Course Curricula

for

Short Term Courses based on Modular Employable Skills (MES)

in

Chemical Sector

DIRECTORATE GENERAL OF EMPLOYMENT AND TRAINING
MINISTRY OF LABOUR & EMPLOYMENT
GOVERNMENT OF INDIA

Course Curricula for Short Term Courses based on Modular Employable Skills (MES) in the Chemical Sector

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Skill Development based on Modular Employable Skills (MES)

Background

The need for giving emphasis on the Skill Development, especially for the less educated, poor and out of school youth has been highlighted in various forums. The skill level and educational attainment of the work force determines the productivity, income levels as well as the adaptability of the working class in changing environment. Large percentage of population in India is living below poverty line. One of the important causes is lower percentage of skilled persons in the workforce

The skill development at present is taking place mostly in the informal way, i.e. persons acquire skill at the work-place when they help their parents, relatives and employers etc. Such persons do not have a formal certificate and thus earn lower wages and are exploited by employers. They have come through informal system due to socio-economic circumstances of the family and the compulsions of earning a livelihood rather than attending a formal course. While their productivity is low, their contribution to the national GDP cannot be ignored. If the country can create a system of certification which not only recognizes their skills but also provides education and training in a mode that suits their economic compulsions, it will not only benefit the workforce to earn a decent living but also contribute to the national economy by better productivity of this workforce.

Another related problem to be tackled is large number of students drop outs (About 63% of the school students drop out at different stages before reaching Class-X).

Frame work for Skill Development based on 'Modular Employable Skills (MES)'

Very few opportunities for skill development are available for the above referred groups (out of school youth & existing workers especially in the informal sector). Most of the existing Skill Development programmes are long term in nature. Poor and less educated persons can not afford long term training programmes due to higher entry qualifications, opportunity cost etc. Therefore, a new frame work for Skill Development for the Informal Sector has been evolved by the DGET to address to the above mentioned problems. The **key features of the new frame work for skill development** are:

- Demand driven Short term training courses based on modular employable skills decided in consultation with Industry
- Flexible delivery mechanism (part time, weekends, full time)
- Different levels of programmes (Foundation level as well as skill upgradation) to meet demands of various target groups
- Central Government will facilitate and promote training while Vocational Training (VT) Providers under the Govt. and Private Sector will provide training
- Optimum utilisation of existing infrastructure to make training cost effective.
- Testing of skills of trainees by independent assessing bodies who would not be involved in conduct of the training programme, to ensure that it is done impartially.
- Testing & certification of prior learning (skills of persons acquired informally)

The Short Term courses would be based on 'Modular Employable Skills (MES)'.
The **concept for the MES** is :

- Identification of 'minimum skills set' which is sufficient to get an employment in the labour market.
- It allows skills upgradation, multiskilling, multi entry and exit, vertical mobility and life long learning opportunities in a flexible manner.
- It also allows recognition of prior learning (certification of skills acquired informally) effectively.
- The modules in a sector when grouped together could lead to a qualification equivalent to National Trade Certificate or higher.
- Courses could be available from level 1 to level 3 in different vocations depending upon the need of the employer organisations.
- MES would benefit different target groups like :
  - Workers seeking certification of their skills acquired informally
  - workers seeking skill upgradation
  - early school drop-outs and unemployed
  - previously child labour and their familly

Age of participants

The minimum age limit for persons to take part in the scheme is 14 years but there is no upper age limit.

Curriculum Development Process

Following procedure is used for developing course curricula

- Identification of Employable Skills set in a sector based on division of work in the labour market.
- Development of training modules corresponding to skills set identified so as to provide training for specific & fit for purpose
- Organization of modules in to a Course Matrix indicating vertical and horizontal mobility. The course matrix depicts pictorially relation among various modules, pre requisites for higher level modules and how one can progress from one level to another.
- Development of detailed curriculum and vetting by a trade committee and by the NCVT

(Close involvement of Employers Organizations, State Governments, experts, vocational training providers and other stake holders is ensured at each stages).

Development of Core Competencies

Possession of proper attitudes is one of the most important attribute of a competent person. Without proper attitudes, the performance of a person gets adversely affected. Hence, systematic efforts will be made to develop attitudes during the training programme.

The trainees deal with men, materials and machines. They handle sophisticated tools and instruments. Positive attitudes have to be developed in the trainees by properly guiding them

and setting up examples of good attitudes by demonstrated behaviors and by the environment provided during training.

Some important core competencies to be developed are:

1. Safety consciousness and safe working practices
2. Care of equipment and tools
3. Punctuality, discipline and honesty
4. Concern for quality
5. Respect for rules and regulations
6. Concern for health and hygiene
7. Cordial relationship and Cooperation with co-workers and team Work
8. Positive attitude and behavior
9. Responsibility and accountability
10. Learn continously
11. Communication Skills
12. Concern for environment and waste disposal

Following competencies should also be developed during level-II and higher courses:

1. Ability for planning, organizing and coordinating
2. Creative thinking, problem solving and decision making
3. Leadership
4. Ability to bear stress
5. Negotiation

Duration of the Programmes

Time taken to gain the qualification will vary according to the pathway taken and will be kept very flexible for persons with different backgrounds and experience. Duration has been prescribed in hours in the curriculum of individual module, which are based on the content and requirements of a MES Module. However, some persons may take more time than the prescribed time. They should be provided reasonable time to complete the course.

Pathways to acquire Qualification:

Access to the qualification could be through:

- An approved training programme; **Or**
- A combination of an approved training programme plus recognition of prior learning including credit transfer; **Or**
- The recognition of prior learning that provides evidence of the achievement of the competencies for the qualification.

Methodology

The training methods to be used should be appropriate to the development of competencies. The focus of the programme is on “performing” and not on “Knowing”. Lecturing will be restricted to the minimum necessary and emphasis to be given for ‘hands on training’.

The training methods will be individual centered to make each person a competent one. Opportunities for individual work will be provided. The learning process will be continuously monitored and feedback will be provided on individual basis.

Demonstrations using different models, audio visual aids and equipment will be used intensively.

Instructional Media Packages

In order to maintain quality of training uniformly all over the country, instructional media packages (IMPs) will be developed by the National Instructional Media Institute (NIMI), Chennai.

