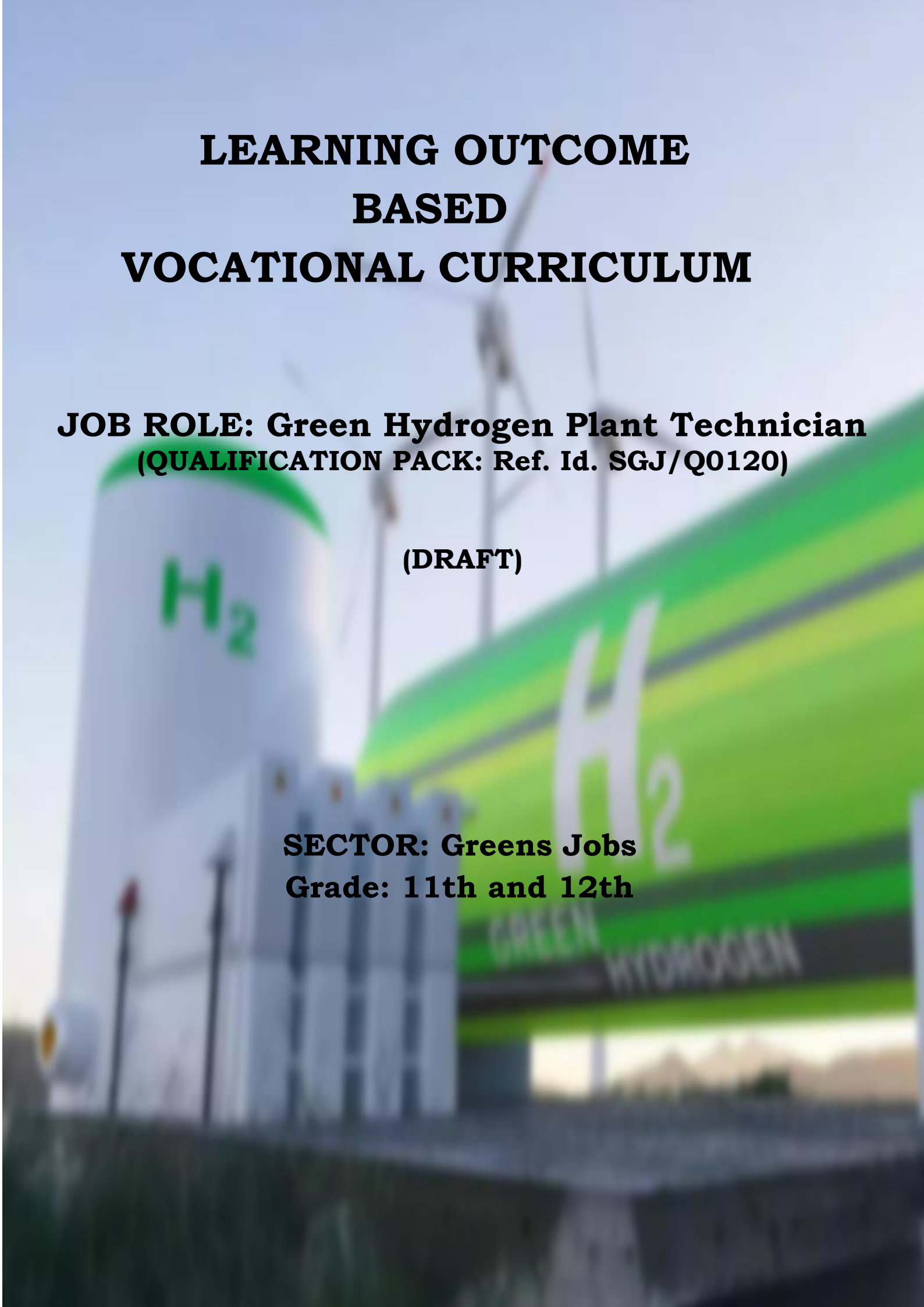

LEARNING OUTCOME BASED VOCATIONAL CURRICULUM

JOB ROLE: Green Hydrogen Plant Technician

(QUALIFICATION PACK: Ref. Id. SGJ/Q0120)

(DRAFT)

SECTOR: Greens Jobs

Grade: 11th and 12th

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION

Shyamla Hills, Bhopal- 462 002, M.P., India

http://www.psscive.ac.in

Gandhiji's Talisman

I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test:

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny? In other words, will it lead to Swaraj for the hungry and spiritually starving millions?

Then you will find your doubts and your self melting away.

LEARNING OUTCOME BASED VOCATIONAL CURRICULUM

Job Role: Green Hydrogen Plant Technician

(QUALIFICATION PACK: Ref. Id. SGJ/Q0120)

SECTOR: GREEN JOBS

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION

Shyamla Hills, Bhopal- 462 002, M.P., India

http://www.psscive.ac.in

LEARNING OUTCOME-BASED CURRICULUM

Green Jobs- Green Hydrogen Plant Technician

http://www.psscive.ac.in

Published by:
Joint Director
PSS Central Institute of Vocational Education, NCERT, Shyamla Hills, Bhopal

PATRON

Dr. DINESH PRASAD SAKLANI,

Director,
National Council of Educational Research and Training (NCERT), New Delhi

Dr. DEEPAK PALIWAL
Joint Director

PSS Central Institute of Vocational Education,
Bhopal

COURSE COORDINATOR

Prof. Saurabh Prakash. Head
Engineering and Technology Department,
PSSCIVE, Bhopal

COURSE CO- COORDINATOR

Dr. Vinod Kumar Yadav
Engineering and Technology Department,
PSSCIVE, 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. The curriculum has been designed for the vocational education programme introduced under the Centrally Sponsored Scheme of *Samagra Shiksha* of the Ministry of Education (erstwhile, Ministry of Human Resource Development) and is aligned to the National Skill Qualifications Framework (NSQF). The curricula for vocational courses are being developed under the project approved by the Project Approval Board (PAB) of '*Samagra Shiksha'*, which is an overarching programme for the school education sector extending from pre-school to Grade 12

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 Green Hydrogen Plant Technician. The curriculum has been developed for the senior secondary students of Grades 11 and 12 which is aligned to the National Occupation Standards (NOSs) for the job role. 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 skill needs. The teaching-learning is to be done through interactive sessions in classrooms, practical activities in laboratories or workshops, projects, field visits, etc. and professional experience is to be provided through on-the-job training.

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.

Prof. Dinesh Prasad Saklani
Director
National Council of Education Research & Training

PREFACE

India today stands poised at a very exciting juncture in its saga. The potential for achieving inclusive growth is 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. In order to fulfil the growing aspirations of our youth and the demand of skilled human resource, the Ministry of Education (MoE), 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 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 with the responsibility of developing learning outcome-based curricula, student workbooks, teacher handbooks and e-learning materials for the job roles in various sectors.

The PSSCIVE firmly believes that the vocationalisation of education in the nation needs 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 fulfil the needs of society and the world of work. In order to honour 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, policymakers, 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.

The success of this curriculum depends upon its effective implementation, and it is expected that the managers of vocational education programmes, vocational educators, vocational teachers/trainers and other stakeholders will make earnest efforts to provide better facilities, develop linkages with the industry or world of work and foster a conducive learning environment for the students to effectively transact the curriculum and to achieve the learning outcomes as per the content of the curriculum document.

