

**SYLLABUS FOR THE SUBJECT**

**OF**

**TRADE THEORY-I**

**AND**

**TRADE PRACTICAL-I**

**Under**

**CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**

**REFRIGERATION & AIR-CONDITIONING MECHANIC**

**Redesigned in 2014**

**By**

**Government of India  
Ministry of Labour & Employment  
Directorate General of Employment and Training**

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## **A. RATIONALE**

Success & Sustainability of any Training System depends upon given other things, availability of good quality Instructors. An Instructor should possess good trade skills to impart skill training. To cope up this quality possession of trade skills is imperative.

Ability to understand and interpret the course content is essential to perform a job /task of engineering Trades. It is the skills, Knowledge and attitude which enables comprehending the given job and subsequent planning to complete the task/job. Thus it is imperative for any trade to instructor to have skill so that same can be transferred.

For an instructor it is essential to have in depth knowledge set which enables analyzing the given job and subsequent detail planning. To transfer skill the practical know how is most important criteria as in ITI system skill is the ultimate requirement. To perform a task/job both theoretical and practical knowledge are very much needed. Thus Trade Technology is regarded as basic/hard skills which are base of all skill based training.

Recognizing this important maximum weight age has been given to the Trade Technology in all Engineering Trade in Craft Instructors Scheme (CITS) under NCVT.

## **B. GENERAL INFORMATION**

- 1. Name of the Course** : Craft Instructor Training
- 2. Duration of Instructor training** : 1 Year (Twelve months) (two semesters each of six months duration)
- 3. Subjects covered in semesters** : Detailed in section C
- 4. Name of the subject** : Trade Theory-I and Trade Practical-I
- 5. Applicability** : REFRIGERATION & AIR-CONDITIONING MECHANIC
- 6. Examination:** : AITT to be held at the end of each semester
- 7. Space Norms** : (a) Class Room : 30 Sq.m.  
(b) Workshop : 120 sq.m..
- 8. Power Norms** : (a) Class Room : 1 kw (6000 lumen)  
(b) Workshop : 13 kw (60000 lumen)  
(The electrical equipment of class room should conform to minimum 3 star Building energy rating as per Bureau of Energy Efficiency (B.E.E.)
- 9. Unit strength** : 20 Trainees
- 10. Entry Qualification** : NTC / NAC in Refrigeration & Air-Conditioning Mechanic trade Or  
3 years Diploma in Refrigeration & Air-Conditioning from recognized board of Technical education
- 11. Trainer's Qualification** : Degree Or Diploma in Mechanical Engineering from recognized University / Board or Institution with Two / Five years' post qualification experience respectively  
OR  
Passed National Craft Instructor Training course in Refrigeration & Air-Conditioning Mechanic trade Five years' post qualification experience
- 12. Desirable** : Passed National Craft Instructor Training course in same or relevant trade.
- 10. Job Role** : After successfully completion of the course, the trainees are able to impart training in ITIs/ITCs in relevant trade with confidence.

In case of two units, one trainer must be Degree in Engineering.

### C. SEMESTER WISE ALLOTMENT OF TIME & MARKS AMONG THE SUBJECTS FOR CITS

	SUBJECTS	Hrs. / Week	% of time allotted	Marks	Sessional	Full Marks	Pass Marks		
							Exam.	Sessional	Total
First semester	Trade Practical – 1	20	50	200	30	230	120	18	138
	Trade Theory - 1	6	15	100	20	120	60	12	72
	Workshop Cal. & Sc.	6	15	50	-	50	30	-	30
	Engineering Drawing	6	15	100	-	100	60	-	60
	Library	2	5	-	-				
	<b>TOTAL for Sem. - I</b>	<b>40</b>		<b>450</b>	<b>50</b>	<b>500</b>	<b>270</b>	<b>30</b>	<b>300</b>
Second semester	Trade Practical – 2	16	40	200	30	230	120	18	138
	Trade Theory - 2	4	10	100	20	120	60	12	72
	Training Methodology - Practical	12	30	200	30	230	120	18	138
	Training Methodology - Theory + IT	6+2	20	100	20	120	60	12	72
	<b>TOTAL</b>	<b>40</b>		<b>600</b>	<b>100</b>	<b>700</b>	<b>360</b>	<b>60</b>	<b>420</b>
	<b>GRAND TOTAL</b>	<b>80</b>		<b>1050</b>	<b>150</b>	<b>1200</b>	<b>630</b>	<b>90</b>	<b>720</b>

Hourly Distribution

TOTAL: 1200 marks for 2 semesters Pass marks: 720



Subject	Time in %	Marks in %
Trade Practical	45	38
Trade Theory	12.5	20
<b>Total for Trade</b>	<b>57.5</b>	<b>58</b>
Training Methodology (Practical)	15	19
Training Methodology (Theory) + IT	12.5	10
<b>Total for Training Methodology &amp; IT</b>	<b>27.5</b>	<b>29</b>
Engineering Drawing	7.5	12
Workshop Cal. & Sc.	7.5	4
Library	2.5	-

## **D. Week wise index for Semester -I**

<b>Sl. No.</b>	<b>Week no.</b>	<b>Content of the Headings</b>	<b>Duration in week</b>
1	1	Introduction, orientation & safety	01
2	2	Fitting & Welding allied	01
3	3-5	Electricals & Electronics	03
4	6-13	Refrigerator & domestic air-conditioners	08
5	14-15	Primary & secondary refrigerants	02
6	16	Lubrication	01
7	17	Thermal insulation	01
8	18-19	Gas charging, testing & faults diagnosis.	02
9	20-21	Commercial RAC plants & Car air-conditioners	02
10	22	Revision	01
11	23-25	Industrial visit & project works	03
12	26	Examination	01

**E. Syllabus for the Trade of  
REFRIGERATION & AIR-CONDITIONING MECHANIC  
under Craftsman Training Scheme (CITS)  
Semester -I**

Week No	Trade Theory	Marks	Trade Practical	Marks
1	Importance of the trade in domestic, industrial & commercial fields. Industrial safety & fire fighting, occupational health & safety.	04	Introduction, orientation & familiarization with the equipments, tools & materials. Use of fire fighting equipments, Different gas cylinder handling procedure, Handling of HC refrigerants & safety observation. Do & Don'ts in RAC shop.	06
2	Allied trade knowledge. Basic fitting, welding, sheet metal work. Concept of shop floor layout of the trade	03	Common fitting allied exercise. Handling gas welding set, simple gas welding, Arc welding (manual metal). Brazing work in copper pipe, simple M. S. joint. Copper & steel pipe joint	16
3	AC Induction Motor – single phase (split phase, capacitor, shaded pole, repulsion) & three phase (squirrel cage & slip ring).	03	Test different types electrical controls and circuits. Test different types of motors. AC Induction Motor – single phase (split phase, capacitor, shaded pole, repulsion) .	16
4	Transformer – single phase (auto transformer & Current transformer, Potential transformer) and three phase. Inverter controls EER motors.	03	Three phase (squirrel cage & slip ring), and related controls. Transformer testing	08
5	Basic Electronics. Concept of Semi conductor, Rectifier, Transistor , FET, Mosfet, Bipolar Transistors, IGBT( Integated Bi-polar Transistor) , IC, Thermister, transducer, function. Concept of Microprocessor, PLC, Regulated Power supplies, SMPS.	03	Identification and Testing of resisters, diodes, transistors , regulated power supplies and (Switched Mode Power Supply) SMPS. Making of Half Wave and Full Wave rectification and Testing.	16
6	Fundamentals and different terminology of RAC machineries. Laws of Thermodynamics, Gas laws, Carnot cycle and reverse Carnot cycle,	04	Wiring of domestic refrigeration appliances ( conventional and frost free) .Measurement of different parameters like pressure, temperature, heat, Humidity, velocity...etc	10
7	Methods of Refrigeration-Ice refrigeration, Dry ice, Steam jet, Gas throttling ,Liquid Gas, Air refrigeration, Vapour absorption, Vapour compression, Thermo electric, magnetic, Thermo acoustic, Pulse tube, Vortex tube.	04	Observe various Thermodynamic processes take place while working, Calculation of Refrigeration capacity (TR)	10
8	Types of refrigeration systems and cycles. Capacity of RAC machineries,	08	Wiring of Bottle cooler, Water cooler, Widow A/C, Split A/C, Visi cooler, Deep	20