Assessment

DGE&T will appoint assessing bodies to assess the competencies of the trained persons. The assessing body will be an independent agency, which will not be involved in conducting the training programmes. This, in turn, will ensure quality of training and credibility of the scheme. Keeping in view the target of providing training/testing of one million persons through out the country and to avoid monopoly, more than one assessing bodies will be appointed for a sector or an area.

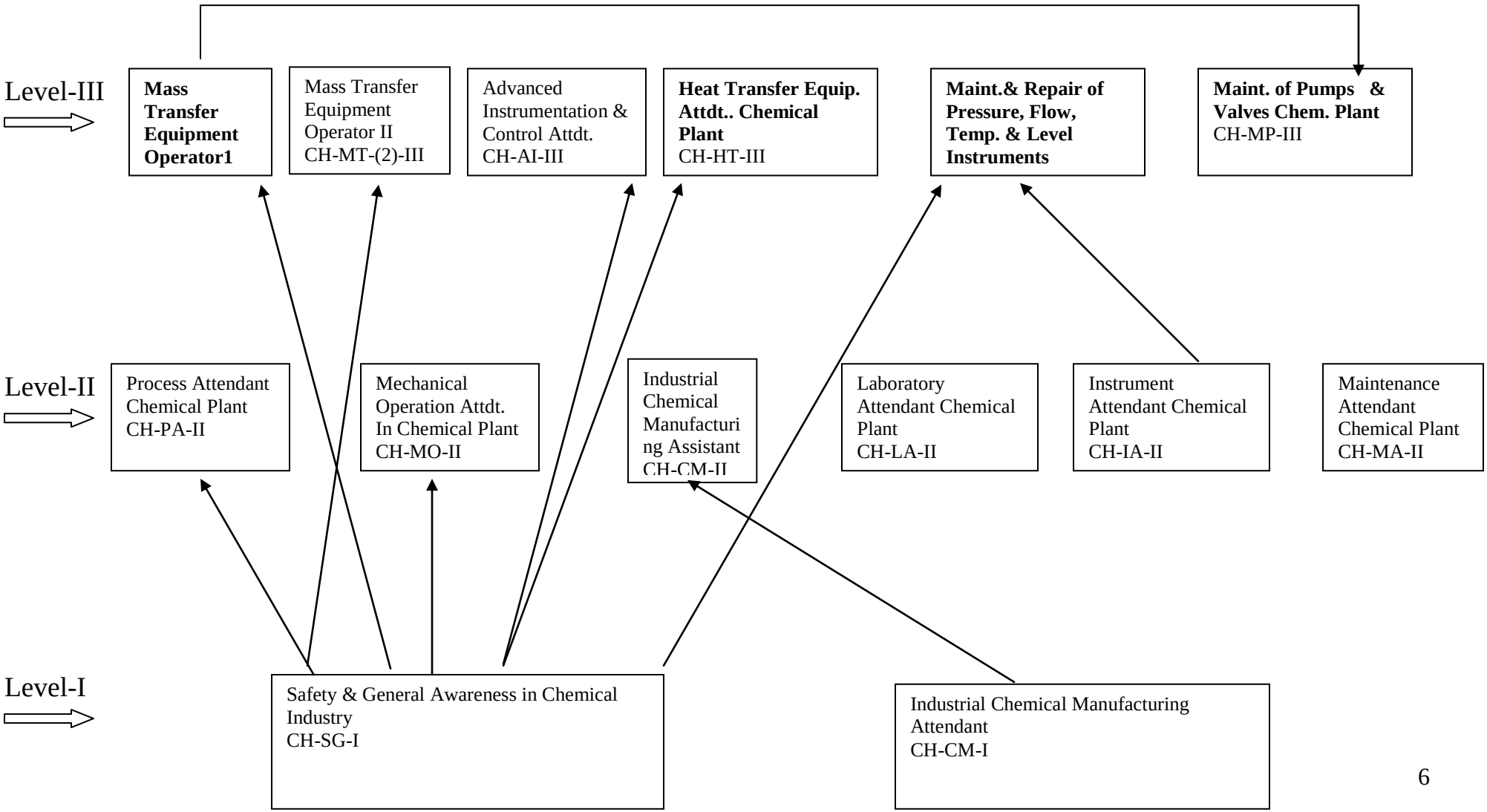
Certificate

Successful persons will be awarded certificates issued by National Council for Vocational Training (NCVT).

STRUCTURE OF MODULES/COURSE MATRIX

COURSE OUTLINE (FIELD OF TASKS) MODULAR TRAINING IN CHEMICAL GROUPS FOR INFORMAL SECTOR

CHEMICAL SECTOR TRADES



MODULES

Safety & General Awareness in Chemical Industry

* **Name of Module** **: Safety & General Awareness in Chemical Industry**

* **Sector** **: Chemical**

* **Code** **: CHE101**

*** Terminal Competency** : On completion of this module, the trainee will be able to- Have knowledge of safety precaution to the observed while working in chemical plant. & Knowledge of General Awareness

*** Duration** : 90 hours

*** Entry requirement** : a) Qualification – VIIIth Standard.
b) Age – 14 years and above

*** Contents** :

Practical Competencies	Underpinning Knowledge (Theory
• To study the importance of personal protective equipments such as Gumboot, Helmet, Gloves, Aprons, Ear plugs, nose mask etc. in chemical plant • To study the different types of fire extinguisher. • Selection of fire extinguisher to put off different types of fires in chemical plant. • To study fire detection system, alarms, smoke detector, heat detector and flame detector. • Identification of hazardous and toxic chemicals. • Study of materials/chemicals safety data sheet of handling of various chemicals. • Study of flow sheets of manufacturing of chemicals by using audio-visual aids for familiarization with pumps, valves, pipes, heat exchanger, etc. and plant utilities. • General Awareness about length, width, height, area, volume, pressure, flow, temperature, level, pH density, viscosity, current, specific gravity, Elements, formula of chemicals, atom, molecule, compounds, mixture, types of reactions & metals, non metals, metalloids, alloys	• Role of process attendant in the chemical plant. • Importance of safety and general precautions to be observed in the chemical plant. • Personal safety and use of personal protective equipments. • Good housekeeping. • Fire prevention and fire fighting equipments. • Cause and prevention of accidents, first aid. • Properties of hazardous and toxic chemicals and safe handling procedures, materials safety data sheets (MSDs), material handling. • Basic knowledge of filling log sheet of workplace. • Classification, sources and harmful effects of air, water and noise pollution. • General introduction of Chemical Plant, raw materials, intermediates and final products. • Introduction of different pumps, pipes, valves, vessels, heat exchanges, dryers, evaporator, filtration unit etc. in chemical plant. • Familiarization with plant utilities and service lines such as – steam, water, vacuum, compressed air, fuel line, refrigeration and air conditioning. • To assess quality of raw material and product by color, odor, pH, density and viscosity