DR. DEEPAK PALIWAL
Joint Director
PSS Central Institute of Vocational Education

ACKNOWLEDGEMENTS

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 Samagrah Shiksha and the officials of the Ministry of Education (MoE), Government of India for the financial support to the project for the 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 National Council of Educational Research and Training (NCERT), National Skill Development Corporation (NSDC), Skill Council for Green Jobs (SCGJ) and Sector Skill Council for Management and Entrepreneurship and Professional Skills for their academic support and cooperation in the development of Qualification file and curriculum.

We are grateful to Prof. Saurabh Prakash, Course Coordinator, for his untiring efforts and contribution to the development of this learning outcome-based curriculum. Dr. Vinod Kumar Yadav, Course Co-Coordinator is also sincerely acknowledged for his valuable input and guidance in shaping the curriculum. Mr. Ankit Singh Chauhan, Assistant Professor, Department of Engineering Technology, is also duly appreciated and acknowledged for his suggestions and editorial support.

PSSCIVE Team

CONTENTS

1. COURSE OVERVIEW

COURSE TITLE: Green Jobs- Green Hydrogen Plant Technician

The present curriculum Green Hydrogen Plant Technician job role is related to Level L-4. This course fulfils the needs of the students willing to learn activities relating to the Green Hydrogen Plant Technician job role. The Green Hydrogen Plant Technician curriculum is designed to equip students with the knowledge and practical skills necessary for the role of a Green Hydrogen Plant Technician. This course addresses the growing need for skilled professionals in the green hydrogen industry, focusing on the production, handling, and maintenance of green hydrogen plants.

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

- Identify the principal components of a computer system
- Identify and control hazards in the workplace that pose a danger or threat to their safety or health, or that of others.
- Demonstrate self-management skills.
- Demonstrate the ability to provide a self-analysis in the context of entrepreneurial skills and abilities.
- Demonstrate knowledge of the importance of green skills in meeting the challenges of sustainable development and environment protection.
- Communicate effectively with the customers
- Greet, escort, seat the customers and offer refreshments (tea/ coffee)
- Identify and use tools & tackles required for the installation of the green hydrogen plant
- Installation of the Mechanical and Electrical equipment of a green hydrogen plant along with associated civil works
- Maintain personal safety and ensure compliance with safety guidelines at Green hydrogen plant and conduct periodic mock exercises of safety-related systems.

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

COURSE LEVEL: This is an Intermediate level course. On completion of this course, a student can take up Graduation Level for a job role.

COURSE DURATION: 6**00 hrs**

Class 11	: 300 hrs
Class 12	: 300 hrs
TOTAL	**: 600 hrs**

2. SCHEME OF UNITS

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 and Practical 100**
Part A	**Employability Skills**		
	Unit 1: Communication Skills-III	25	**10**
	Unit 2: Self-management Skills-III	25	
	Unit 3: Information and Communication Technology Skills-III	20	
	Unit 4: Entrepreneurial Skills-III	25	
	Unit 5: Green Skills-III	15	
		110	**10**
Part B	**Vocational Skills**		
	Unit 1: Introduction to Green Hydrogen	30	40
	Unit 2: Components of Green Hydrogen Plant and its Layout	30	
	Unit 3: Electric power source for Green Hydrogen Plant	30	
	UNIT 4: Installation of Electrolyser for Green Hydrogen Production-I	35	
	UNIT 5: Installation of Electrolyser for Green Hydrogen Production-II	40	
		165	**40**
Part C	**Practical Work**		
	Practical Examination	06	15
	Written Test	01	10
	Viva Voce	03	10
		10	**35**
Part D	**Project Work/Field Visit**		
	Practical File/Student Portfolio	10	10
	Viva Voce	05	05
		15	**15**
	Grand 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	20	10
	Unit 2: Self-management Skills-IV	10	
	Unit 3: Information and Communication Technology Skills-IV	20	
	Unit 4: Entrepreneurial Skills-IV	15	
	Unit 5: Green Skills-IV	10	
		110	**10**
Part B	**Vocational Skills**		
	Unit 1: Installation of water feed system	30	
	Unit 2: Hydrogen conditioning and compression	30	
	Unit 3: Hydrogen storage	30	
	Unit 4: Commissioning Checklist	35	
	Unit 5: Health and safety measures for installing and operating Green hydrogen system	40	
		165	**30**
Part C	Practical Examination	06	15
	Written Test	01	10
	Viva Voce	03	10
		10	**35**
Part D	**Project Work/Field Visit**		
	Practical File/Student Portfolio	10	10
	Viva Voce	05	05
		15	**15**
	Grand Total	**300**	**100**

3. TEACHING/TRAINING ACTIVITIES

The teaching and training activities have to be conducted in classrooms, 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 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 or teaching 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 is not limited to hands-on training, simulated training, role play, case-based studies, exercises, etc. Equipment and supplies should be provided to enhance the 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 the knowledge of students. Necessary arrangements should be made for using technology in the assessment of students.

KNOWLEDGE ASSESSMENT (THEORY)

Knowledge Assessment should include two components: one comprising of internal assessment and a 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 blueprint for the question paper may be as follows:

Duration: 3 hrs Max. Mark: 30

		No. of Questions			
S.No.	**Typology of Question**	**Very Short Answer (1 mark)**	**Short Answer (2 Marks)**	**Long Answer (3 Marks)**	**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,	**2**	**3**	**2**	**14**

	compare, contrast, explain, paraphrase, or interpret information)				
3.	Application – (Use abstract information in concrete situation, to apply knowledge to new situations: Use given content to interpret a situation, private 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 questions)**

SKILL ASSESSMENT (PRACTICAL)

Assessment of skills by the students should be done by the assessors/examiners based on 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

S.No.	Units	Duration (Hrs)
1.	Communication Skills - III	25
2.	Self-management Skills - IIII	25
3.	Information and Communication Technology Skills- III	20
4.	Entrepreneurial Skills - III	25
5.	Green Skills - III	15
	Total	**110**

UNIT 1: COMMUNICATION SKILLS – III

Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. **Demonstrate knowledge of communication**	1. Introduction to communication 2. Importance of communication 3. Elements of communication 4. Perspectives in communication 5. Effective communication	1. Role-play on the communication process 2. Group exercise on factors affecting perspectives in communication 3. Classroom discussion on the 7Cs of effective communication 4. Chart making on elements of communication	**03**
2. Demonstrate verbal communication	1. Verbal communication 2. Public Speaking	1. Role-play of a phone conversation. 2. Group exercise on public speaking	**02**
3. Demonstrate non-verbal communication	1. Importance of non-verbal communication 2. Types of non-verbal communication 3. Visual communication	1. Role-play on non-verbal communication 2. Group exercise on body language 3. Group activity on methods of communication	**02**
4. Speak using correct pronunciation	1. Pronunciation basics 2. Speaking properly 3. Phonetics 4. Types of sounds	1. Group activities on practicing pronunciation	**01**

