

LEARNING OUTCOME BASED VOCATIONAL CURRICULUM

JOB ROLE:

Field Technician – Refrigerator

(QUALIFICATION PACK: Ref. Id. ELE/Q3103)

SECTOR: Electronics

Classes 11 and 12

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
Shyamla Hills, Bhopal – 462 002, M.P., India

www.psscive.ac.in

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Electronics Sector

January, 2020

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Joint Director

PSS Central Institute of Vocational Education, NCERT, Shyamla Hills, Bhopal

FOREWORD

The Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE) a constituent of the National Council of Educational Research and Training (NCERT) is spearheading the efforts of developing learning outcome based curricula and courseware aimed at integrating both vocational and general qualifications to open pathways of career progression for students. It is a part of Centrally Sponsored Scheme of Vocationalisation of Secondary and Higher Secondary Education (CSSVSHSE) launched by the Ministry of Human Resource Development, Government of India in 2012. The PSS Central Institute of Vocational Education (PSSCIVE) is developing curricula under the project approved by the Project Approval Board (PAB) of *Rashtriya Madhyamik Shiksha Abhiyan (RMSA)*. The main purpose of the competency based curricula is to bring about the improvement in teaching-learning process and working competences through learning outcomes embedded in the vocational subject.

It is a matter of great pleasure to introduce this learning outcome based curriculum as part of the vocational training packages for the job role of **Electronics – Field Technician Refrigerator**. The curriculum has been developed for the secondary students of vocational education and is aligned to the National Occupation Standards (NOSs) of a job role identified and approved under the National Skill Qualification Framework (NSQF).

The curriculum aims to provide children with employability and vocational skills to support occupational mobility and lifelong learning. It will help them to acquire specific occupational skills that meet employers' immediate needs. The teaching process is to be performed through the interactive sessions in classrooms, practical activities in laboratories and workshops, projects, field visits, and professional experiences.

The curriculum has been developed and reviewed by a group of experts and their contributions are greatly acknowledged. The utility of the curriculum will be adjudged by the qualitative improvement that it brings about in teaching-learning. The feedback and suggestions on the content by the teachers and other stakeholders will be of immense value to us in bringing about further improvement in this document.

Hrushikesh Senapaty
Director
National Council of Educational Research & Training

PREFACE

India today stands poised at a very exciting juncture in its saga. The potential for achieving inclusive growth are immense and the possibilities are equally exciting. The world is looking at us to deliver sustainable growth and progress. To meet the growing expectations, India will largely depend upon its young workforce. The much-discussed demographic dividend will bring sustaining benefits only if this young workforce is skilled and its potential is channelized in the right direction.

In order to fulfill the growing aspirations of our youth and the demand of skilled human resource, the Ministry of Human Resource Development (MHRD), Government of India introduced the revised Centrally Sponsored Scheme of Vocationalisation of Secondary and Higher Secondary Education that aims to provide for the diversification of educational opportunities so as to enhance individual employability, reduce the mismatch between demand and supply of skilled manpower and provide an alternative for those pursuing higher education. For spearheading the scheme, the PSS Central Institute of Vocational Education (PSSCIVE) was entrusted the responsibility to develop learning outcome based curricula, student workbooks, teacher handbooks and e-learning materials for the job roles in various sectors, with growth potential for employment.

The PSSCIVE firmly believes that the vocationalisation of education in the nation need to be established on a strong footing of philosophical, cultural and sociological traditions and it should aptly address the needs and aspirations of the students besides meeting the skill demands of the industry. The curriculum, therefore, aims at developing the desired professional, managerial and communication skills to fulfill the needs of the society and the world of work. In order to honor its commitment to the nation, the PSSCIVE has initiated the work on developing learning outcome based curricula with the involvement of faculty members and leading experts in respective fields. It is being done through the concerted efforts of leading academicians, professionals, policy makers, partner institutions, Vocational Education and Training experts, industry representatives, and teachers. The expert group through a series of consultations, working group meetings and use of reference materials develops a National Curriculum. Currently, the Institute is working on developing curricula and course-ware for over 100 job roles in various sectors.

We extend our gratitude to all the contributors for selflessly sharing their precious knowledge, acclaimed expertise, and valuable time and positively responding to our request for development of curriculum. We are grateful to MHRD and NCERT for the financial support and cooperation in realising the objective of providing learning outcome based modular curricula and course-ware to the States and other stakeholders under the PAB (Project Approval Board) approved project of *Rashtriya Madhyamik Shiksha Abhiyan (RMSA)* of MHRD.

Finally, for transforming the proposed curriculum design into a vibrant reality of implementation, all the institutions involved in the delivery system shall have to come together with a firm commitment and they should secure optimal community support. The success of this curriculum depends upon its effective implementation and it is expected that the managers of vocational education and training system, including subject teachers will make efforts to create better facilities, develop linkages with the world of work and foster a conducive environment as per the content of the curriculum document.

The PSSCIVE, Bhopal remains committed in bringing about reforms in the vocational education and training system through the learner-centric curricula and course-ware. We hope that this document will prove useful in turning out more competent Indian workforce for the 21st Century.

RAJESH P. KHAMBAYAT
Joint Director

PSS Central Institute of Vocational Education

ACKNOWLEDGMENT

On behalf of the team at the PSS Central Institute of Vocational Education (PSSCIVE) we are grateful to the members of the Project Approval Board (PAB) of Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and the officials of the Ministry of Human Resource Development (MHRD), Government of India for the financial support to the project for development of curricula.

We are grateful to the Director, NCERT for his support and guidance. We also acknowledge the contributions of our colleagues at the Technical Support Group of RMSA, MHRD, RMSA Cell at the National Council of Educational Research and Training (NCERT), National Skill Development Agency (NSDA) and National Skill Development Corporation (NSDC) and Electronics Sector Skill Council of India (ESSCI) for their academic support and cooperation.

We are grateful to the expert contributors and Deepak D. Shudhalwar, Associate Professor (CSE), PSSCIVE, for their earnest effort and contributions in the development of this learning outcome based curriculum. Their contributions are duly acknowledged.

The contributions made by Vinay Swarup Mehrotra, Professor and Head, Curriculum Development and Evaluation Centre (CDEC), Vipin Kumar Jain, Associate Professor and Head, Programme Planning and Monitoring Cell (PPMC) and Deepak Shudhalwar, Associate Professor (CSE) and Head, Computer Centre, PSSCIVE in development of the curriculum for the employability skills are duly acknowledged.

We are also grateful to the Course Coordinator Deepak D. Shudhalwar, Associate Professor (CSE), Head, Department of Engineering and Technology, PSSCIVE, for bringing out this curriculum in the final form.

PSSCIVE Team

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1. COURSE OVERVIEW

COURSE TITLE: Field Technician Refrigerator

Refrigerator Field Technician: Also, called 'Fridge Technician', the Refrigerator Field Technician provides installation and after sales service to the refrigerator buyers. The individual at work interacts with customers to install the refrigerator and diagnose the problem to assess possible causes of malfunction. Once the problem and causes have been identified, the individual rectifies minor problems or replaces faulty modules for failed parts or recommends factory repairs for bigger faults. The individual must be willing to work in the field and travel through the day from one customer's premise to another. Punctuality, amenable behaviour, patience, good interpersonal relationship building, trustworthiness, integrity, and critical thinking are important attributes for this job.

After completion of the job role on Field Technician Refrigerator, the candidate may opt a career as a technician, service engineer. After having training on designing, s/he can become a product designer.