Tools / Equipment:

Sl.No.	Description	Quantity
1.	Fire extinguisher (soda acid)	1 no.
2.	Chemical foam extinguisher	1 no.
3.	Mechanical foam extinguisher	1 no.
4.	Dry chemical powder extinguisher	1 no.
5.	Carbon-dioxide extinguisher	1 no.
6.	Smoke detector	1 no.
7.	Flame detector	1 no.
8.	Heat detector	1 no.
9.	Materials/chemical safety data sheet	20 sheets.
10.	Flow sheets of manufacturing processes audio-visual aids	CDs.
11.	Personal protective equipments kit (gumboot, helmet, gloves, aprons, air plugs, nose mask)	10 kit.
12.	Tool kit.	1 no.

Process Attendant Chemical Plant

*** Name of Module** : **Process Attendant Chemical Plant**

* **Sector** **: Chemical**

* **Code** **: CHE202**

*** Terminal Competency** **:** On completion of this module, the trainee will be able to operate different types of pumps, Flow meter , valves and pipe fittings in the Chemical Plant.

*** Duration** : 90 hours

*** Entry requirement** : a) **Qualification – VIIIth Standard + CHE101**
b) Age – 14 years & Above

*** Contents :**

Practical Competencies	Underpinning Knowledge (Theory
• Maintenance work: Dismantling, Cleaning and assembling of gate, globe , ball , stop cock and plug valve. • Dismantling, cleaning, assembling, installation and alignment in Chemical Plant of: Centrifugal pump, Gear Pump, Plunger pump Vacuum pump ,Hydraulic pump • Practical on use and selection of lagging material, glass, wool, asbestos, gaskets, thermo coal, lead & rubber during maintenance work.	• An introduction about valves:- Types, construction, functions and uses. • Knowledge of different types of pumps, their construction details and uses & maintenance in Chemical Plant. • Information about Lagging materials, types & uses.
• Fitting of pipe line. Cutting & threading of pipes, bending & fittings of pipes as per drawing. • Practical on – Fitting of different types of pipe joints. • Practical on use of Locking devices: Use of correct material and locking devices: such as split pin, locknut, Spring washers, Fitting & dismantling of cir clip	• Introduction of pipe, pipe joints, pipe bending fixture, Standard pipe threads, Tap & dies, standard pipe fittings. • Introduction, types, uses and importance of locking devices, Washers, circuits, flanges, gas kits etc. • Method of replacement of pipe fittings.
• Operation and flow measurement by: Venturimeter, Orificemeter, Rotameter • Operation and flow measurement by gas flow meter:, wet gas meter -dry diaphragm meter • Operation and head v/s capacity curve for: Centrifugal pump, Reciprocating pump Gear pump	• Basic properties of fluids, density, refractive index and viscosity. • Fundamentals of flow of fluids, flow pattern laminar and turbulent flow and flow measurements. • Construction, working, operations and trouble shooting of flow measuring devices: Venturimeter, Orifice meter, Pitot tube, Rotameter, Quantity meter.

• Operation of Diaphragm pump for slurry or corrosive liquid. • Dismantling and assembling of different types of valves. • Operation of given vacuum pump.	• Construction, working principles, operation and trouble shooting of fluid transporting devices: Centrifugal pump, Positive displacement pump Reciprocating Rotary, Diaphragm. pump Different types of blowers, fans, compressors. Vacuum pumps – water ring and oil ring type. Different types of valves, pipes and pipe fittings.

*Tools/Equipments :

Sl. No.	Description	Quantity
1.	Venturimeter test rig	1 no.
2.	Orifice meter test rig	1 no.
3.	Rotameter test rig	1 no.
4.	Gas flow meter test rig	1 no.
5.	Centrifugal pump test rig	1 no.
6.	Reciprocating pump test rig	1 no.
7.	Gear pump test rig	1 no.
8.	Series/parallel two gear pump test rig	1 no.
9.	Series/parallel two gear pump test rig	1 no.
10.	Vacuum pump – water ring type normal and gland	1 no.
11.	Vacuum pump – oil ring types, mechanical seal type	1 each
12.	Blower	1 no.
13.	Centrifugal fan	1 no.
14.	Two stage compressor	1 no.
15.	GATE valve 4”Non-rising stem, Rising stem	1 no. each
16.	Globe valve 4”	1 no.
17.	Ball valve 4”	1 no.
18.	Needle valve 4”	1 no.
19.	Plug valve 4”	1 no.
20.	Butterfly valve 4”	1 no.
21.	Diaphragm valve 4”	1 no.
22.	Check valve (NRV) 4”	1 no.
23.	Ball valve (NRV) 4”	1 no.
24.	Lift check valve (NRV) 4”	1 no.
25.	Diaphragm pump test rig	1 no.
26.	Tool kit	1 no.
27	Pipe vice 4”	1 no.
28	Pipe wrench 12”118”	1no.
29	Pipe die set	1 set

Mechanical Operation attendant in chemical plant

***Name of Module: : Mechanical Operation attendant in chemical plant**

* **Sector** : **Chemical**

* **Code** **: CHE203**

***Terminal Competency** : On completion of this course the trainee will be able to operate size reduction, screening, conveying, filtration, centrifugation, mixing in various chemical Industry