5. Apply an assertive communication style	1. Important communication styles 2. Assertive communication 3. Advantages of assertive communication 4. Practicing assertive communication	1. Group discussion on communication styles 2. Observing and sharing communication styles	**03**
6. Demonstrate the knowledge of saying no	1. Steps for saying 'No' 2. Connecting words	1. Group discussion on how to respond 2. Group activity on saying 'No'	**02**
7. Identify and use parts of speech in writing	1. Capitalisation 2. Punctuation 3. Basic parts of speech 4. Supporting parts of speech	1. Group activity on identifying parts of speech 2. Writing a paragraph with punctuation marks 3. Group activity on constructing sentences 4. Group activity on identifying parts of speech	**03**
8. Write correct sentences and paragraphs	1. Parts of a sentence 2. Types of object 3. Types of sentences 4. Paragraph	1. Activity on writing sentences 2. Activity on active and passive voice 3. Assignment on types of sentences	**02**
9. Communicate with people	1. Greetings 2. Introducing self and others	1. Role-play on formal and informal greetings 2. Role-play on introducing someone 3. Practice greetings	**02**
10. Introduce yourself to others and write about oneself	1. Talking about self 2. Filling a form	1. Practice self-introduction and filling up forms 2. Practice self-introduction to others	**01**
11. Develop questioning skill	1. Main types of questions 2. Forming closed and open-ended	1. Practice exercise on forming questions 2. Group activity on framing questions	**01**

	questions		
12. Communicate information about family to others	1. Names of relatives 2. Relations	1. Practice talking about family 2. Role-play on relations	**01**
13. Describe habits and routines	1. Concept of habits and routines	1. Discuss habits and routines 2. Group activity on describing routines	**01**
14. Ask or give directions to others	1. Asking for directions 2. Using landmarks	1. Role-play on asking and giving directions 2. Identifying symbols	**01**
Total			25

UNIT 2: SELF-MANAGEMENT–III

Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. **Identify and analyze own strengths and weaknesses**	1. Understanding self 2. Techniques for identifying strengths and weaknesses 3. Difference between interests and abilities	1. Activity on writing aims in life 2. Prepare a worksheet on interests and abilities	**03**
2. Demonstrate personal grooming skills	1. Guidelines for dressing and grooming 2. Preparing a personal grooming checklist	1. Activity on dressing and grooming standards 2. Self-reflection on dressing and grooming	**04**
3. Maintain personal hygiene	1. Importance of personal hygiene 2. Three steps to personal hygiene 3. Essential steps of hand washing	1. Role-play on personal hygiene 2. Assignment on personal hygiene	**03**
4. Demonstrate the knowledge of working in a team and participating in group activities	1. Describe the benefits of teamwork 2. Working in a team	1. Assignment on working in a team 2. Self-reflection on teamwork	**03**

5. Develop networking skills	1. Benefits of networking skills 2. Steps to build networking skills	1. Activity on networking 2. Assignment on networking skills	**03**
6. Describe the meaning and importance of self-motivation	1. Meaning of self-motivation 2. Types of motivation 3. Steps to building self-motivation	1. Activity on staying motivated 2. Assignment on reasons hindering motivation	**03**
7. Set goals	1. Meaning of goals and purpose of goal-setting 2. Setting SMART goals	1. Assignment on setting SMART goals 2. Activity on developing long-term and short-term goals	**03**
8. Apply time management strategies and techniques	1. Meaning and importance of time management 2. Steps for effective time management	1. Checklist for preparing daily activities 2. Preparing To-do-list	**03**
Total			**25**

UNIT 3: INFORMATION AND COMMUNICATION TECHNOLOGY-III			
Learning Outcome	**Theory (08 hrs)**	**Practical (12 hrs)**	**Duration (20 hrs)**
1. Create a document on the word processor	1. Introduction to ICT 2. Advantages of using a word processor. 3. Work with Libre Office Writer	1. Demonstration and practice of the following: • Creating a new document • Typing text • Saving the text • Opening and saving file on Microsoft word/Libre Office Writer.	**02**
2. Identify icons on the toolbar	1. Status bar 2. Menu bar 3. Icons on the Menu bar 4. Multiple ways to perform a function	1. Work with a basic user interface of LibreOffice writer 2. Working with Libre Office Writer or	**02**

		Microsoft Word	
3. Save, close, open and print document	1. Save a word document 2. Close 3. Open an existing document 4. Print	1. Perform the functions for saving, closing and printing documents on LibreOffice Writer 2. Perform the functions on Microsoft Word	**02**
4. Format text in a word document	1. Change style and size of text 2. Align text 3. Cut, Copy, Paste 4. Find and replace	1. Perform the functions of formatting on LibreOffice Writer 2. Perform the functions of formatting on Microsoft Word	**02**
5. Check spelling and grammar in a word document	1. Use of spell checker 2. Autocorrect	1. Perform the functions of checking spellings on LibreOffice Writer 2. Perform the functions of checking the spelling on Microsoft Word	**02**
6. Insert lists, tables, pictures, and shapes in a word document	1. Insert bullet list 2. Number list 3. Tables 4. Pictures 5. Shapes	1. Perform the functions on LibreOffice Writer	**03**
7. Insert header, footer and page number in a word document	1. Insert header 2. Insert footer 3. Insert page number 4. Page count	1. Perform the functions on LibreOffice Writer 2. Perform the functions on Microsoft Word	**03**
8. Make changes by	1. Tracking option 2. Manage option	1. Perform the functions on	**04**

using the track change option in a word document	3. Compare documents	LibreOffice Writer 2. Perform the functions on Microsoft Word	
Total			20

UNIT 4: ENTREPRENEURIAL SKILLS – III			
Learning Outcome	**Theory (10 hrs)**	**Practical (15 hrs)**	**Duration (25 hrs)**
1. **Differentiate between different kinds of businesses**	1. Introduction to entrepreneurship 2. Types of business activities	1. Role-play on different kinds of businesses	**03**
2. Describe the significance of entrepreneurial values	1. Meaning of value 2. Values of an Entrepreneur 3. Case study on qualities of an entrepreneur	1. Role-play on qualities of an entrepreneur	**03**
3. Demonstrate the attitudinal changes required to become an entrepreneur	1. Difference between the attitude of entrepreneur and employee	1. Interviewing employees and entrepreneurs	**03**
4. Develop thinking skills like an entrepreneur	1. Problems of entrepreneurs 2. Problem-solving 3. Ways to think like an entrepreneur	1. Group activity on identifying and solving problems	**04**
5. Generate business ideas	1. The business cycle 2. Principles of idea creation 3. Generating a business idea 4. Case studies	1. Group activity to create business ideas	**04**
6. Describe customer needs and the importance of conducting a customer survey	1. Understanding customer needs 2. Conducting a customer survey	1. Conducting a customer survey	**04**
7. Create a business plan	1. Importance of business planning 2. Preparing a business plan 3. Principles to follow for	1. Activity on developing a business plan	**04**

	growing a business 4. Case studies		
Total			25

UNIT 5: GREEN SKILLS – III			
Learning Outcome	**Theory (07 hrs)**	**Practical (08 hrs)**	**Duration (15 hrs)**
1. Describe the importance of the main sector of the green economy	1. Meaning of ecosystem, food chain and sustainable development 2. Main sectors of the green economy- E-waste management, green transportation, renewal energy, green construction, and water management	1. Discussion on sectors of green economy 2. Preparing posters on various sectors for promoting green economy 3. Writing an essay or a short note on the important initiatives for promoting green economy.	**06**
2. Describe the main recommendations of policies for the green economy	1. Policies for a green economy	1. Discussion on initiatives for promoting the green economy	**03**
3. Describe the major green sectors/ areas and the role of various stakeholders in the green economy	1. Stakeholders in the green economy	1. Group discussion on the role of stakeholders in the green economy 2. Preparation of posters on green sectors and their stakeholders 3. Making solar bulbs.	**03**
4. Identify the role of government and private agencies in the green economy	1. Role of the government in promoting a green economy 2. Role of private agencies in promoting green economy	1. Discussion on the role of Government and Private Agencies in promoting a green economy. 2. Posters on green sectors.	**03**
Total			15

