

**MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION,  
MUMBAI -51**

|         |  |  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
|---------|--|--|---------|-------|------------|------------|--|--|---------|------------|-----------------|---------|----------|------------|------------|---|----------|-----------------|------|-------|-----|----|---|----------|--------------|--------|-------|-----|----|---|----------|--|---------|-------|-----|-----|--|--|-------|--|--|-----|-----|
| 1       | Name of Syllabus                       | <b>C.C.in Air Conditioning &amp; Refrigeration Mechanic<br/>(303104)</b>   |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 2       | Max. No's of Student                   | 25 students  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 3       | Duration                               | 6 Month  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 4       | Type                                   | Part Time  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 5       | No's Of Days / Week                    | 6 Days   |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 6       | No's Of Hours /Days                    | 4 Hrs  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 7       | Space Required                         | Workshop = 200 Sq feet<br><u>Class Room = 200 Sq feet</u><br>TOTAL = 400 Sq feet   |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 8       | Entry Qualification                    | VIII passed  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 9       | Objective Of Syllabus/<br>introduction | The Course will generally comprise of servicing of Air-Conditioner & Refrigerator. This will full-fill the long fault need of availability of lower grade Technician in this field.  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 10      | Employment Opportunity                 | A) Self- Employment :-<br>After completion of course, he can open service center.<br>B) Wage-Employment :-<br>Scope for employment in various companies.   |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 11      | Teacher's Qualification                | ITI/NCVT in RAC with 2 years experience.   |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 12      | Training System                        | <div>Training System Per Week</div> <table><tr><td>Theory</td><td>Practical</td><td>Total</td></tr><tr><td>6 Hours</td><td>18 Hours</td><td>24 Hours</td></tr></table>   |         |       |            |            |  |  | Theory  | Practical  | Total           | 6 Hours | 18 Hours | 24 Hours   |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| Theory  | Practical                              | Total  |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 6 Hours | 18 Hours                               | 24 Hours   |         |       |            |            |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 13      | Exam. System                           | <table><tr><td>Sr. No.</td><td>Paper Code</td><td>Name of Subject</td><td>TH/PR</td><td>Hours</td><td>Max. Marks</td><td>Min. Marks</td></tr><tr><td>1</td><td>30310411</td><td>AIR CONDITIONER</td><td>TH-I</td><td>3 hrs</td><td>100</td><td>35</td></tr><tr><td>2</td><td>30310421</td><td>REFRIGERATOR</td><td>PR - I</td><td>3 hrs</td><td>100</td><td>50</td></tr><tr><td>3</td><td>30310422</td><td>MAINTENANANCE AND REPAIRING OF AIR CONDITIONER</td><td>PR - II</td><td>6 hrs</td><td>200</td><td>100</td></tr><tr><td></td><td></td><td>TOTAL</td><td></td><td></td><td>400</td><td>185</td></tr></table> |         |       |            |            |  |  | Sr. No. | Paper Code | Name of Subject | TH/PR   | Hours    | Max. Marks | Min. Marks | 1 | 30310411 | AIR CONDITIONER | TH-I | 3 hrs | 100 | 35 | 2 | 30310421 | REFRIGERATOR | PR - I | 3 hrs | 100 | 50 | 3 | 30310422 | MAINTENANANCE AND REPAIRING OF AIR CONDITIONER | PR - II | 6 hrs | 200 | 100 |  |  | TOTAL |  |  | 400 | 185 |
| Sr. No. | Paper Code                             | Name of Subject  | TH/PR   | Hours | Max. Marks | Min. Marks |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 1       | 30310411                               | AIR CONDITIONER  | TH-I    | 3 hrs | 100        | 35         |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 2       | 30310421                               | REFRIGERATOR   | PR - I  | 3 hrs | 100        | 50         |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
| 3       | 30310422                               | MAINTENANANCE AND REPAIRING OF AIR CONDITIONER   | PR - II | 6 hrs | 200        | 100        |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |
|         |  | TOTAL  |         |       | 400        | 185        |  |  |         |            |                 |         |          |            |            |   |          |                 |      |       |     |    |   |          |              |        |       |     |    |   |          |  |         |       |     |     |  |  |       |  |  |     |     |