***Duration-** : 60 Hrs.

***Entry Requirement** **: a) Qualification-VIII th Standard Pass + CHE101**
b) Age – 14 years minimum

*** Contents:-**

Practical Competencies	Underpinning Knowledge (Theory
• Operation of Ball mill • Operation of hammer Mill • Operation of Sieve Analysis • Operation of Plate & Frame Filter Press • Operation of Rotary vacuum Filter • Operation of Basket Centrifuge • Operation Of Mixing Equipment • Operation of settler & decantation	• Introduction of Size Reduction like crushing Grinding & Pulverization • Construction & working of Various Size Reduction Equipments • Screening defination & Identification about mesh size • Introduction to Conveyers & Equipments • Introduction to solid liquid separation & their equipments like centrifuge, filter press, Rotary vacuum filter • Introduction about solid - solid ,solid - liquid liquid-liquid mixing • Sedimentation & decantation methods • Safety Precautions while working on above equipments

*** Tools / Equipment:**

Sr. No.	Description	Quantity
1.	Ball mill	1 Set
2.	Hammer mill	1 Set
3.	Blake jaw crusher	1 set
4.	Sieve shaker	1 set
5.	Plate & Frame filter Press	1 set
6.	Rotary vacuum filter	1 set
7	Basket Centrifuge	1 set
8	Ribbon Blender	1 set
9	Mixer & Agitator	1 set
10	Mixer Settler	1 set
11	Batch sedimentator	1 set

Maintenance Attendant Chemical Plant

- **Name of Module : Maintenance Attendant Chemical Plant**
- **Sector : Chemical**
- **Code : CHE204**
- **Terminal Competency :** On completion of this course the trainee will be able to carry out Maintenance of pumps, pipes & valves in chemical plant .
- **Duration :** 60 Hrs
- **Entry requirement : A) Qualification – VIII th Standard Pass+CHE101**

  b) Age – 14 years minimum

- **Course Contents**

Practical Competencies	Underpinning Knowledge (Theory
• Importance and uses of the personal protective equipments such as ' Gum boot, Helmet, Gloves, aprons, Ear Plug , Nose Mask' & First Aid. • Practical on different tools in maintenance work. • Dismantling , cleaning and assembling of different types of pumps, pipes and valves.	• Purpose of Maintenance work in Chemical Plant. • Maintenance and Safety Precautions to be observed in Chemical Plant. • Identification & uses of Tools, Equipment and material used for Maintenance work . • Roles of fitter such as Measuring , Marking, Checking, filing, punching, Drilling, Tapping etc. • Introduction about pumps, pipes, valves, compressors, blowers, crushers, pulverizer etc . used in Chemical Plant . • Types, construction and working of Pumps.

Tools & Equipments :

Sr. No.	Tools & Equipments	Quantity
1	Calipers outside spring 6"/15 cm.	1 no
2	Calipers inside spring 6"/15 cm.	1 no
3	Divider Spring 6" /15 cm.	1 no
4	Center punch 4" /10 cm.	1 no

5	Chisel Cold Flat 1”	1 no
6	Ball pen hammer 1 lb	1 no
7	Steel rule 12 “	1 no
8	Screw Driver set	1 no
9	Scriber 6”	1 no
10	Safety Goggles	1 no
11	Combination Pliers 8” / 20 cm	1 no
12	Long Nose Pliers	1 no
13	Try Square 6”	1 no
14	Different Types of Files 10 to 21 “ set (Flat/Half Round/Tri) each	1 set
15	Drill Twist /Straight Shank Drill set	1 set
16	Double ended spanner set of 1/8”,3/16”,to ½” to 9/16 “	1 set
17	Double Ended Spanner set metric size 6 x 9 to 20 x 22	1 set
18	Pipe Wrench 24 “ long	1 no
19	Drilling Machine to drill up to ½ “ Dia.	1 no
20	Models of Centrifugal Pump, Gear Pump, Vacuum Pump	1 no. each
21	Personal Protective Equipments kit (Gum Boot, Helmet, Gloves, Apron, Nose Mask)	1 no

Instrument Attendant Chemical Plant

*** Name of Module : Instrument Attendant Chemical Plant**

*** Sector : Chemical**

*** Code : CHE205**

*** Terminal Competency :** On completion of this module, the trainee will be able to identify and take readings of measuring, recording, indicating and controlling instruments related to pressure, temperature, flow, level and pH.

*** Duration :** 90 hours

*** Entry requirement : a) Qualification – VIII th Standard+CHE101**
b) Age – 14 years minimum

Course Contents:

Practical Competencies	Underpinning Knowledge (Theory
❖ Familiarization with tool kit and uses of tools. ❖ Identification, reading and installation of following instruments used ❖ in Chemical Plant: ❖ Voltmeter (a) Analog (b) digital ❖ Ammeter (a) Analog (b) digital ❖ Multi meter (a)Analog (b)digital ❖ Wattmeter and its uses and installation. ❖ Manometers , ❖ Pressure Gauges: Bourdon Tube type and ▪ Diaphragm type. ❖ Pressure gauge: installation on line or on Dead ▪ Weight Tester. Pressure switch, Pressure Regulating Valve. ❖ Glass Thermometer, Bimetallic thermometer, Filled ❖ System thermometer and temperature switches. ❖ Thermocouples ,Venturimeter ,Rotameter ❖ Indicator, Level switch – Magnetic type. ❖ Strip Chart Recorder ,Circular chart recorder pH meter , Digital ON-OFF, P.I.D. Controller.	• Safety precautions related to Chemical Plant. • Introduction to measuring, recording, indicating and controlling instruments related to pressure, temperature, flow and level used in chemical plant. • Protection of Instruments from corrosive fluids, moisture and dust. • Identification and use of hand tools - hack saw, hammer, punch, soldering iron, spanners etc. • An introduction about Basic Electricity, A.C. current and D.C. current. • Electric supply to instrument, proper connections and wiring. • Importance of Earthing in instruments. • Introduction and uses of pressure switch, temperature switch and level switch.

Tools / Equipments:

Sr.No.	Description	Quantity
1.	Hand Tool Set.	2 nos. each
2.	Different type of Bourdon tube, Pressure gauges like – C type, spiral, Helical type, Diaphragm type with different ranges.	2 nos. each.
3.	A.C. Voltmeter different ranges.	2 nos. each.
4.	D.C. Voltmeter different ranges.	2 nos. each.
5.	Multi meter analog.	2 nos.
6.	Multi meter Digital 4 ½ digit.	2 nos.
7.	Watt meter, 250 watts, 500 watts.	1 each.