	applications in domestic, commercial and industrial fields.		freezer and related control (capacitors, relays, OLP, PTCR, centrifugal switch, starter, thermostat etc).	
9	Description of major components used in RAC systems. Function, construction, application of domestic and commercial applications.	04	Faults finding and remedial measures of components used in RAC systems. Dismantling and assembling of various types of Compressors like Reciprocating , Rotary, Scroll etc.	08
10	Types of compressor used in domestic appliances Reciprocating Rotary Scroll screw etc.	08	Dismantle and assemble of Open type and sealed type compressors, blower motors, check bearing/ bush, centrifugal switch. Check worn out parts, inspect and measure clearance, diameter by micrometer, vernier calipers etc. replace and compensate lubricant in compressor.	08
11	Types of condenser used in domestic appliances Water cooled, Air cooled Evaporative etc.	08	Find out the heat rejection factor, Condenser capacity , efficiency & effect of fouling factor. Repairing of Air cooled Condenser Water cooled condenser and Evaporative condenser	08
12	Expansion Device-types, construction, working, adjustments & application	08	Capillary bore checking, Performance test conducted by Test rig ( consisting of capillary tube and TEV) for finding C.O.P. Familiarization of capillary selection guide, Measuring superheat, Observe the working of pilot solenoid valve.	08
13	Evaporator –types (domestic & Commercial), construction, working (Direct & Indirect systems), DX Chiller, Flooded, Types & application.	08	Practice of Cu-Al brazing technique. Compare the performance of single, double ,multi feeding evaporators. Compare different diameter & length of capillary Vs Performance. Use anti freezing thermostat.	08
14	Refrigerants Description Function Composition Application & Types Environmental impact of different refrigerants . Alternatives of cfc's. Thermodynamic properties & characteristics of ideal refrigerants. Azeotropic and Zeotropic blends. Description odp Retro fitting, filter, drier	04	Identification of refrigerant cylinders by colour coding &standing pressure. Types of cylinders, Refrigerant recovery(Active &passive method) ,Use of peircing valve. HC blend charging. Importance of molecular sieve drier (XH-5,XH-7,XH-9 Retrofitting of cfc filled refrigerator in to HFC-134a. Retrofitting of CFC-12 into HC blend. Limitation of retrofitting, Tripple evacuation method.	08
15	Secondary Refrigerants, Properties of brines & glycols. Application of various brines ,Inhibitor & other secondary refrigerants	04	Find out the eutectic temperature of Sodium chloride & Calcium chloride brine. Calculation of heat removal rate of various brines.	06
16	Basic concepts of Tribology Lubricants & Lubrication in RAC compressors, properties of lubricants. Thermal insulation types & function Properties	04	Identification of lubricants grades, unit, types, Mineral oil &POE oils. Oil charging of domestic & commercial compressors, Different methods	04



	of insulating materials.			
17	Thermal insulation types, Selection of insulating material ,Duct insulation & Properties of insulating materials.	04	Technique of Glass wool filling method in conventional refrigerator. PUF, Puf mixing procedure.	04
18	Conventional Refrigerator, frost free refrigerator, Water cooler, Deep Freezer..etc	04	Testing of electrical components used in HC refrigerator. Servicing, Wiring, repairing, retrofitting of Conventional & frost free Refrigerator. Charging of refrigerants (HFC &HC),Performance checking	08
19	Window AC, Split, & Package AC description Advantage & application.	04	Testing of electrical components used in Window & Split Air Conditioners, Electrical Wiring , Testing...etc. System processing ( cleaning, flushing, Dehydrating, assembling, leak testing, evacuating, charging & testing)	08
20	Introduction about commercial plants	04	Layout of AC Plant, ice plant, cold storage ...etc.	10
21	Automobile AC, Function of individual components. Refrigerants used & retrofitting of old car / Mobile AC's	04	Test and diagnosis faults of Car A/C system. Pressure test/leak of the system. Strip the component parts. Cleaning Flushing leak testing , evacuating and charging & use of suitable chemicals (Trichloro Ethylene) for more contaminated coils.	10
22	Revision		Revision	
23-25	Industrial visit & project work		Industrial visit & project work	
26	Examination		Examination	

**F. LIST OF TOOLS & EQUIPMENT For a batch of 20 Trainees  
FOR THE TRADE OF “REFRIGERATION AND AIRCONDITIONING MECHANIC”**

**For Semester -1**

Sl.no	Name of the tools & equipments	Qty. per unit
1	Flaring tool set, single type for tube 4.7 to 16 mm OD	5 Sets
2	Swaging tool, punch type, set of size, for tube 4.7 to 16 mm OD.	2 Sets
3	Swaging tool, screw type, with adapter set of size for tube 4.7 to 16 mm OD.	2 Sets
4	Bending spring external type, for copper tube 3 to 6 mm. Dia	2 Sets
5	Pipe cutter miniature for copper tube 3 to 16 mm. Dia	5 Nos.
6	Pipe cutter with built-in reamer and space cutter, for copper tube 3 to 32 mm.	4 Nos.
7	Pinch off tool, for copper tube 6 to 18 mm. dia	4 Nos.
8	Ratchet spanner of 6.4 mm. sq. reversible	4 Nos.
9	Capillary plug gauge	2 Nos.
10	Pinch off pliers/crimping pliers tool 6-18 mm. dia	2 Nos.
11	Piercing pliers 6-18 mm. & piercing valves both with access fittings	4 Nos. each
12	Spanner, double ended 4.7 mm to 16 mm.	3 sets
13	Spanner, double ended 19 mm to 31.8 mm.	1 set
14	Ring spanner, off set 4.7 mm to 16 mm.	3 Sets
15	Ring spanner, off set 19 mm to 31.8 mm.	1 set
16	Box spanner size 6.4 to 10 mm.	2 sets
17	Wrench adjustable length 150 mm.	4 Nos
18	Wrench adjustable length 200 mm.	4 Nos.
19	Wrench adjustable length 225 mm.	2 Nos.
20	Pipe wrench size 150 mm.	2 Nos.
21	Pipe wrench size 250 mm.	2 Nos.
22	Torque wrench 300 mm. 12.7 mm. square drive right and left hand	1 set
23	Valve key –T, handle – 4.7 & 6.4 mm. sq.	4 sets
24	Socket set, ratchet, reversible 12.7 mm. square drive with extension, 4.7 to 31.2 mm.	2 sets
25	Socket set, ratchet, reversible, 1/2 square drive with extension, 3/16 to 11/4 BSW & SR	1 Set
26	Pressure gauge, diameter 63 mm. with recalibration set screw, scale 0 to 35 kg/sq.cm.	6 Nos.
27	Compound gauge, diameter 63 mm. with recalibration set screw, scale vacuum 76 mm. pressure 15 kg/sq.cm.	6 Nos.
28	Serviceman thermometer in metal case (-30 to +30 Deg. C)	2 Nos.
29	Sling psychrometer mounted on aluminum back scale (-50 Deg. c. to +50 Deg. C).	2 Nos.
30	Gas leak detector for halogen gas	2 Nos.
31	Lapping plate 250x200 mm.	1 No.
32	Punch hole for cutting gasket, 4.7 to 16 mm. dia	2 Nos.
33	Scissor, gasket cutting stainless steel, length 25 mm.	2 Nos.
34	L –Allen key set, size 1.5 to 6.4 mm.	2 sets
35	T –Allen key set, size 5/32 & 1/8	2 sets
36	Screw driver, plastic handle, 6 mm. tip length 100, 150 mm.	5 each

