GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

CENTRAL AIRCONDITION PLANT MECHANIC

(Duration: Two Years)
(Revised in July 2022)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR –CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

CENTRAL AIRCONDITION PLANT MECHANIC

(Engineering Trade)

(Revised in July 2022)
Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

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1. COURSE INFORMATION

During the two-year duration of "Central Air Condition Plant Mechanic" trade a candidate is trained on professional skill, professional knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work, extracurricular activities and on job training to build up confidence. The broad components covered under Professional Skill subject are as below:-

FIRST YEAR: In the first year trainee learns about personal safety and machinery safety, manipulating tools, instruments and equipment's in refrigeration workshop. The trainee will be able to perform fitting, sheet metal works related to repair refrigeration and air conditioning equipment's. The trainee will be able to work in carpentry work. The trainee will be able to work in electrical area to measure current, voltage, resistance and able to connect star and delta connections. The trainee will be able to check and rectify the electrical defects in refrigerators. He will be able to identify the electronic components in refrigerator and rectify the defects and able to construct rectifiers.. The trainee will be able to operate gas welding machines for brazing in refrigeration systems. The trainee shall be able to repair, maintenance, Install, servicing, trouble shooting, fault detection, leak testing and gas charging, diagnosis & remedial measures in Refrigerator (Direct cool), Frost free refrigerator and Inverter technology Refrigerator. the trainee shall be able to identify different compressor, dismantling and assembling compressors. The trainee shall be able to start the motor through DOL, Star Delta starter and changing DOR. The trainee shall be able to service condensers. The trainee shall be able to fix refrigerant controls and service evaporator. The trainee shall be able to Recover and Recharge of Refrigerant used in systems, transfer & handling of gas cylinders. The trainee shall be able to Retrofit CFC/HFC machine with ozone friendly refrigerant. The trainee shall be able to fix thermal insulation. The trainee shall be able to install window AC, test Electrical, electronic components, Fault diagnosis & remedial measures in window A.C. The trainee shall be able to Install, servicing, trouble shooting, fault detection, leak testing and gas charging in Split A.C (wall mounted), Split A.C (floor, ceiling /cassette mounted Split A.C), Split A.C (ducted), multi Split A.C and Inverter Split A.C. The trainee shall be able to Install, service, maintenance, trouble shooting, fault finding and rectification, leak testing, evacuation and gas charging, electrical circuit repairing in water cooler & water dispenser, visible cooler, bottle cooler, deep freezer.

SECOND YEAR: In second year, the trainee shall be able to perform Installation, servicing, trouble shooting, fault detection, leak testing and gas charging in Car Air Conditioner. The trainee learns about different commercial compressor and its dismantling, assembling, fault finding and rectification. The trainee shall be able to perform de-scaling in water cooled condensers**,** Evaporative condenser and Cooling tower. The trainee shall be able to perform Selection of Expansion valves and its installations. The trainee shall be able to Service air cooled evaporator and blower. The trainee shall be able to Service, operate, test electrical controls, test

leak, evacuation and gas charging, Periodic maintenance in Ice candy plant, Ice plant, walk in cooler & reach in cabinet and cold storage. The trainee learns about HVAC (study of psychometry, blowers& fans, static and velocity pressure measurements). The trainee shall be able to make duct designing, duct making, insulating in ducts. The trainee shall be able to clean and fix air filters. The trainee shall be able to identify various components, Leak testing, evacuation, gas charging, Commissioning and troubleshooting of package A.C with air and water cooled condenser, split package. The trainee shall be able to trace electrical circuit, testing components, gas charging, Servicing AHU including fire dampers, Checking airflow, damper, temperature and pressure, operation, De-scaling condenser and cooling tower of central AC plant (Direct and Indirect). The trainee shall be able to Identify VRF / VRV system, Check and service of VRF / VRV system, connect master unit and IDU, identify the location of ODU, identify the size of piping's and laying work, Check control system and identify error code. The trainee shall be able to service and maintain the mobile A.C (bus, train).

The trainee also undergoes project work and Industrial visit/ In plant training at the mid and end of each year which gives them more practical exposure and helps to build up confidence level.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of Labour market. The vocational training programmes are running under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS)with variants and Apprenticeship Training Scheme (ATS) are two pioneer programmes under DGT for propagating vocational training.

The "Central Air Condition Plant Mechanic" trade under CTS is one of the popular courses and delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area(Trade Theory & Practical) impart professional skills and knowledge, while Core area (Employability Skills) impart requisite core skill, knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Trainee broadly needs to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform work with due consideration to safety rules, Govt. Bye laws and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the work
- Check the components as per drawing for functioning, identify and rectify errors in components.
- Document the technical parameters related to the work undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as AC Plant Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programme in industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
5	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal)during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure are being notified by DGT from time to time. The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment.

craftsmanship with occasional guidance, and due regard for safety procedures and practices	• 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieve while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Central Air Condition Plant Mechanic; installs and repairs refrigeration or air conditioning system by replacing or repairing defective parts, re-seating valves, refitting coils, insulting, requiring electrical connections, soldering etc. Installs at site assembled air conditioning unit and refrigerators giving necessary power connections and making changes to units as necessary to attain desired results. Examines faulty equipment to ascertain nature and location of defects. Dismantle equipment partly or completely according to nature of defects to remove damaged or worn out parts. Replaces defective parts. Replaces defective parts to units by re-seating valves, refitting coils, reinsulating system, etc. Over hauls units and reassembles them after cleaning components and replacing defective or worn out parts of pumps, compressors, motors, etc., Removes faulty sealed units or sub-units of refrigerators or air conditioning systems and obtains replacements. Conducts vacuum and pressure test in systems and charge system with fresh refrigerant. Sets plant to desire cooling conditions prevents leakage and ensures attainment and maintenance of required temperature. Gets burnt out motors repaired and installs repaired ones to plant giving necessary electrical connections. May work in ice factory, cold storage plants, specialized air conditioning systems. Repair and service in refrigerator, water cooler, bottle cooler, deep freezer, Visi Cooler, Walk in Cooler, Ice candy plant, Cold storage, Ice plant, Split Air Conditioner, Package Air Conditioner, VRV, Central Air Conditioner, mobile Air Conditioner like ship and air craft air conditioning.

Plan and organize assigned work and detect & resolve issues during execution in his own work area within defined limit. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO-2015:

a) 7127.0100 – Central Air Condition Plant Mechanic

Reference NOS: - CSC/N0304, CSC/N0301, CSC/N9424, CSC/N0204, ELE/N 3108, CSC/N9425, CSC/N9426, CSC/N9427, CSC/N9428, ELE/N3141, CSC/N9416, CSC/N9429, CSC/N9430, ELE/N3140.

4. GENERAL INFORMATION

Name of the Trade	**CENTRAL AIR CONDITION PLANT MECHANIC**
Trade Code	DGT/1109
NCO - 2015	7127.0100
NSQF Level	Level-4
NOS Covered	CSC/N0304, CSC/N0301, CSC/N9424, CSC/N0204, ELE/N 3108, CSC/N9425, CSC/N9426, CSC/N9427, CSC/N9428, ELE/N3141, CSC/N9416, CSC/N9429, CSC/N9430, ELE/N3140.
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF
Unit Strength (No. Of Students)	24 (There is no separate provision of supernumerary seats)
Space Norms	120 Sq. m
Power Norms	6 KW
Instructors Qualification for:	
1. Central Air Condition Plant Mechanic Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the trade of "Central Air Condition Plant Mechanic" with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT ***NOTE:-Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.***

	However, both of them must possess NCIC in any of its variants.
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and	As per Annexure – I

Equipment	

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES

FIRST YEAR

1. Perform basic fitting works like Marking, Punching, Filing, drilling, reaming, tappingfollowing safety precautions. NOS CSC/N0304
2. Perform marking, Cutting, Folding, Soldering, riveting on sheet metal. NOS CSC/N0301
3. Perform marking, sawing, planning, chiselling on wooden materials. NOS CSC/N9424
4. Perform gas welding and arc welding for different joint. NOS CSC/N0204
5. Perform brazing work on copper tubes. NOS ELE/N 3108
6. Perform different wire joint, measure power, currents, volts and earth resistance, AC motors, DC generators, ohm's law verification. Different starters for single and three phase motor with awareness in electrical safety. NOS ELE/N 3108
7. Perform testing of circuits for electronic Components. NOS ELE/N 3108
8. Identify general and special tools used in RAC work. Measurement of pressure and temperature. NOS ELE/N 3108
9. Perform testing of electrical and mechanical components of refrigerator. NOS ELE/N 3108
10. Perform copper tube works, test electrical components, service and maintenance in refrigerator. NOS ELE/N 3108
11. Perform oil charging cleaning & flushing of sealed and open unit. NOS CSC/N9425
12. Perform GPW, ODP and charging new refrigerant and recovery of CFC/HCFC/HFC refrigerant. NOS ELE/N 3108
13. Identify the refrigerator system and its components. NOS ELE/N 3108
14. Recognise electrical systems of refrigerator, freezer, Bottle cooler. NOS CSC/N9426
15. Perform gas charging in frost free refrigerator. NOS CSC/N9427
16. Perform copper tube brazing and gas charging in window AC. NOS ELE/N 3108
17. Performs gas charging in Deep freezer and bottle cooler. NOS CSC/N9428
18. Install and test Split AC. NOS ELE/N 3108
19. Perform VRV/VRF Air conditioning system, duct able AC. NOS- ELE/N3141
20. Check and service visi cooler, trouble shooting, test insulation, performance of water cooler. NOS CSC/N9416
21. Check components of chest type cooler, deep freezer, visi cooler. NOS CSC/N9429

22. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401
23. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402