8.	U, Tube Manometer, Well type Manometer, Inclined Manometer.	1 each.
9.	Mercury in Glass Thermometers. Different ranges – 0 to 110^{o}C, 0 – 210^{o}C.	2 nos. each.
10.	Bimetallic Thermometer – 0 – 100^{o}C	2 nos.
11.	Filled system temperature Indicator –Capillary type 0 – 200^{o}C Stem type 0 – 150^{o}C	 2 nos. each.
12.	Orifice Assembly suitable for 25mm pipe line.	1 no.
13.	Venturimeter – suitable for 25mm pipe line.	1 no.
14.	Rotameter 0-200 l/hr – 25 mm pipe size	1 no.
15.	Water pump – suitable for 25mm pipe.	1 no.
16.	Thermocouples – different types- - 'J', 'K', 'R', 'S'	2 nos. each.
17.	Potentio metric types strip chart recorder. 1) Single point 0-300^{o}C 2) Double Point 0 – 300^{o}C 3) 0 – 20 mA 4) 4-20 mA receiver recorder	 1 no. 1 no. 1 no. 1 no.
18.	Circular chart recorder 0-20mA input	1 no.
19.	Dead Weight Tester 0-100 Kg/cm^{2}	1 no.
20.	Comparator	1 no.
21.	Pressure Regulating Valve (P.R.V.) (i) 0 – 25 P.S.I. (ii) 0 – 100 P.S.I.	1 no.each
22.	Pressure Switch Different Pressure 0-2 Kg/Cm^{2} Pressure Max – 0 – 10 Kg/cm^{2}	1 no.
23.	Temperature switch adjustable filled system 0-150^{o}C	1 no.
24.	Magnetic switch for level	2 nos.
25.	Air Purge System Level Indicator	1 no.
26.	Spanner Set	1 no.
27.	Screw Driver Set.	2 nos
28.	pH meter	1 no.
29.	Digital ON-OFF PID Controller	2 nos.

Laboratory Attendant Chemical Plant

*** Name of Module** : **Laboratory Attendant Chemical Plant**

* **Sector** **:** **Chemical**

* **Code** **:** **CHE206**

*** Terminal Competency :** On completion of this course the trainee will be able to work in Chemical Laboratory to assist the Chemist / Scientist.

*** Duration** **:** 60 Hrs.

*** Entry requirement** : **a) Qualification - VIIIth Standard+ CHE101**

b) Age - 14 yrs.

*** Course Content**s :

Practical Competencies	Underpinning Knowledge (Theory
• Identification and testing of acids, alkalis and Solvents. • Operational exercise on- a) Filtration b) Distillation c) Crystallization d) Evaporation • Practical on – pouring/transferring of Chemicals. • Operation of distillation unit for preparing distilled water. • Operation and installation of: ◆ Stirrer ◆ Hot Plates ◆ Heating mantles ◆ Oven ◆ Pump ◆ Furnace ◆ Balances ◆ Fire extinguisher ◆ Incubator	• Safety precautions to be observed during handling of Chemicals and glassware. • Introduction and identification of general Lab. outfit used in Chemical Lab like hot plate, stirrer, oven, furnace, balances etc. • Introduction and upkeep of Testing Instruments used in Chemical Lab. • Information about different types of Chemicals used in Chemical Lab., their nature, identification, physical testing, handling and upkeep in Lab. • Identification and selection of glass wares used in Lab. • Storage of Chemicals. • Types and selection of containers used for Chemicals. • Methods of transfer of Chemicals. • Preparation of various reagents, solution, Indicators and distilled water.

*** Tools / Equipments :**

SR.No.	Tools and equipment	Quantity
1.	All types of glass ware used in Laboratory	-
2.	Various types of Balances	1 each
3.	Distillation Unit for distilled water	1 No.
4.	Various containers for storing of various chemicals	-
5.	All Lab. chemicals.	-
6.	First Aid box	1 No.
7.	Fire extinguisher	1 No.
8.	Hot plates	1 No.
9.	Heating Mantles	1 No.
10.	Oven	1 No.
11.	Vacuum oven	1 No.
12.	Furnace	1 No.
13.	PH meter	1 No.
14.	M P,& B..P apparatus	1 No.
15.	Refractometer	1 No.
16.	Vacuum Pump	1 No.
17.	Viscometer	1 No.
18.	Refrigerator	1 No.

Industrial Chemical Manufacturing Attendant

*** Name of Module** : **Industrial Chemical Manufacturing Attendant**

* **Sector** **: Chemical**

* **Code** **: CHE107**

*** Terminal Objectives** : On completion of this module, the trainee will be able to work in small units manufacturing Industrial Chemicals.

*** Duration** : 60 hours

*** Entry requirement** : a) Qualification – VIIIth Standard.
b) Age – 14 years

*** Course Contents:**

Practical Competencies	Underpinning Knowledge (Theory
• Operation and installation of balances, hot plates, stirrer, ovens, furnace, distillation units, melting .point. and boiling point apparatus etc. Practical on – - Solution preparation. - Precipitation - Filtration - Drying - Ignition - Weighing - Crystallization - Distillation - Solvent extraction - Decantation	• Safety precaution and proper up keep of manufacturing place. • Introduction and operational details of glass wares, equipment, balances and fire extinguishers, relevant to chemical manufacturing unit. • Industrial chemicals: Introduction, identification, handling, storage, transportation and related hazards. • Various types of containers and their selection - used in industry for storing raw materials and produced chemicals. • Packing and re-packing of bulk chemicals. • Introduction of steps in manufacturing process viz. – solution preparation, filtration, drying, weighing, evaporation, crystallization, distillation, melting, boiling etc.

*** Tools / Equipments:**

Sr .No.	Description	Quantity
1.	General lab glass wares	1 set
2.	Balances	1 no.
3.	Distillation unit for distilled water	1 no.
4.	Hot plate	1 no.
5.	Heating mantle	1 no.
6.	Stirrer	1 no.
7.	Oven	1 no.
8.	Vacuum oven	1 no.
9.	Furnace	1 no.
10.	pH meter	1 no.
11.	M.P. and B.P . apparatus	1 no.
12.	Refractometer	1 no.
13.	Vacuum pump	1 no.
14.	Viscometer	1 no.
15.	Refrigerator	1 no.
16.	De mineralized water plant	1 no.