37	Screw driver, plastic handle, 10 mm. tip length 200.250mm.	5 each
38.	Philips screw driver- complete set in leather case	2 sets
39.	Screw driver, plastic handle,3 mm. tip length 100 and 150mm. insulated	2 sets
40.	Pliers combination insulated, length 200 mm.	4 Nos.
41.	Pliers long nose, length 200mm.	2 Nos.
42.	Pliers flat nose, length 150mm.	2 Nos.
43.	Hammer ball peen 450 gms.	2 Nos.
44.	Hammer ball peen 220 gms.	2 Nos.
45.	Hammer nylon 300 gms.	2 Nos.
46.	Tape, measuring 10 m graduation in mm.	1 No.
47.	Tape, measuring 2 m graduation in mm.	2 Nos.
48.	Chisel flat length 150 mm.	2 Nos.
49.	Hack-saw tubular metal frame adjustable	4 Nos.
50.	Centre punch length 100 mm.	4 Nos.
51.	Oil can pressure type – 1 liter	2 Nos.
52.	File, flat medium double cut, length 200 mm.	4 Nos.
53.	File, half round medium, double cut length 200 mm	4 Nos.
54.	File, half round, fine double cut, length 150 mm.	4 Nos.
55.	File, round, fine, double cut, length 150 mm.	4 Nos.
56.	File flat, fine double cut, length 150 mm.	4 Nos.
57.	File square, fine double cut, length 150 mm.	4 Nos.
58.	Soldering Iron exchangeable copper tip 65 watts.	5 Nos.
59.	Pipe bending tool, lever type with degree indicator, for tube OD 6.4 to 16 mm.	2 Sets
60.	Puller 3 legged, with flexible arm 120 mm.	1 No.
61.	Puller 2 legged, with flexible arm 300 mm.	1 No.
62.	Hand blower portable complete 1/10 HP motor & other attachments.	1 No.
63.	Snipper sheet metal straight nose 200 mm.	1 No.
64.	Vernier Caliper length 250 mm.	1 No.
65.	Micrometer, outside measurement 0-25 mm.	2 Nos.
66.	Vernier height gauge 250 mm.	1 No.
67.	Bench vice 75 mm. jaw	2 Nos.
68.	Bench vice 120 mm. jaw	2 Nos.
69.	Electrical drill portable with chuck and key, capacity 6.4 mm.	2 Nos.
70.	Pillar drilling machine 200 to 2500 rpm. capacity 20 mm.	1 No.
71.	Pedestal grinder, double ended wheel dia 200 mm. 3000 rpm.	1 No.
72.	Oxy- Acetylene welding set complete with cylinders regulators welding torches with difference nozzles	1 set complete
73.	Gas cylinder truck two wheel type	1 No.
74.	Line tester 500 volt. Heavy duty	4 Nos.
75.	Tong-tester 0-10-30 amps. 0-500 volts (Clamp on Multimeter)	4 Nos.
76.	Voltmeter AC/DC portable, precision grade teak wood case, leather belt, 0 to 5 amp.	5 Nos.
77.	Ammeter AC/DC portable, precision grade teak wood case, leather belt, 0 to 30 amp.	5 Nos.
78.	Megger- 1000 Volt.	1 No.

79.	Variac input 230 volt output 400 volt. amp. portable complete with meters and controls.	1 No.
80.	Wattmeter, multi range up to 1 KW	1 No.
81.	Wattmeter, multi range up to 5 KW	1 No.
82.	Multimeter – Analog type	3 Nos.
83.	Multimeter – Digital type	3 Nos.
84.	Tachometer digital, multi range 0 to 3000 rpm. Portable, small size in leather case.	1 No.
85.	Transistor tester	1 No.
86.	R.L.C. Bridge	1 No.
87.	Stop watch	1 No.
88.	Hand grinder small	1 No.
89.	Filler, gauge 0.05 mm. -1 mm.	1 Set
90.	Wire gauge metric and Whitworth	1 Set
91.	Refrigerant cylinder capacity 2.5 Kg.	2 Nos.
92.	Refrigerant cylinder capacity 20 Kg.	2 Nos.
93.	Refrigerant cylinder capacity 05 Kg.	2 Nos.
94.	Evacuating & refrigerant charging station comprising Rotary two stage vacuum pump and motor (with gas ballast & anti suck back) Manifold with gauges & valves and capable of pulling vacuum up to 50 microns of Hg and with provision of connecting to a micro level vacuum Gauge. Graduated charging cylinder with provisions for temperature correction and all necessary isolating valves Evacuating & charging station as above but fitted with weighing scale (up to 2 kg. in lieu of (b) above and with accuracy of +/- 1gram, for charging hydrocarbons.	1 Set.
95.	Dial thermometer remote control, armored capillary dial 75 mm.-50 Deg. C to + 50 Deg. C.	1No.
96.	Two stage rotary vacuum pump of capacity approx 60-100 L/min., capable of evacuating to 50 microns of Hg and fitted with gas ballast, anti suck back valve and single phase motor.	1 No.
97.	Anemometer (Vane type)	1 No.
98.	Air compressor, two stage for oil-less dry air, with rust proof tank assembly. Heater and control max. Pressure. 10 kg/sq. cm cap. 45 liter, Motor 1 HP	1 No.
99.	Scraper, triangular blade removable 60 mm.	2 Nos.
100.	Descaling pump set with stainless steel impeller and housing complete with motor 1 HP and accessories.	1 No.
101.	Spray outfit, 'V' twin, with motor ½ HP. delivery up to 120 liter free air pressure up to 3 Kg/sq.cm. with spray gun and fitting.	1 No.
102.	Pressure testing tank with lighting arrangement, pressure gauge (0 to 35 kg/sq.cm.) double stage	1 No.
103.	Heating kit with infra red bulb (200 watt capacity)	1 set
104.	Refrigerator, compression type 165 litter /170 litter capacity	2 nos
105.	Refrigerator compression type 300 litters double door, double compressor system	2 nos
106.	Deep freezer 165 liter -18 °C, 1/4 HP	1 no
107.	Window Air Conditioner capacity 3000 Kcal/Hr	2 Nos