SECOND YEAR

24. Service mechanical and electrical components of Car Air conditioning and Mobile refrigerator. NOS CSC/N9430
25. Perform servicing and maintenance in package AC and split package. NOS- ELE/N3141
26. Installation, servicing, repairing, gas charging and test performance of ICE candy plant. NOS- ELE/N3140
27. Servicing and preventive maintenance of cold storage. NOS- ELE/N3140
28. Identify components of indirect chiller system, service and maintenance, trouble shooting. NOS- ELE/N3140
29. Perform chiller piping and insulator. NOS- ELE/N3140
30. Perform service and maintenance of shell and tube type condenser &evaporator. NOS- ELE/N3140
31. Perform HVAC (Heating Ventilation and AC) duct designing, pipings and chiller. Maintenance of compressor. Designing central AC plant. NOS- ELE/N3140
32. Dismantle, repair and assemble commercial compressor. NOS- ELE/N3140
33. Service compressor and check capacity control. NOS- ELE/N3140
34. Perform psychrometric process. NOS- ELE/N3140
35. Measure air velocity, air quantity by using anemometer and pitot tube. NOS- ELE/N3141
36. Check and service fan, blowers & motors. NOS- ELE/N3140
37. Installation of duct, maintenance of Air filters. NOS- ELE/N3141
38. Identify components of Dx system. Test components, make wiring of dx system service and maintenance of plant. NOS- ELE/N3141
39. Trouble shooting of centralized AC. NOS- ELE/N3141
40. Routine maintenance of central plant. NOS- ELE/N3141
41. Ascertain plant capacity and install compressor, check operation of electrical and mechanical comports. NOS- ELE/N3141
42. Perform cooling tower maintenance. NOS- ELE/N3141
43. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401
44. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9401
45.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic fitting works like Marking, Punching, Filing, drilling, reaming, tapping following safety precautions. NOS CSC/N0304	Demonstrate safety precautions with first aid and fire fittings.
	Marking and punching on M.S. flat.
	Hack sawing through marked surface.
	Marking on Cylindrical job.
	Filing on M.S. flat surface.
	Make male and female joint.
	Check flatness, straightness and squareness.
	Measure the jobs by precision instruments.
	Make a drill hole on M.S. flat.
	Reaming on drilled hole.
	Make internal threads.
	Make a nut and bolt.
2. Perform marking, Cutting, Folding, Soldering, riveting on sheet metal. NOS CSC/N0301	Identify the sheet metal tools.
	Marking and cut sheet metal.
	Folding/bending in sheet metal.
	Make funnels, cylindrical
	Soldering in sheet metal
	Riveting on sheet metal.
3. Perform marking, sawing, planning, chiselling on wooden materials. NOS CSC/N9424	Identify the carpentry tools.
	Marking and sawing on wood.
	Planning and chiseling on wood.
	Drilling on wood
	Make simple joints and frames for AC work in wood.
4. Perform gas welding and arc welding for different joint. NOS CSC/N0204	Setting of oxy- acetylene welding system.
	Setting different gas flames.
	Perform different joints (Tee, Lap joint, Corner, etc.) by gas welding.
	Perform different joint with arc welding.
5. Perform brazing work on	Identify the RAC tools for tube works.

copper tubes. NOS ELE/N 3108	Straightening, Cutting, Swaging, flaring on copper tubes.
	Bending on copper tubes.
	Brazing on copper tube and aluminium tubes.
6. Perform different wire joint, measure power, currents, volts and earth resistance, AC motors, DC generators, ohm's law verification. Different starters for single and three phase motor with awareness in electrical safety. NOS ELE/N 3108	Identify electrical hand tools.
	Demonstrate safety equipments and artificial respiration.
	Measure current, voltage, resistance, power, frequency and energy.
	Cut wire and make different joint is electrical.
	Identify Neutral, phase and earth line.
	Identify the different types of resistance, earthing and fuses.
	Identify the different types of wire and cables.
	Selection of wires and cables.
	Soldering practice on aluminium conductor, cable joints.
	Identify various electrical symbols.
	Practice of crimping of various wires.
	Prepare a circuit with lamp and battery
	Measure current, voltage, in DC/AC Circuits.
	Prepare a series and parallel circuits.
	Use tong tester and meggar on circuits.
	Identify common faults in electrical circuits.
	Identify the parts of DC generator.
	Test and measure the field and armature resistance.
	Testing and measurement in induction motors.
	Testing and grouping of cells for specified voltage and current.
	Make a charging in battery.
	Prepare a list for wiring and switching materials.
	Verification of ohm's law.
	Testing transformers.
	Identification of AC motors.
	Identify the terminals of AC motors.
	Start the AC single phase motors with DOL starter.
	Test the OLP of motor.
	Check PTC relay.
	Check Ampere and voltage type relay.
	Test and run PSC, motor.
	Test and run capacitor start capacitor run motor.
7. Perform testing of circuits	Identify the resistor and colour code.

for electronic Components. NOS ELE/N 3108	Identify the diodes, transistors, IC's etc.
	Test the electronic components.
	Construct and test half ware, full ware and bridge rectifier
	Construct transistor amplifier circuit.
	Testing solid state thermostat, PTCR, remote controls, relay, pressure control, timer, solenoid and heater.
	Check and test microprocessor.
8. Identify general and special tools used in RAC work. Measurement of pressure and temperature. NOS ELE/N 3108	Identify general tools used in refrigeration.
	Identify and operate special tools used in refrigeration and AC.
	Care and maintenance of tools, instruments and equipments.
	Identify the components used in refrigeration and AC cycle.
9. Perform testing of electrical and mechanical components of refrigerator. NOS ELE/N 3108	Check and service the condenser and evaporator.
	Check, test and replace relay, OLP, thermostat, door switch of refrigerator.
	Check and identify the terminals of refrigerator compressor motor.
	Make wiring of refrigerator.
10. Perform copper tube works, test electrical components, service and maintenance in refrigerator. NOS ELE/N 3108	Make a flaring and swaging.
	Make a bend joint.
	Braze a copper tube joint.
	Trace the electrical circuit of refrigerator and find fault.
	Check and replace faulty components in refrigerator.
	Check and replace door gasket of refrigerator.
	Test leak, evacuation and gas charging in refrigerator.
	Service a refrigerator.
	Install a refrigerator.
11. Perform oil charging cleaning & flushing of sealed and open unit. NOS CSC/N9425	Check compressor oil in open type compressor.
	Dismantling and assembling of sealed compressor.
	Dismantling and assembling of open type compressor.
	Clear the condenser, evaporator and capillary tube by chemically.
12. Perform GPW, ODP and charging new refrigerant and recovery of CFC/HCFC/HFC refrigerant. NOS ELE/N 3108	Identify ODP & GWP of refrigerants.
	Identify the colour codes of refrigerant.
	Identify chemical formula, numerical designation, B.P and F.P of refrigerants.

	Recovery of CFC, HCFC and HFC refrigerants Dom systems.
13. Identify the refrigerator system and its components. NOS ELE/N 3108	Identify the parts of refrigerator cycle.
	Identify the low side and high side of system.
	Check the components of refrigerator cycle.
14. Recognise electrical systems of refrigerator, freezer, Bottle cooler. NOS CSC/N9426	Check and test electrical wiring circuit of refrigerator.
	Check and test electrical wiring circuit of freezer and Bottle cooler.
15. Perform gas charging in frost free refrigerator. NOS CSC/N9427	Test leak in refrigerator.
	Make evacuation in refrigerator.
	Charge gas in refrigerator.
16. Perform copper tube brazing and gas charging in window AC. NOS ELE/N 3108	Make a brazed joint.
	Test and wire the electrical system of window AC.
	Install a window AC.
	Charge gas in window AC.
17. Performs gas charging in Deep freezer and bottle cooler.NOS CSC/N9428	Recover CFC gas.
	Charge HC gas.
	Check the performance of deep freezer and Bottle cooler.
18. Install and test Split AC. NOS ELE/N 3108	Install a split AC
	Service a split AC
	Gas charging in split AC
	Measure the temper hive, velocity, of a Air conditioner.
19. Perform VRV/VRF Air conditioning system, duct able AC. NOS- ELE/N3141	Trace the wiring system of VRV/VRF system
	Install indoor unit cassette type.
	Check the performance of ductable AC.
	Testing of three door refrigerator.
	Check and test PTC relay, timer and defrost heater.
	Service a cassette type Air Conditioner.
20. Check and service visi cooler, trouble shooting, test insulation, performance of	Check he insulation material of deep freezer.
	Check the energy conservation of visi cooler.
	Preventive maintenance of deep freezer.

water cooler. NOS CSC/N9416	Install a water cooler.
	Check the electrical systems of water cooler.
	Check and test condenser fan.
21. Check components of chest type cooler, deep freezer, visi cooler. NOS CSC/N9429	Identify the components of chest type bottle cooler.
	Charge gas in a deep freezer.
	Check the performance of a visi cooler.
	Charge R 134 a refrigerate in bottle cooler.
21. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
22. Service mechanical and electrical components of Car Air conditioning and Mobile refrigerator. NOS CSC/N9430	Check electrical and mechanical components of car AC.
	Check & service mobile refrigerator.
	Check and test magnetic clutch assembly.
	Test leak, evacuation and gas charging in car AC
	Over hauling the compressor of mobile refrigerator
	Charge oil in car AC compressor.
	Check and rectify the wiring circuit of mobile refrigerator.
23. Perform servicing and maintenance in package AC and split package. NOS-ELE/N3141	Test leak, evacuation, charge gas in package AC install and check the performance of split package
	Test electrical components of package AC
	Identify the faults of split package AC

24. Installation, servicing, repairing, gas charging and test performance of ICE candy plant. NOS-ELE/N3140	Identify the components at ICE candy plant.
	Check and service ICE candy compressor.
	Trace and check wiring circuit.
	De sealing of condenser.
	Test leak, evacuate and charge gas.
	Run the plant and record different parameters.
	Maintain log book.
25. Servicing and preventive maintenance of cold storage. NOS- ELE/N3140	Identify the electrical and mechanical components.
	Check and test control systems.
	Check the wiring system.
	Add oil and gas to the system.
	Install compressor.
	Test leak, evacuation and gas charging.
	Trouble shoots in cold storage.
	Check the plant performance.
26. Identify components of indirect chiller system, service and maintenance, trouble shooting. NOS-ELE/N3140	Identify indirect chiller system components.
	Servicing the plant.
	Pump down the gas.
	Operation of chiller plant.
27. Perform chiller piping and insulator. NOS- ELE/N3140	Insulate chiller pipe line and duct.
	Check air how system.
	Service FCU.
28. Perform service and maintenance of shell and tube type condenser &evaporator. NOS-ELE/N3140	Trouble shooting in AC plant.
	Check condensing unit, vibration eliminator and insulations.
	De sealed shell & tube condenser.
	Service chiller.
29. Perform HVAC (Heating Ventilation and AC) duct designing, pipings and chiller. Maintenance of compressor. Designing central AC plant. NOS-	Designing of duct.
	Selector of fan.
	Making of duct.
	Section of grills and dampers.
	Designing of pipings.
	Selection of pump.