Part B: Vocational Skills

S. No.	Units	Duration (Hrs.)
1	Unit 1: Introduction to Green Hydrogen	30
2	Unit 2: Components of Green Hydrogen Plant and its Layout	30
3	Unit 3: Electric power source for Green Hydrogen Plant	30
4	UNIT 4: Installation of Electrolyser for Green Hydrogen Production-I	40
5	UNIT 5: Installation of Electrolyser for Green Hydrogen Production-II	35
	Total	**165**

Unit 1: Introduction to Green Hydrogen			
Learning outcomes	**Theory (20 hrs)**	**Practical (10 hrs)**	**Duration (Hrs)**
1. Understand the global energy transition and the role of green hydrogen.	• Necessity of Green Hydrogen in Sustainable Energy Transition	• Analyse case studies demonstrating the successful integration of green hydrogen in energy systems.	
2. Learn about hydrogen's chemical and physical properties.	• Properties and Characteristics of Hydrogen	• Conduct experiments to observe hydrogen properties in a controlled environment.	
3. Study the principles of hydrogen as an energy carrier.	• Basic Concepts of Hydrogen as an Energy Carrier	• Simulate hydrogen energy carrier systems and their efficiency.	
4. Explore the colour codes associated with hydrogen and their significance.	• Colour Code Nomenclature of Hydrogen	• Participate in a hands-on activity matching colour codes with production methods.	
5. Understand the stages in the value chain for green hydrogen.	• Value Chain for Green Hydrogen	• Visit a green hydrogen production facility and observe each stage of the value chain.	
6. Analyse the pros and cons of various hydrogen production methods.	• Benefits and Drawbacks of Existing Hydrogen Production Methods	• Evaluate real-world examples of hydrogen production methods and their impact.	
7. Explore challenges in the green hydrogen value chain.	• Key Aspects and Challenges in Green Hydrogen Production, Storage, Transportation, and Distribution	• Develop strategies to address challenges in a simulated green hydrogen value chain.	
8. Study applications in industry, transport, and power production.	• End-Use Applications of Green Hydrogen	• Visit industries using green hydrogen and assess its practical applications.	

9. Explore different technologies for green hydrogen production.	• Technology Options for Green Hydrogen Production	• Design a hypothetical green hydrogen production system using specific technologies.	
10. Learn about renewable sources suitable for hydrogen production.	• Renewable Energy Sources for Large-scale Green Hydrogen Production	• Analyse data to determine the most viable renewable energy sources for large-scale hydrogen production.	
11. Understand India's position in the global green hydrogen economy.	• Green Hydrogen Economy in the Indian Context	• Research and present a case study on India's initiatives in green hydrogen.	
12. Study the government's policy measures for green hydrogen.	• Key Aspects of Green Hydrogen Policy and Mission in India	• Participate in a policy analysis exercise on green hydrogen in India.	
13. Explore the technician's role in green hydrogen production.	• Roles and Responsibilities of a Green Hydrogen Plant Technician	• Simulate the responsibilities of a green hydrogen plant technician.	
14. Create a visual representation of hydrogen colour codes.	• Demonstrate the Colour Code Nomenclature of Hydrogen	• Design and present a chart illustrating hydrogen colour codes.	
15. Participate in an activity matching colour codes with production processes.	• Matching Production Processes to Colour Codes	• Conduct hands-on exercises associating colour codes with specific hydrogen production methods.	
16. Learn about the flow of green hydrogen from production to end use.	• Flow Diagram of Green Hydrogen Production and End Uses	• Create a flow diagram depicting green hydrogen production and its various applications.	
17. Understand the critical role of green hydrogen in energy transition.	• Importance of Green Hydrogen Economy for Energy Transition	• Engage in discussions and debates on the importance of a green hydrogen economy.	
18. Learn about key policy measures supporting green hydrogen in India.	• Government of India's Key Policy Measures for Green Hydrogen	• Analyze government documents outlining policy measures and their implications.	
Total			30

Unit 2: Components of Green Hydrogen Plant and its Layout			
Learning outcomes	**Theory (20 hrs)**	**Practical (10 hrs)**	**Duration (Hrs)**
1. Identify key components of the Green Hydrogen plant including electrical,	• Green Hydrogen Plant Components: Electrolyser stacks, renewable power supply system, feedwater supply and demineralization system, gas separator, transformer and	• Demonstrate the schematic of the Green hydrogen	

mechanical, and civil components	rectifier, gas compression unit, etc.	production plant	
2. Discuss functions of key components	• Electrolyser Stacks: Electrochemical process of water splitting. • Renewable Power Supply System: Harnessing energy from renewable sources. • Feed Water Supply and Demineralization System: Providing purified water for electrolysis. • Gas Separator: Separating hydrogen and oxygen gases. • Transformer and Rectifier: Converting and regulating electrical input. • Gas Compression Unit: Compressing produced hydrogen for storage/transport.	• Demonstrate the key components of the plant and outline their functions through plant schematic	
3. Discuss the fundamental principles of the main components	• Electrolyser Stack: Utilizes the principle of electrolysis to split water into hydrogen and oxygen. • Gas Collector: Gathers and directs produced gases. • Power Source: Converts renewable energy into electrical power.		
4. Types of Electrolysers: Brief description	• Alkaline Electrolysers: Use potassium hydroxide solution. • PEM (Proton Exchange Membrane) Electrolysers: Use a solid polymer electrolyte. • Solid Oxide Electrolysers: Operate at high temperatures with a solid ceramic electrolyte.		
5. Explain the overall layout of the plant	• Plant Layout: Integration of components for efficient hydrogen production. • Flow of Processes: Sequential stages from renewable power input to hydrogen compression.	• Demonstrate how to interpret the Plant Layout including various equipment and materials used in a Green hydrogen production facility.	
6. Discuss sparking items, MCBs, switch placement	• Safety Measures: Isolating sparking items from the hydrogen production area. • MCBs (Miniature Circuit Breakers), Switches: Preventing electrical hazards in the plant.		