COURSE OUTCOMES: On completion of the course, students should be able to:

- 🌐 Apply effective oral and written communication skills to interact with customers;
- 🌐 Identify the principal components of a computer system;
- 🌐 Demonstrate the basic skills of using computer;
- 🌐 Demonstrate self-management skills;
- 🌐 Demonstrate the ability to provide a self-analysis in context of entrepreneurial skills;
- 🌐 Demonstrate the knowledge of the importance of green skills in meeting the challenges of sustainable development and environment protection;
- 🌐 Identify the basic parameters of electricity;
- 🌐 Demonstrate to verify the Ohm's Law and Kirchhoff's Law;
- 🌐 Develop an electric circuit and explain its types;
- 🌐 Identify and list active, passive and electromechanical components used in a circuit;
- 🌐 Demonstrate to read values of electronic components;
- 🌐 Identify and use different hand tools and electronics tools;
- 🌐 Identify the different types and models of refrigerator with its features;
- 🌐 Conduct pre-installation tasks;
- 🌐 Conduct installation of refrigerator ;
- 🌐 Conduct post-installation tasks;
- 🌐 Perform troubleshooting to identify the fault and its cause;
- 🌐 Repair or replace the dysfunctional part of refrigerator ;
- 🌐 Perform post-repair check up and documentation;
- 🌐 Identify, troubleshoot and resolve IoT application related issues;
- 🌐 Identify, troubleshoot and resolve hardware related issues;
- 🌐 Check the functionality after troubleshooting through mobile app;
- 🌐 Comply with the standard safety procedures to maintain a safe work area;

COURSE REQUIREMENTS: The learner should have basic knowledge of science.

COURSE LEVEL: This course can be taken up at Intermediate level in Class 11 and Class 12.

COURSE DURATION: Total : 600 hours
 Class 11 : 300 hours
 Class 12 : 300 hours

2. SCHEME OF UNITS AND ASSESSMENT

This course is a planned sequence of instructions consisting of Units meant for developing employability and vocational competencies of students of Class 11 and 12 opting for vocational subject along with general education subjects. The unit-wise distribution of hours and marks for Class 11 is as follows :

CLASS 11			
	Units	No. of Hours for Theory and Practical 300	Max. Marks for Theory & Practical 100
Part A	Employability Skills		
Unit 1	Communication Skills – III	25	10
Unit 2	Self-management Skills – III	25	
Unit 3	Basic ICT Skills – III	20	
Unit 4	Entrepreneurial Skills – III	25	
Unit 5	Green Skills – III	15	
	Total	110	10
Part B	Vocational Skills		
Unit 1	Basic Electricity	30	40
Unit 2	Basic Electronics	40	
Unit 3	Refrigerator Technology	30	
Unit 4	Installation of Refrigerator	45	
Unit 5	Workplace Safety Measures	20	
	Total	165	40
Part C	Practical Work		
	Practical Examination	6	15
	Written Test	1	10
	Viva Voce	3	10
	Total	10	35
Part D	Project Work/Field Visit		
	Practical File/ Student Portfolio	10	10
	Viva Voce	5	5
	Total	15	15
	Total	300	100

The unit-wise distribution of hours and marks for **Class 12** is as follows:

CLASS 12			
	Units	No. of Hours for Theory and Practical 300	Max. Marks for Theory and Practical 100
Part A	Employability Skills		
Unit 1	Communication Skills – IV	25	10
Unit 2	Self-management Skills – IV	25	
Unit 3	Basic ICT Skills – IV	20	
Unit 4	Entrepreneurial Skills – IV	25	
Unit 5	Green Skills – IV	15	
	Total	110	10
Part B	Vocational Skills		
Unit 1	Repair and Maintenance of Refrigerator	70	40
Unit 2	Advanced Technologies in Refrigeration	25	
Unit 3	Troubleshooting IoT applications in Refrigerator	50	
Unit 4	Workplace Safety Measures	20	
	Total	165	40
Part C	Practical Work		
	Practical Examination	6	15
	Written Test	1	10
	Viva Voce	3	10
	Total	10	35
Part D	Project Work/Field Visit		
	Practical File/ Student Portfolio	10	10
	Viva Voce	5	5
	Total	15	15
	Total	300	100

3. TEACHING/TRAINING ACTIVITIES

The teaching and training activities have to be conducted in classroom, laboratory/ workshops and field visits. Students should be taken to field visits for interaction with experts and to expose them to the various tools, equipment, materials, procedures and operations in the workplace.

Special emphasis should be laid on the occupational safety, health and hygiene during the training and field visits.

CLASSROOM ACTIVITIES

Classroom activities are an integral part of this course and interactive lecture sessions, followed by discussions should be conducted by trained vocational teachers. Vocational teachers should make effective use of a variety of instructional aids, such as audio-video materials, colour slides, charts, diagrams, models, exhibits, hand-outs, online teaching materials, etc. to transmit knowledge and impart training to the students.

PRACTICAL WORK IN LABORATORY/WORKSHOP

Practical work may include but not limited to hands-on-training, simulated training, role play, case based studies, exercises, etc. Equipment and supplies should be provided to enhance hands-on learning experience of students. Only trained personnel should teach specialized techniques. A training plan that reflects tools, equipment, materials, skills and activities to be performed by the students should be submitted by the vocational teacher to the Head of the Institution.

FIELD VISITS/ EDUCATIONAL TOUR

In field visits, children will go outside the classroom to obtain specific information from experts or to make observations of the activities. A checklist of observations to be made by the students during the field visits should be developed by the Vocational Teachers for systematic collection of information by the students on the various aspects. Principals and Teachers should identify the different opportunities for field visits within a short distance from the school and make necessary arrangements for the visits. At least three field visits should be conducted in a year.

4. ASSESSMENT AND CERTIFICATION

Upon successful completion of the course by the candidate, the Central/ State Examination Board for Secondary Education and the respective Sector Skill Council will certify the competencies.

The National Skills Qualifications Framework (NSQF) is based on outcomes referenced to the National Occupation Standards (NOSs), rather than inputs. The NSQF level descriptors, which are the learning outcomes for each level, include the process, professional knowledge, professional skills, core skills and responsibility. The assessment is to be undertaken to verify that individuals have the knowledge and skills needed to perform a particular job and that the learning programme undertaken has delivered education at a given standard. It should be closely linked to certification so that the individual and the employer could come to know the competencies acquired through the vocational subject or course. The assessment should be reliable, valid, flexible, convenient, cost effective and above all it should be fair and transparent. Standardized assessment tools should be used for assessment of knowledge of students. Necessary arrangements should be made for using technology in assessment of students.

KNOWLEDGE ASSESSMENT (THEORY)

Knowledge Assessment should include two components: one comprising of internal assessment and second an external examination, including theory examination to be conducted by the Board. The assessment tools shall contain components for testing the knowledge and application of knowledge. The knowledge test can be objective paper based test or short structured questions based on the content of the curriculum.

WRITTEN TEST

It allows candidates to demonstrate that they have the knowledge and understanding of a given topic. Theory question paper for the vocational subject should be prepared by the subject experts comprising group of experts of academicians, experts from existing vocational subject experts/teachers, and subject experts from university/colleges or industry. The respective Sector Skill Council should be consulted by the Central/State Board for preparing the panel of experts for question paper setting and conducting the examinations.

The blue print for the question paper may be as follows:

Duration: 3 hrs

Max. Mark: 30

	Typology of Question	No. of Questions			Marks
		Very Short Answer (1 mark)	Short Answer (2 Marks)	Long Answer (3 Marks)	
1.	Remembering – (Knowledge based simple recall questions, to know specific facts, terms, concepts, principles, or theories; identify, define or recite, information)	3	2	2	13
2.	Understanding – (Comprehension – to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase, or interpret information)	2	3	2	14
3.	Application – (Use abstract information in concrete situation, to apply knowledge to new situations: Use given content to interpret a situation, provide an example, or solve a problem)	0	2	1	07
4.	High Order Thinking Skills – (Analysis & Synthesis – Classify, compare, contrast, or differentiate between different pieces of information; Organize and/ or integrate unique pieces of information from a variety of sources)	0	2	0	04
5.	Evaluation – (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	0	1	0	02
	Total	5x1=5	10x2=20	5x3=15	40 (20 Ques.)