ELE/N3140	Preparing layout of central plant.
	Maintenance of chiller and condenser pump.
	Checking of wiring system.
	Testing leak, evacuation and gas charging.
	Testing safety controls.
	Maintenance of plant log book.
	Servicing of cooling tower.
30. Dismantle, repair and assemble commercial compressor. NOS-ELE/N3140	Over hauling reciprocity, compressor and check its performance.
	Check and service the compressor components
	Make gasket and check belt tension and alignment.
	Lap compressor parts.
31. Service compressor and check capacity control. NOS-ELE/N3140	Check lubrication system.
	Check oil pump and service.
	Check the compressor capacity control system.
32. Perform psychrometric process. NOS- ELE/N3140	Identify DDT, WBT, DPT, RH lines in psychrometry.
	Use psychometric chart.
	Find cooling and dehumidification process.
33. Measure air velocity, air quantity by using anemometer and pitot tube. NOS- ELE/N3140	Identify the instrumental.
	Measure air velocity and air quantity.
	Measure static pressure, velocity pressure and total pressure.
	Balancing air flow in duce.
34. Check and service fan, blowers & motors. NOS-ELE/N3140	Check and service fan and blowers
	Test the motor
	Lubricate the motors.
	Check the performance of fan and blowers.
35. Installation of duct, maintenance of Air filters. NOS- ELE/N3141	Make duct for AC.
	Insulate heat insulation material in duct.
	Service air filter.
	Fix Air filter in AHU & FCU.
36. Identify components of Dx system. Test components;	Check and test the wiring system.
	Operate the plant.

make wiring of dx system service and maintenance of plant. NOS- ELE/N3140	Service the system.
	Maintenance of plant log book.
37. Trouble shooting of centralized AC. NOS-ELE/N3141	Fault diagnosis and servicing of central AC.
	Check machine operation and its controls.
	Make electrical wiring in central AC.
	Check the performance of plant.
	Gas charging in central AC plant.
38. Routine maintenance of central plant. NOS-ELE/N3141	Check pressure and temperature of machine.
	Check current and voltage of machine.
	De scale condenser.
	Service cooling tower.
	Maintain log book.
39. Ascertain plant capacity and install compressor, check operation of electrical and mechanical comports NOS-ELE/N3141	Make survey of building for heat load.
	Prepare heat load of the building.
	Check cut in and cut out temperature.
	Check the operation of plant.
40. Perform cooling tower maintenance. NOS-ELE/N3141	Check the cooling tower.
	Measure range, approach efficiency of cooling tower.
	Check the water and maintain water pts value.
	Service the cooling tower.
41. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
42. Demonstrate basic mathematical concept and	Solve different mathematical problems

principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR CENTRAL AIR CONDITION PLANT MECHANIC TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 63 Hrs; Professional Knowledge 12 Hrs	Perform basic fitting works like Marking, Punching, Filing, drilling, reaming, tapping following safety precautions. NOS CSC/N0304	**Basic Fitting:** 1. Demonstrate Safety precautions and First aid. (8 hrs) 2. Identify general tools, instruments & equipments. Care and maintenance of tool, instruments and equipments. (12 hrs)	Workshop & Personal Safety - Introduction to basic workshop tools & operations like measuring, marking, hacksawing & cutting. Tools used, their identification & classification, use care & maintenance, direct & indirect measurements, marking medias. (04 hrs)
		3. Perform flat filing, marking, punching and hack sawing to make a job as per drawing. (10 hrs). 4. Filing & Fitting of male & female joints within accuracy of +0.2mm. (8 hrs). 5. Using a sprit level and dial test indicator and Measurements by precision instruments. (4 hrs).	Introduction to files, their types and uses, care & maintenance, Bench & pipe vice, their constructional details & uses. Sprit levels & their uses, straight and angular measurements, Bevel Protractors. Introduction to precision measuring & least count. Micrometers, Venires & Height gauges.(04 hrs)
		6. Perform Drilling, reaming & tapping as per given drawings. (4 hrs) 7. Make external thread cutting on pipes. (4 hrs) 8. Perform Fitting of two parts with the help of fastener such as key cotters Nut & Bolt. (13 hrs)	Constructional details, applications, care & maintenance. Dial gauge Vernier& indicator. Drilling, tapping & reaming, types of drills & reamers, different drilling operations, dies & die stocks. Drilling machines, their types & uses, holding devices

			&fixtures. Types of fasteners, threads. Adhesives & their applications. (04 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Perform marking, Cutting, Folding, Soldering, riveting on sheet metal. NOS CSC/N0301	**Sheet Metal Work:** 9. Demonstrate the protective safety devices on shop floor. (4 hrs) 10. Identification of Tools & Equipment. (4 hrs) 11. Practice in Scribing of straight line, Bisection of straight lines with marking tools. (4 hrs) 12. Practice in cutting sheet metal to different shapes like Straight & oblique cutting, using various types of snips. (08 hrs)	Introduction to sheet metal work & its applications, materials used for sheet metal work. Hand tools, measuring tools & gauges used in sheet metal work. Different sheet metal operations, their necessity & applications. (04 hrs)
		Folding/Bending 1. Sheet metal to 90 using wooden mallet. (05 hrs) 2. Practice on hard soldering method (Lead & Tin). (05 hrs) 3. Forming simple sheet metal articles like funnels, cylindrical vessels, boxes & buckets. (08 hrs) 4. Making holes on sheet metal by punching & riveting. (4 hrs)	Sheet metal joining processes, Sheet metal machinery, shears, forming & folding machines, bending & shearing machines seaming & nibbling machines. Development of surfaces for simple objects like boxes, cylinders, cones, prism & pyramids. Riveting practice, practice on removing dents on spherical & hemi spherical articles. (04 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Perform marking, sawing, planning, chiselling on wooden materials. NOS CSC/N9424	**Carpentry:** 5. Perform marking, sawing, planning, chiseling& drilling in wood. (08 hrs) 6. Making joints & simple frames in wood for A.C. work. (13 hrs)	Timber, its classification &sources, seasoning of timber. Plywood & alternative materials. Carpentry tools, their uses, care & maintenance, simple carpentry operations & commonly used joints. Glues & adhesives, polishing & varnishing. (04 hrs)

Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Perform gas welding and arc welding for different joint. NOS CSC/N0204	**Basic Welding:** 7. Identification of gas welding, equipments & accessories, setting up of a) AIR-LPG, b) O**2**-LPG c) O**2**-C**2**H**2.** (4 hrs) 8. Practice in1) Oxy Acetylene Gas welding, brazing and cutting on thin sheet metal. (13 hrs) 9. Demonstrate the Safety in handling of Oxy Acetylene Cylinders, Regulators etc.,(4 hrs)	Workshop & personal safety - Metal joining processes. Introduction to gas & arc welding, advantages & disadvantages. Different hand tools used in welding. Oxy-Acetylene gas welding plant. Welding accessories like regulators, nozzles cylinders etc. Handling, setting of pressure. (04 hrs)
		Basic Welding: 10. Setting beading practices, striking & maintaining an arc setting up an oxy-acetylene flame. (08 hrs) 11. Perform Laying short, straight line & weaved beads on M.S. plates, Fillet welds in open corner, Tee & Lap Joint, fusion runs with & without filler rods. (13 hrs)	Welding machines & welding transformers, welding processes & positions, welded joints, welding symbols, weld depositions, & electrodes, their types & selection, care & maintenance. Distortion in welding, welding defects, their causes & remedial measures. (04 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Perform brazing work on copper tubes. NOS ELE/N 3108	**Basic Brazing: -** 23. Make unroll, cut, Swaging, Flaring with proper method in copper tubes.(05 hrs) 24. Make Joining of Copper to copper joint, Copper to steel. Cooper to Aluminum on difference size pipe. (08 hrs) 25. Make 'T' Joint, Cross Joint angle, Reducer joint all with above.(08 hrs)	Importance of brazing joint in R&A/C sector Selection of nozzle, Setting of line pressure. Importance of Right temperature of Brazing. PPE required when brazing. Preparation before brazing, Swaging method, Flaring method filler rods, Fluxes, types & application. (04 hrs)
Professional Skill 84 Hrs; Professional Knowledge	Perform different wire joint, measure power, currents, volts and earth resistance, AC	**BASIC ELECTRICITY: -** 26. Demonstration of Safety equipment's and artificial respiration. (02 hrs) 27. Use of hand tools and	Safety - in electrical shops. Introduction of AC, DC Current Static & current Electricity, Description, specification, general care & maintenance of

16 Hrs	motors, DC generators, ohm's law verification. Different starters for single and three phase motor with awareness in electrical safety. NOS ELE/N 3108	Measuring of Voltage current ampere (04 hrs) 28. Identification of Neutral, Phase, Earth, Proper size cable as per load. (02 hrs) 29. Joining Practice with single and multi-stand conductors. Joining practice of bare conductor. (08 hrs) 30. Identify different types of resistances, Earthing and fuses, types, grades and sizes of insulated wire and cables - their selection and use. (05 hrs)	common electrical hand tools. Wires & cables -conductors, Insulators & semiconductors, their shapes, sizes with respect to low, medium & high voltage. Different fluxes for different purposes on metals, Crimping equipment -Single & Multistranded conductors joining. Selected letters symbols and sign as per I. S. I. Rules for medium voltage. (04 hrs)
		31. Demonstration & practice on soldering the Aluminum conductor, cable joints and Use of Aluminum flux and Alca 'P' solder. (04 hrs) 32. Demonstration and practice of crimping of various wires and Electrical symbols. (02 hrs) 33. Making a simple circuit with a lamp and battery. (03 hrs) 34. Practice and use of Multimeters, measurement of current, voltage, resistance in DC/AC circuits. (03 hrs) 35. Demonstration& verification of ohm's law- Series circuits - Parallel circuits. (04 hrs) 36. Demonstration& Practice on connecting & replacement of common electrical accessories in circuits and Use of tong tester and megger. (5 hrs)	Resistance, Voltage, Current, open circuit and short circuits- Ohm's law - Voltage drop in series & parallel circuits, Power & energy relations, Electrical measuring Instruments, Multimeters, Insulation Testers. Common electrical accessories used in Industries, Bus-bars, Relays, Contactors, Circuit Breakers, etc.. Fuses and their ratings, materials used. Earthing & its importance. Preventive maintenance, routine & periodical tests. (04 hrs)