108	Window Air Conditioner capacity 4500 Kcal/Hr	2 nos
109	Split Air Conditioner capacity 4500 Kcal/Hr	2 nos
110	Split Air Conditioner capacity 4500 Kcal/Hr inverter control energy saver	2 nos
111	Split Air Conditioner capacity 6000 Kcal/Hr (Ductable)	2 nos
112	Bottle Cooler 110 liters, 1/6Hp	1 no
113	Water Cooler Instantaneous Type	2 nos
114	Water cooler Storage Type 30 litter storage Capacity	2 nos
115	Ice Candy Unit complete with stainless steel tank, Mould Box, Thermocole insulated sun mica body, agitator compressor, motor etc. Temperature and Pressure gauges, motor and pipe fittings etc. 3000 Kcal/Hr or working trainer model/simulator.	1 no
116	Prefab PUF insulated panel for cold room 6X4.5X8 cft. Maintaining temperature 0 °C to +5°C. Condensing unit complete with semi sealed compressor duly mounted on base plate and charged R-22 gas. Evaporating unit complete with expansion valve and other accessories. Electrical control panel complete with digital temperature and pressure indicators and other electrical controls. Fabrication ,erection, Insulation completed by supplier.	1 complete set.
117	Air conditioning Plant, Direct system with Air cooled condenser, complete with all controls including humidity control etc. capacity 15000 Kcal/hr or working trainer model/simulator. Alternatively, a packaged Air-conditioner of similar capacity.	1 no
118	Air conditioning plant, Indirect system with Water cooled condenser, chiller, cooling tower, complete with all controls including humidity control etc. capacity 15000 KCal /hr or working trainer model/ simulator.	1 no
119	Condensing unit with open type compressor air cooled condenser controls etc. capacity 3000 kcal/hr.	1 no
120	Condensing unit with open type compressor evaporative condenser controls etc. capacity 3000 Kcal/hr.	1no
121	Reciprocating compressor with provision of capacity control etc. for demonstration, capacity 9000 Kcal/hr.	1 no
122	Micron vacuum gauge capable of reading up to 20 microns	2 no.
123	Sensor Thermometer (digital)	2 nos
124	Fin Straightener/fin comb	4 nos
125	HC refrigerant cylinders / disposable containers	2 nos
126	134a refrigerant cylinders	2 nos
127	Recovery unit for 134a refrigerants with recovery cylinder.	1 no
128	Recovery unit for CFC refrigerants with recovery cylinder	1 no
129	Reverse cycle AC/Heat pump 3000 Kcal/hr or 4500 kcal/hr	1no
130	Refrigerator 170 liter using 134a refrigerant	2 nos
131	No Frost refrigerator 300 liter capacity using HC refrigerant	2 nos
132	Automatic Ice cube m/c capacity 5 Kg/hr.	1no
133	Fire extinguisher powder type	2 nos
134	Dry Nitrogen gas cylinder with drier unit and 2 stage pressure regulator	1 no
135	Two way manifold with gauges	1 no
136	Four way manifold with gauges	1 no
137	Small car A/C kit with driving arrangements	1 no
138	Components of Car A/C systems . Wobble plate compressor with mounting brackets, serpentine evaporator, parallel flow condenser hoses, tubes, receiver, expansion valve, electrical components and siring harness.	1 no each.

139	Small capacity shell and tube condenser	1 no
140	Fan Coil unit with water valves(2 & 3 way)	1 no
141	Shell and tube DX chillers (small)	1 no
142	Circulating water pump(small)	1 no
143	Schraeder valve core removal tool	1 no
144	Pitot tube & inclined tube manometer	1 no
145	Hermetic compressors(1/6hp)	2 nos
146	Hermetic compressors(1/2hp)	1 no
147	Semi-hermetic compressor(1/2hp)	1 no
148	Rotary compressor 1 TR	2 nos
149	Quick couplers, process tube adapters for 1/4", 3/8" tubes	2 pairs for each tube.
150	VRV/VRF package unit with 2 indoor( casset) units 2.5 tTR each and 05 TR capacity out door unit complete with air cooled condenser . ccccccaccessaccessories & controls	01 unit complete
<p><b>*** <u>Tools items as per the specification if not available , may be procured similar items available in the market.</u></b></p>		

**G. FURNITURE,ACCESSORIES AND AUDIO VISUAL AIDS FOR TRADE THEORY AND TRADE PRACTICAL**

<u>SL.No.</u>	<u>Name of the tools &amp; equipments</u>	<u>Qty. per unit</u>
01	Almirahs, 195 X 90 X 49 cm	4 no
02	Lockers of eight compartments	2nos
03	White board portable	1 no
04	Desktop table and two revolving chairs.	1 set.
05	Work bench 1000X600X800 mm. high.	2 nos.
06	Over head projector	01no
07	LCD projector	01no.
08	Computer(Latest version) complete with UPS & other accessories	01 no.
09	Photo copy machine	01no.
10	Laser printer	01no.
11	Scanner	01no.
12	Interactive Board	01no.
13	Internet connectivity	01 no.
14	Computer Table	01 no.
15	Computer Chair	01no.

## H. LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Mentor Council Designation
1.	Prof. Nirjhar Dhang. (H.O.D)	Dept. of Civil Engg. IIT Kharagpur	Chairman
2.	Col. N. B. Saxena.	Construction Skill Development Council of India (CSDCI)	Member
3.	Satish Gottipati. (M. D.)	Preca Solutions (E)	Member
4.	Meena Raghunathan. (Director, Community Science.)	GMRU Foundation, Hyderabad.	Member
5.	D. K. Chattopadhyay. (Training Officer.)	ATI, Kolkata. Dasnagar, Howrah.	Member
6.	S. R. Vhatkar. (Training Officer.)	ATI, Kolkata. Dasnagar, Howrah.	Member
7.	A. K. Naskar. (Training Officer.)	ATI, Kolkata. Dasnagar, Howrah.	Member
8.	S. Chockalingam. (Training Officer.)	CTI, Chennai,	Member
9.	Tapan Kr. Halder. (Training Officer.)	RDAT, Kanpur.	Member
10.	Arpana Singh. (T.O.)	N.V.T.I (W) Noida.	Member
11.	P. Karithashankar. (T. O.)	N.V.T.I (W) Noida.	Member
12.	Simni. (T. O.)	N.V.T.I (W) Noida.	Member
13.	Suman Kumari. (T. O.)	N.V.T.I (W) Noida.	Member

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**OF**

**TRADE THEORY-II**

**AND**

**TRADE PRACTICAL-II**

**Under**

**CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**

**REFRIGERATION & AIR-CONDITIONING MECHANIC**

**Redesigned in 2014**

**By**

**Government of India  
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Directorate General of Employment and Training**



## Contents

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H	List of Expert Members	

## **A. RATIONALE**

Success & Sustainability of any Training System depends upon given other things, availability of good quality Instructors. An Instructor should possess good trade skills to impart skill training. To cope up this quality possession of trade skills is imperative.

Ability to understand and interpret the course content is essential to perform a job /task of engineering Trades. It is the skills, Knowledge and attitude which enables comprehending the given job and subsequent planning to complete the task/job. Thus it is imperative for any trade to instructor to have skill so that same can be transferred.

For an instructor it is essential to have in depth knowledge set which enables analyzing the given job and subsequent detail planning. To transfer skill the practical know how is most important criteria as in ITI system skill is the ultimate requirement. To perform a task/job both theoretical and practical knowledge are very much needed. Thus Trade Technology is regarded as basic/hard skills which are base of all skill based training.

Recognizing this important maximum weight age has been given to the Trade Technology in all Engineering Trade in Craft Instructors Scheme (CITS) under NCVT.