SKILL ASSESSMENT (PRACTICAL)

Assessment of skills by the students should be done by the assessors/examiners on the basis of practical demonstration of skills by the candidate, using a competency checklist. The competency checklist should be developed as per the National Occupation Standards (NOSs) given in the Qualification Pack for the Job Role to bring about necessary consistency in the quality of assessment across different sectors and Institutions. The student has to demonstrate competency against the performance criteria defined in the National Occupation Standards and the assessment will indicate that they are 'competent', or are 'not yet competent'. The assessors assessing the skills of the students should possess a current experience in the industry and should

have undergone an effective training in assessment principles and practices. The Sector Skill Councils should ensure that the assessors are provided with the training on the assessment of competencies.

Practical examination allows candidates to demonstrate that they have the knowledge and understanding of performing a task. This will include hands-on practical exam and viva voce. For practical, there should be a team of two evaluators – the subject teacher and the expert from the relevant industry certified by the Board or concerned Sector Skill Council. The same team of examiners will conduct the viva voce.

Project Work (individual or group project) is a great way to assess the practical skills on a certain time period or timeline. Project work should be given on the basis of the capability of the individual to perform the tasks or activities involved in the project. Projects should be discussed in the class and the teacher should periodically monitor the progress of the project and provide feedback for improvement and innovation. Field visits should be organised as part of the project work. Field visits can be followed by a small-group work/project work. When the class returns from the field visit, each group might be asked to use the information that they have gathered to prepare presentations or reports of their observations. Project work should be assessed on the basis of practical file or student portfolio.

Student Portfolio is a compilation of documents that supports the candidate's claim of competence. Documents may include reports, articles, photos of products prepared by students in relation to the unit of competency.

Viva voce allows candidates to demonstrate communication skills and content knowledge. Audio or video recording can be done at the time of viva voce. The number of external examiners would be decided as per the existing norms of the Board and these norms should be suitably adopted/adapted as per the specific requirements of the vocational subject. Viva voce should also be conducted to obtain feedback on the student's experiences and learning during the project work/field visits.

CONTINUOUS AND COMPREHENSIVE EVALUATION

Continuous and Comprehensive Evaluation (CCE) refers to a system of school-based evaluation of students that covers all aspects of student's development. In this scheme, the term 'continuous' is meant to emphasize that evaluation of identified aspects of students 'growth and development' is a continuous process rather than an event, built into the total teaching-learning process and spread over the entire span of academic session. The second term 'comprehensive' means that the scheme attempts to cover both the scholastic and the co-scholastic aspects of students' growth and development. For details, the CCE manual of Central Board of Secondary Education (CBSE) or the guidelines issued by the State Boards on the procedure for CCE should be followed by the Institutions.

5. UNIT CONTENTS

CLASS 11

Part A: Employability Skills

Unit No.	Unit Name	Duration in Hours
Unit 1	Communication Skills – III	25
Unit 2	Self-management Skills – III	25
Unit 3	Basic ICT Skills – III	20
Unit 4	Entrepreneurial Skills – III	25
Unit 5	Green Skills – III	15
	Total	110

Unit 1: Communication Skills – III

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Demonstrate knowledge of various methods of communication	<ul style="list-style-type: none"> ■ Methods of communication ■ Verbal ■ Non-verbal ■ Visual 	<ul style="list-style-type: none"> ■ Writing pros and cons of written, verbal and non-verbal communication ■ Listing do's and don'ts for avoiding common body language mistakes 	15
2.	Identify specific communication styles	<ul style="list-style-type: none"> ■ Communication styles- assertive, aggressive, passive-aggressive, submissive, etc. 	<ul style="list-style-type: none"> ■ Observing and sharing communication styles of friends, teachers and family members and adapting the best practices ■ Role plays on communication styles. 	10
3.	Demonstrate basic writing skills	<ul style="list-style-type: none"> ■ Writing skills to the following: ■ Sentence ■ Phrase ■ Kinds of Sentences ■ Parts of Sentence ■ Parts of Speech ■ Articles ■ Construction of a Paragraph 	<ul style="list-style-type: none"> ■ Demonstration and practice of writing sentences and paragraphs on topics related to the subject 	15
			Total Duration in Hours	25

Unit 2: Self-management Skills – III

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Demonstrate impressive appearance and grooming	<ul style="list-style-type: none"> ■ Describe the importance of dressing appropriately, looking decent and positive body language. ■ Describe the term grooming ■ Prepare a personal grooming checklist. ■ Describe the techniques of self-exploration. 	<ul style="list-style-type: none"> ■ Demonstration of impressive appearance and groomed personality. ■ Demonstration of the ability to self- explore. 	07
2.	Demonstrate team work skills	<ul style="list-style-type: none"> ■ Describe the important factors that influence in team building. ■ Describe factors influencing team work. 	<ul style="list-style-type: none"> ■ Group discussion on qualities of a good team. ■ Group discussion on strategies that are adopted for team building and team work. 	08
3.	Apply time management strategies and techniques	<ul style="list-style-type: none"> ■ Meaning and importance of time management – setting and prioritizing goals, creating a schedule, making lists of tasks, balancing work and leisure, using different optimization tools to break large tasks into smaller tasks. 	<ul style="list-style-type: none"> ■ Game on time management. ■ Checklist preparation. ■ To-do-list preparation. 	10
			Total Duration in Hours	25

Unit 3: Basic ICT Skills – III

Sn	Learning Outcome	Theory (08 Hours)	Practical (12 Hours)	20 Hrs
1.	Create a document on word processor	<ul style="list-style-type: none"> ■ Introduction to word processing. ■ Software packages for word processing. ■ Opening and exiting the word processor. ■ Creating a document 	<ul style="list-style-type: none"> ■ Demonstration and practice of the following: ■ Listing the features of word processing, ■ Listing the software packages for word processing, ■ Opening and exit the word processor, ■ Creating a document 	10
2.	Edit, save and print a document in word processor	<ul style="list-style-type: none"> ■ Editing text ■ Wrapping and aligning the text ■ Font size, type and face. ■ Header and Footer ■ Auto correct 	<ul style="list-style-type: none"> ■ Demonstration and practicing the following: ■ Editing the text ■ Word wrapping and alignment, 	10

		<ul style="list-style-type: none"> ■ Numbering and bullet ■ Creating table ■ Find and replace ■ Page numbering. ■ Printing document. ■ Saving a document in various formats 	<ul style="list-style-type: none"> ■ Changing font type, size and face, ■ Inserting header and footer, ■ Removing header and footer, ■ Using autocorrect option, ■ Insert page numbers and bullet, ■ Save and print a document. 	
			Total Duration in Hours	20

Unit 4: Entrepreneurial Skills – III

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Describe the significance of entrepreneurial values and attitude.	<ul style="list-style-type: none"> ■ Values in general and entrepreneurial values. ■ Entrepreneurial value orientation with respect to inattentiveness, independence, outstanding performance and respect for work. 	<ul style="list-style-type: none"> ■ Listing of entrepreneurial values by the students. ■ Group work on identification of entrepreneurial values and their roles after listing or reading 2-3 stories of successful entrepreneur. ■ Exhibiting entrepreneurial values in Ice breaking, rapport building, group work and home assignments. 	10
2.	Demonstrate the knowledge of attitudinal changes required to become an entrepreneur.	<ul style="list-style-type: none"> ■ Attitudes in general and entrepreneurial attitudes ■ Using imagination/ intuition ■ Tendency to take moderate risk ■ Enjoying freedom of expression and action ■ Looking for economic opportunities ■ Believing that we can change the environment ■ Analyzing situation and planning action ■ Involving in activity 	<ul style="list-style-type: none"> ■ Preparing a list of factors that influence attitude in general and entrepreneurial attitude. ■ Demonstrating and identifying own entrepreneurial attitudes during the following micro lab activities like thematic appreciation test. ■ Preparing a short write-up on "who am I". ■ Take up a product and suggest how its features can be improved. ■ Group activity for suggesting brand names, names of enterprises, etc. 	15
			Total Duration in Hours	25