		37. Make simple wiring practice with distribute on boards, Junction Boxes, Main Switches, two way and intermediate Switches. (04 hrs) 38. Identification of different parts of DC generators-testing and measuring the field and Armature resistances. (04 hrs) 39. Identification of different parts of AC Motors - Testing and measurement on Induction motors - and generators. (04 hrs) 40. Identification and testing of transformers. (02 hrs) 41. Grouping& testing of cells for a specified voltage & current, Preparation of battery charging. (04 hrs) 42. Drawing simple panel board wiring diagrams and prepare list of material for wiring. (03 hrs)	Induction principles - Electro-magnetism-Faraday's Laws. Single phase & Poly phase system 3 phase star-delta connections, Impedance & power factor -Principles & Applications of DC Motors, Series, Shunt & compound motor - AC Motors. Transformers their types and applications. Chemical effect of electric current - Rechargeable batteries - Care & maintenance of cells. AC Motor starting with DOL Starter and Star - Delta Starter. Panel boards & their designing. (04 hrs)
		43. Make simple electrical circuit, series circuit and parallel circuit, measuring insulation resistance & earth resistance. (04 hrs) 44. Verification of Ohm's law in D.C Circuit. (04 hrs) 45. Fixing and connecting electrical switches, holder's fuses, plug sockets on T. W. Board and testing. A.C. Motor, starters and transformer. (04 hrs) 46. Run/start motors, test	Use of electrical Control Instruments. Joints on single and stranded conductors and soldering. Care & maintenance and running of A. C. Single and poly phase motor, starters and transformer. Single phase motor starting methods like RSIR, PSC, CSIR & CSCR and the use of Current and Potential relays. Measurement of current, voltage, power and energy by voltmeter, Ammeter, wattmeter & energy meter. Measurement

		capacitors and Motor Protection devices. (04 hrs) 47. Check the temperature rise of windings, Rewiring of existing motor wiring. (05 hrs)	of resistance with Ohm Meters Formation of simple electrical circuit, series circuit and parallel circuit, measuring insulation resistance & earth resistance. Verification of Ohm's law in D.C Circuit, Fixing and connecting electrical switches, holders fuses, plug sockets on T. W. Board and testing. (04 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Perform testing of circuits for electronic Components. NOS ELE/N 3108	**BASIC ELECTRONICS: -** 48. Identification and testing of different types of electronic components and symbols. (04 hrs) 49. Identification and Testing of assorted diodes, capacitors, PNP/NPN Transistors - Uni - junction Transistor, Field effect, Transistor & Silicon Controlled Rectifier ICs etc. (04 hrs) 50. Practice soldering& de soldering. (03 hrs) 51. Demonstration and Identification of ICs, Rectifiers, Full wave & bridge rectifier circuits, voltage regulators. (04 hrs) 52. Construction of low voltage power supply. (04 hrs) 53. Construction of transistor, amplifier circuits, multi vibrator circuits, CR circuits for wave shaping, wiring of SCR, UJT for motor control. (04 hrs) 54. Construct a full wave and bridge rectifier circuit, voltage regulators. (05 hrs)	**ELECTRONICS** Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes. Identification of resistance value as colour code. Tools & Equipments used in Electronic trade. Fundamentals of electron theory -passive components semiconductor devices -Symbols - specifications - Diodes, Transistors, Uni-junction Transistor, Field effect Transistor Silicon Controlled Rectifier & ICs. Half wave, full wave & Bridge rectifier with filters, DC Power supply. Rectification and Rectifiers, zener diode as voltage regulator, Transistor parameters-CB, CC, CE configuration, amplification, photo diodes, transistors, multi vibrations CR & LR circuits, SCRs, UJTs &ICs. Multi-vibrator circuits and RC wave shaping circuits. Wiring of SCR, UJT for power control circuits,

		55. Construction of low voltage Power Supply and transistor amplifier circuit. (04 hrs) BASIC ELECTRO-MECHANICS: - 56. Testing solid state thermostats, PTCR, remote controls. (04 hrs) 57. Operating & testing contactors, relay, pressure controls, timer, solenoid, heater, pressure controls. (04 hrs) 58. Identification of microprocessor trainer kit. (2 hrs)	applications of OP -AMP, Applications of photo transistor. Thermistor, RTDs, Electronic thermostat, principle of remote control & controllers. Use & specifications of contactors, starter & crankcase heater etc., Introduction to Microprocessors. (08 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Identify general and special tools used in RAC work. Measurement of pressure and temperature. NOS ELE/N 3108	**BASIC REFRIGERATION.** 59. Identification& use of general and special tools, instruments, equipment's used in refrigeration work. (08 hrs) 60. Measuring Temperature, Pressure, and Humidity. (08 hrs) 61. Identification of refrigerant, measuring cylinder pressure. (09 hrs) 62. Identify electrical and mechanical parts of a refrigerator. (08 hrs) 63. Dismantling and assembling of compressor. (09 hrs)	Introduction to basic refrigeration, job opportunities, Safety precautions and first aids, Applications and History of Refrigeration and Air conditioning principle & need. Fundamentals of Refrigeration, units and measurements, Pressure & its Measurements Introduction to refrigeration Tools & equipment, Heat and temperature. Types of heat and its measurement. Thermometers & thermometric conversions. Atmosphere, air & its constituents. Properties of gases & gas laws. Measurement of pressure. Pressure gauges. Humidity, relative humidity & due point temperature. Constructional details of a refrigerator. Functions of refrigeration system components i.e., condensers,

			evaporators and capillary tube. Compressor, its types & working principle. Reciprocating compressors. Comparative study of sealed & open type compressors, Internal construction of a sealed compressor, its part & their functions. (08 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Perform testing of electrical and mechanical components of refrigerator NOS ELE/N 3108	64. Flushing condenser, evaporators and capillary tube. (2 hrs) 65. Testing of sealed compressor. (3 hrs) 66. Test leak, evacuate and charge gas in refrigerator. (08 hrs) 67. Testing of refrigerator component. (04 hrs) 68. Installation of refrigerator. (04 hrs)	Electrically & mechanically testing of refrigerator component. i.e. condensers, evaporators and capillary tube, Relay, OLP, Compressor Terminal find out, defective compressor identification & remedy. (04 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Perform copper tube works, test electrical components, service and maintenance in refrigerator. NOS ELE/N 3108	69. Practice Joining, Bending, Swaging, Flaring, brazing. (11 hrs) 70. Cleaning, inspection, testing of components in refrigeration system. (13 hrs) 71. Tracing the electrical components and testing relay, OLP, Thermostat, light assembly, door switch etc. (18 hrs)	Difference type of joint Procedure for temporary, Semi, permanent Brazing Processes. Defects& remedial measures. Introduction to soldering & brazing, their applications. Brazing Vs welding. Advantages & disadvantages. Maintenance of tool, instruments and equipment's. (08 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Perform oil charging cleaning & flushing of sealed and open unit. NOS CSC/N9425	72. Remove & refit refrigerator door gaskets. (8 hrs) 73. Refrigerator service, care & maintenance. (09 hrs) 74. Oil charging, cleaning &flushing of the sealed & open unit. (04 hrs)	Compressor lubrication method. Lubricants & their properties. Selecting of lubricant for refrigerant sector. Cleaning& flushing of system with chemical cleaning & flushing. Special about safety. (04 hrs)

Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Perform GPW, ODP and charging new refrigerant and recovery of CFC/HCFC/HFC refrigerant. NOS ELE/N 3108	75. Identify the Global warming, Ozone depletion refrigerant. (08 hrs) 76. Identify the alternative refrigerant for ODP and GWP. (13 hrs)	Environmental effect of refrigerant, Action taken, Alternative refrigerant. (04 hrs)
		77. Recovering CFC / HCFC / HFC by using recovery machine. (13 hrs) 78. Charge eco-friendly refrigerant. (08 hrs)	Status & states of the refrigerant in every spot of the cycle, Recovery, recycling of refrigerant & their procedure. (04 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Identify the refrigerator system and its components. NOS ELE/N 3108	79. Identify the Refrigeration systems.(08 hrs) 80. Identify the components of vapor compression cycle, low side & high side components. (13 hrs)	Types of Refrigeration systems, Study the construction and working of vapor compression cycle, low side & high side components of vapour compression system like , compressor, condenser, expansion valve and evaporator, functions and applications of above components. (04 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Recognise electrical systems of refrigerator, freezer, Bottle cooler. NOS CSC/N9426	81. Check and trace electrical circuit diagram of Refrigerator. (5 hrs) 82. Check and trace electrical wiring circuit of Freezer. (08 hrs) 83. Check and trace electrical wiring circuit of Bottle cooler. (08 hrs)	Electrical circuit diagram of refrigeration cycle Refrigerator, Freezer, Bottle cooler. (04 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Perform gas charging in frost free refrigerator. NOS CSC/N9427	84. Repairing rewiring & servicing of a refrigerator. (04 hrs) 85. Carry out with R-134 a Leak testing in the system Evacuation & gas charging of a refrigerator. (08 hrs) 86. Trouble shooting of electrical & mechanical	Repairing rewiring & servicing of a refrigerator. Carrying with R-134a Leak testing in the system Evacuation & gas charging of a refrigerator. Trouble shooting of electrical & mechanical faults Study of Frost Free Refrigerators, Refrigeration system of Frost Free

		faults. (02 hrs) 87. Stripping the components of Frost Free Refrigerator. (03 hrs) 88. Tracing and testing electrical circuits of Frost free refrigerator. (04 hrs)	Refrigerators, components & their functions, electrical components, wiring, automatic defrost. (04 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Perform copper tube brazing and gas charging in window AC. NOS ELE/N 3108	89. Practice on soft copper tubing like, cutting, bending, flaring, swaging, pinching & preparing flare joints. (13 hrs) 90. Make Brazing of tube joints (Cu to Cu, Cu to Steel, Cu to Brass) using (i)Air-LPG (ii) 02-LPG (iii) 02-C2 H2 set up & use of the above gases with the right torches, Brazing Filler Rods. (08 hrs)	Working on soft copper tubing like, cutting, bending, flaring, swaging, pinching & preparing flare joints. Brazing of tube joints (Cu to Cu, Cu to Steel, Cu to Brass) using (i)Air-LPG (ii) 02-LPG (iii) 02-C2 H2 set up & use of the above gases with the right torches, Brazing Filler Rods. Distinguishing good joints from bad joints.(04 hrs)
		91. Flush evaporator, condenser and capillary tube. (07 hrs) 92. Replace capillary and drier. (07 hrs) 93. Test leak, Evacuation, gas charging in Window A/C. (07 hrs)	Cleaning, Flushing, replacing capillary and drier, fault rectification, Advantage of proper evacuation, leak testing, gas charging in window A/C Refrigerant charging.(04 hrs)
Professional Skill 21 Hrs; Professional Knowledge 04 Hrs	Performs gas charging in Deep freezer and bottle cooler. NOS CSC/N9428	94. Service a window air conditioner. (04 hrs) 95. Retrofitting of HFC filled appliances with Non HFC refrigerant HC blend. (04 hrs) 96. Replace electrical and mechanical components in Refrigerator, Deep freezer and Bottle cooler. (13 hrs)	Air cleaning: Filters, their types and specifications. Air flow measurements Use of velocity meters. Performance Testing criterion. Scope and methodology of retrofitting HFC appliances with HC blend refrigerants, study of refrigerator components using HC refrigerants. Comparative study of performance of refrigerators using different refrigerants. Comparative study