Heat Transfer Equipments Attendant Chemical Plant

***Name of Module** : **Heat Transfer Equipments Attendant Chemical Plant**

* **Sector** **: Chemical**

* **Code** : **CHE208**

***Terminal Competency** : On completion of this course the trainee will be able to work on evaporator, Heat Exchanger, cooling tower etc. in Chemical Plant.

***Duration-** : 90 Hrs.

***Entry Requirement-** **:** a) Qualification-VIII th Standard+ **CHE101**
b) Age – 14 years minimum

*** Contents: -**

Practical Competencies	Underpinning Knowledge (Theory
● Operation, dismantling, cleaning and assembling of ✓ Shell & Tube Heat Exchanger ✓ Double Pipe Heat Exchanger ✓ Floating Head Heat Exchanger ✓ Plate Heat Exchanger ✓ Standard Vertical Tube Evaporator ✓ Triple Effect Evaporator ✓ Steam Jacketed Vat ● Generation of Steam by using Boiler ● Study of different types of Steam Traps ● Study and operation of Cooling Tower ● Conducting Hydraulic Test for finding leakage in Heat Exchanger Tubes, Boiler Tubes, Vacuum line, Evaporators, Pipeline.	● Introduction of Heat Transfer Operation in Chemical Plant. ● Importance of safety & General precautions observed while working on Heat Transfer Equipments. ● Importance of - Conservation of Energy. ● Introduction of – Various insulating Materials such as Glass wool, Thermocol, Mica, Magnesia, Asbestos etc. ● An idea about – Modes of Heat Transfer : Conduction, Convection, Radiation. ● An introduction about – Co-Current, Counter current Heat Exchanges, ● Basic Knowledge of construction, Sketches, Working Principles, Start up & shut down procedures, tubes cleaning, Trouble shooting of following Heat Transfer Equipments. ✓ Heat Exchanger: Shell & tube, Double pipe, Floating Head, Plate Heat Exchanger ✓ Pre Heater, Heater, Economizer, Vaporizer, Furnaces, Kilns, Reboilers ✓ Evaporators : Types of Evaporators & their applications in different Chemical Plant. ✓ Boiler : Types of Boilers, Boiler Accessories, Steam Traps, Properties of Steam, Boiler Feed Water Treatment. ✓ Cooling Tower: Different types of Cooling Tower & application in Chemical Plant. Leakage finding methods in Heat exchanger tube

*** Tools/ Equipments :**

Sl.No.	Description	Quantity
1.	Shell and Tube Heat Exchanger	1
2.	Double Pipe Heat Exchanger	1
3.	Floating Head Heat Exchanger	1
4.	Plate Heat Exchanger	1
5.	Standard Vertical Tube Evaporator	1
6.	Triple Effect Evaporator	1
7.	Steam Jacketed Vat	1
8.	Electrical/Fuel Based Boiler-capacity 100Kg/hr.	1
9.	Set of Stream Traps	1
10.	Cooling Tower	1
11.	Plunger Pump	1
12.	Tool Kit	1

Mass Transfer Equipment Operator

***Name of Module:** **: Mass Transfer Equipment Operator I**

* **Sector** **: Chemical**

* **Code** : **CHE209**

***Terminal Competency** : On completion of this course the trainee will be able to operate Distillation Unit, absorption unit and various driers in various chemical process Industry

***Duration** : 60 Hrs.

***Entry Requirement** **:** a) Qualification-VIII th Standard + **CHE101**
b) Age – 14 years minimum

*** Contents:-**

Practical Competencies	Underpinning Knowledge (Theory
• Operation of a distillation unit by carrying out separation of Binary liquid mixture using 1. Simple Distillation Unit 2. Bubble Cup Tray Distillation column 3. Packed Glass Distillation column • To determine the effect of purity by variation of reflux Ratio in Bubble Cap Tray Distillation column(Fractional Distillation). • To determine flooding velocity using Packed Absorption Tower • Operation of tray drier / Vacuum Tray Drier • Rotary Drier • Spray Drier	• Introduction of Distillation Operation in Chemical Plants • Introduction of Distillation Operation • Importance of Safety & General Precautions to be observed while working on Distillation Unit. • Basic knowledge of methods of distillation such as Flash Distillation, differential distillation, Rectification. Reflux Ratio and importance of Reflux Ratio • Basics of Binary & multi component Distillation. • Azeo tropic Distillation • Extractive Distillation • Vacuum/.Low pressure Distillation • Steam Distillation • Introduction of different types of Distillation columns used in Chemical Plant. • Absorption defination And terms, Rate of Absorption its Effecting Factors, Flooding Velocity ,Stripping • Drying Terms, Rate of Drying, Factors Effecting to the Rate, Drying Equipments

*** Tools / Equipment:**

Sl.No.	Description	Quantity
1.	Simple Distillation Unit	1 Set
2.	Bubble Cup Tray Distillation Column	1 Set
3.	Packed Glass Distillation Column	1 set
4	Flooding velocity experiment unit	1 set
5	Tray Drier / Vacuum tray Drier	1 set
6	Rotary Drier	1 set
7	Spray Drier	1 set

Mass Transfer Equipment Operator II

***Name of Module:** : **Mass Transfer Equipment Operator II**

* **Sector** **: Chemical**

* **Code** : **CHE210**

***Terminal Competency** : On completion of this course the trainee will be able to operate Extraction Tower, crystallizer Leaching and Adsorption unit in various chemical processes Industry

***Duration-** : 60 Hrs.

***Entry Requirement** **:** a) Qualification-VIII th Standard+ **CHE101**
b) Age – 14 years minimum

*** Contents:-**

Practical Competencies	Underpinning Knowledge (Theory
• Operation of a mixer settler Extractor • Operation of a Spray Extraction Tower • Crystal formation by Heating & Cooling Methods in Vacuum Crystallization/ Batch Crystallizer • Operation of Leaching Unit	• Introduction to Extraction • Various terms of l – l Extractor • Application of Liquid - Liquid Extraction • Choice of Solvent • Extraction Equipment • Introduction of Leaching • Introduction Of Adsorption • Application of various Adsorbent • Regeneration of Adsorbent • Introduction to crystallization & their Equipments • Safety Precautions of above equipments

*** Tools / Equipment:**

Sl.No.	Description	Quantity
1.	Spray Extraction Tower	1 Set
2.	Mixer settler Extractor	1 Set
3.	Vacuum Crystalliser / Batch Crystallizer	1 set
4.	Leaching Unit	1 set

Maintenance of pumps & valves Chemical Plant

*** Name of Module** : **Maintenance of pumps & valves Chemical Plant**

* **Sector** : **Chemical**

* **Code** : **CHE311**

*** Terminal Competency** : On completion of this course the trainee will be able to carry out Maintenance of pumps, pipes & valves in Chemical Plant.