Unit 5: Green Skills – III

Sn	Learning Outcome	Theory (07 Hours)	Practical (08 Hours)	15 Hrs
1.	Describe importance of main sector of green economy	<ul style="list-style-type: none"> ■ Main sectors of green economy- E-waste management, green transportation, renewal energy, green construction, water management. ■ Policy initiatives for greening economy in India. 	<ul style="list-style-type: none"> ■ Preparing a poster on any one of the sectors of green economy. ■ Writing a two-page essay on important initiatives taken in India for promoting green economy. 	08
2.	Describe the major green Sectors/ Areas and the role of various stakeholder in green economy	<ul style="list-style-type: none"> ■ Stakeholders in green economy. ■ Role of government and private agencies in greening cities, buildings, tourism, industry, transport, renewable energy, waste management, agriculture, water, forests and fisheries. 	<ul style="list-style-type: none"> ■ Preparing posters on green Sectors/Areas: cities, buildings, tourism, industry, transport, renewable energy, waste management, agriculture, water, forests and fisheries. 	07
			Total Duration in Hours	15

Class XI, Part B: Vocational Skills

Unit No.	Unit Name	Duration in Hours
Unit 1	Basic Electricity	30
Unit 2	Basic Electronics	40
Unit 3	Refrigerator Technology	30
Unit 4	Installation of Refrigerator	45
Unit 5	Workplace Safety Measures	20
Total Duration		165

Unit 1: Basic Electricity

Sn	Learning Outcome	Theory (12 Hours)	Practical (18 Hours)	30 Hrs
1.	Describe the basic concept of electricity	<ul style="list-style-type: none"> ■ Definition of electricity, ■ Types of electricity – AC, DC ■ Definition of Current, Voltage, Resistance ■ Concept of frequency and time period ■ Electrostatics 	<ul style="list-style-type: none"> ■ Switch on/ off the electrical appliances such as electric fan, TV, Refrigerator and observe the presence of electricity. ■ Observe the presence of power in mobile phones 	8

		<ul style="list-style-type: none"> ■ Laws of Electrostatics ■ Potential and Potential difference ■ Concept of magnetic field ■ Comparison between magnetic circuit and electric circuit ■ Electromagnetic induction ■ Electromagnetic force emf ■ Measurement units of current, voltage and resistance 	<p>without connecting to electricity.</p> <ul style="list-style-type: none"> ■ Read the voltage, current, resistance, ratings of the appliances. ■ Demonstrate the experiment of magnetic attraction. ■ List the measurement units of voltage, current, resistance 	
2.	Verify the laws of electricity	<ul style="list-style-type: none"> ■ Ohm's law ■ Kirchhoff's law ■ Faraday's law of electromagnetic induction 	<ul style="list-style-type: none"> ■ Verify the ohm's law by using ohm's experiment. ■ Verify the Kirchhoff's law by using experiment. ■ Verify Faraday's law of electromagnetic induction 	4
3.	Identify and connect the electrical components in series and parallel combination	<ul style="list-style-type: none"> ■ Resistor and types of resistor ■ Resistance in series and parallel combination ■ Capacitor and types of capacitors ■ Capacitor in series and parallel combination ■ Charging and discharging capacitor ■ Inductor and types of inductor ■ Concept of resonance circuit ■ Series RLC and parallel RLC circuit ■ Concept of filter circuit ■ Band stop and band pass filter circuits 	<ul style="list-style-type: none"> ■ Identify different types of resistors. ■ Connect the resistor in series and parallel combination and measure effective resistance. ■ Identify different types of capacitors. ■ Connect the capacitors in series and parallel combination and measure effective capacitance. ■ Demonstrate the charging and discharging of capacitor ■ Identify different types of inductors. ■ Demonstrate the experiment of series and parallel RLC. ■ Demonstrate the experiment of band stop and band pass filter circuits 	10
4.	Describe the concept of power and motor	<ul style="list-style-type: none"> ■ Definition of power ■ Unit of power measurement ■ Maximum power transfer theorem ■ Self induction and mutual induction ■ AC motors, DC motors ■ Starter in motors 	<ul style="list-style-type: none"> ■ Read the power ratings on LED bulb. ■ Perform an experiment to demonstrate the working of AC motor and DC motor. 	8
			Total Duration in Hours	30

Unit 2: Basic Electronics

Sn	Learning Outcome	Theory (12 Hours)	Practical (18 Hours)	30 Hrs
1.	Determine the values of basic electronic components	<ul style="list-style-type: none"> ■ Relay, contractor and switches ■ Electronic components ■ Types of electronic components – active and passive components ■ Color code of resistors ■ Color code of capacitors ■ Transformer, types of transformer 	<ul style="list-style-type: none"> ■ Draw the symbol of the given relay, contractor and switches ■ List the active and passive components and draw their symbols ■ Determine the value of resistance by using color code ■ Determine the value of capacitor by using color code ■ Determine the input and output voltage of a given transformer 	6
2.	Measure electrical quantities and test electronic components	<ul style="list-style-type: none"> ■ Measuring instruments – Multi-meter analog and digital, Cathode Ray Oscilloscope (CRO), ■ Measurement of AC, DC voltage and current using multi-meter ■ Measurement of AC, DC voltage and current using CRO ■ Measurement of frequency and time period using CRO ■ Testing of electronic component using CRO 	<ul style="list-style-type: none"> ■ Measure the given AC, DC voltage and current by using analog multi-meter ■ Measure the given AC, DC voltage and current by using digital multi-meter ■ Measure the given AC, DC voltage and current using CRO ■ Measure the frequency and time period of the given input by using CRO ■ Test electronic component using CRO 	6
3.	Describe and test semiconductor diode	<ul style="list-style-type: none"> ■ Concept of semiconductor ■ PN Junction diode ■ Forward and reverse bias characteristics of PN junction diode ■ Testing of PN junction diodes using multimeter ■ Specialised diodes such as zener diode, schottky diode, light emitting diode, photo diode, thermistor 	<ul style="list-style-type: none"> ■ Draw the symbol of PN junction diode and determine the name of terminals by observing the PN junction diode ■ Test the continuity of given diode using multimeter ■ Construct the circuit for forward and reverse bias of the diode and draw its characteristic curve ■ Draw the characteristics curve of zener diode, schottky diode, light emitting diode, photo diode and thermistor 	5
4.	Identify and test the transistor and transistor amplifier	<ul style="list-style-type: none"> ■ Bipolar transistors ■ Field effect transistors ■ Transistor biasing ■ Transistor amplifier 	<ul style="list-style-type: none"> ■ Draw the symbols of NPN and PNP bipolar transistors ■ Draw the symbols of Field Effect Transistors 	8