			of appliances available in the market.(04 hrs)
Professional Skill 63 Hrs; Professional Knowledge 12 Hrs	Install and test Split AC. NOS ELE/N 3108	97. Dismantling& Assembly of a Split Air conditioner. (09 hrs) 98. Identify the components of Split A.C. (04 hrs) 99. Measure Relative Humidity by using sling psychrometric. (04 hrs) 100. Check air circulation of a window A.C. (04 hrs)	Introduction to Air conditioning Split type, its past, present & future. Air conditioning Fundamentals. Constructional details and functioning of room air conditioner. Air circulation system. Psychrometric & psychrometric charts, construction & use of sling psychrometer.(04 hrs)
		101. Test thermostat, relay, capacitors, OLP and blower motor. (07 hrs) 102. Inspecting& testing condenser & evaporator coil. (07 hrs) 103. Check and rewire the electrical wiring circuit of CSR and PSC of a Room A.C. (07 hrs)	Study of mechanical & electrical components of Split A. C. Role of each part. Split A. C its constructional details, comparison with window air conditioner advantages & Disadvantages. Air cooled condensers: Constructional details & selection.(04 hrs)
		104. Test leak, Evacuating & gas charging of a Split Air conditioner. (08 hrs) 105. Test performance of Air Velocity, grill & condenser temperature. (04 hrs) 106. Check smooth running of fan motor. (04 hrs) 107. Check the faults, Causes and their remedies of a Split AC for not working. (05 hrs)	Principles of pipe sizing & study of services valves for charging at site. Principle of working of infra red remote control, study of electronic circuits.(04 hrs)
Professional Skill 84 Hrs; Professional Knowledge	Perform VRV/VRF Air conditioning system, duct able AC. NOS-	108. Testing all weather air conditioners. (08 hrs) 109. Trouble shooting for Window A.C. (08 hrs) 110. Identify the components of	Testing all weather air conditioners. Trouble shooting electrical& mechanical faults. VRV/VRF system, Frost Free Refrigerator.

16 Hrs	ELE/N3141	VRV/VRF system. (04 hrs) 111. Identify the faults of VRV/VRF system. (08 hrs) 112. Test the Frost Free Refrigerator. (Double and Three Door). (04 hrs) 113. Trouble shooting in frost free refrigerator. (05 hrs) 114. Check the operation of timer, defrost heater, PTC Relay etc. (05 hrs)	(Double and Three door) Identify faults; rectify defects, installation method, study wiring circuit, evacuation, leak testing & gas charging and installation.(08 hrs)
		115. Installation of Window A/C. (13 hrs) 116. Install ODU of a Split A/C. (08 hrs) 117. Prepare a customer orientation service report, Dealing with customer. (13 hrs) 118. Install a duct for a duct able A/C. (04 hrs) 119. Install IDU of a cassette A/C. (04 hrs)	Proper Installation procedure of Window A/C, Normal Split A/C Customer orientation service report preparation, Dealing with customer Proper Installation procedure of Duct able A/C, Cassette A/C. (08 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Check and service visi cooler, trouble shooting, test insulation, performance of water cooler. NOS CSC/N9416	120. Identify the heat Insulation and Energy conservation. (04 hrs) 121. Checking- and servicing visi cooler. (04 hrs) 122. Preventive maintenance in Deep freezer. (09 hrs) 123. Retrofitting with Hydrocarbons and HFC 134a. (04 hrs) 124. Installation of a water cooler. (09 hrs) 125. Check electric wiring circuit and components of water cooler. (4 hrs) 126. Test leak, evacuation, gas charging in water cooler.	Types of insulation U-Value EER calculation as star rated calculation Checking and servicing Preventive maintenance and Trouble Shooting. Retrofitting with Hydrocarbons and HFC134a a) Water storage, distribution and drainage b) Refrigeration system using R-22 and components in lieu of R-12, Retrofitting with HFC-134a & HCs c) Electrical and control system working and control, soldering of copper tubes with stainless steel,

		(08 hrs)	Trouble shooting of commonly faced problem like condenser Fan Failure, corrosion etc.(08 hrs)
Professional Skill 42 Hrs; Professional Knowledge 08 Hrs	Check components of chest type cooler, deep freezer, visi cooler. NOS CSC/N9429	127. Check and test Chest type bottle cooler. (09 hrs) 128. Check and test Deep Freezer. (08 hrs) 129. Check and test Visi cooler. (08 hrs) 130. Test leak, evacuation and gas charging in Deep freezer. (09 hrs) 131. Check the performance of Visi cooler. (08 hrs)	Deep Freezers description, Construction and function, Low temperature thermostat, different type of deep freezer construction. Substituting R-22 with R-134a or Hydrocarbon (Montreal protocol) (08 hrs)
Engineering Drawing (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	**Introduction to Engineering Drawing and Drawing Instruments** • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument **Lines- Types and applications in drawing** **Free hand drawing of –** • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. **Drawing of Geometrical figures:** • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. **Dimensioning** • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. **Concept and reading of Drawing in** • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) **Reading of Job drawing related to trades**	
WORKSHOP CALCULATION & SCIENCE (40 hrs)			

Professional Knowledge WCS- 40 Hrs	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	**Unit, Fractions** • Classification of unit system • Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units • Measurement units and conversion • Factors, HCF, LCM and problems • Fractions - Addition, subtraction, multiplication & division • Decimal fractions - Addition, subtraction, multiplication & division • Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** • Square and square root • Simple problems using calculator • Applications of Pythagoras theorem and related problems • Ratio and proportion • Ratio and proportion - Direct and indirect proportions • Percentage • Percentage - Changing percentage to decimal and fraction **Material Science** • Types metals, types of ferrous and non-ferrous metals • Physical and mechanical properties of metals • Introduction of iron and cast iron • Difference between iron & steel, alloy steel and carbon steel • Properties of insulating materials **Mass, Weight, Volume and Density** • Mass, volume, density, weight and specific gravity, **numerical related to L,C,O section only** • Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** • Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** • Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals • Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature • Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation • Co-efficient of linear expansion and related problems with assignments • Problem of heat loss and heat gain with assignments • Thermal conductivity and insulators • Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used

		for measuring pressure **Basic Electricity** • Introduction and uses of electricity, electric current AC, DC their comparison, voltage, resistance and their units • Conductor, insulator, types of connections - series and parallel • Ohm's law, relation between V.I.R & related problems • Electrical power, energy and their units, calculation with assignments **Mensuration** • Area and perimeter of square, rectangle and parallelogram • Area and perimeter of Triangles
Project work/Industrial Visit (Optional) **Broad areas:** a) Assemble a split AC. b) Make a refrigeration cycle of a refrigerator.		

SYLLABUS FOR CENTRAL AIRCONDITION PLANT MECHANIC TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 42 Hrs; Professional Knowledge 11 Hrs	Service mechanical and electrical components of Car Air conditioning and Mobile refrigerator. NOS CSC/N9430	**CAR AIR CONDITIONING** 132. Identifying various components of Car AC. (04 hrs) 133. Check and test electrical circuits and components of Car AC. (04 hrs) 134. Identify faults in Car AC and rectification. (04 hrs) 135. Check and test leak, evacuation, gas charging in Car AC. (04 hrs) 136. Install a Car AC. (05 hrs)	**CAR AIR CONDITIONING** Study various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting, Magnetic clutch operation, freewheeling. (06 hrs)
		MOBILE Refrigeration 137. Test magnetic clutch and compressor. (04 hrs) 138. Service a Car AC. (04 hrs) 139. Overhaul the compressor of mobile refrigeration. (04 hrs) 140. Charge/Add oil to compressor. (04 hrs) 141. Check freewheeling of compressor.(05 hrs)	**MOBILE Refrigeration** Study the refrigeration cycle in Mobile Refrigeration, its Construction, Magnetic clutch operation, freewheeling. Planning for Preventive maintenance and scheduling of maintenance activities MOBILE Refrigeration. (05 hrs)
Professional Skill 42 Hrs; Professional Knowledge 11 Hrs	Perform servicing and maintenance in package AC and split package NOS-ELE/N3141	**PACKAGE A.C** 142. Identifying various components of package AC. (04 hrs) 143. Trace electrical circuits of package AC. (04 hrs) 144. Testing electric components of package AC. (04 hrs) 145. Identify faults of a package AC. (04 hrs)	**PACKAGE A.C** Study Package AC, types, construction and working principle, trouble shooting, various applications. Duct system, AHU, Care and maintenance, installation method, application, capacity calculation. (06 hrs)

		146. Test leak, evacuation, gas charging in package AC. (05 hrs)	
		SPLIT PACKAGE 147. Installation of a package AC.(13 hrs) 148. Trouble shooting in a package AC.(04 hrs) 149. Check the performance of a package AC.(04 hrs)	**SPLIT PACKAGE** Construction and working principle, types, troubleshooting Controls used in AC system, Electromechanical, pneumatic and electronic. (05 hrs)
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Installation, servicing, repairing, gas charging and test performance of ICE candy plant NOS-ELE/N3140	**Ice Candy Plant** 150. Preventive maintenance in Ice candy plant. (4 hrs) 151. Trace the electrical circuit of Ice candy plant. (4 hrs) 152. Check the electrical controls of Ice candy plant. (4 hrs) 153. Check the specific gravity and temperature of brine solution. (4 hrs) 154. Measure the pressure and current drawn by the unit. (5 hrs)	Ice Candy Plant, Refrigerant used, Brine agitator, Expansion Device; used, Electrical Motor Controls etc. Repairing of Repairing & maintenance of Condensing unit water cooled unit including water circulation system. (06 hrs)
Professional Skill 63 Hrs; Professional Knowledge 17 Hrs	Servicing and preventive maintenance of cold storage NOS-ELE/N3140	**COLD STORAGE** 155. Identify parts, Controls & accessories Specification of Cold storage plant. (3 hrs) 156. Servicing of Cold storage plant, including Electrical controls and cooling system. (08 hrs) 157. Test leak, evacuation, gas charging of Cold storage plant. (08 hrs) 158. Operate a Cold storage plant. (2 hrs)	**COLD STORAGE** Study of cold storage plant, parts, Construction, applications, controls & electrical diagram used in cold storage plant. Food preservation spoiling agents-controlling of spoiling agents, preservation by refrigeration system, maintaining temperature in different places. Types of cold storage and its details. (06 hrs)
		159. Installing a compressor in Cold storage plant. (09 hrs) 160. Use of vibration eliminator	Cold storage- type construction, capacity and specification. Method of installing compressor