7. Explain how to read and interpret codes, standards	• Electrical Codes: Compliance with national and international electrical standards. • Protocols: Adherence to industry-specific protocols. • Interpretation: Understanding the implications and requirements of codes and standards.	• Identify processes where energy /electricity and material utilization can be optimized	
8. Explain key material and safety codes in the Green Hydrogen industry	• Material Codes: Compliance with standards for materials used in plant construction. • Safety Codes: Ensuring adherence to safety regulations to prevent accidents. Adhering to regulations ensures the safe production, storage, and transportation of hydrogen.	• Demonstrate how to interpret signs, notices and/or cautions at the project site	
9. Technology protocols and standards	• Technology Standards: Compliance with industry-specific technological norms. • Protocols: Following established procedures for the safe and efficient operation of the plant.		
Total			30

Unit 3: Electric power source for Green Hydrogen Plant			
Learning Outcomes	**Theory (15 hrs)**	**Practical (15 hrs)**	**Duration (Hrs)**
1. Discuss key parameters of renewable and hybrid power plants	• Renewable Power Plants: Parameters include capacity, efficiency, and reliability of renewable sources (solar, wind, etc.). • Hybrid Power Plants: Integration of multiple renewable sources for enhanced reliability and efficiency.	• Illustrate how reliable renewable power can be supplied by integrating various renewable energy sources for generating green hydrogen. • Show how the integration of variable renewable energy (VRE) for powering electrolysers is performed.	
2. Explain how cost-effective and reliable Renewable Power can be assured for Green	• Cost-Effectiveness: Optimizing renewable energy systems to minimize production costs. • Reliability: Ensuring continuous and stable power supply from renewable sources.	• Show how to Calculation of hydrogen production equipment load	

Hydrogen production			
3. Discuss flexible system operation for the supply of power from different sources	• System Flexibility: Ability to adapt to varying power inputs from different renewable sources. • Integration: Seamless incorporation of power from solar, wind, or other sources based on availability.	• Show how rectifiers operate to cater for the load of the electrolyser	
4. Discuss how the sizing of the renewable power plant and storage capacity is critical to meet the hydrogen load demand	• Sizing: Determining the appropriate capacity of the renewable power plant based on hydrogen production requirements. • Storage: Ensuring sufficient storage capacity to meet demand during periods of low renewable energy availability.		
5. Discuss the functions of transformers and rectifiers	• Transformers: Convert electrical voltage for efficient transmission. • Rectifiers: Convert alternating current (AC) to direct current (DC) for electrolysis in the production of hydrogen.		
6. Explain key aspects of maintaining the stability of the power supply for the green hydrogen plant	• Stability: Ensuring consistent power supply for reliable hydrogen production. • Electrolyser Cell Switching: Adapting the number of operating cells based on the availability of electric power to maintain stability.		
7. Discuss the switching of the number of electrolyser cells as per the availability of electric power	• Adaptive Operation: Adjusting the number of active electrolyser cells based on real-time power availability. • Efficiency: Optimizing the operation of electrolyser cells to match the power supply.	• Illustrate the process of splitting water into hydrogen and oxygen using renewable electricity	
Total			**30**

UNIT 4: Installation of Electrolyser for Green Hydrogen Production-I			
Learning Outcomes	**Theory (20 hrs)**	**Practical (10 hrs)**	**Duration (Hrs) 30**
1. Discuss types of Electrolysers and their technology maturity	• PEM Electrolysis: Utilizes a solid polymer membrane. • Alkaline Electrolysis (AE): Uses potassium hydroxide solution. • Solid Oxide Electrolysis (SOEC): Operates at high temperatures with	• Present various electrolyser types with their key specifications and technical parameters using visuals such as pictures, videos, and product data sheets.	

	a solid ceramic electrolyte. • Anion Exchange Membranes (AEM): Features a membrane with anion conductivity. • Technology Maturity: Overview of the current maturity status of each electrolyser type in the industry.		
2. Explain key technical specifications of various Electrolyser types	• Capacity and Sizing: Understanding the production capacity and sizing requirements for PEM, AE, AEM, and SOEC electrolysis systems.	• Showcase the differences in design, capacity, and efficiency between electrolyser models to provide a comprehensive understanding of available options	
3. Provide an overview of various Electrolysers and their comparison	• Electrolyser Types: Overview of PEM, AE, AEM, and SOEC electrolyser types. • Key Features: Comparison of characteristics such as efficiency, cost, and applications for each type.	• Illustrate the schematics of each electrolyser type, highlighting their unique features and operation principles.	
4. Explain the major components of an Electrolyser	• Electrolyser Components: Identification and explanation of key parts, including electrodes, membranes, and gas separation units.	• Utilize diagrams or animations to showcase the internal workings and components of PEM (Proton Exchange Membrane), AE (Alkaline Electrolyser), AEM (Anion Exchange Membrane), and SOEC (Solid Oxide Electrolysis Cell) electrolysers.	
5. Discuss operating principles of PEM, AE, and SOEC Electrolysers	• PEM Electrolysis: Proton exchange mechanism in a solid polymer membrane. • Alkaline Electrolysis: Electrochemical reactions in a potassium hydroxide solution. • SOEC: Electrolysis at high temperatures with a solid ceramic electrolyte.		

6. Identify suitable tools and equipment for installation	• Installation Tools: Selection and use of tools and equipment conforming to technical sheets, safety standards, and technical specifications for effective and safe installation of Electrolysers and associated systems.	• Detail the tools and equipment required for electrolyser installation based on technical sheets and relevant safety and technical standards.	
7. Explain the inputs/outputs of an Electrolyser system	• Inputs: Identification of power and water requirements. • Outputs: Generation of hydrogen and oxygen gases.	• Provide visual guides or checklists to aid in the identification and selection of appropriate tools and equipment for safe and efficient installation.	
8. Explain key O&M requirements for an Electrolyser	• O&M Requirements: Overview of key maintenance needs, including membrane inspection, electrode cleaning, and gas handling.		
9. Discuss how to calculate losses and equipment efficiency	• Loss Calculation: Determining losses in the electrolysis process. • Efficiency Calculation: Assessing the overall efficiency of the electrolyser system.	• Demonstrate the calculation process for estimating losses and equipment efficiency using relevant formulas and data.	
10. Discuss the basic technical specifications of each cell	• Cell Specifications: Detailing technical aspects of individual cells within an electrolyser, including capacity, voltage, and current characteristics.	• Utilize practical examples or case studies to illustrate how to apply these calculations in real-world scenarios, considering factors such as electrical losses, thermal losses, and overall system efficiency.	
Total			30

UNIT 5: Installation of Electrolyser for Green Hydrogen Production-II			
Learning Outcomes	**Theory (10 hrs)**	**Practical (20 hrs)**	**Duration (Hrs) 30**
1. Mechanical and electrical diagrams	• Read and interpret drawings, Mechanical and electrical diagrams, Plant specifications	• Demonstrate the handling of different tools and equipment as per concerned standards and industry practices.	

	• Explain how to install the plant using design drawings and documents provided	• Demonstrate the • procedure for electrolyser stack assembly and operations	
2. Assembly/ Installation of Parts and Components of Electrolyser	• Discuss in detail the input renewable power from various sources and its integration with electrolyser	• Perform requisite data • and document management	
	• Discuss the assembly/Installation of Parts and Components of Electrolyser	• Demonstrate the mechanical/electrical systems for system installation, troubleshooting • and commissioning work	
	• Discuss the step-by-step process for assembly/Installation of the Electrolyser-Bipolar plate, separator(membrane), Porous Transport layer, electrodes etc.	• Show how to ensure that design guidelines and relevant engineering codes and standards are rigorously followed for installation, commission and maintenance of the electrolyser	
3. Operation, maintenance and troubleshooting of an electrolyser	• Discuss how to perform stack assembling, testing, operation, maintaining and troubleshooting of an electrolyser	• Show how to perform assembling, • testing, maintaining and • troubleshooting of an electrolyser	
	• Discuss the importance of Manifold and sealing.	• Show how to monitor various • parameters of electrolysis	
4. Parameters of Electrolysis	• Discuss Key selection parameters of electrolysis including density, pressure, operating temperature, hydrogen purity, Export component and Volume and weight.	• Demonstrate how to support in performing process control functions in conjunction with overall project engineering and other functional teams	
5. Maintenance of Electrolysis	• Explain how to Maintain the log for the daily operation of the electrolyser		
	• Explain the Startup, shutdown, and operate the production processes		
Total			30