		<ul style="list-style-type: none"> ■ CE, CB and CC amplifiers ■ Power amplifier ■ Oscillators ■ Multi vibrators 	<ul style="list-style-type: none"> ■ Identify Base, Emitter and Collector terminals of the given transistor using multimeter ■ Test the continuity of given transistor by using multimeter ■ Demonstrate the saw tooth oscillators circuit and observe waveform on CRO ■ Demonstrate astable, mono-stable, and bi-stable multi-vibrator circuit using kit and observe their waveform in CRO 	
5.	Construct the circuit for rectifier and power supply	<ul style="list-style-type: none"> ■ Rectifiers, half wave and full wave rectifiers ■ Regulated power supply using zener diode 	<ul style="list-style-type: none"> ■ Draw the waveform of half wave rectifier and construct the circuit, measure input and output voltage ■ Draw the waveform of full wave rectifier and construct the circuit, measure input and output voltage ■ Draw the waveform of regulated power supply using zener diode and measure input and output voltage 	4
6.	Identify and test the integrated circuits (IC)	<ul style="list-style-type: none"> ■ Integrated Circuits (IC) ■ Classification of Integrated Circuits ■ Parameters of Integrated Circuits 	<ul style="list-style-type: none"> ■ List the different parameters for the given IC by using IC manual/ data sheet ■ Test the pins of IC using multimeter 	3
7.	Test the IC of various logic gates	<ul style="list-style-type: none"> ■ Introduction to digital electronics ■ Number systems, logic gates, arithmetic circuits, ■ Half adder, full adder 	<ul style="list-style-type: none"> ■ Convert the given decimal number into binary, octal and hexadecimal numbers ■ Construct the circuit for AND, OR and NOT gate and verify its truth table ■ Construct the circuit for half adder and full adder and verify its truth table 	4
8.	Construct the electric circuit using transducer	<ul style="list-style-type: none"> ■ Concept of transducer ■ Classification of transducer ■ Thermocouple transducer – NTC, PTC ■ Inductive transducer ■ Capacitive transducer ■ Microphone and loudspeaker 	<ul style="list-style-type: none"> ■ Identify the type of transducer ■ Construct the circuit by using thermocouple and thermister and observe how temperature is converted into voltage ■ Construct the circuit by using microphone and loudspeaker and observe how sound is 	4

			converted into electric signals	
			Total Duration in Hours	40

Unit 3: Refrigerator Technology

Sn	Learning Outcome	Theory (15 Hours)	Practical (15 Hours)	30 Hrs
1.	Describe the compressor technology	<ul style="list-style-type: none"> ■ Type of compressor – Hermatic, Semihermatic, Rotary, Screw, Scroll, Direct drive, Belt drive, Centrifugal compressor, Thermo compressor, Wobble plate, Swash plate ■ Reciprocating compressor ■ Internal parts of reciprocating compressor ■ Various terms associated with reciprocating compressor – Compression stroke, Suction stroke, Compression ratio, Top dead centre (TDC), Bottom dead centre (BDC), Clearance pocket, Bypass capacity control, Volumetric efficiency, Compression speed, Capacity control methods 	<ul style="list-style-type: none"> ■ Identify the compressor ■ Demonstrate the functioning of compressor ■ Identify and list the types of compressor ■ List the advantages and disadvantages of reciprocating compressor ■ List the different terms associated with reciprocating compressor ■ Demonstrate the Internal parts of reciprocating compressor 	8
2.	Describe inverter technology in refrigerator	<ul style="list-style-type: none"> ■ Inverter technology – concept, Variable speed, Power saving, Less noise, 	<ul style="list-style-type: none"> ■ Demonstrate the speed control of compressor using frequency ■ List the features of inverter technology 	6
3.	Demonstrate the functioning of motors in refrigerator	<ul style="list-style-type: none"> ■ Motor used in refrigerator, Types of motor, Construction of motors, Working, Function of starting relays, capacitor, Overload protector ■ Starting method – Resistance Start Induction Run (RSIR), Positive temperature coefficient start induction run (PTCSIR), Positive temperature coefficient start capacitive run (PTCSCR) ■ Fan motor - Shaded pole 	<ul style="list-style-type: none"> ■ Demonstrate the different types of motors ■ Demonstrate the parts of fan motor ■ Demonstrate the parts of compressor motor ■ List the feature of relay and overload protector ■ Draw the circuit diagram of different starting methods 	10

		<p>induction motor</p> <ul style="list-style-type: none"> ■ Compressor motor – Split phase induction motor 		
4.	Identify the different refrigerants	<ul style="list-style-type: none"> ■ Definition of refrigerants ■ Characteristics of refrigerants ■ Eco-friendly, economical and efficient refrigerants. ■ Refrigerant numbering and color codes ■ Different types refrigerants such as R600a, R134, Hydrocarbon (HC) ■ Refrigerant cylinders and valves. ■ Ozone layer and green house effect 	<ul style="list-style-type: none"> ■ Identify the refrigerants by using pressure gauge. ■ Identify the different refrigerants by using color codes. ■ Prepare a chart of refrigerant color codes. 	6
Total Duration in Hours				30

Unit 4: Installation of Refrigerator

Sn	Learning Outcome	Theory (15 Hours)	Practical (30 Hours)	45 Hrs
1	Describe the refrigeration cycle	<ul style="list-style-type: none"> • Refrigeration – Concept, Application, measuring unit – Calorie, Kilo-calorie, British Thermal Unit, • Types of Refrigeration system/cycle – Absorption refrigeration system, vapour compression refrigeration system, steam jet refrigeration system, air refrigeration system 	<ul style="list-style-type: none"> • Perform the experiment of heating the water, observe the amount of heat absorb by water in calories • Demonstrate the different types of refrigeration system and its application • Search on the internet and list the application of refrigeration • Draw the diagram of refrigeration cycle 	8
2	Describe the basic gas laws, pressure, temperature, energy conversion	<ul style="list-style-type: none"> • Basic gas laws - Dalton's law of partial pressure, Avagadro's law, Joule Thompson effect , Boyle's law, Charle's law • Concept of Pressure, atmospheric pressure, absolute pressure, absolute zero • Concept of Energy conversion- Heat engine, Heat pump 	<ul style="list-style-type: none"> • Search on the internet and list the appliances which uses Dalton's law of partial pressure, Avagadro's law, Joule Thompson effect, Boyle's law, Charle's law • Demonstrate the measurement of atmospheric pressure • Perform experiment to verify Dalton's law of partial pressure, Avagadro's law, Joule Thompson effect, Boyle's law, 	10

			Charle's law	
3	Demonstrate the refrigerator assembly	<ul style="list-style-type: none"> Refrigerator – Definition, application Different types of refrigerator – direct cool, frost free (Double door) Parts of refrigerator – Compressor (Reciprocating compressor), thermostat, positive temperature coefficient relay (PTCR), overload protector, defrost timer, control panel, bimetal, thermal fuse, heater coil Different features and functionality of various refrigerator models 	<ul style="list-style-type: none"> Demonstrate the different types of refrigerator Demonstrate the parts of refrigerator List the distinguishing features of different models of refrigerator Draw the line diagram of refrigeration cycle and electrical wiring diagram 	10
4	Use basic tools and equipment	<ul style="list-style-type: none"> Tools for installation – cutter, scissors, screwdriver, clamp meter, combination plier 	<ul style="list-style-type: none"> Demonstrate the use of cutter, scissors, screwdriver, combination plier Demonstrate the continuity testing, resistance, voltage and current testing using clamp meter Demonstrate to check the compressor using the clamp meter 	5
5	Install the refrigerator	<ul style="list-style-type: none"> Site preparation, Refrigerator unpackaging, Refrigerator placing, Installation setup, Fix different parts Accessories of refrigerator – Voltage stabilizer, refrigerator stand, vegetable tray 	<ul style="list-style-type: none"> Check functionality of all the parts – fan, compressor Check the proper earthing in the power supply Check the required input voltage in power socket using clamp meter 	8
6	Complete post installation procedure	<ul style="list-style-type: none"> Post installation procedure Documents and records such as Job-sheet Packaging based disposal procedure 	<ul style="list-style-type: none"> Demonstrate the function of refrigerator to the customer Fill online warranty of product Demonstrate the procedure to claim the warranty online Demonstrate to install additional accessories 	4
			Total Duration in Hours	45