		and shock absorber in a Cold storage plant. (4 hrs) 161. Check and wire electrical system of Cold storage plant. (08 hrs)	vibration eliminator and shock absorber there type and application. Study the lay out and electric wiring of the storage plant. Mobile refrigeration in transport vehicles. (06 hrs)
		162. Check the efficiency of a Cold storage plant. (04 hrs) 163. Check the operation of Cold storage plant. (04 hrs) 164. Prepare a maintenance schedule of a cold storage. (04 hrs) 165. Check the LP, HP, Oil pressure cut out of a cold storage. (09 hrs)	Method of pressure testing, evacuation & charging to the system and testing efficiency. Cold storage plant operation, its common trouble & remedies. Deep freezing, freezing tunnel, blast freezer its function and working, its application. (05 hrs)
Professional Skill 42 Hrs; Professional Knowledge 11 Hrs	Identify components of indirect chiller system, service and maintenance, trouble shooting. NOS- ELE/N3140	**INDIRECT/CHILLER SYSTEM** 166. Identifying various components, electrical circuits, testing components, of a Chiller plant. (04 hrs) 167. Trouble shooting for a cold storage. (04 hrs) 168. Testing leak, evacuation, gas charging in a chiller plant. (09 hrs) 169. Service AHU, FCU of a chiller plant. (04 hrs)	**INDIRECT/CHILLER SYSTEM** Understanding central station AHU and FCU, **Air washers** used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion tanks. (06 hrs)
		170. Insulate Chilled water piping. (08 hrs) 171. Servicing of FCU and water controls valves. (08 hrs) 172. Checking Mixing dampers and bypass dampers. (05 hrs)	Study of Humidification & De-humidification And Humidifier's & De-humidifier's. (05 hrs)
Professional Skill 21 Hrs;	Perform chiller piping and insulator	173. Servicing of direct and indirect A.C Plant. (04 hrs) 174. Erection of commercial type	Construction and study of commercial A.C plant, package chiller, screw chiller,

Professional Knowledge 06 Hrs		condensing unit. (09 hrs) 175. Check and install vibration eliminator and water proofing insulation. (04 hrs) 176. Repairing& maintenance of Shell & tube type Condenser & Evaporator. (04 hrs)	reciprocating chiller. Proper Repairing & maintenance of Shell & tube type Condenser & Evaporator. (06 hrs)
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Perform service and maintenance of shell and tube type condenser &evaporator. NOS-ELE/N3140	**Heat ventilation & Air condition, Duct designing** 177. Draw the layout & piping arrangement of the given Central A.C. Plant. (08 hrs) 178. Draw the chilling water & condensate water circuits. (08 hrs) 179. Check the controls used in Central AC plant. (05 hrs)	Heat ventilation &Air condition, Duct designing Introduction to Central A.C. plants, selection & applications. Direct & Indirect cooling, Air & water as media for cooling. Central A.C. Plant system components, Compressor, condenser & chiller.(06 hrs)
Professional Skill 168 Hrs; Professional Knowledge 45 Hrs	Perform HVAC (Heating Ventilation and AC) duct designing, pipings and chiller. Maintenance of compressor. Designing central AC plant NOS-ELE/N3140	180. Service and maintenance of pumps. (04 hrs) 181. Draw the panel board connections & wiring. (04 hrs) 182. Testing, pumping down & re-testing the plant. (05 hrs) 183. Evacuating& gas charging the system. (04 hrs) 184. Design Central A.C. systems for different applications. (04 hrs)	Fan coiled units & Air handling units. Cooling Towers, their types, constructional details & operation. Cooling Tower installation & maintenance make up water arrangements. Types of compressors used, loading and unloading arrangements. Ducting & its installation. Different switches & controls. Trouble shooting.(06 hrs)
		INDIRECT/CHILLER SYSTEM 185. Check and service air washer. (08 hrs) 186. Check the modulating valves for temperature controls. (5 hrs) 187. Check and service expansion valves. (08 hrs)	**INDIRECT/CHILLER SYSTEM** Understanding central station AHU and FCU, **Air washers** used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion tanks. (06 hrs)
		188. Make survey of the building for head load calculations.	Heat load calculations for different site conditions &

		(08 hrs) 189. Identify the heat flow rate through different materials for air-conditioning. (5 hrs) 190. Prepare tonnage for air conditioning building. (08 hrs)	applications.(06 hrs)
		191. Identify the location of mechanical and electrical components of Bus Air conditioner. (05 hrs) 192. Check the components and service the Bus A.C. (08 hrs) 193. Check the wiring system of Bus Air conditioner. (08 hrs)	Study the construction, working, application, capacity of bus Air conditioning. (05 hrs)
		194. Identify the location of mechanical and electrical components of Train Air conditioner. (08 hrs) 195. Check the components and service the A.C.(17 hrs) 196. Check the wiring system of Air conditioner of Train Air conditioning. (17 hrs)	Study the construction, working, capacity of Train Air conditioning. (10 hrs)
		197. Identify the location of mechanical and electrical components of Air Craft Air conditioning.(05 hrs) 198. Check the components and service the A.C.(08 hrs) 199. Check the wiring system of Air Craft Air conditioning. (08 hrs)	Study the construction, working, application, capacity of Air craft Air conditioning. (06 hrs)
		200. Identify the location of mechanical and electrical components of Marine Air conditioning. (05 hrs) 201. Check the components and service the A.C. (08 hrs)	Study the construction, working, capacity of Marine Air conditioning. (06 hrs)

		202. Check the wiring system of Marine Air Conditioning.(08 hrs)	
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Dismantle, repair and assemble commercial compressor. NOS-ELE/N3140	**COMMERCIAL COMPRESSOR:-** 203. Dismantling and assembling of Commercial type reciprocating compressor. (04 hrs) 204. Dismantling and assembling of centrifugal compressor. (08 hrs) 205. Checking & servicing of valve plate and piston assembly. (04 hrs) 206. Lapping valve plate and preparing gasket. (2hrs) 207. Check belt tension and replacing. (3 hrs)	**COMMERCIAL COMPRESSOR:-** Types, Construction & applications of Open type compressor and working, Performance of reciprocating compressor volumetric efficiency, Capacity control, factor influencing volumetric efficiency. (06hrs)
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Service compressor and check capacity control. NOS-ELE/N3140	208. Check the lubricating system, and servicing oil pump. (13 hrs) 209. Checking and servicing of capacity control of the compressor. (08 hrs)	Selection of lubricant, Function and characteristic of lubricant, types of lubrication methods such as splash, forced feed. (06 hrs)
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Perform psychrometric process. NOS-ELE/N3140	**PSYCHROMETRY: -** 210. Identify psychrometric lines. (05 hrs) 211. Use psychrometric chart. (08 hrs) 212. Measure DBT, WBT, RH &and other properties by using psychrometric chart and psychrometer. (08 hrs)	Central Air Conditioning fundamentals, requirements of comfort A.C, study of psychrometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity. Comfort air conditioning. (06 hrs)
Professional Skill 21 Hrs; Professional Knowledge 05 Hrs	Measure air velocity, air quantity by using anemometer and pitot tube. NOS-ELE/N3140	213. Check the Air flow by using Anemometers. (13 hrs) 214. Measure air velocity by Pitot tube. (08 hrs)	Types of Central air conditioning (Direct and indirect system)Construction, working, components, faults, care and maintenance. (05 hrs)

Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Check and service fan, blowers & motors. NOS-ELE/N3140	215. Identify different types of fan and blowers. (08 hrs) 216. Check and service fans, blowers & motors in air conditioning system. (13 hrs)	Description of blowers & fans, function and types, static and velocity pressure measurements. (06 hrs)
Professional Skill 21 Hrs; Professional Knowledge 05 Hrs	Installation of duct, maintenance of Air filters. NOS-ELE/N3141	**DUCT: -** 217. Identify different types of ducts. (2 hrs) 218. Identify the different types of grills and dampers. (3 hrs) 219. Construct square, rectangle and round duct and prepare Longitudinal and transverse joints. (08 hrs) 220. Make heat and acoustic insulation on duct. (04 hrs) 221. Prepare duct lay out drawings and install duct on ceilings. (2 hrs) 222. Servicing and maintenance of different filters. (2 hrs)	DUCT:-Function, types, materials, duct designing, duct insulation, air distribution methods, air flow, AHU, fan, blower. AIR FILTERS: - Function of air filters, types, construction, maintenance, effect of chocked Air filter. (05 hrs)
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Identify components of Dx system. Test components, make wiring of dx system service and maintenance of plant NOS- ELE/N3140	**DIRECT EX. SYSTEM** 223. Identifying various electrical component and electrical circuits of central AC plant. (02 hrs) 224. Test leak in central AC plant. (02 hrs) 225. Evacuate central AC plant. (03 hrs) 226. Charge gas in central AC plant. (02 hrs) 227. Installation work of central AC plant. (08 hrs) 228. Service and Maintenance of Central AC plant. (02 hrs) 229. Trouble shooting and Operation of Central AC plant. (02 hrs)	**DIRECT EX. SYSTEM** Understanding Direct expansion system. Operation & Preventive Maintenance Schedule of central AC plant. (06 hrs)