CLASS 12

Part A: Employability Skills

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

UNIT 1: COMMUNICATION SKILLS - IV			
Learning Outcome	**Theory (10 hrs)**	**Practical (15 hrs)**	**Duration (25 hrs)**
1. Demonstrate active listening skills	1. Active listening - listening skill, stages of active listening 2. Overcoming barriers to active listening	1. Demonstration of the factors affecting active listening 2. Preparing posters of steps for active listening 3. Role-play on negative effects of not listening actively	**10**
2. Identify the parts of speech	1. Parts of speech – using capitals, punctuation, basic parts of speech, supporting parts of speech	1. Group practice on identifying parts of speech 2. Group practice on constructing sentences	**10**

3. Write sentences	1. Writing skills to the following: • Simple sentence • Complex sentence • Types of object 2. Types of sentences - Active and Passive sentences - Statement/ Declarative sentence - Question/ Interrogative sentence - Emotion/ Reaction or Exclamatory sentence - Order or Imperative sentence 3. Paragraph writing	1. Group work on writing sentences and paragraphs 2. Practice writing sentences in the active or passive voice 3. Writing different types of sentence	**5**
Total			25

UNIT 2: SELF-MANAGEMENT SKILLS – IV			
Learning Outcome	**Theory (10 hrs)**	**Practical (15 hrs)**	**Duration (25 hrs)**
1. Describe the various factors influencing motivation and positive attitude	1. Motivation and positive attitude 2. Intrinsic and extrinsic motivation 3. Positive attitude – ways to maintain positive attitude 4. Stress and stress management - ways to manage stress	1. Role-play on avoiding stressful situations 2. Activity on self-reflection	**10**
2. Describe how to become result oriented	1. How to become result oriented? 2. Goal setting – examples of result-oriented goals	1. Pair and share activities on the aim of life	**5**
3. Describe the importance of self-awareness and the basic personality traits, types and	1. Steps towards self-awareness 2. Personality and basic personality traits 3. Common personality disorders-	1. Group discussion on self-awareness	

disorders	• Suspicious • Emotional and impulsive • Anxious 4. Steps to overcome personality disorders		**10**
Total			25

UNIT 3: INFORMATION AND COMMUNICATION TECHNOLOGY SKILLS - IV			
Learning Outcome	**Theory (06 hrs)**	**Practical (14 hrs)**	**Duration (20 hrs)**
1. Identify the components of a spreadsheet application	1. Introduction to spreadsheet application - types of a spreadsheet, creating a new worksheet, components of a worksheet.	1. Group practice on working with LibreOffice	**02**
1. Perform basic operations in a spreadsheet	1. Opening workbook and entering data – types of data, steps to enter data, editing and deleting data in a cell 2. Selecting multiple cells 3. Saving the spreadsheet in various formats 4. Closing the spreadsheet 5. Opening the spreadsheet. 6. Printing the spreadsheet.	1. Group practice on working with data on LibreOffice Calc.	**03**
2. Demonstrate the knowledge of working with data and formatting text	1. Using a spreadsheet for addition – adding value directly, adding by using cell address, using a mouse to select values in a formula, using sum function, copying and moving formula 2. Need to format cell and content 3. Changing text style and font size 4. Align text in a cell 5. Highlight text	1. Demonstration of basic calculations in LibreOffice Calc. 2. Group practice on formatting a spreadsheet in LibreOffice Calc.	**02**
3. Demonstrate the knowledge of using advanced features in spreadsheet	1. Sorting data 2. Filtering data 3. Protecting spreadsheet with password	1. Group practice on sorting data in LibreOffice Calc	**03**

4. Make use of the software used for making slide presentations	1. Available software presentation 2. Stapes to start LibreOffice Impress 3. Adding text to a presentation	1. Group practice on working with LibreOffice Impress tools 2. Group practice on creating a presentation in LibreOffice Impress	**02**
5. Open, close and save slide presentations	1. Open, Close, Save and Print a slide presentation	1. Practice exercises on steps to save, close, open and save a presentation	**01**
6. Demonstrate the operations related to slides and texts in the presentation	1. Working with slides and text in a presentation- adding slides to a presentation, deleting slides, adding and formatting text, highlighting text, aligning text, changing text colour	1. Group practice on working with font styles and types in LibreOffice Impress	**04**
7. Demonstrate the use of advanced features in a presentation	1. Advanced features used in a presentation 2. Inserting shapes in the presentation 3. Inserting clipart and images in a presentation 1. Changing slide layout	1. Group practice on working with slides in LibreOffice Impress	**03**
Total			20

UNIT 4: ENTREPRENEURIAL SKILLS-IV			
Learning Outcome	**Theory (10 hrs)**	**Practical (15 hrs)**	**Duration (25 hrs)**
1. Describe the concept of entrepreneurship and the types and roles and functions entrepreneur	1. Entrepreneurship and entrepreneur 2. Characteristics of entrepreneurship 3. Entrepreneurship-art and science 4. Qualities of a successful entrepreneur 5. Types of entrepreneurs 6. Roles and functions of an entrepreneur 7. What motivates an entrepreneur 8. Identifying opportunities and risk-	1. Group discussion on the topic “An entrepreneur is not born but created”. 2. Quiz on various aspects of entrepreneurship.	**10**

	taking 9. Startups		
2. Identify the barriers to entrepreneurship	1. Barriers to entrepreneurship 2. Environmental barriers 3. No or faulty business plan 4. Personal barriers	1. Fishbowl of fears-group discussion about what we fear about entrepreneurship 2. Facing an Interview.	**05**
3. Demonstrate the knowledge of entrepreneurial attitude and competencies	1. Entrepreneurial attitude 2. Entrepreneurial competencies 3. Decisiveness, 4. Initiative 5. Interpersonal skills-positive attitude, stress management 6. Perseverance 7. Organisational skills-time management, goal setting, efficiency, managing quality.	1. Group discussion on business ideas 2. Group practice on best out of waste 3. Group discussion on the topic of lets grow together 4. Group practice on a snowball fight. 5. Activity on rating friends and self for entrepreneurial qualities. 6. Playing games, such as "Who am I".	**10**
Total			25

UNIT 5: GREEN SKILLS-IV			
Learning Outcome	**Theory (05 hrs)**	**Practical (10 hrs)**	**Duration (15 hrs)**
1. Identify the benefits of the green jobs	1. Green jobs 2. Benefits of green jobs 3. Green jobs in different sectors: • Agriculture • Transportation • Water conservation • Solar and wind energy • Eco-tourism • Building and construction • Solid waste management • Appropriate technology	1. Group discussion on the importance of green job.	**8**
2. State the importance of green jobs	1. Importance of green jobs in • Limiting greenhouse gas emissions • Minimizing waste and	1. Preparing posters on green jobs.	**7**

	pollution • Protecting and restoring ecosystems • Adapting to the effects of climate change	2. Activities on tree plantation .	
Total			15

Part B: Vocational Skills

S.No.	Units	Duration (Hrs.)
1	Unit 1: Installation of Water Feed System	30
2	Unit 2: Hydrogen Conditioning and Compression	30
3	Unit 3: Hydrogen Storage	30
4	Unit 4: Commissioning Checklist	30
5	Unit 5: Health and Safety Measures for Installing and Operating Green Hydrogen System	30
	Total	**165**