## **B. GENERAL INFORMATION**

- 1. Name of the Course** : Craft Instructor Training
- 2. Duration of Instructor training** : 1 Year (Twelve months) (two semesters each of Six months duration)
- 3. Subjects covered in semesters** : Detailed in section C
- 4. Name of the subject** : Trade Theory - II and Trade Practical - II
- 5. Applicability** : REFRIGERATION & AIR-CONDITIONING MECHANIC
- 6. Examination:** : AITT to be held at the end of each semester
- 7. Space Norms** : (a) Class Room : 30 Sq.m.  
(b) Workshop : 120 sq.m..
- 8. Power Norms** : (a) Class Room : 1 kw (6000 lumen)  
(b) Workshop : 13 kw (60000 lumen)  
(The electrical equipment of class room should conform to minimum 3 star Building energy rating as per Bureau of Energy Efficiency (B.E.E.)
- 9. Unit strength** : 20 Trainees
- 10. Entry Qualification** : Completed Semester – I of REFRIGERATION & AIR CONDITIONING MECHANIC trade under CITS OR Diploma / Degree in Mechanical or relevant Engineering from AICTE recognized Board / University
- 11. Trainer's Qualification** : Degree Or Diploma in Mechanical Engineering from recognized University / Board or Institution with Two / Five years' post qualification experience respectively  
OR  
Passed National Craft Instructor Training course in Refrigeration & Air-Conditioning Mechanic trade Five years' post qualification experience
- 13. Desirable** : Passed National Craft Instructor Training course in same or relevant trade.
- 10. Job Role** : After successfully completion of the course, the trainees are able to impart training in ITIs/ITCs in relevant trade with confidence.

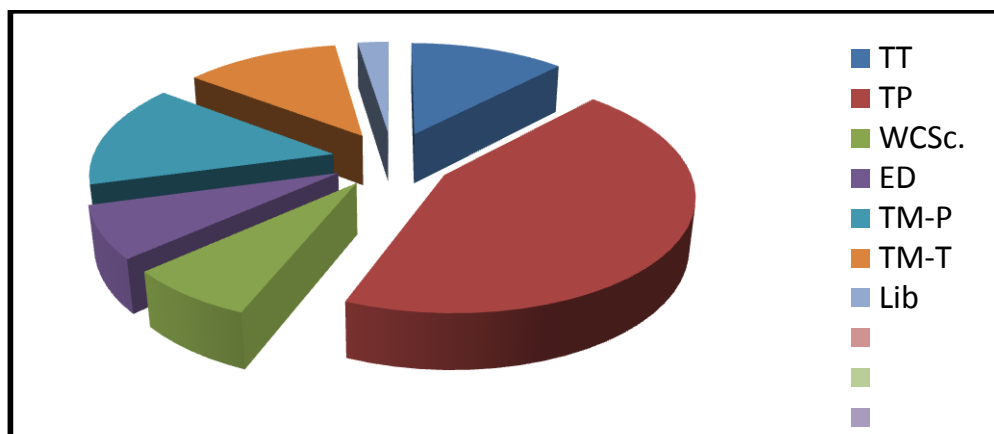
In case of two units, one trainer must be Degree in Engineering.

## D. SEMESTER WISE ALLOTMENT OF TIME & MARKS AMONG THE SUBJECTS FOR CITS

	SUBJECTS	Hrs. / Week	% of time allotted	Marks	Sessional	Full Marks	Pass Marks		
							Exam.	Sessional	Total
<b>First semester</b>	Trade Practical – 1	20	50	200	30	<b>230</b>	120	18	<b>138</b>
	Trade Theory - 1	6	15	100	20	<b>120</b>	60	12	72
	Workshop Cal. & Sc.	6	15	50	-	<b>50</b>	30	-	30
	Engineering Drawing	6	15	100	-	<b>100</b>	60	-	60
	Library	2	5	-	-				
	<b>TOTAL for Sem. - I</b>	<b>40</b>		<b>450</b>	<b>50</b>	<b>500</b>	<b>270</b>	<b>30</b>	<b>300</b>
<b>Second semester</b>	Trade Practical – 2	16	40	200	30	<b>230</b>	120	18	<b>138</b>
	Trade Theory - 2	4	10	100	20	<b>120</b>	60	12	72
	Training Methodology - Practical	12	30	200	30	<b>230</b>	120	18	<b>138</b>
	Training Methodology - Theory + IT	6+2	20	100	20	<b>120</b>	60	12	72
	<b>TOTAL</b>	<b>40</b>		<b>600</b>	<b>100</b>	<b>700</b>	<b>360</b>	<b>60</b>	<b>420</b>
	<b>GRAND TOTAL</b>	<b>80</b>		<b>1050</b>	<b>150</b>	<b>1200</b>	<b>630</b>	<b>90</b>	<b>720</b>

Hourly Distribution

TOTAL: 1200 marks for 2 semesters Pass marks: 720



Subject	Time in %	Marks in %
Trade Practical	45	38
Trade Theory	12.5	20
<b>Total for Trade</b>	<b>57.5</b>	<b>58</b>
Training Methodology (Practical)	15	19
Training Methodology (Theory) + IT	12.5	10
<b>Total for Training Methodology &amp; IT</b>	<b>27.5</b>	<b>29</b>
Engineering Drawing	7.5	12
Workshop Cal. & Sc.	7.5	4
Library	2.5	-

## H. Week wise index for Semester -II

Sl. No.	Week no.	Content of the Headings	Duration in week
1	01	Observation, Analysis of Carnot cycle, non conventional Refrigeration system.	01
2	2-3	Electronic controls, transistors	02
3	03	Commercial compressor & capacity control	01
4	5-9	Water cooled condenser, cooling tower, water softening plants, chillers & Refrigerant controls	05
5	10-11	Food Preservation, Refrigerants, Lubrication	02
6	12-17	Erection of plants, Ducts, HVAC, VAV system	06
7	18-21	Psychrometry, Heat load estimation, Commissioning & preventive maintenance of different plants	04
8	22	Revision	01
9	23-25	Industrial visit & project work	03
10	26	Examination	01