Professional Skill 42 Hrs; Professional Knowledge 11 Hrs	Trouble shooting of centralized AC NOS-ELE/N3140	**CENTRALISED/INDUSTRIAL AIRCONDITIONING.** 230. Identifying various electrical components and electrical circuits of industrial air conditioner. (08 hrs) 231. Gas charging in industrial air conditioner.(08 hrs) 232. Trouble shooting of industrial air conditioning. (09 hrs) 233. Installing compressor and other components of industrial air conditioning. (08 hrs) 234. Checking electrical wiring in central AC. (09 hrs)	**CENTRALISED/INDUSTRIAL AIRCONDITIONING.** Construction and working principle, types, maintenance of Industrial Air-conditioning plant. Humidification and dehumidification methods. Introduction to heat load calculation in AC building. Sensible & latent heat load. Basic of HVAC and its applications. (11 hrs)
Professional Skill 21 Hrs; Professional Knowledge 06 Hrs	Routine maintenance of central plant NOS-ELE/N3140	235. Check the heating system of central A.C Plant. (08 hrs) 236. Check the ventilation system of central A.C plant. (08 hrs) 237. Measure the different parameters of AC Plant. (5 hrs)	Fundamental of Central AC Plant Comfort Air conditioning - Comfort Air-conditioning conditions. Psychrometrics Dry and wet bulb. Dew point temperature. Introduction to psychrometric charts.(06 hrs)
Professional Skill 21 Hrs; Professional Knowledge 05 Hrs	Ascertain plant capacity and install compressor, check operation of electrical and mechanical comports. NOS-ELE/N3140	238. Identify the heat pumps. (08 hrs) 239. Check the air flow through ducts. (13 hrs)	Various types of central A.C. heat pumps like All air, All water, Air water and unitary AC assessing air- flow requirements and distribution. (06 hrs)
Professional Skill 189 Hrs; Professional Knowledge 51 Hrs	Perform cooling tower maintenance. NOS- ELE/N3140	240. Routine maintenance and preventive maintenance of large AC plants. (13 hrs) 241. Maintenance of log book and record keeping. (08 hrs)	Planning for preventive maintenance and scheduling of Maintenance activities in large AC and Refrigeration plants.(06 hrs)
		242. Conduct air balancing in	Duct systems - Principle of

		duct. (08 hrs) 243. Check the duct for air leakage. (5 hrs) 244. Design duct for a central AC. (08 hrs)	locating outlets, ducts and equipment. Basic of duct sizing. Duct Designing and duct arrangement.(06 hrs)
		245. Service & maintenance of various types of Air filters. (08 hrs) 246. Check the Noise level. (05 hrs) 247. Fix acoustic material in AHU. (08 hrs)	Basic of indoor air quality particles, vapors and gases. Types of filters- pre-filter flat and V type, Electrostatic, HEPA, Electronics filters acoustic materials.(06 hrs)
		248. Install compressor of a plant. (09 hrs) 249. Fix various components in a plant. (04 hrs) 250. Verifying airflow and distribution. (04 hrs) 251. Check the operation of electrical and Mechanic components in central AC plant. (04 hrs)	Introduction to load calculation in A.C. building. Sensible and latent heat, cooling load calculation.(05 hrs)
		252. Pull and verify deep vacuum. (08 hrs) 253. Perform leak checks and make repairs. (08 hrs) 254. Check system operation with all safety procedures. (05 hrs)	Method of leak detection, evacuation, charging gas, testing system.(06 hrs)
		Operation of A.C Plant. 255. Commissioning procedure of central air conditioning plant. (10 hrs) 256. Starting and stopping procedure of central ac plant. (06 hrs) 257. Prepare log book for commercial air conditioning plant. (06 hrs) 258. Check for system leaks and check and clean heat	System service and problem analysis. a) Proper temperature and pressures at various location. b) Thermostat settings c) Noises d) Electrical measurements e) Methods of measuring superheat and sub cooling f) Effects of overcharge and undercharge Performance of reciprocating

		exchanger. (10 hrs) 259. Check out the sample for acidity of water. (04 hrs) 260. Measure superheat and sub cooling. (06 hrs)	compressor Volumetric efficiency Commercial type Reciprocating compressor their type Construction and application. Installation of Ducts/AHUs. Multi stage compressor, their function, centrifugal compressor, construction and function refrigerant used. (11 hrs)
		261. Servicing of cooling tower.(08 hrs) 262. Calculate the cooling tower range and approach. (08 hrs) 263. Service and maintenance of water softening plant. (09 hrs) 264. Routine maintenance of large AC plants. (08 hrs) 265. Overhauling of large AC plants. (09 hrs)	Cooling tower - its principle, type capacity construction and disadvantage of different types of cooling towers. Selection of site efficiency. Wet bulb temp and cooling tower approach, range, drift loss etc. Water conditioning scale and deposit control corrosion and its control Planning for preventive maintenance and scheduling of Maintenance activities in large AC and Refrigeration plants(11 hrs)
Engineering Drawing (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	**Engineering Drawing:** Reading of Electrical, Electronic & Mechanical Sign and Symbols used in RAC Sketches of Electrical, Electronic & Mechanical components used in RAC Reading of Electrical wiring diagram and Layout diagram Drawing of Electrical circuit diagram used in RAC Drawing of Block diagram of Instruments & equipment of trades	
WORKSHOP CALCULATION & SCIENCE (34 Hours)			
Professional Knowledge WCS- 34 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. .	**Friction** • Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction • Friction - Lubrication **Centre of Gravity** • Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** • Area of cut out regular surfaces - circle, segment and sector of circle • Related problems of area of cut out regular surfaces - circle,	

	NOS CSC/N9402	segment and sector of circle **Elasticity** • Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus • Elasticity - Ultimate stress and working stress **Heat Treatment** • Heat treatment and advantages • Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening **Estimation and Costing** • Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade • Estimation and costing - Problems on estimation and costing
Projects works/ Industrial Visit **Broad areas:** a) Prepare duct lay out work. b) Prepare heat load estimation. c) Make different types of ducts.		

SYLLABUS FOR CORE SKILLS

1. Employability Skills (Common for all CTS trades) (120 Hrs + 60 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in /www.dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
CENTRAL AIRCONDITION PLANT MECHANIC (For batch of 24 Candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit s no. 1-24 is required additionally)			
1.	File flat rough double cut	200mm	25 (24+1) nos.
2.	File, half round, fine double cut,	length 150mm	25 (24+1) nos.
3.	File, round, fine double cut	length 150mm	25 (24+1) nos.
4.	File flat, fine double cut,	length 150mm	25 (24+1) nos.
5.	File square, fine double cut,	length 150mm	25 (24+1) nos.
6.	File triangular fine double cut	length 150mm	25 (24+1) nos.
7.	Scriber	150mm length	25 (24+1) nos.
8.	Centre punch	length 100mm	25 (24+1) nos.
9.	Try square	150 mm	25 (24+1) nos.
10.	Divider spring joint	length 150mm	25 (24+1) nos.
11.	Caliper spring joint in side	length 150mm	25 (24+1) nos.
12.	Caliper, odd leg, spring joint	length 150mm	25 (24+1) nos.
13.	Hammer ball pain	220 gms	25 (24+1) nos.
14.	Cold Chisel flat and cross cut	length 150mm	25 (24+1) nos.
15.	Engineers rule	300mm long	25 (24+1) nos.
16.	Tape measuring	10m graduation in mm	25 (24+1) nos.
17.	Pliers combination insulated	length 200mm	25 (24+1) nos.
18.	Pliers long nose	200 mm	25 (24+1) nos.
19.	Pliers flat nose	150mm	25 (24+1) nos.
20.	Line tester	500 v heavy duty	25 (24+1) nos.
21.	End cutting nipper	15cm	25 (24+1) nos.
22.	Tweezers	10 cm	25 (24+1) nos.
23.	Gloves for welding[Treated as consumable]		25 (24+1) nos.
24.	Leather Apron [Treated as consumable]		25 (24+1) nos.
B. INSTRUMENT AND GENERAL SHOP OUTFIT			
25.	Surface plate	45 x45 cms	1no.
26.	Oil can	500 ml	5 nos.
27.	Surface Gauge universal	150 mm	5 nos.

28.	Bench vice	150 mm jaw	12 nos.
29.	Hack saw tubular metal frame adjustable	300mm	12 nos.
30.	Snip sheet metal straight nose	200 mm	12 nos.
31.	Snip sheet metal curved nose	200 mm	12 nos.
32.	Anvil	100X200mm	1no.
33.	Stakes [different Types]	100mm	1 no each
34.	Tin smith	400mm	1 No.
35.	Wooden mallet /Nylon mallet	500 gm good finish	5 Nos.
36.	Round Punch	3mm,4mm,6mm	5 Nos. each
37.	Grover set	4mm forming	1 set
38.	Electrical drill portable drill with chuck and key,	Capacity 6.4 -12 mm capacity.	5 nos.
39.	Tape measuring graduation in mm	2 m	5nos.
40.	Screw driver, plastic handle,	6mm TIP length 100mm to 150mm	6nos.
41.	Screw driver, plastic handle, Flat tip	10mm TIP length 200mm & 250mm	6 nos. each
42.	Philips screw driver -	complete set in leather case	5 nos.
43.	Screw driver, plastic handle, Flat tip	handle 3mm TIP length 100mm to 150mm insulated	5 nos.
44.	Soldering iron exchangeable copper tip	65 watts	12 nos.
45.	Knife folded stainless steel -	150mm	12 nos.
46.	Tong tester (clamp on multi meter)	0-10-30 amps 0-500 v	5 nos.
47.	Voltmeter, AC/DC portable precision grade Digital Panel board type	0 to 500 volt	5nos.
48.	Ammeter, AC/DC portable precision grade Digital Panel board type	belt 0 to 5 amp	5nos.
49.	Ammeter, AC/DC portable precision grade Digital Panel board type	0 to 30 amp	5nos.
50.	Megger	1000v	5nos.
51.	Wattmeter multi-range up to	1 KW	1no.
52.	Multi meter digital type		5nos.
53.	Tenon saw	250 mm	5nos.
54.	Firmer chisel	6,12,25mm	2 nos.

55.	Rawal plug tool	6 mm	2 nos.
56.	K.W. meter	0 -1 K w	4 no.
57.	Fire extinguisher	Arrange all proper NOCs and equipment from municipal / competent authorities.	
58.	D.E spanner	6-32 mm	5 set
59.	Ring spanner	6 -32 mm	5 set
60.	Diagonal cutter	15 cm	5 nos.
61.	Service Oscillator		1 no.
62.	C.R.O Single beam	5 MHZ	2 nos.
63.	C.R.O Dual trace/ Double beam	60 MHZ	2 nos.
64.	A.F.O Oscillators		2 nos.
65.	Tong, Close mouth and pick up		1 no.
66.	Welding table for gas/Arc	1200x760 mm	1each
67.	Flaring tool set, single type for tube.	4.7mm to 16mm O.D	5 nos.
68.	Swaging tool, punch type, set of size for tube.	4.7mm to 16mm O.D	5sets
69.	Swaging tool, screw type with adaptor set of size for tube	4.7mm to 16mm O.D.	5sets
70.	Bending spring external type, for copper tube	3mm to 16mm DIA	5sets
71.	Pipe cutter miniature for copper tube	3mm to 16mm DIA	5 Nos.
72.	Pinch of tool, for copper tube,	6mm to 18mm DIA	5 Nos.
73.	Ratchet spanner .	6.4 sq.mm reversible	5 Nos.
74.	Capillary plug gauge		5 Nos.
75.	Pinch of pliers/crimping pliers tool	6mm - 18mm DIA	5 Nos.
76.	Piercing pliers & reversing valve with access fitting	6-18mm	5 Nos.
77.	Spanner double ended	4.7mm to 16mm	5sets
78.	Ring spanner off set	4.7mm to 16mm	5sets
79.	Wrench adjustable	length 150mm	5 Nos.
80.	Wrench adjustable	length 200mm	5 Nos.
81.	Wrench adjustable	length 250mm	5 Nos.
82.	Valve key handle[Treated as consumable]	- 4.7mm & 6.4mm sq.	5 Nos.
83.	Pressure gauge Digital type	diameter 63mm with recalibration set	5 Nos.