UNIT 1: Installation of Water Feed System			
Learning Outcomes	**Theory (15 hrs)**	**Practical (15 hrs)**	**Duration (Hrs) 30**
1. Input Water System	• Explain the schematic of the input water system for the electrolyser		
2. Water Supply Treatment Processes:	• Explain the various processes for treating the water supply for feedstock purposes		
3. Essential Parameters for Water Feedstock **4. Selection of Water Quality for Hydrogen Production**	• Discuss various parameters essential for water as feedstock Discuss the Selection of water quality for hydrogen production	• Installation and • interconnection of major equipment for • hydrogen conditioning system along with other balance of plant	
5. Monitoring Water Feedstock Quality	• Discuss how to monitor the quality of water feedstock for input to the electrolyser.	• Demonstrate the setup of the Green Hydrogen • compression system	
6. Piping System Layout for Water Supply	• Explain the layout of the piping system for the supply of water to the electrolyser	• perform selection and sizing of hydrogen tank	
7. Installation of Piping and Accessories	• Explain how to install the Piping and Piping accessories for supplying a controlled quantity of water to the	• perform the required safety procedures as per industry standard	

	electrolyser using a level controller etc.		
8. Recording Results and Data Organization	• Discuss how to record results, organize data, and perform basic computations to set up and operate the input water system	• how to read and interpret Material Safety Data Sheet (MSDS)	
9. Installation of Water supply unit (Do's and Don'ts)	• Explain do's and don'ts in the installation of the water supply unit and its piping and joints	• Demonstrate the Compression system comply and follow all the applicable safety and regulatory standards.	
Total			**30**

UNIT 2: **Hydrogen Conditioning and Compression**			
Learning Outcomes	**Theory (15 hrs)**	**Practical (15 hrs)**	**Duration (Hrs) 30**
1. Describe the importance of Hydrogen purification and conditioning	Explain the process of conditioning/purification of green hydrogen	Show how to undertake installation and interconnection of major equipment for hydrogen conditioning system along with other balance of plant.	
	Explain De-Oxo System		
	Explain Dryer System		
	Discuss how to set up and operate the hydrogen conditioning system		
	Discuss other key balance of plants components		
2. Describe the requirement of Hydrogen compression	Explain compression process	Show the functions of Green hydrogen compression system	
	Discuss how to install compression system	Show how the compression system is set up	
	Explain about H2 compression types such as reciprocating, ionic & diaphragm	Illustrate key challenges in compression	
	Explain how to read and interpret Material Safety Data Sheet (MSDS)	Demonstrate how to read and interpret Material Safety Data Sheet (MSDS)	
	Discuss how to select and install hydrogen compression system		

	Discuss the precautions required to compress hydrogen		
	Explain key components/parameters of compressors including Pressure Valve, indicators, Gas Outlet & Inlets Valves, Tank size and Placement etc	Show how to perform the required safety procedures as per industry standard	
		Show how compression system comply and follow all the applicable safety and regulatory standards	
		Show how to perform selection and sizing of hydrogen tank	
	Total		**30**

UNIT 3: Set Up and Operate Hydrogen Storage System

Learning Outcomes	**Theory (15 hrs)**	**Practical (15 hrs)**	**Duration (Hrs)30**
1. Discuss various Hydrogen storage systems	• Explain the need for hydrogen storage	• Show how to perform the required safety procedures as per industry standard	
	• Explain the Challenges associated with Hydrogen in storage, handling, and transportation		
	• Discuss how to select and install a hydrogen storage system		
2. Discuss the precautions required to store hydrogen	• Discuss the safety guidelines to be followed as per applicable standard		
	• Discuss the architecture of Piping arrangement and Basics of Storage layout requirement		
	• The different methods of H2 storage (single vessel/multi cylinder cascade/portable storage/tube-trailers etc.) and how these systems are set up		
	• Explain about type I/II/III/IV cylinders and difference in setting up method		

3. Outline Use of special tools and tackles	• Discuss the Depressurization methods of Hydrogen Storage System • Use of Water seal or vent stack system	• Show how storage system comply and follow all the applicable safety and regulatory standards	
	• Explain key safety measures to be followed at hydrogen compression and storage system including performing Periodic/regular leak testing of Hydrogen, Storage Systems using soap solution, carry out Gas leak detection & method of placement, understand the use of Firefighting system, Use of FRC (Flame Resistant Clothing) in Hydrogen area • Discuss Safety – Do's & Don'ts	• Demonstrate how to read and interpret Material Safety Data Sheet (MSDS)	
	• Illustrate key challenges in storage		
Total			**30**

UNIT 4: Commissioning of Green Hydrogen System			
Learning Outcomes	**Theory (15 hrs)**	**Practical (15 hrs)**	**Duration (Hrs) 30**
1. Describe the importance of Commissioning	• Describe the importance and use of checklists for commissioning of each hydrogen system/ equipment/ • machinery/ piping as per OEM recommendation	• Show how to perform various activities conforming to the checklists for commissioning of each hydrogen system/ equipment/ machinery/ piping as per OEM recommendation	
	• Explain Green hydrogen system installation, testing, and commissioning checklist	• Show how to follow the checklist for Green hydrogen system installation, testing, and commissioning	
	• Discuss various inputs, outputs, and key performance metrics for hydrogen generation	• Show how various inputs, outputs, and key performance metrics for hydrogen generation are analysed	
	• Discuss pre-commissioning tests/ Downstream considerations including hydrogen		

	purity & pressure test, to detect leakage, Compressor Assembly operational and performance test, Drying Plant Hydraulic, Safety test, and performing trial run		
	• Explain trial run and pre-commissioning tests and the commissioning of Green Hydrogen Generation Plant in accordance with the applicable norms/ statutory requirements /regulatory standards	• Show how to perform trial run and pre-commissioning tests and the commissioning of Green Hydrogen Generation Plant under the applicable norms/ statutory requirements/ regulatory standards	
2. Show how required activities according to commissioning checklist are performed	Show dismantling and removal of components	• Show how to arrange all instruments, equipment, and facilities as required for inspection and testing at works to carry out trial run, commissioning tests	
Total			**30**

Unit 10: Health and Safety Measures for Installing and Operating Green Hydrogen System			
Learning Outcomes	**Theory (15 hrs)**	**Practical (15 hrs)**	**Duration (Hrs) 30**
1. Explain the requirements for a safe work area at the hydrogen generation project site	• Explain the requirements for a safe work area at the hydrogen generation project site	• Demonstrate the usage of personal protective equipment for ensuring safety during installation and O&M work	
	• Explain the importance of Occupational health & Safety standards and regulations for basic considerations for the safety of hydrogen systems	• Demonstrate the use of fire extinguishers, fire detection, and alarm system	

	• Describe potential causes of emergency such as gas leaks, fire, explosion, bomb threats, natural calamities, etc.	• Show how to comply with all applicable statutory requirements along with safety regulations in terms of fire protection	
	• Discuss the importance of different detectors and safety tools	• Demonstrate how to follow necessary and adequate safety measures including personal protective equipment and precautions to avoid any accident at the hydrogen generation site	
	• Review the Material Safety Data Sheet (MSDS) and labels of chemicals contained in cylinders to be aware of their hazards and precautionary measures	• Demonstrate good housekeeping and infection control & prevention practices	
	• Explain the need to maintain ideal temperature and humidity levels of storage areas used to safely contain gas cylinders		
	• Utilize sensors that can alert the responsible person, such as a safety officer, when storage rooms are not maintaining the ideal conditions for storing hazardous chemicals		
	• Explain the importance of administering first aid	• Demonstrate how to administer first aid	
	• Identify the personal protective equipment used for the specific purpose		
2. Identify the hazards associated	• Identify the hazards associated with hydrogen generation system		

with hydrogen generation system and their mitigation measures	• Identify work safety procedures and instructions for working at the hydrogen generation project site		
Total			**30**

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 power plant of Green Hydrogen.

