perform required adjustment 11. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty 2. Circuit diagram 3. Assortment of the component used in SMPS <ul style="list-style-type: none"> • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain SMPS power supply <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit repaired correctly and functioned normally with multiple output voltage correctly 	<p>SMPS</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Disadvantages • Application • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper, screw driver set, nose pliers, tweezers and AC mains socket

Safety:-

1. Use safety spectacle, rubber shoe, fitted working dress, globe
2. Check electric lines and possible hazard

Task: 7 Install DSL/ADSL Router

Time:-3 hrs
Theory:- 1 hrs
Practical:- 2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for the unit. 2. Mount and fasten the unit to the stable and solid concrete wall. 3. Install proper RJ-45 cable to the computer and router socket. 4. Connect the system with AC supply system. 5. Power on the system 6. Setup the normal required Parameter of router. 7. Follow the instruction and readjust if necessary. 8. Check operational function 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Router • Telephone line • Wiring pair cable • AC cord • Protection module • Layout diagram • Tools and equipment. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install DSL/ADSL Router. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit including router must be installed at appropriate and safe location with proper connection using proper cable. 	<p>Router</p> <ul style="list-style-type: none"> • Introduction • Function • Importance • Types • Principle of operation • Importance and use of connection diagram • Installation procedures and techniques • Application • Advantage • Safety precautions

Tools and Materials:- Screw driver set,router,RJ-45 cable, computer ,ADSL line etc,

Safety:-

Task: 8 Perform computer networking.

Time:- 12 hrs
 Theory:- 2 hrs
 Practical:- 10 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for HUB. 2. Collect element of computer networking with accessories. 3. Mount the unit on wall or place on stable with flat base. 4. Install the proper cable for required computer 5. Install Rj-45 cable on each point 6. Connect required cable to its HUB/Computer unit. 7. Configure the computer with proper networking protocol and readjust if necessary. 8. Check operational function of unit. 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Computer • HUB • Ac main socket with power • Layout diagram • Data cable • Tool and equipment • Well-equipped computer lab <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install printer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed Networking system works properly without error • Computer functioned sharing data properly. 	<p>Computer Networking</p> <ul style="list-style-type: none"> • Definition • Types • Function • Layout diagram • Networking procedures • Advantage • Application

Tools and Materials:-HUB, computer, crimping tools, RJ-45 connector, tools set etc

Safety:- Networking cable of HUB removes and fix safely without damaging

Task: 9 Install printer

Time:-2 hrs
 Theory:- 1 hrs
 Practical:- 1 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for the unit. 2. Install device on stable and flat base near CPU. 3. Install paper tray with paper. 4. Connect data cable to CPU and printer. 5. Plug AC power cord into AC outlets. 6. Check normal operational function of unit. 7. Search for correct driver until detecting PNP device 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Printer • AC cord • Ac main socket with power • Connection diagram • Data cable • Tool and equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install printer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Installed printer properly without damaging • Printer functioned normal operational. 	<p>Printer</p> <ul style="list-style-type: none"> • Definition • Types • Function • Connection diagram • Installation procedures • Advantage • Application

Tools and Materials:-Printer, computer, AC cord, paper etc.

Safety:- Data cable and paper of printer removes and fix safely without damaging

Task: 10 Repair printer

Time:- 5 hrs
 Theory:- 1 hrs
 Practical:-4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section 2. Dismantle the unit. 3. Readjust the printer driver if necessary. 4. Observe physical condition of the unit. 5. Check voltage of the test pins of unit. 6. Identify the faulty components. 7. Replace the faulty components by right one. 8. Test the unit for normal operation. 9. Assemble the unit in the enclosure. 10. Perform the final test of unit. 11. Perform required adjustment 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Printer • AC cord • Assortment of electronic component used in printer • Circuit diagram • Sensor • Cartridge • Power supply module • Tool and equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair printer <p>Standard (How well):</p> <ul style="list-style-type: none"> • Repaired printer works properly. • Printer functioned normal operational. 	<p>Printer</p> <ul style="list-style-type: none"> • Definition • Types • Function • Connection diagram • Installation procedures • Advantage • Application • Sensor • Cartridge

Tools and Materials:- :- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper nose pliers, screw driver set, tweezers and AC mains socket with power supply

Safety:-

- Sensor and cartridge of printer removes and fix safely without damaging.