Unit 5: Workplace Safety Measures

Sn	Learning Outcome	Theory (10 Hours)	Practical (10 Hours)	20 Hrs
1	Observe electrical and safety measures	<ul style="list-style-type: none"> Electrical earthing Different hazards related to installation and repair of refrigerator Safety guidelines while installation and repair of refrigerator Workplace safety policies and general guidelines 	<ul style="list-style-type: none"> Demonstrate to check electrical earthing Identify and list different hazards related to installation and repair of refrigerator List and use the organisational safety guidelines while installation and repair of refrigerator 	5
2	Use proper personal protective equipment (PPE)	<ul style="list-style-type: none"> Electrical safety guidelines by using proper personal protective equipment (PPE) 	<ul style="list-style-type: none"> Demonstrate the use of proper personal protective equipment (PPE) for electrical safety 	7
3	Use safety and protection equipment	<ul style="list-style-type: none"> Safety and protection equipment such as fire extinguisher, safety instrument and clothing Basic first aid Types of accident injury or hazard 	<ul style="list-style-type: none"> Demonstrate the use of safety and protection equipment Demonstrate the use of first aid to provide the basic first aid Identify and report any accident injury or hazard 	8
			Total Duration in Hours	20

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CLASS 12

Part A: Employability Skills

Unit No.	Unit Name	Duration in Hours
Unit 1	Communication Skills – IV	25
Unit 2	Self-management Skills – IV	25
Unit 3	Basic ICT Skills – IV	20
Unit 4	Entrepreneurial Skills – IV	25
Unit 5	Green Skills – IV	15
	Total	110

Unit 1: Communication Skills – IV

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Describe the steps to active listening skills	<ul style="list-style-type: none"> ■ Importance of active listening at workplace ■ Steps to active listening. 	<ul style="list-style-type: none"> ■ Demonstration of the key aspects of becoming active listener. ■ Preparing posters of steps for active listening. 	10
2.	Demonstrate basic writing skills	<ul style="list-style-type: none"> ■ Writing skills to the following: ■ Sentence ■ Phrase ■ Kinds of Sentences ■ Parts of Sentence ■ Parts of Speech ■ Articles ■ Construction of a Paragraph 	<ul style="list-style-type: none"> ■ Demonstration and practice of writing sentences and paragraphs on topics related to the subject. 	15
			Total Duration in Hours	25

Unit 2: Self-management Skills – IV

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Describe the various factors influencing self-motivation	<ul style="list-style-type: none"> ■ Finding and listing motives (needs and desires); ■ Finding sources of motivation and inspiration (music, books, activities); expansive thoughts; living fully in the present moment; dreaming big. 	<ul style="list-style-type: none"> ■ Group discussion on identifying needs and desire. ■ Discussion on sources of motivation and inspiration. 	10
2.	Describe the basic	<ul style="list-style-type: none"> ■ Describe the meaning of 	<ul style="list-style-type: none"> ■ Demonstrate the knowledge of 	

personality traits, types and disorders	<p>personality.</p> <ul style="list-style-type: none"> ▣ Describe how personality influence others. ▣ Describe basic personality traits. ▣ Describe common personality disorders- paranoid, antisocial, schizoid, borderline, narcissistic, avoidant, dependent and obsessive. 	different personality types.	15
		Total Duration in Hours	25

Unit 3: Basic ICT Skills – IV

Sn	Learning Outcome	Theory (06 Hours)	Practical (14 Hours)	20 Hrs
1.	Perform tabulation using spreadsheet application	<ul style="list-style-type: none"> ▣ Introduction to spreadsheet application, ▣ Spreadsheet applications, ▣ Creating a new worksheet, ▣ Opening workbook and entering text, ▣ Resizing fonts and styles, ▣ Copying and moving, ▣ Filter and sorting, ▣ Formulas and functions, ▣ Password protection, ▣ Printing a spreadsheet, ▣ Saving a spreadsheet in various formats. 	<ul style="list-style-type: none"> ▣ Demonstration and practice on the following: ▣ Introduction to the spreadsheet application, ▣ Listing the spreadsheet applications, ▣ Creating a new worksheet, ▣ Opening the workbook and enter text, ▣ Resizing fonts and styles, ▣ Copy and move the cell data, ▣ Sorting and Filter the data, ▣ Applying elementary formulas and functions, ▣ Protecting the spreadsheet with password, ▣ Printing a spreadsheet, ▣ Saving the spreadsheet in various formats. 	10
2.	Prepare presentation using presentation application	<ul style="list-style-type: none"> ▣ Introduction to presentation, ▣ Software packages for presentation, ▣ Creating a new presentation, ▣ Adding a slide, ▣ Deleting a slide, ▣ Entering and editing text, ▣ Formatting text, ▣ Inserting clipart and images, ▣ Slide layout, ▣ Saving a presentation, ▣ Printing a presentation 	<ul style="list-style-type: none"> ▣ Demonstration and practice on the following: ▣ List the software packages with features for presentation, ▣ Creating a new presentation, ▣ Adding a slide to presentation, ▣ Deleting a slide, ▣ Entering and edit text, ▣ Formatting text, ▣ Inserting clipart and images, ▣ Sliding layout, ▣ Saving a presentation, 	10

		document.	☐ Printing a presentation.	
			Total Duration in Hours	20

Unit 4: Entrepreneurial Skills – IV

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Identify the general and entrepreneurial behavioral competencies	<ul style="list-style-type: none"> ☐ Barriers to becoming entrepreneur. ☐ Behavioral and entrepreneurial competencies – adaptability/decisiveness, initiative/perseverance, interpersonal skills, organizational skills, stress management, valuing service and diversity. 	<ul style="list-style-type: none"> ☐ Administering self-rating questionnaire and score responses on each of the competencies. ☐ Collect small story/ anecdote of prominent successful entrepreneurs. ☐ Identify entrepreneurial competencies reflected in each story and connect it to the definition of behavioral competencies. ☐ Preparation of competency profile of students. 	10
2.	Demonstrate the knowledge of self-assessment of behavioral competencies	<ul style="list-style-type: none"> ☐ Entrepreneurial competency in particular: self-confidence, initiative, seeing and acting on opportunities, concern for quality, goal setting and risk taking, problem solving and creativity, systematic planning and efficiency, information seeking, persistence, influencing and negotiating, team building. 	<ul style="list-style-type: none"> ☐ Games and exercises on changing entrepreneurial behavior and development of competencies for enhancing self-confidence, problem solving, goal setting, information seeking, team building and creativity. 	15
			Total Duration in Hours	25

Unit 5: Green Skills – IV

Sn	Learning Outcome	Theory (05 Hours)	Practical (10 Hours)	15 Hrs
1.	Identify the role and importance of green jobs in different sectors	<ul style="list-style-type: none"> ☐ Role of green jobs in toxin-free homes. ☐ Green organic gardening, public transport and energy conservation, ☐ Green jobs in water conservation. ☐ Green jobs in solar and wind 	<ul style="list-style-type: none"> ☐ Listing of green jobs and preparation of posters on green job profiles. ☐ Prepare posters on green jobs. 	15

		<p>power, waste reduction, reuse and recycling of wastes,</p> <ul style="list-style-type: none"> ■ Green jobs in green tourism ■ Green jobs in building and construction. ■ Green jobs in appropriate technology. ■ Role of green jobs in Improving energy and raw materials use ■ Role of green jobs in limiting greenhouse gas emissions ■ Role of green jobs minimizing waste and pollution ■ Role of green jobs in protecting and restoring ecosystems ■ Role of green jobs in support adaptation to the effects of climate change 		
			Total Duration in Hours	15