Organizing a green hydrogen power plant visit, requires careful planning and coordination. First, define the objectives and identify the audience. Then, contact the power plant management to discuss visit possibilities, confirm dates, and obtain necessary permissions. Plan the visit itinerary, including arrival, welcome briefing, plant tour, Q&A session, and departure, while ensuring visitors are briefed on safety protocols. Arrange logistics, provide pre-visit information, ensure safety compliance, and plan follow-up activities. By coordinating all aspects, the visit can offer valuable insights into cutting-edge technology and sustainability efforts.

Visit a Green Hydrogen Power Plant and observe the following: During the visit, students should arrange for a knowledgeable guide to lead the tour and provide detailed explanations about the plant's operations, technology, and environmental benefits. Some of

1. Activity and duties in Green Hydrogen Power Plant
2. Different section of green hydrogen plant like Electric Power source, Production area, water feed system.
3. Hydrogen Storage area
4. Green Hydrogen plant Layout
5. Presentation on the plant's role and impact
6. Quantity of Hydrogen Produced
7. Sale procedure
8. Manpower engaged
9. Total expenditure of Plant
10. Total annual income
11. Profit/Loss (Annual)
12. Any other information
13. Discussion with plant engineers and experts

7. LIST OF EQUIPMENT AND MATERIALS

The list 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 students can regularly perform routine tasks for practice and acquire adequate practical experience.

Tools and Equipment and Training materials

S.No.	Equipment	Quantity
1	Colour code nomenclature chart of Hydrogen	10
2	Hydrogen production flowchart	10
3	Hydrogen supply chain flow chart	5
4	Schematics of Green Hydrogen Production Plant	05
5	Small size/demonstration units of transformer	01
6	Rectifier	02
7	Electrolyser	5 liitre
8	Solar power plant	2kwh
9	Multimeter	04
10	Clamp meter	04
11	Phase sequence meter	02
12	Earth tester	02
13	Frequency meter	02
14	Pressure meter	02
15	Hand driven Megger	01
16	Tools required for laying water pipelines	02
17	Sample signs	10
18	Associated plumbing accessories	1 set
19	Block diagram/flow chart of hydrogen compression	02
20	Hydrogen purification systems with alert labels at important parts	01
21	Tool kit	01
22	IR Thermometer	02

23	Barometer	01
24	Double-ended flat spanner (1 set)	2
25	Double-ended ring spanner (1 set)	02
26	Wrenches (1 set)	01
27	Combination pliers (1 set)	01
28	Side cutting pliers (1 set)	01
29	Nose pliers	01
30	Screw driver (1 set)	01
31	Vanier calliper	01
32	Hammer (1 set)	01
33	Cutters	01
34	Tweezers	01
35	Stripping & Crimping Tools (1 set)	01
36	Safety helmet	08
37	Electronic pressure gauge	01
39	KOH concentration measuring tools	02
40	Gas leakage detector	02
41	Nose mask	08
42	Safety goggles	08
43	Ear plug	08
44	PVC hand glove	08
45	Cotton hand glove	08
46	Reflective jacket	08
47	Safety Gloves	08
48	Chemical Mask	08
49	Leather gloves	08
50	Flame proof aprons	08
51	Flame proof overalls buttoned to neck	08
52	Helmets/hard hats	08
53	Full body harness	08
54	Hand shields	08
55	Fire extinguishers	02

56	First aid equipment	02
60	First aid kit	02
61	Material Safety Data Sheet	02
62	Display of emergency contact numbers (including hospitals having dedicated treatment facility for hydrogen-related accidents)	04

8. VOCATIONAL TEACHER'S/ TRAINER'S QUALIFICATION AND GUIDELINES

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:

S.No.	Qualification	Minimum Competencies	Age Limit
1.	Degree in Automobile or Mechanical Engineering from a recognized Institute /University, with at least 1-year work / teaching experience Or Diploma in Automobile or Mechanical Engineering from a recognized Institute /University, with at least 3-year work / teaching experience Or B.Voc in Automotive with at least 2 year of experience	• Effective communication skills (oral and written) • Basic computing skills.	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 Samagrah Shiksha. 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 Samagrah Shikhsha in the following ways:

(i) 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

(ii) 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:

(i) Written test for the technical/domain specific knowledge related to the sector;
(ii) Interview for assessing the knowledge, interests and aptitude of trainer through a panel of experts from the field and state representatives; and
(iii) 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:

(i) Prepare session plans and deliver sessions that have a clear and relevant purpose and that engage the students;
(ii) Deliver education and training activities to students, based on the curriculum to achieve the learning outcomes;
(iii) Make effective use of learning aids and ICT tools during the classroom sessions;
(iv) Engage students in learning activities, which include a mix of different methodologies, such as project-based work, teamwork, and practical and simulation-based learning experiences;
(v) 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;
(vi) Identify the weaknesses of students and assist them in up-gradation of competency;
(vii) Cater to different learning styles and level of ability of students;
(viii) Assess the learning needs and abilities, when working with students with different abilities

(ix) Identify any additional support the student may need and help to make special arrangements for that support;
(x) Provide placement assistance

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

1. Participation in guidance and counselling activities conducted at Institutional, District and State level;
2. Adoption of innovative teaching and training methods;
3. Improvement in results of vocational students of Class X or Class XII;
4. Continuous up-gradation of knowledge and skills related to the vocational pedagogy, communication skills and vocational subject;
5. Membership in professional society at the District, State, Regional, National and International levels;
6. Development of teaching-learning materials in the subject area;
7. Efforts made in developing linkages with the Industry/Establishments;
8. Efforts made towards involving the local community in Vocational Education
9. Publication of papers in National and International Journals;
10. Organisation of activities for the promotion of vocational subjects;
11. Involvement in placement of students/student support services.

10. LIST OF CONTRIBUTORS

1. Mr. Ankit Singh Chauhan, Assistant Professor (contractual), Automotive, Department of Engineering and Technology, PSS Central Institute of Vocational Education, Shyamla Hills, Bhopal- 462002.
2. Dr. Vinod Kumar Yadav, Associate Professor, Mechanical, Department of Engineering and Technology, PSS Central Institute of Vocational Education, Shyamla Hills, Bhopal- 462002.

Coordinator Reviewer:

1. Dr Saurabh Prakash, Professor and Programme Coordinator, Department of Engineering and Technology, PSS Central Institute of Vocational Education, Shyamla Hills, Bhopal- 462002.
2. Dr. Vinod Kumar Yadav, Associate Professor, Mechanical, Department of Engineering and Technology, PSS Central Institute of Vocational Education, Shyamla Hills, Bhopal- 462002.

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION

Shyamla Hills, Bhopal- 462 002, M.P., India