*** Duration** : 90 Hrs.

*** Entry requirement** : **a) Qualification -VIIIth Standard Pass and CHE209**
b) Age - 14 yrs.and above

*** Course Contents** :

Practical Competencies	Underpinning Knowledge (Theory
• Importance and uses of the personal protective equipments such as 'Gum boot, Helmet, Gloves, Aprons, Ear Plug, Nose Mask' & First Aid. • Practical on different tools in maintenance work. • Maintenance work: Dismantling, Cleaning and assembling of gate, globe , ball , stop cock and plug valve. • Dismantling, cleaning, assembling, installation and alignment in Chemical Plant of: -Centrifugal pump -Gear pump -Plunger pump -Vacuum pump -Hydraulic pump • Practical on use and selection of lagging material, glass, wool, asbestos, gaskets, thermo coal, lead & rubber during maintenance work.	• Purpose of Maintenance work in Chemical Plant. • Maintenance and Safety Precautions to be observed in Chemical Plant. • Identification & uses of Tools, Equipment and material used for Maintenance work.. • Roles of Fitter such as Measuring, Marking, Checking, Filing, Punching, Drilling, Tapping etc. • An introduction about valves:- Types, construction, functions and uses. • Knowledge of different types of pumps, their construction details and uses & maintenance in Chemical Plant. • Information about Lagging materials, types & uses. • Importance of preventive maintenance

- **Tools & Equipments:**

S.No.	Tools & Equipment	Quantity
1.	Calipers outside spring 6"/15 cm.	1 no.
2.	Calipers inside spring 6"/15 cm.	1 no.
3.	Divider spring 6"/15 cm.	1 no.
4.	Centre punch 4"/10 cm.	1 no.
5.	Chisel cold flat 1"	1 no.
6.	Ball pen Hammer 1 lb	1 no.
7.	Steel rule 12"	1 no.
8.	Screw Driver set	1 no.

9.	Scriber 6”	1 no.
10.	Safety Goggles	1 no.
11.	Combination Pliers 8”/20 cm.	1 no.
12.	Long nose pliers	1 no.
13.	Try square 6”	1 no.
14.	Different types of files 10 to 21” set (Flat/Half rd/Round/Tri.) each	1 set
15.	Drill Twist/Straight shank drill set	1 set
16.	Double ended spanner set of $^{1}/_{8}$” x $^{3}/_{16}$” to ½” x $^{9}/_{16}$”	1 set
17.	Double ended spanner metric size 6x9 to 20x22	1 set
18.	Pipe Wrench 24” long	1 no.
19.	Drilling machine to drill up to ½: dia.	1 no.
20.	Models of Centrifugal Pump, Gear Pump, Vacuum Pump	1 no. each
21.	Personal protective equipments kit (Gum boot, Helmet, Gloves, Aprons, Nose Mask)	1 no.
22.	Centrifugal Pump	1 No.
23.	Gear Pump	1 No.
24.	Vacuum Pump	1 No.
25.	Plunger pump	1 No.
26.	Hydraulic pump	1 No.
27.	Blower	1 No.
28.	Compressor 100 PSI	1 No.
29.	Globe valve 4”	1 No.
30.	Gate valve 4” rising/non rising stem	1 No.
31.	Ball valve 4”	1 No.
32.	Plug valve 4”	1 No.
33.	Mechanical seals	1 No.
34.	Lagging Materials Glass wool, Asbestos, Thermo coal & Rubber	As required
35.	Tool Kit	1 No.

Industrial Chemical Manufacturing Assistant

*** Name of Module** : **Industrial Chemical Manufacturing Assistant**

* **Sector** **: Chemical**

* **Code** **: CHE212**

*** Terminal Objectives** : On completion of this module, the trainee will be able to carry out manufacturing of Chemicals on small scale.

*** Duration** : 60 hours

*** Entry requirement** : **a) Qualification – 8th Std.and completed CHE107**
b) Age – 14 years

*** Course Contents:**

Practical Competencies	Underpinning Knowledge (Theory
• Chemical analysis by dry tests. • Chemical analysis by wet tests. • Installation and operation of PH meter, Colorimeter, viscometer, distilled water plant, Demineralized water plant, solvent distillation apparatus etc. • Manufacturing of following chemicals on lab scale: - Copper sulphate - Ferrous Sulphate - Potash Alum - Soap - Bleaching Powder • Measurement of density, R.I., pH, M.P. B. P Apparatus.. Viscosity, Turbidity, colour & flash point.	• Introduction about various steps involved in the manufacture of Industrial Chemicals. • Methods of preparation of solution, distilled water and Demineralized water. • Introduction about dilution of acids/reagents, precaution and hazards. • Methods of weighing, selection of balance & transfer of substance to prepare solution. • Information about manufacturing procedure of important chemicals like Alums, copper sulphate, Ferrous sulphate, Bleaching powders etc. • Procedure of Purification of commercial grade chemicals to prepare fine chemicals like Benzene, Toluene etc. • Introduction about identification of Chemicals using litmus, dry tests and wet tests. • Introduction about testing of purity of Chemicals by measuring M.P., B.P.. PH, density, colour, viscosity, turbidity, Flash point etc.

***Tools / Equipments :**

Sl.No.	Description	Quantity
1.	General glass wares	1 set.
2.	Balances	1 no.
3.	Distillation unit for distilled water	1 no.
4.	Hot plate	1 no.
5.	Heating mantle	1 no.
6.	Stirrer	1 no.
7.	Oven	1 no.
8.	Vacuum oven	1 no.
9.	Furnace	1 no.
10.	pH meter	1 no.
11.	M.pt. and B. pt. apparatus	1 no.
12.	Refractometer	1 no.
13.	Vacuum pump	1 no.
14.	Viscometer	1 no.
15.	Refrigerator	1 no.
16.	Demineralized water plant	1 no.
17.	Colorimeter	1 no.
18.	Nephelometer	1 no.