Class XII, Part B: Vocational Skills

Unit No.	Unit Name	Duration in Hours
Unit 1	Repair and Maintenance of Refrigeration	70
Unit 2	Advanced Technologies in Refrigeration	25
Unit 3	Troubleshooting IoT applications in Refrigeration	50
Unit 4	Workplace Safety Measures	20
	Total Duration	165

Unit 1: Repair and Maintenance of Refrigerator

Sn	Learning Outcome	Theory (25 Hours)	Practical (45 Hours)	70 Hrs
1.	Identify and check the faults in refrigerator	<ul style="list-style-type: none"> • Preventive maintenance of refrigerator – cleaning compressor, condenser, waste water tray, defrost, • Fault finding using customer interaction, initial inspection, symptom, history of problem, age of appliance, • Process for checking the components of refrigerator like compressor, capacitor, fan motor, PCB or control panel, 	<ul style="list-style-type: none"> • Demonstrate the preventive maintenance of refrigerator • List and resolve the common faults in refrigerator • Check the various components of refrigerator using continuity tester. Components – compressor, capacitor, fan motor, PCB or control panel, thermostat, overload protector, positive temperature coefficient relay (PTCR), 	25

		<p>thermostat, overload protector, positive temperature coefficient relay (PTCR),</p> <ul style="list-style-type: none"> Frost free refrigerator - Thermal fuse, Bimetal switch, Defrost timer, Heater coil 	<ul style="list-style-type: none"> Check thermal fuse, bimetal switch, defrost timer, heater coil, fan motor of frost free refrigerator Demonstrate the starting and running method of testing the compressor 	
2.	Use tools and test equipment for repairing	<ul style="list-style-type: none"> Testing equipment – clamp meter, pressure gauge, flexible charging line Tools for repair and servicing - Wiring accessories, Tube cutter, Flaring tool, Brazing torch, Vacuum pump weight scale, Gas cylinder, Temperature meter, breathing torch, adjustable wrench, Allen key, Flat file, Round file, gauge manifold, Tube cutter, 	<ul style="list-style-type: none"> Demonstrate to use : Clamp meter for measuring the electric current Pressure gauge to measure the pressure of compressor, Various test equipment for testing Various tools for repairing and servicing of refrigerator 	20
3.	Attempt common problem in repair maintenance of refrigerator	<ul style="list-style-type: none"> Some common problems, their possible causes and remedy of refrigerator such as – compressor do not start, compressor starts for few seconds and then switch off, humming sound from refrigerator, low temperature in cabinet, refrigerator not maintaining the freshness of food inside the refrigerator, energy consumption is much higher, short circuiting of electricity, Procedure for repairing of different components such as fan, PCB, brazing in case of gas leak, power supply, motor, compressor Procedure to check the functionality of repaired components Customer feedback 	<ul style="list-style-type: none"> Identify and list the common problems, their possible causes and remedy of refrigerator Carry out repairing of different components Demonstrate the checking of functionality and take customer feedback Prepare invoice of billing 	25
			Total Duration in Hours	70

Unit 2: Advanced Technologies in Refrigeration

Sn	Learning Outcome	Theory (10 Hours)	Practical (15 Hours)	25 Hrs
1.	Demonstrate the connectivity of refrigerator to Internet	<ul style="list-style-type: none"> • Internet technology • Internet of things (IoT) technology • Controlling refrigerator using smart phone Apps • Use of micro controller and sensors • Fuzzy logic technology 	<ul style="list-style-type: none"> • Establish the device connectivity to the wireless network using Internet technology • Demonstrate the different functionalities of App • Demonstrate the use of micro controller and sensors • Demonstrate the effect of cooling by using Fuzzy logic technology 	15
2.	Describe the advanced technology in refrigeration	<ul style="list-style-type: none"> • Concept of smart cooling • Auto clean technology • Anti-corrosive technology • Blue fin technology • Protection from voltage fluctuations and fire • Fast cooling technology • Efficient cooling technology • Convertible technology • Sixth sense technology • Taste guard technology 	<ul style="list-style-type: none"> • List various advanced technologies and their advantages • Demonstrate the features of convertible technology, smart cooling, auto clean technology, anti corrosive, blue fin, sixth sense and taste guard 	10
			Total Duration in Hours	25

Unit 3: Troubleshooting IoT applications in Refrigerator

Sn	Learning Outcome	Theory (20 Hours)	Practical (30 Hours)	50 Hrs
1	Identify common problem related to IoT applications	<ul style="list-style-type: none"> ☞ Common problem in IoT application ☞ List of error codes of related issues 	<ul style="list-style-type: none"> ☞ Demonstrate the troubleshooting of the product through mobile app ☞ Prepare a chart of error codes their cause and remedies 	15
2	Troubleshoot to resolve IoT software issues	<ul style="list-style-type: none"> ☞ Software issues - Internet connection, wi-fi, Bluetooth version compatibility ☞ Troubleshooting software issues ☞ Steps to resolve software issues ☞ Software setting – Update software and network setting 	<ul style="list-style-type: none"> ☞ Identify the issue and rectify the faulty sensor and circuit board ☞ Demonstrate the updation of software. ☞ Demonstrate the network setting in the installed software ☞ Identify and list the different cables and connectors use in 	15

			the network connectivity	
3	Troubleshoot to resolve IoT hardware issues	<ul style="list-style-type: none"> ■ Hardware issues - IoT circuit board, sensor, power connection, network cables ■ Steps for troubleshooting hardware issues ■ Steps to replace the faulty sensor and circuit board 	<ul style="list-style-type: none"> ■ List the common hardware issues ■ Troubleshoot the common hardware issues ■ Check and replace the faulty sensor and circuit board 	10
4	Ensure the functionality using mobile app	<ul style="list-style-type: none"> ■ Mobile app for checking the functionality ■ Various functions in mobile app ■ Troubleshooting through mobile app 	<ul style="list-style-type: none"> ■ Checking the functionality using mobile app ■ Demonstrate the refrigerator control using mobile app 	10
Total Duration in Hours				50

Unit 4: Workplace Safety Measures

Sn	Learning Outcome	Theory (8 Hours)	Practical (12 Hours)	20 Hrs
1.	Use safe handling of refrigerant cylinder	<ul style="list-style-type: none"> • Refrigerant cylinder – Handling and storage • Precautions in safe handling • Effect of moisture • Use of recovery unit • Prevention of HFC become flammable 	<ul style="list-style-type: none"> • Demonstrate the safe handling of refrigerant cylinder • List the precautionary measures needed for safety of refrigerant 	12
2.	Safe Handling of tool	<ul style="list-style-type: none"> • Vacuum pump and leak detector • Micron gauge • Manifold gauge in charging hoses • Safety by using power tool 	<ul style="list-style-type: none"> • Demonstrate the safe handling of tools • Demonstrate the safe handling of vacuum pump and leak detector 	8
Total Duration in Hours				20

6. ORGANISATION OF FIELD VISITS

In a year, at least 3 field visits/educational tours should be organised for the students to expose them to the activities in the workplace.

Visit a Refrigerator service centre and observe the following: Location, Site, Refrigerator Parts of Refrigerator, Wiring required for installation of Refrigerator, components on PCB, compressor.

During the visit, students should obtain the following information from the owner or the supervisor :

1. Refrigerator brands, types, capacity, star ratings,
2. Refrigerator parts, wires, primary unit, secondary unit,
3. Specifications of various Refrigerator and their parts,
4. Comparison of various brands, models,
5. Energy consumption for various star ratings,

6. Reading the specifications of each part,
7. Observe the refrigerants used in different Refrigerator,
8. Comparison of various parts based on cost,
9. Tools and equipment required for installation, repair and maintenance.
10. Cost benefit analysis to purchase Refrigerator,
11. Advanced technology in Refrigerator.