Task: 11 Repair and maintain UPS

Time:- 3 hrs
Theory:- 1 hrs
Practical:-2 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Test the unit to be repaired and diagnose the faulty section. 2. Dismantle the unit. 3. Observe physical condition of component. 4. Check voltage of test pins 5. Identify faulty components of unit 6. Replace faulty components by right one. 7. Test set for normal operation. 8. Assemble unit in the enclosure. 9. Perform final test of particular unit. 10. Perform required adjustment 11. Store tools and equipment in proper place 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Faulty inverter /UPS • Circuit diagram • Assortment of the component used in UPS • Tool set • Fully equipped electronic workshop with power supply. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain UPS <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit repaired correctly and gained normal AC output Voltage of unit • Passed test of backup system 	<p>UPS</p> <ul style="list-style-type: none"> • Definition • Types • Principle of operation • Circuit diagram • Trouble shooting procedure • Operating procedure • Advantages • Application • Safety precaution • Difference between inverter and UPS Measurement • Safety precautions

Tools and Materials:- Multi meter, soldering iron with stand, de-soldering pump, soldering leads, soldering paste /flux, wire cutter, wire stripper nose pliers, screw driver set, tweezers and AC mains socket with power supply

Safety:- Connect battery safely without damaging circuit

Telecommunication

Total:	4 hrs/wk
Theory:	1 hr/wk
Practical:	3 hrs/wk

Course Description:

This course intends to provide knowledge and skills on operating as well as repairing and maintenance of telecommunication devices such as telephone sets, fax machines and mobile phones.

Course Objectives:

After completion of this course students will be able to:

1. Understand application and principle of operation of telecommunication devices.
2. Install telecommunication devices.
3. Operate telecommunication devices.
4. Repair and maintain telecommunication devices.

List of Tasks

1. Install telephone set
2. Repair and maintain telephone set
3. Repair and maintain mobile phone set
4. Repair Fax machine
5. Install EPABX

Task Analysis

Task: 1 Install telephone set

Time:- 1 hrs
Theory:- 0 hrs
Practical:- 1 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location 2. Provide appropriate stable flat surface 3. Place set on the stable flat surface 4. Place hand set on the cradle and connect it to hand set jack 5. Install telephone cable with socket 6. Connect telephone line to line jack of the set 7. Check operational function-using programs according to manual 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Telephone set • Telephone line • Telephone cable • Telephone cord and socket • PVC tape • Connection diagram • Tools and Equipment <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install telephone set. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit installed to appropriate and safe location with proper connection using proper cable and gain normal function. 	<p>Telephone</p> <ul style="list-style-type: none"> • Definition • Principle of operation of telephone and communication system. • Transmission media. • Importance and use of connection diagram • Installation procedures and techniques • Types and uses of telephone cable • Application • Advantage • Safety precautions

Tools and Materials: - Screw driver set , Roset box (telephone connection box), Telephone , cord, Manual, Telephone set

Safety:-

Task: 2 Repair and maintain telephone set

Time:- 8 hrs
Theory:- 2 hrs
Practical:- 6 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Dismantle the set. 3. Test the unit to be repaired. 4. Diagnose the faulty section. 5. Dismantle the unit. 6. Observe the physical condition of components. 7. Check voltage of test pins 8. Identify faulty components. 9. Replace faulty components by right one. 10. Test unit for normal operation. 11. Assemble unit in the enclosure. 12. Perform final test of particular unit. 13. Perform required adjustment 14. Store tools and materials in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty telephone set 2. Circuit diagram 3. Assortment of component used in telephone set 4. Tool set 5. Fully equipped workshop with telephone line and socket. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain telephone set. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Repaired set must operate normally. • Safety measures must be followed. 	<p>Telephone Set</p> <ul style="list-style-type: none"> • Explanation • Block diagram • Types • Principle of operation • Circuit diagram • Troubleshooting procedures • Operating procedure • Advantages • Applications • Safety precaution

Tools and Materials:- Multimeter, Soldering iron with stand, De-soldering pump, Soldering leads, Soldering paste /flux, Wire cutter, Wire stripper, Wire stripper for RJ-45, Nose pliers, Screw driver set, Telephone line with socket, Manual