84.	Compound gauge, Digital type	diameter 63mm, with recalibration set screw, scale vacuum 76mm. Pressure 15 Kg/sq.cm	5 Nos.
85.	Service man thermometer in metal case	- 30 C to +110 ˚C	5 Nos.
86.	Scissor, gasket cutting stainless steel	length 25mm	5 Nos.
87.	L-Allen key	set size 1.5mm to 6.4mm	5 sets
88.	T-Allen key set	size 5/32" to 1/8"	5sets
89.	Pipe cutter with built in reamer and space cutter, for copper tube	3mm to 32mm	5 Nos.
90.	Pipe /Tube bender lever type	3-16 mm	1 no. each
91.	Spanner double ended	19mm to 31.8 mm	5nos.
92.	Pipe wrench	size 50mm to 150mm	5nos.
93.	Electronic leak detector for HFC,HC,R-22		5nos.
94.	Sling psychro meter mounted on aluminum back,	scale 10 ˚C to +50˚C	5nos.
95.	Lapping plate	250mm x 200mm	2nos.
96.	Hammer ball peen	450 gms	5nos.
97.	Puller 3 legged with flexible arm	300mm	5nos.
98.	Hand blower portable complete	1/10 HP	2nos.
99.	Spirit level precision metallic	200mm	2nos.
100.	Stop watch		2nos.
101.	Tap set with matching drills	3 mm to 16mm	3nos.
102.	Tap set with matching drills	¼'' to 5/8''	3nos.
103.	Refrigerant cylinder	2.5 Kg	3nos.
104.	Vernier caliper	length 250mm	2nos.
105.	Micrometer outside measurement	0 to 25mm	2nos.
106.	Heating kit with infrared bulb	(200 w capacity)	2nos.
107.	Plumbing hammer weight	200 gm	2nos.
108.	Multi meter analogue type		5nos.
109.	Tachometer digital, multi range	0 r m p to 3000 r m p. Portable small size in leather case	2nos.
110.	Micron vacuum gauge	capable of reading up to 20 microns	2nos.

111.	Sensor thermometer (digital)	-50 degree Celsius to150 degree 26Celsius	2nos.
112.	Fin straightened/fin comb.	With strong steel wire based combing on wood	3nos.
113.	Filler gauge	0.05 mm - 1 mm	3nos.
114.	Wire gauge metric and with worth	Steel plate embossing converse of British & Metric	2nos.
115.	Dial thermometer remote control, armored capillary dial	75mm - 50C to +50 C	3nos.
116.	Anemometer Digital type		1no.
117.	Compressors testers for small hermetic compressors	Fixed with electrical input/ output indicating facilities	2nos.
118.	Electrical accessories [Treated as consumable]	current and potential relays, start & run capacitors, PTCs overload protectors', relays contactors	As required
119.	Engineers square	150mm with 5' tolerance	5nos.
120.	Digital thermometer [Treated as consumable]	Graduated disc analogy type	1no.
121.	Temperature &Humidity recorder	Capacity to record 24 hrs record	1no.
122.	Electronic leak detector Digital type	Capable to detect of R134a,HC,R-22	2nos.
123.	Instrumentation screw driver set	100mm	5nos.
124.	Digital weighing machine	20 kgcapacity Accuracy 1 gm	1no.
125.	Recycling unit		1 no.
126.	Quick couplers/Self sealing coupler [Treated as consumable]	1/4 - 3/8"	2 pairs for each
127.	Schrader valve [Treated as consumable]		1 each
128.	Cylinder 134 a	5 kg	1 no.
129.	Recovery Cylinder-R-22	10 Kg Capacity	2 Nos.
130.	Recovery & recycling machine	Suitable for R-22	1 No
131.	Gas charging Station suitable for-22 along with 10 kg capacity digital weighing balance L.C 1 Gm	Vacuum pump High efficiency Blanking 50 Micron	1 No
C. GENERAL MACHINERY SHOP OUTFIT			
132.	Split phase induction motor	5 hp, 230 V	1 no.
133.	Capacitor start induction motor	5 Hp, 230 V	1 no.

134.	AC 3 Phase motor, 400/50 Hz	2 Hp	1 no.
135.	Star delta starter	2 hp	1 no.
136.	Auto Transformer starter	3 hp	1 no.
137.	D.O.L Starter	2 hp	1 no.
138.	Portable air - LPC brazing kit	2 kg. LPC cylinder, torches, houses, stand	1 no.
139.	Oxy-acetylene welding set complete	Cylinders, regulators welding torches with different nozzles	1 no.
140.	Refrigerator	165L carrying with HFC-134a, & HC	2 Each
141.	Frost free refrigerator	200L carrying with HC blend	2 nos.
142.	Three/four door refrigerator	300L carrying with HC R-600a	2 nos.
143.	Bench Drilling machine	20 mm capacity,200-	1 no.
144.	Grinding Machine	200mm, 3000 rpm, Double ended½ hp	1 no.
145.	Evacuating and refrigerant charging station, consist of a) Rotary two stage vacuum pump and motor (with gas ballast and anti such back) b) manifold with gauges and valves and capable of pulling vacuum up to 50 microns of Hg and with provision of connecting to a microns level vacuum gauge c) Graduated charging cylinder with provision for temperature correction and all necessary isolating valves II) Evacuating and charging station as above but fitted with weighing scale	(CAP. 2 kg. In lieu of (b) above and with accuracy of ±1g for charging hydrocarbons)	1 no.
146.	Two stage rotary vacuum pump	capacity approx. 60 -10rmp capable of evacuating to 50 microns of Hg and fitted with gas ballast, anti such back valve and single phase motor	1 no.
147.	Air compressor,	Two stage for oil - less dry air,	1 no.

		with rush proof tank assembly, heater and controls max. pr. 10kgs /sq.m Capacity 45m ltr. Motor 1 hp.	
148.	Reciprocating compressor	Provision of capacity control etc. for demonstration. Capacity 9000Kcal/hr. semi hermetic open type.	1 no.
149.	Dry N2 in cylinder	2 stage regular or commercial N 2 in cylinder with drier unit and 2 stage regular 7meter cube	1 no.
150.	A.C		5 nos.
151.	Recovery unit with cylinders	CFC& 134 a	1 each
152.	Heat pump	3000 Kcal/hr	1 no.
153.	Cassette Air conditioner	4500 kcal/hr with R-404.	1 no.
154.	De scaling pump set	with stainless steel impeller and housing complete with motor 1/2 hp and accessories	1 no.
155.	Small capacity shell and tube condenser	5 Ton with Cu tubing only	1 no.
156.	Fan coil unit	with water valves (2 & 3 way)	1 no.
157.	Shell and tube, DX chillers (small)	5 Ton with Cu tubing only	1 no.
158.	Circulating water pump (small)	0.5 H.P with stainless steel tank capacity 20 liters with inlet/ outlet provision.	1 no.
159.	Shell and tube type condenser	5 Ton	1 no.
160.	Rotary hermetic compressor	2 Ton	1 no.
161.	Screw compressor	5Ton	1 no.
162.	scroll compressor	1Ton	1 no.
163.	Bottle cooler visible	200 L carrying with HFC-134a& reciprocating compressor	1 no.
164.	Deep freezer	200 L carrying with HFC-134a& reciprocating compressor	1 no.
165.	Water cooler storage type	200 L carrying with HFC-134a& reciprocating compressor	1 no.
166.	Ice candy plant	2 ton with capacity to make 32 ice candy at a time with	1 no.

		Forma tray, stainless steel tank on trolley	
167.	Walk in cooler	3 Ton cap. with open type compressor, water cooled condenser, providing with PUF insulated room sealed proof size 8X8X10Ft maintain 0 - 5 degree centigrade.	1 no.
168.	Air-conditioning, direct and indirect water chiller.	Complete with all controls including humidity control capacity 15000Kcal/hr	1 no.
169.	Package A/C	7.5 ton capacity, Water cooled type with open type compressor reciprocating type	1 no.
170.	Car A.C components(full kit) a) Wobble plate compressor with mounting brackets. b) Serpentine Evaporator c) Parallel Flow Condenser d) Hoses, tubes, Receiver, Ex. valve. e) Electrical components & wiring Harness		1 Set
171.	CAR AC tutorial model		1 Set
172.	Desktop Computer	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch. Licensed Operating System and Antivirus compatible with trade related software.	1 no.
173.	LCD PROJECTOR / LED / LCD TV	Big Size	1 no.
174.	Laptop	Latest version	1 no.
175.	UPS		As required
D. WORKSHOP FURNITURE			
176.	Class room table	One table for each trainee size of 2.5 provisions with open rack. Frame square conduit of1".top	12 nos.

		V2" sun mica ply board	
177.	Work bench	2000 x1000 x 700 mm with ***2"*** pipe frame. Top with teak slab and fixing with3/4" good quality rubber sheet.	6 nos.
178.	Almirah	195 x90 x 48 cm outer sheet 20 SWG inner partition with four selves of 22Swg	4 nos.
179.	Lockers	195 x 90 x 48 set six locker in one structure	2 nos.
180.	Glass board portable	2.5'X4' with stand	2 nos.
181.	Instructor table	4'X2'X2.5' with steel tubular frame & sun mica top	1 no.
182.	Instructor chair	Standard	1 no.
183.	Computer table	Standard with drawers & self to accommodate UPS&CPU	1 no.
184.	Computer chair	metal based & metal wheel standard one	1 no.
185.	White board	4'X3' ferrous base sheet to hold magnetic duster with white finish surface.	1 no.
186.	Chart stand	6'X3' providing with hanging clip top & bottom plate	1 no.
187.	Stool		As required
188.	Book Self with glass panel		1 No.
189.	Storage rack		As required
190.	Storage shelf		As required
Note: - 1. Internet facility is desired to be provided in the class room.			

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्