**I. Syllabus for the Trade of  
REFRIGERATION & AIR-CONDITIONING MECHANIC  
under Craftsman Training Scheme (CITS)**

## Semester -II

Week No	Trade Theory	Marks	Trade Practical	Marks
1	<b>Non conventional Refrigeration System:-</b> Thermo-Acoustic, Magnetic, Vortex-tube, Pulse-Tube Refrigeration & Lithium Bromide-Vapour Absorption System,	08	Observe various processes taking place while working, Calculation of C.O.P, Analysis of Carnot cycle & Service / check operation commercial plant-keep record data during operation.	16
2	PTC & NTC function & applications, Rectifications in single phase and three phase AC to DC, Variable Frequency Drive (VFD), Starters-DOL, Star Delta Starter, Inter locking	06	Identification of resistors. Value and Power Identification of resistors. Testing Transistors. Testing control circuits of micro controller and IGBT (Integrated Bi-polar Transistor) . Servicing of remotes circuit boards.	12
3	IC's, PWM (Pulse Width Modular) controller, Micro processor, Micro controller, CRO.	06	78XX IC's, making regulated power supplies using 78XX IC's. Oscillator circuits testing. Testing Oscillators using CRO. Testing Variable Frequency Drive and its circuits.	12
4	Commercial used Compressors Digital Scroll Compressor, Centrifugal Compressor, Capacity control of commercially used compressor,	10	Oil charging, Testing of bi-pass valve, cylinder unloading mechanism, Valve lifting mechanism, Water jacket, Crank case oil heater, Oil pump & Dismantling of multi cylinder compressor & check parts, bushes/bearings etc. Check piston assembly & remove piston pin	08
5	Commercial Used Condenser, Air cooled , Water cooled ,Evaporative , Description, Types, Condenser Capacity	04	Servicing of Water cooled condenser, Descaling , Checking of Pressure regulating Valve, Purging, water regulating valve, water failure switch, Centrifugal water pump, Spray nozzle, Relief valves .....etc	20
6	Fibre Reinforced Plastic (FRP)Cooling Tower Description & Types construction Application, and Function. Descaling Procedure. Cooling tower capacity, terms etc.	04	Servicing of FRP-Cooling Tower, Descaling, Float valve adjustments, Checking of fan, bearings ,sound, louvers, eliminators, Pump-suction & Delivery head , Cavitation & Priming ,Gland packing, Air flow through tower, Air-Velocity, Tower approach &efficiency...etc	08
7	Water Treatment Plant/Softening Plant pH value of water recycling regeneration, Description, Types, Construction, Function and Application	04	Servicing of Water Treatment Plant, regenerate/back-wash etc. Service water Pump, fixing bearing/packing. PH measuring-various methods.	08
8	Refrigerant Controls for Commercial Plants, Description , Types Liquid Expansion Valve, Electronic Expansion	04	Check & Adjust of different refrigerant controls, floats, Solenoid Valves, Safety switches, Pressure stats, Water flow	08

	Valve, Level Master Control & Equalizer , Construction , Function & application		switch, Thermostats, Equalizers, Crank case Heater etc. Measuring superheat, Observe the working of pilot operated solenoid valve.	
9	Chilled Water System-DX and Flooded chiller	04	Checking of chilled water system, anti freezing thermostat, insulation Inlet and Out let water temperature, water pressure- Inlet & Outlet , water regulating valve, water leaking, Chilled water pump, pipe insulation..etc	08
10	<b>Food preservation systems:</b> Cold storage, milk chilling, ice plant-pasteurizing , Description, Types, Construction, Function and Application.	05	Prepare layout ,technical specification ,capacity of various food preservation systems, Servicing of ice candy plants/ Mini cold storage plant etc., charge refrigerants & check performance	10
11	Refrigerant and Lubrication Variable Refrigerant Flow System (VRF),with Micro controller controlling	05	list out ODP & GWP of various refrigerants, TEWI calculation, Charging of HC blend refrigerants , Numerical designation of refrigerants, Prepare layout of VRF & VRV, Types of lubrication, Lub. pump checking, Measure of fire point, floc point ...etc of lubrication oils (Mineral Oil & POE oil), Testing of micro controller.	10
12	Cassette Type Systems, Inverter A/C's Ductable Package, Ceiling Suspended split A/C, Floor standing Type, Panel A/C,	04	Installation procedure, Assembling & performance checking, Technical specification of all systems.	08
13	Precision Air Conditioning System. Comfort Air Conditioning System. Hospital Air Conditioning system and Unitary systems.	04	Care & Maintenance , Installation procedure ,Assembling & performance checking, Collect Technical specification of all systems, Wiring screw chillers with variable speed motors.	08
14	Central Air Conditioning Plants. Starting and stopping procedure of central air conditioning plant.	04	Wiring of refrigeration and Air Conditioning Plants with pilot control solenoid valve and cylinder unloading system. Interlocking of starters with refrigeration controls.	08
15	<b>HVAC systems.</b> Different heating systems. Calculating the tonnage of heating system.	04	Repairing and Servicing of Reverse cycle Air Conditioner. Wiring and trouble shooting.	08
16	<b>Air Distribution System:-Duct.</b> Designing, material, classifications, applications and Fabrication. Air filtering, classifications and applications. Air outlets, fans and blowers. Acoustic and air washer. Application of clean rooms. Air curtain. AHU and FCU.	04	Checking performance of air ducting system. Duct fabrication, Air balancing in ducts, Acoustic insulation. Calculation of velocity and pressure of duct system. Servicing of air filters.	08
17	Heat recovery wheel (HRW) for maintaining <b>IAQ</b> (Indoor Air Quality). CAV(constant air Volume) and <b>VAV</b>	04	Standard of Indoor air, Static and dynamic pressure measurement using pitot tube and manometer. Use of decibel meter and	08

	(variable Air Volume system.		anemometer. Maintenance of Air Curtain.	
18	<b>Psychrometry:-</b> Properties of air, Preparation of chart, processes, Relations, Different systems, Heating , Cooling, Humidifying, De-humidifying	04	Study the properties of air by using sling psychrometer. RH calculation, air washer, de-humidifier etc.	08
19	<b>Cooling Load Calculations</b> and Design of Air Conditioning Systems, Different Heat source and Heat load Bypass Factor	04	Estimate the total heat load of practical workshop using anemometer, calorimeter, sling psychrometer etc. Use of BMS (Building Management system).	08
20	<b>Errection, Commissioning, heat balancing and Evaluation</b> (parameters of Controlling Device) of Central Air Conditioning System. System performance, Plant operation , Maintain Log Book, Preventive Maintenance of Commercial Plants, Trouble Shooting etc.	04	Commissioning Procedure, selection criteria of different components. Super heat balancing of DX chiller. Chilled water pipe line construction, insulation of chilled water pipe lines.	08
21	<b>Transport Air conditioning:-</b> Introduction, Bus, Railway, Marine, Air craft—Types Function, Construction, Types Capacity Application of Central Air conditioning system.	<b>04</b>	<b>Familiarization through industrial site.</b> ie. Railway coach A/C, Air craft A/C, Marine Refrigeration, VAM machine Commercial Milk Chilling, Ice & Plant & Cold Storage, Commercial Plate freezers, Air Washer System etc. Large Centrifugal, Screw, Scroll Compressor system.VAM machines.  <ul style="list-style-type: none"> <li>Covered in Industrial training/Visit.</li> </ul>	<b>08</b>
22	Revision		Revision	
23-25	Industrial visit & project work		Industrial visit & project work	
26	Examination		Examination	

### Achievement:-

- 1) After completion of the course, participants are able to impart training in ITI / ITCs effectively in RAC trade.