Safety:-

Task 3: Repair and maintain mobile phone set

Time:- 113 hrs
Theory:- 25 hrs
Practical:- 88 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Dismantle the mobile phone set. 3. Test the unit to be repaired. 4. Diagnose the faulty section. 5. Dismantle the unit. 6. Observe the physical condition of components. 7. Check voltage of test pins 8. Identify faulty components. 9. Replace faulty components by right one. 10. Test unit for normal operation. 11. Assemble unit in the enclosure. 12. Perform final test of particular unit. 13. Perform required adjustment 14. Store tools and materials in proper place 	<p>Condition (Given):</p> <ol style="list-style-type: none"> 1. Faulty mobile phone set 2. Circuit diagram 3. Assortment of components used in mobile phone set 4. Tool set 5. Fully equipped workshop with mobile phone network and socket. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Perform Fault Finding • Repair Power Supply Unit • Repair Charging Section • Repair BGA IC • Repair Network Section • Repair Connectivity Section • Repair Light Section • Troubleshoot Display Unit • Repair Keypad • Repair SIM/RUIM Card Section • Repair UI (audio/vibration) Unit • Repair Camera Section • Repair Radio Section <p>Standard (How well):</p> <ul style="list-style-type: none"> • Repaired set must operate normally. • Safety measures must be followed. 	<p>Telephone Set</p> <ul style="list-style-type: none"> • Explanation • Block diagram • Types • Principle of operation • Circuit diagram • Related softwares • Troubleshooting procedures • Operating procedure • Concept of 3G,4G • Advantages • Applications • Safety precaution

Tools and Materials:-

Multimeter, Screw driver set, Soldering iron, De-soldering pump, Frequency counter, SMD Rework Station, PCB Holder, Multivibrator, Propyl Alcohol, Computer with flashing software and other applications, Universal Flashing Devices, Manual

Safety:-

Task 4 Repair Fax machine

Time:- 6 hrs
Theory:- 2 hrs
Practical:- 4 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect required tools and materials. 2. Observe the fax set 3. Dismantle the fax set. 4. Test the unit to be repaired. 5. Diagnose the faulty section. 6. Dismantle the unit. 7. Observe the physical condition of components. 8. Check voltage if required 9. Identify faulty components. 10. Replace faulty components by right one. 11. Test unit for normal operation. 12. Assemble unit in the enclosure. 13. Perform final test of particular unit. 14. Perform required adjustment 15. Store tools and materials in proper place 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • Fax machine • Telephone line • AC cord and socket • PVC tape • Thermal paper • Connection diagram • Tools and Equipment. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Repair and maintain data transmitting and receiving unit of fax machine. • Repair and maintain mechanical unit of fax machine. • Repair and maintain control unit of fax machine. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Repaired fax machine must operate normally. 	<p>Fax machine</p> <ul style="list-style-type: none"> • Introduction • Function • Importance • Types • Principle of operation • Installation procedures and techniques • Application • Advantage <ul style="list-style-type: none"> • Safety precaution

Tools and Materials: - Screw driver set, Multimeter, Manual

Safety:-

Task 5: Install EPABX

Time:- 28 hrs
Theory:- 10 hrs
Practical:- 18 hrs

Steps	Terminal performance objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Select appropriate location for the unit. 2. Mount and fasten the unit to the stable and solid concrete wall. 3. Connect the frame of the unit to earth. 4. Connect the trunk line to the unit. 5. Install proper station cable and AC power cable with socket. 6. Connect the system with surge protection. 7. Connect output of surge protection to definite required point 8. Connect the normal telephone set to extension points 9. Connect the hybrid set to the operator console. 10. Check operational function 	<p>Condition (Given):</p> <ul style="list-style-type: none"> • EPABX • Telephone line • Wiring pair cable • AC cord • PVC tape • Protection module • Connection diagram • Tools and Equipment. <p>Tasks (What):</p> <ul style="list-style-type: none"> • Install EPABX. <p>Standard (How well):</p> <ul style="list-style-type: none"> • Unit including operator console must be installed at appropriate and safe location with proper connection using proper cable. 	<p>EPABX</p> <ul style="list-style-type: none"> • Introduction • Function • Programing • Importance • Types • Principle of operation • Basic principle of telephone and wireless communication • Importance and use of connection diagram • Installation procedures and techniques • Application • Advantage • Safety precautions

Tools and Materials: -

Multi meter, Screw driver set, Nose pliers, Wire cutter, Wire stripper, Hammer, Pair cable, Manual

Safety:-

References:

- Marivin Tepper, **Basic Radio Volume 1 to 6**, Tarapore Valla Sons, India
- Harry Miliat, **Electricity Volume 1 to 7**, Traapore Valla Sons, India
- Harry Miliat, **Electronics Volume 1 to 7**, Traapore Valla Sons, India
- G.N. Pathet, **Television Servicing Vol. 1 to 4**, Norman, London
- Paul Owes, **Stereo Troubleshooting and Repair Manual**, Prentice hall 1979, USA
- Philip Hoff, **Consumer Electronics for Engineers**, University Press, UK
- A.P. Malvino, **Electronics Principles**
- A.P. Malvino, **Digital Principles and Applications**, Donald P. Leachm Goutam Saha, SIE Special Indian Edition
- Thomas L. Floyd, **Electronic Devices**, First Indian Reprint 2001, (5th Edition, Education Inc.
- Dr. Sanjaya Sharma, **Electronics Principles**, Katson Publication, India
- Dr. Shanjay Sharma, **Digital Electronics and Logic Design**, Katson Publications, India
- J. B. Gupta, **An Integrated course in Electronics Engineering**, Katson Publication India, S.K. Kataria and sons
- M. Lotia, P.Nair and A. Chakra Borty, **Modern CD player Servicing Manual**, Lotial/BPB Publications
- AEPC, सौर्य विद्युत प्राविधिक तह २
- Prof. Jagarnath Shrestha, Prof. Dr. Dinesh Sharma, **Solar PV. Handbook**