7. LIST OF EQUIPMENT AND MATERIALS

The list given below is suggestive and an exhaustive list should be prepared by the vocational teacher. Only basic tools, equipment and accessories should be procured by the Institution so that the routine tasks can be performed by the students regularly for practice and acquiring adequate practical experience.

Tools	Equipment	Material
<ul style="list-style-type: none"> • Phase tester • Screwdriver set • Nut driver set • Combination Plier • Spanner set • Electrical tape • Soldering kit • Flaring tool • Tube Bender • Tube cutter • Wire gauge • Drill machine • Measuring tape • Pipe cutter • Hacksaw • Hammer • Scissor • Peltzier • Flat file • Round file • Allen wrench • Adjustable wrench • Yoke vise • Brazing tool • Weight scale 	<ul style="list-style-type: none"> • Cathode Ray Oscilloscope(CRO) • Multimeter • Clamp-meter • Pressure gauge • Brazing torch • Personal Protective Equipment • Fire Extinguisher • Vaccum pump • Temperature meter • Wifi • Bluetooth • Cable Connector • Micron Gauge • Leak Detector • Manifold Gauge • Continuity Tester • Pressure Gauge 	<ul style="list-style-type: none"> • Electrical and electronic components: Resistor, capacitor, inductor, various diode, Bipolar Junction Transistor, transformer, starter, relay, contractor, Field Effect Transistor (FET), Integrated Circuit, Thermistor, Circuit breaker • Wiring layout • Colour code chart of resistor • Code chart of capacitor • Datasheet of Integrated Circuit • Astable, Monostable, Bistable Multivibrator kit • Refrigerant- R600a,R134, Hydrocarbon • First aid kit • Wire • Ohm's Law kit • Kirchhoff's Law kit • AC and DC motors • Regulated power supply kit • Error Code chart for IoT • Internet connection • Network cable • Printed Circuit Board • Microcontroller • Sensor • Smart phone • Capillary tube • Compressor • Condenser

8. TEACHER'S/TRAINER'S QUALIFICATION

Qualification and other requirements for appointment of vocational teachers/trainers on contractual basis should be decided by the State/UT. The suggestive qualifications and minimum competencies for the vocational teacher should be as follows:

Qualification	Minimum Competencies	Age Limit
Master degree in Refrigeration Engineering/ Bachelor of Engineering / Technology in Electrical/ Electronics OR Master of Science in Electronics/ Electrical. It is recommended to have the specialised qualification in Refrigeration.	The candidate should have a minimum of 1 year of work experience in the same job role. S/He should be able to communicate in English and local language. S/He should have knowledge of equipment, tools, material, Safety, Health & Hygiene.	18-37 years (as on Jan. 01 (year)) Age relaxation to be provided as per Govt. rules

Vocational Teachers/Trainers form the backbone of Vocational Education being imparted as an integral part of Rashtriya Madhyamik Shiksha Abhiyan (RMSA). They are directly involved in teaching of vocational subjects and also serve as a link between the industry and the schools for arranging industry visits, On-the-Job Training (OJT) and placement.

These guidelines have been prepared with an aim to help and guide the States in engaging quality Vocational Teachers/Trainers in the schools. Various parameters that need to be looked into while engaging the Vocational Teachers/Trainers are mode and procedure of selection of Vocational Teachers/Trainers, Educational Qualifications, Industry Experience, and Certification/Accreditation.

The State may engage Vocational Teachers/Trainers in schools approved under the component of Vocationalisation of Secondary and Higher Secondary Education under RMSA in following ways:

1. Directly as per the prescribed qualifications and industry experience suggested by the PSS Central Institute of Vocational Education(PSSCIVE), NCERT or the respective Sector Skill Council(SSC). **OR**
2. Through accredited Vocational Training Providers accredited under the National Quality Assurance Framework (NQAF*) approved by the National Skill Qualification Committee on 21.07.2016. If the State is engaging Vocational Teachers/Trainers through the Vocational Training Provider (VTP), it should ensure that VTP should have been accredited at NQAF Level 2 or higher.

* The National Quality Assurance Framework (NQAF) provides the benchmarks or quality criteria which the different organisations involved in education and training must meet in order to be accredited by competent bodies to provide government-funded education and training/skills activities. This is applicable to all organizations offering NSQF-compliant qualifications.

The educational qualifications required for being a Vocational Teacher/Trainer for a particular job role are clearly mentioned in the curriculum for the particular NSQF compliant job role. The State should ensure that teachers / trainers deployed in the schools have relevant technical competencies for the NSQF qualification being delivered. The Vocational Teachers/Trainers preferably should be certified by the concerned Sector Skill Council for the particular Qualification Pack/Job role which he will be teaching. Copies of relevant certificates and/or record of experience of the teacher/trainer in the industry should be kept as record.

To ensure the quality of the Vocational Teachers/Trainers, the State should ensure that a standardized procedure for selection of Vocational Teachers/Trainers is followed. The selection procedure should consist of the following:

1. Written test for the technical/domain specific knowledge related to the sector;
2. Interview for assessing the knowledge, interests and aptitude of trainer through a panel of experts from the field and state representatives; and
3. Practical test/mock test in classroom/workshop/laboratory.

In case of appointment through VTPs, the selection may be done based on the above procedure by a committee having representatives of both the State Government and the VTP.

The State should ensure that the Vocational Teachers/ Trainers who are recruited should undergo induction training of 20 days for understanding the scheme, NSQF framework and Vocational Pedagogy before being deployed in the schools.

The State should ensure that the existing trainers undergo in-service training of 5 days every year to make them aware of the relevant and new techniques/approaches in their sector and understand the latest trends and policy reforms in vocational education.

The Head Master/Principal of the school where the scheme is being implemented should facilitate and ensure that the Vocational Teachers/Trainers:

- Prepare session plans and deliver sessions which have a clear and relevant purpose and which engage the students;
- Deliver education and training activities to students, based on the curriculum to achieve the learning outcomes;
- Make effective use of learning aids and ICT tools during the classroom sessions;
- Engage students in learning activities, which include a mix of different methodologies, such as project based work, team work, practical and simulation based learning experiences;
- Work with the institution's management to organise skill demonstrations, site visits, on-job trainings, and presentations for students in cooperation with industry, enterprises and other workplaces;
- Identify the weaknesses of students and assist them in up-gradation of competency;
- Cater to different learning styles and level of ability of students;
- Assess the learning needs and abilities, when working with students with different abilities
- Identify any additional support the student may need and help to make special arrangements for that support;
- Provide placement assistance

Assessment and evaluation of Vocational Teachers/Trainers is very critical for making them aware of their performance and for suggesting corrective actions. The States/UTs should ensure that the performance of the Vocational Teachers/Trainers is appraised annually. Performance based appraisal in relation to certain pre-established criteria and objectives should be done periodically to ensure the quality of the Vocational Teachers/Trainers. Following parameters may be considered during the appraisal process:

- Participation in guidance and counseling activities conducted at Institutional, District and State level;
- Adoption of innovative teaching and training methods;
- Improvement in result of vocational students of Class X or Class XII;
- Continuous up-gradation of knowledge and skills related to the vocational pedagogy, communication skills and vocational subject;

- Membership of professional society at District, State, Regional, National and International level;
- Development of teaching-learning materials in the subject area;
- Efforts made in developing linkages with the Industry/Establishments;
- Efforts made towards involving the local community in Vocational Education
- Publication of papers in National and International Journals;
- Organisation of activities for promotion of vocational subjects;
- Involvement in placement of students/student support services.

9. LIST OF CONTRIBUTORS

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