**J. LIST OF TOOLS & EQUIPMENT For a batch of 20 Trainees  
FOR THE TRADE OF “REFRIGERATION AND AIRCONDITIONING MECHANIC”**

**For Semester - II**

Sl.no	Name of the tools & equipments	Qty. per unit
1	Flaring tool set, single type for tube 4.7 to 16 mm OD	5 Sets
2	Swaging tool, punch type, set of size, for tube 4.7 to 16 mm OD.	2 Sets
3	Swaging tool, screw type, with adapter set of size for tube 4.7 to 16 mm OD.	2 Sets
4	Bending spring external type, for copper tube 3 to 6 mm. Dia	2 Sets
5	Pipe cutter miniature for copper tube 3 to 16 mm. Dia	5 Nos.
6	Pipe cutter with built-in reamer and space cutter, for copper tube 3 to 32 mm.	4 Nos.
7	Pinch off tool, for copper tube 6 to 18 mm. dia	4 Nos.
8	Ratchet spanner of 6.4 mm. sq. reversible	4 Nos.
9	Capillary plug gauge	2 Nos.
10	Pinch off pliers/crimping pliers tool 6-18 mm. dia	2 Nos.
11	Piercing pliers 6-18 mm. & piercing valves both with access fittings	4 Nos. each
12	Spanner, double ended 4.7 mm to 16 mm.	3 sets
13	Spanner, double ended 19 mm to 31.8 mm.	1 set
14	Ring spanner, off set 4.7 mm to 16 mm.	3 Sets
15	Ring spanner, off set 19 mm to 31.8 mm.	1 set
16	Box spanner size 6.4 to 10 mm.	2 sets
17	Wrench adjustable length 150 mm.	4 Nos
18	Wrench adjustable length 200 mm.	4 Nos.
19	Wrench adjustable length 225 mm.	2 Nos.
20	Pipe wrench size 150 mm.	2 Nos.
21	Pipe wrench size 250 mm.	2 Nos.
22	Torque wrench 300 mm. 12.7 mm. square drive right and left hand	1 set
23	Valve key –T, handle – 4.7 & 6.4 mm. sq.	4 sets
24	Socket set, ratchet, reversible 12.7 mm. square drive with extension, 4.7 to 31.2 mm.	2 sets
25	Socket set, ratchet, reversible, 1/2 square drive with extension, 3/16 to 11/4 BSW & SR	1 Set
26	Pressure gauge, diameter 63 mm. with recalibration set screw, scale 0 to 35 kg/sq.cm.	6 Nos.
27	Compound gauge, diameter 63 mm. with recalibration set screw, scale vacuum 76 mm. pressure 15 kg/sq.cm.	6 Nos.
28	Serviceman thermometer in metal case (-30 to +30 Deg. C)	2 Nos.
29	Sling psychrometer mounted on aluminum back scale (-50 Deg. c. to +50 Deg. C).	2 Nos.
30	Gas leak detector for halogen gas	2 Nos.
31	Lapping plate 250x200 mm.	1 No.
32	Punch hole for cutting gasket, 4.7 to 16 mm. dia	2 Nos.
33	Scissor, gasket cutting stainless steel, length 25 mm.	2 Nos.
34	L –Allen key set, size 1.5 to 6.4 mm.	2 sets
35	T –Allen key set, size 5/32 & 1/8	2 sets
36	Screw driver, plastic handle, 6 mm. tip length 100, 150 mm.	5 each

37	Screw driver, plastic handle, 10 mm. tip length 200.250mm.	5 each
38.	Philips screw driver- complete set in leather case	2 sets
39.	Screw driver, plastic handle,3 mm. tip length 100 and 150mm. insulated	2 sets
40.	Pliers combination insulated, length 200 mm.	4 Nos.
41.	Pliers long nose, length 200mm.	2 Nos.
42.	Pliers flat nose, length 150mm.	2 Nos.
43.	Hammer ball peen 450 gms.	2 Nos.
44.	Hammer ball peen 220 gms.	2 Nos.
45.	Hammer nylon 300 gms.	2 Nos.
46.	Tape, measuring 10 m graduation in mm.	1 No.
47.	Tape, measuring 2 m graduation in mm.	2 Nos.
48.	Chisel flat length 150 mm.	2 Nos.
49.	Hack-saw tubular metal frame adjustable	4 Nos.
50.	Centre punch length 100 mm.	4 Nos.
51.	Oil can pressure type – 1 liter	2 Nos.
52.	File, flat medium double cut, length 200 mm.	4 Nos.
53.	File, half round medium, double cut length 200 mm	4 Nos.
54.	File, half round, fine double cut, length 150 mm.	4 Nos.
55.	File, round, fine, double cut, length 150 mm.	4 Nos.
56.	File flat, fine double cut, length 150 mm.	4 Nos.
57.	File square, fine double cut, length 150 mm.	4 Nos.
58.	Soldering Iron exchangeable copper tip 65 watts.	5 Nos.
59.	Pipe bending tool, lever type with degree indicator, for tube OD 6.4 to 16 mm.	2 Sets
60.	Puller 3 legged, with flexible arm 120 mm.	1 No.
61.	Puller 2 legged, with flexible arm 300 mm.	1 No.
62.	Hand blower portable complete 1/10 HP motor & other attachments.	1 No.
63.	Snipper sheet metal straight nose 200 mm.	1 No.
64.	Vernier Caliper length 250 mm.	1 No.
65.	Micrometer, outside measurement 0-25 mm.	2 Nos.
66.	Vernier height gauge 250 mm.	1 No.
67.	Bench vice 75 mm. jaw	2 Nos.
68.	Bench vice 120 mm. jaw	2 Nos.
69.	Electrical drill portable with chuck and key, capacity 6.4 mm.	2 Nos.
70.	Pillar drilling machine 200 to 2500 rpm. capacity 20 mm.	1 No.
71.	Pedestal grinder, double ended wheel dia 200 mm. 3000 rpm.	1 No.
72.	Oxy- Acetylene welding set complete with cylinders regulators welding torches with difference nozzles	1 set complete
73.	Gas cylinder truck two wheel type	1 No.
74.	Line tester 500 volt. Heavy duty	4 Nos.
75.	Tong-tester 0-10-30 amps. 0-500 volts (Clamp on Multimeter)	4 Nos.
76.	Voltmeter AC/DC portable, precision grade teak wood case, leather belt, 0 to 5 amp.	5 Nos.
77.	Ammeter AC/DC portable, precision grade teak wood case, leather belt, 0 to 30 amp.	5 Nos.
78.	Megger- 1000 Volt.	1 No.

79.	Variac input 230 volt output 400 volt. amp. portable complete with meters and controls.	1 No.
80.	Wattmeter, multi range up to 1 KW	1 No.
81.	Wattmeter, multi range up to 5 KW	1 No.
82.	Multimeter – Analog type	3 Nos.
83.	Multimeter – Digital type	3 Nos.
84.	Tachometer digital, multi range 0 to 3000 rpm. Portable, small size in leather case.	1 No.
85.	Transistor tester	1 No.
86.	R.L.C. Bridge	1 No.
87.	Stop watch	1 No.
88.	Hand grinder small	1 No.
89.	Filler, gauge 0.05 mm. -1 mm.	1 Set
90.	Wire gauge metric and Whitworth	1 Set
91.	Refrigerant cylinder capacity 2.5 Kg.	2 Nos.
92.	Refrigerant cylinder capacity 20 Kg.	2 Nos.
93.	Refrigerant cylinder capacity 05 Kg.	2 Nos.
94.	Evacuating & refrigerant charging station comprising Rotary two stage vacuum pump and motor (with gas ballast & anti suck back) Manifold with gauges & valves and capable of pulling vacuum up to 50 microns of Hg and with provision of connecting to a micro level vacuum Gauge. Graduated charging cylinder with provisions for temperature correction and all necessary isolating valves Evacuating & charging station as above but fitted with weighing scale (up to 2 kg. in lieu of (b) above and with accuracy of +/- 1gram, for charging hydrocarbons.	1 Set.
95.	Dial thermometer remote control, armored capillary dial 75 mm.-50 Deg. C to + 50 Deg. C.	1No.
96.	Two stage rotary vacuum pump of capacity approx 60-100 L/min., capable of evacuating to 50 microns of Hg and fitted with gas ballast, anti suck back valve and single phase motor.	1 No.
97.	Anemometer (Vane type)	1 No.
98.	Air compressor, two stage for oil-less dry air, with rust proof tank assembly. Heater and control max. Pressure. 10 kg/sq. cm cap. 45 liter, Motor 1 HP	1 No.
99.	Scraper, triangular blade removable 60 mm.	2 Nos.
100.	Descaling pump set with stainless steel impeller and housing complete with motor 1 HP and accessories.	1 No.
101.	Spray outfit, 'V' twin, with motor ½ HP. delivery up to 120 liter free air pressure up to 3 Kg/sq.cm. with spray gun and fitting.	1 No.
102.	Pressure testing tank with lighting arrangement, pressure gauge (0 to 35 kg/sq.cm.) double stage	1 No.
103.	Heating kit with infra red bulb (200 watt capacity)	1 set
104.	Refrigerator, compression type 165 litter /170 litter capacity	2 nos
105.	Refrigerator compression type 300 litters double door, double compressor system	2 nos
106.	Deep freezer 165 liter -18 °C, 1/4 HP	1 no
107.	Window Air Conditioner capacity 3000 Kcal/Hr	2 Nos