Other/some BPB publications

- Television service manual (Toshiba, Grunding, Konark and Webel, BPL, Snanyo etc.
- Tape recorders
- Amplifiers
- Satellite and Cable TV manual
- VCP/VCR service manual
- SMPS and STR servicing
- Telephone and cordless servicing
- Remote control operating system and servicing manual etc.

On the Job Training (OJT)

Full Marks: 500

Practical: 24 weeks/960 Hrs

Description:

On the Job Training (OJT) is a 6 months (24 weeks/144 working days) program that aims to provide trainees an opportunity for meaningful career related experiences by working fulltime in real organizational settings where they can practice and expand their classroom based knowledge and skills before graduating. It will also help trainees gain a clearer sense of what they still need to learn and provides an opportunity to build professional networks. The trainee will be eligible for OJT only after attending the final exam. The institute will make arrangement for OJT. The institute will inform the CTEVT at least one month prior to the OJT placement date along with plan, schedule, the name of the students and their corresponding OJT site.

Objectives:

The overall objective of the On the Job Training (OJT) is to make trainees familiar with firsthand experience of the real work of world as well as to provide them an opportunity to enhance skills.

The specific objectives of On the Job Training (OJT) are to;

- apply knowledge and skills learnt in the classroom to actual work settings or conditions and develop practical experience before graduation
- familiarize with working environment in which the work is done
- work effectively with professional colleagues and share experiences of their activities and functions
- strengthen portfolio or resume with practical experience and projects
- develop professional/work culture
- broaden professional contacts and network
- develop entrepreneurship skills on related occupation.

Activity:

In this program the trainees will be placed in the real work of world under the direct supervision of related organization's supervisors. The trainees will perform occupation related daily routine work as per the rules and regulations of the organization.

Potential OJT Placement Sites:

The nature of work in OJT is practical and potential OJT placement site should be as follows;

- National Planning Commission (National Volunteer Development Voluntary Service)
- Telecommunication service providers
- Television broadcasting organizations
- Electronics goods manufacturers
- Electronics repair & maintenance workshops
- Radio broadcasting organizations
- FM stations
- Electronics equipment production industries

Requirements for Successful Completion of On the Job Training:

For the successful completion of the OJT, the trainees should;

- submit daily attendance record approved by the concerned supervisor and minimum 144 working days attendance is required
- maintain daily diary with detail activities performed in OJT and submit it with supervisor's signature
- prepare and submit comprehensive final OJT completion report with attendance record and diary
- secured minimum 60% marks in each evaluation

Complete OJT Plan:

SN	Activities	Duration	Remarks
1	Orientation	2 days	Before OJT placement
2	Communicate to the OJT site	1 day	Before OJT placement
3	Actual work at the OJT site	24 weeks/960 hours	During OJT period
4	First-term evaluation	one week (for all sites)	After 6 to 7 weeks of OJT start date
5	Mid-term evaluation	one week (for all sites)	After 15 to 16 weeks of OJT start date
6	Report to the parental organization	1 day	After OJT placement
7	Final report preparation	5 days	After OJT completion

- First and mid-term evaluation should be conducted by the institute.
- After completion of 6 months OJT period, trainees will be provided with one week period to review all the works and prepare a comprehensive final report.
- Evaluation will be made according to the marks at the following evaluation scheme but first and mid-term evaluation record will also be considered.

Evaluation Scheme:

Evaluation and mark distribution are as follows:

S.N	Activities	Who/Responsibility	Marks
1	OJT Evaluation (should be three evaluation in six months –one evaluation in every two months)	Supervisor of OJT provider	300
2	First and mid- term evaluation	The Training Institute	200
	Total		500

Note: Trainees must secure 60 percent marks in each evaluation to pass the course.

OJT Evaluation Criteria and Marks Distribution:

- OJT implementation guideline will be prepared by the CTEVT. The detail OJT evaluation criteria and marks distribution will be incorporated in the guidelines.
- Representative of CTEVT, Regional offices and CTEVT constituted technical schools will conduct the monitoring & evaluation of OJT at any time during the OJT period.