Maintenance and Repair of Pressure, Flow,Temperature and Level Instruments

*** Name of Module** : **Maintenance and Repair of Pressure, Flow, Temperature and Level Instruments**

* **Sector** **: Chemical**

* **Code** **: CHE213**

*** Terminal Competency** : On completion of this module, the trainee will be able to repair and test pressure gauges, dial thermometer, recorder, pyrometer and control valves.

*** Duration** : 90 hours

* **Entry requirement** : a) Qualification – VIIIth Standard + **CHE101**
b) Age – 14 years

***Course Contents**:

Practical Competencies	Underpinning Knowledge (Theory
• Dismantle Pressure Gauge – clean internal parts with C.T.C. • Install Pressure Gauge on Dead Weight Tester – take reading. • Install Master Gauge and under Test Gauge on Comparator. • Connect Pressure switch as per diagram and set range. • Dismantling, cleaning and assembling of Rotameter. • Dismantling, cleaning and assembling of Rotating Vane. • Dismantling, cleaning and assembling of Venturimeter. • Bimetallic Thermometer and filled system Thermometer – readings and calibration. • Thermocouple – open head, clean +ve and –ve terminal wire connection and take readings. • Pt-100 sensor. Open its head and clean +ve and –ve terminal reconnect, measure output of it at room temperature with Ohm meter. • Air Purge level indicator – remove liquid in tank, clean it, clean P.R.V. of air line. • D.P. Transmitter. Pneumatic open H.P. and L.P. chamber clean with C.T.C. Assemble it connect Pneumatic fittings with air connection, manometer for testing. • High and Low level alarm system clean connection. Connect set up for testing for low and high level settings. • Capacitance – probe type level indicator.	• Introduction, types, construction and use of Pressure Gauges. • Dead Weight Tester – uses and working. • Comparator – uses and working. • Press switch – uses and working. Use for alarm. • Rotameter – working, measurement and calibration. • Rotating Vane, flow meter, total flow use and calibration. • Venturimeter – uses and working. • Introduction and methods of calibration of thermometer and other temperature measuring instruments. • Thermocouple RTD types, use, checking and testing method. • Use of air purge level indicator, P.R.V., use of P.R.V. and its maintenance and calibration. • Manometer – types and uses. • Level measurement – level alarm. • Types and uses of control valve.

*** Tools / Equipments:**

Sl.No.	Tools and equipment	Quantity
1.	'C' tube pressure gauge 0-7 Kg/cm^2 ,150mm dial.	2 nos.
2.	Dead Weight Tester 0-100 Kg/cm^2	1 no.
3.	Comparator	1 no.
4.	Pressure switch Range – 0-100 P.S.I. Diff. Range – 0-10 P.S.I.	1 no.
5.	Pressure Switch Range 0 – 10 Kg/cm^2 Diff. Range – 0-2 Kg/cm^2	1 no.
6.	Rotameter (0-100 /hr.) Venturi meter. Suitable for 25mm pipe	1 each.
7.	Bimetallic thermometer 0-100^oC	2 nos.
8.	Filled system temperature indicator (1) Capillary type 0-200^oC (2) Stem type 0-100^oC.	 2 nos. each. 2 nos. each.
9.	Thermocouple, Iron Constantan copper constantan, S.S. stem.	2 each.
10.	Pt. 100	1 no.
11.	Digital Ohm meter	1 no.
12.	Air Purge level Indicator with Acrylic plastic tank, P.R.V.	2 nos.
13.	D.P. Transmitter input Pressure 20 P.S.I. DPT input Pressure 0-1000mm , H_2O out put pressure 3-15 P.S.I.	2 nos.
14.	High and low level alarm system (setting high and low adjustable)	2 nos.
15.	Capacitance probe type level indicator	1 no.
16.	Air compressor 0-100 P.S.I.	1 no.
17.	Master Pressure gauges- 1) 0 – 7 Kg/cm^2 2) 0 – 14 Kg/cm^2	1 each.

Advanced Instrumentation & control attendant

***Name of Module: : Advanced Instrumentation & control attendant**

* **Sector : Chemical**

* **Code** : **CHE214**

***Terminal Competency**: On completion of this course the trainee will be able to operate Digital Electronics, PLC & DCS operation in various chemical Industry

***Duration-** : 90 hrs.

***Entry Requirement :** a) Qualification-Xth Standard + **CHE101**
b) Age – 14 years minimum

*** Contents:-**

Practical Competencies	Underpinning Knowledge (Theory
• Soldering & De soldering practice of PCB • Testing of power supply • Verification of different gates & flip flop • Practical on counter & timer training kit • Ladder logic design • Various process control through PLC • Routine & preventive maintenance & trouble shooting of PLC • Process Control (temperature, level, flow, pressure) through DCS • Ala ram generation – cascade control, point built up, tripping generator through DCS simulator • Computer language programming in DCS Graphic Architecture	• Basic idea of solid state devices • Digital logic & Boolean algebra • Logic diagram of various gates & truth tables • Gate symbol • Flip Flop circuits, counter, timer • Micro processor use & working • Micro controller use & working • PLC Architecture Building of a ladder diagram • PLC programming & Installation • Advantages & Application of PLC • Over view of distributed control system • Operating System Configuration • DCS communication • Data highway design • Application & Advantages of DCS

*** Tools / Equipment:**

Sl.No.	Description	Quantity
1.	Hand tools set	2 Set
2.	Digital multi meter 4 ½ digit	2 Set
3.	Digital Electronic Trainer, i.e. Logic gates, Boolean Expression flip flop counters registers	1 set
4.	Power supply Trainer	1 set
5.	Micro processor training kit Applicable to process control & Instrumentation	1 set
6.	PLC Trainer	1 set
7	Process Simulator Based on DCS	1 set

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CURRICULUM DEVELOPMENT FOR SHORT TERM COURSES BASED ON MODULAR EMPLOYABLE SKILLS

SECTOR/AREA: **Chemical**

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