108	Window Air Conditioner capacity 4500 Kcal/Hr	2 nos
109	Split Air Conditioner capacity 4500 Kcal/Hr	2 nos
110	Split Air Conditioner capacity 4500 Kcal/Hr inverter control energy saver	2 nos
111	Split Air Conditioner capacity 6000 Kcal/Hr (Ductable)	2 nos
112	Bottle Cooler 110 liters, 1/6Hp	1 no
113	Water Cooler Instantaneous Type	2 nos
114	Water cooler Storage Type 30 litter storage Capacity	2 nos
115	Ice Candy Unit complete with stainless steel tank, Mould Box, Thermocole insulated sun mica body, agitator compressor, motor etc. Temperature and Pressure gauges, motor and pipe fittings etc. 3000 Kcal/Hr or working trainer model/simulator.	1 no
116	Prefab PUF insulated panel for cold room 6X4.5X8 cft. Maintaining temperature 0 °C to +5°C. Condensing unit complete with semi sealed compressor duly mounted on base plate and charged R-22 gas. Evaporating unit complete with expansion valve and other accessories. Electrical control panel complete with digital temperature and pressure indicators and other electrical controls. Fabrication ,erection, Insulation completed by supplier.	1 complete set.
117	Air conditioning Plant, Direct system with Air cooled condenser, complete with all controls including humidity control etc. capacity 15000 Kcal/hr or working trainer model/simulator. Alternatively, a packaged Air-conditioner of similar capacity.	1 no
118	Air conditioning plant, Indirect system with Water cooled condenser, chiller, cooling tower, complete with all controls including humidity control etc. capacity 15000 KCal /hr or working trainer model/ simulator.	1 no
119	Condensing unit with open type compressor air cooled condenser controls etc. capacity 3000 kcal/hr.	1 no
120	Condensing unit with open type compressor evaporative condenser controls etc. capacity 3000 Kcal/hr.	1no
121	Reciprocating compressor with provision of capacity control etc. for demonstration, capacity 9000 Kcal/hr.	1 no
122	Micron vacuum gauge capable of reading up to 20 microns	2 no.
123	Sensor Thermometer (digital)	2 nos
124	Fin Straightener/fin comb	4 nos
125	HC refrigerant cylinders / disposable containers	2 nos
126	134a refrigerant cylinders	2 nos
127	Recovery unit for 134a refrigerants with recovery cylinder.	1 no
128	Recovery unit for CFC refrigerants with recovery cylinder	1 no
129	Reverse cycle AC/Heat pump 3000 Kcal/hr or 4500 kcal/hr	1no
130	Refrigerator 170 liter using 134a refrigerant	2 nos
131	No Frost refrigerator 300 liter capacity using HC refrigerant	2 nos
132	Automatic Ice cube m/c capacity 5 Kg/hr.	1no
133	Fire extinguisher powder type	2 nos
134	Dry Nitrogen gas cylinder with drier unit and 2 stage pressure regulator	1 no
135	Two way manifold with gauges	1 no
136	Four way manifold with gauges	1 no
137	Small car A/C kit with driving arrangements	1 no
138	Components of Car A/C systems . Wobble plate compressor with mounting brackets, serpentine evaporator, parallel flow condenser hoses, tubes, receiver, expansion valve, electrical components and siring harness.	1 no each.

139	Small capacity shell and tube condenser	1 no
140	Fan Coil unit with water valves(2 & 3 way)	1 no
141	Shell and tube DX chillers (small)	1 no
142	Circulating water pump(small)	1 no
143	Schraeder valve core removal tool	1 no
144	Pitot tube & inclined tube manometer	1 no
145	Hermetic compressors(1/6hp)	2 nos
146	Hermetic compressors(1/2hp)	1 no
147	Semi-hermetic compressor(1/2hp)	1 no
148	Rotary compressor 1 TR	2 nos
149	Quick couplers, process tube adapters for 1/4", 3/8" tubes	2 pairs for each tube.
150	VRV/VRF package unit with 2 indoor( casset) units 2.5 tTR each and 05 TR capacity out door unit complete with air cooled condenser . ccccccaccessaccessories & controls	01 unit complete
<p><b>*** <u>Tools items as per the specification if not available , may be procured similar items available in the market.</u></b></p>		

**K. FURNITURE,ACCESSORIES AND AUDIO VISUAL AIDS FOR TRADE THEORY AND TRADE PRACTICAL**

<u>SL.No.</u>	<u>Name of the tools &amp; equipments</u>	<u>Qty. per unit</u>
01	Almirahs, 195 X 90 X 49 cm	4 no
02	Lockers of eight compartments	2nos
03	White board portable	1 no
04	Desktop table and two revolving chairs.	1 set.
05	Work bench 1000X600X800 mm. high.	2 nos.
06	Over head projector	01no
07	LCD projector	01no.
08	Computer(Latest version) complete with UPS & other accessories	01 no.
09	Photo copy machine	01no.
10	Laser printer	01no.
11	Scanner	01no.
12	Interactive Board	01no.
13	Internet connectivity	01 no.
14	Computer Table	01 no.
15	Computer Chair	01no.

## H. LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Mentor Council Designation
14.	Prof. Nirjhar Dhang. (H.O.D)	Dept. of Civil Engg. IIT Kharagpur	Chairman
15.	Col. N. B. Saxena.	Construction Skill Development Council of India (CSDCI)	Member
16.	Satish Gottipati. (M. D.)	Preca Solutions (E)	Member
17.	Meena Raghunathan. (Director, Community Science.)	GMRU Foundation, Hyderabad.	Member
18.	D. K. Chattopadhyay. (Training Officer.)	ATI, Kolkata. Dasnagar, Howrah.	Member
19.	S. R. Vhatkar. (Training Officer.)	ATI, Kolkata. Dasnagar, Howrah.	Member
20.	A. K. Naskar. (Training Officer.)	ATI, Kolkata. Dasnagar, Howrah.	Member
21.	S. Chockalingam. (Training Officer.)	CTI, Chennai,	Member
22.	Tapan Kr. Halder. (Training Officer.)	RDAT, Kanpur.	Member
23.	Arpana Singh. (T.O.)	N.V.T.I (W) Noida.	Member
24.	P. Karithashankar. (T. O.)	N.V.T.I (W) Noida.	Member
25.	Simni. (T. O.)	N.V.T.I (W) Noida.	Member
26.	Suman Kumari. (T. O.)	N.V.T.I (W) Noida.	Member