| <b>Sr. No.</b> | <b>THEORY - I - AIR CONDITIONER</b>   |
|----------------|---|
| 1              | Trade introduction & History Workshop Safety & Introduction Heat & Temperature. Work, Power, energy. Symbols of trade.  |
| 2              | General Tools & specification. Refrigeration tools & specification. Heat & their types conversion. Addition & Subtraction of fraction.  |
| 3              | Mass volume & weight & its connection, multiplication & Division of fraction. Free hand sketching tools.  |
| 4              | General WD tools-use & specification Heat transferring methods & problems square tools of diff Quantities. Free hand sketching.   |
| 5              | Basic Electrician current, Voltage resistance etc. Insulating Materials. Free hand sketching solids.  |
| 6              | Diff. type of raw material used. Refrigeration equipments & specification. Conversation of diff guratition. Free hand sketching &” Hallow bodies.   |
| 7              | Absorption system and its functions Advantage & Disadvantage of cycle Types of compressor & Functions pressure & its conversion.  |
| 8              | Open type compressor construction& its function. Boiling, Freezing, condensing evaporation, vaporization  |
| 9              | Sealed compressor construction Advantage & disadvantages. Free hand sketching of compressor parts.  |
| 10             | Condenser & its types. Construction of each types of condensers. Air cooled condenser water cooled condenser. Free hand sketching of Diff condensers.   |
| 11             | Motor controls. Relay, over load, capacitor. High pressure, low pressure & oil pressure controls. Temperature controls. Free hand sketching of diff type of controls.                                     |
| 12             | Pressure and Temperature controls. Pressure Guages and Thermometers. Solenoid valve press relief valve. Heat and its effects on solid and liquid gases. Freehand sketching different controls and valves. |
| 13             | Liquid controlling devices capillary, Hand valve Expansion valve. Expansion valve.  |
| 14             | Thermostatic Exp. Valve. Automatic Exp. Valve. Float valves Ohms Low basic electricity. Single phase and three hose supply.   |
| 15             | Evaporator types Dry and flooded types evaporator. Air cooling, Liquid cooling. Free hand sketching of different types of evaporators.  |
| 16             | Evaporator construction. Air cooled. Liquid cooled. Lubrication. Conversion of temperature. And pressure.   |
| 17             | Oil and their properties. Refrigerants and their properties boyles and Charles laws. Free hand sketching of refrigeration cycles.   |
| 18             | Refrigerant transferring. Refrigerant handling. Problems of boyles and charls laws. Trade drawing practice.   |
| 19             | Many fold gauge. Vacuum & vacuum pump Metals & non metals relevant to trade. Symbols of trade.  |
| 20             | Vacuuming method. Pressure testing methods. Leakage testing methods. Gas charging methods. Free hand sketching of trade drawings.   |
| 21             | Air – conditioning. Air – conditioner construction & its function. Problems on heat. Free hand sketching trade drawing.   |
| 22             | Air-filter & Air cycle. Air distribution & psychometric. Ducts psychyometers. Free hand sketching & Equipments.   |
| 23             | Dry bulb temp & wet bulb temp. Humidity, Dew point temperature Air –velocity of purification..dehumidification. Cooling load-calculation.   |
| 24             | Modern Air-Conditioner. Advantage & Disadvantage. Trouble shooting.   |

## Practical – I - REFRIGERATOR

1. To study series circuit & Parallel circuit.
2. To study use of electrical tester, multimeter, ammeter, voltmeter.
3. To study use of controls in air conditioning equipments like window unit, refrigerator etc.
4. To study Refrigeration Mechanic tool kits & use of each tool.
5. To test different controls in air conditioning equipments.
6. To study wiring diagram and working principle of electrical.
7. To study compressor unit.
8. To study wiring diagram for window type unit.
9. To study wiring diagram for refring erator unit.
10. To study window unit assembly.
11. To study refrigerator unit assembly.
12. To study method of leakage test used for air condoning unit.
13. To study method o leakage test used for refrigerator unit.
14. To study method used for gas charging the air conditioning unit.
15. To study method of soldering, brazing and electric are welding.
16. To study different types of tools used in air conditioning.
17. To study method of fault finding in air conditioning unit.

## PRACTICAL – II - MAINTENACE AND REPAIRING OF AIR CONDITIONER

|    |   |
|----|---|
| 1  | Repair and replace liquid controls, flush and refit capillary tube. Repair and replace hand valve. Study the function of Exp. Valve Repair and refit expansion valve. Pump down the refrigeration system. Measuring current and voltage single and Three phase supplies.  |
| 2  | Connect voltmeter in single phase supply. Connect ammeter in single and three phase. Refrigerator wiring practice removing and Refitting of different component of refrigeration system.  |
| 3  | Servicing of different types of evaporator. Repair and refitting evaporators. Test leakage in evaporator flush and remove oil from evaporator study. The function of bourdon tube gauge.  |
| 4  | Vacummising the refrigeration system. Leak testing in refrigeration system, Refrigerants system. Operation and testing refrigeration system   |
| 5  | Remove and replace oil of compressor. Transfer of refrigerants from starting cylinder and to service cylinder study the color code of refrigerants handling of different type of refrigerants Remove refrigerant from the system check the weight of refrigerant Repair leakage cylinder valves. Use of vacuum pump. Use of charging station etc. |
| 6  | Vacuums the refrigeration system Leakages test in refrigeration system.(charge refrigerant in system) operate & test the refrigeration system Replace diff part of refrigerator. Installation & care of refrigerators.  |
| 7  | Air – conditioner system pressuring. Air – conditioner system leak testing checking diff Air – conditioner parts. Repairing & replacing.  |
| 8  | Air –conditioner servicing. Air-conditioner wiring. Air – conditioner repairs & fitting air – conditioner fan, motor testing & wiring.  |
| 9  | Air –conditioner vacuuming. Air conditioner Gas charging. Air conditioner leakage tasting. Air-conditioner operation & testing. Air- conditioner installing & inspecting.   |
| 10 | Use of sling psychmmeter. Study the psychmmeter chart. Checking of Air-Velocity. Trouble shooting.  |
| 11 | Modern Air-Conditioner checking . Air-conditioner testing. Air-conditioner servicing. Air-conditioner repairing. Visits to various Industries of Air-Conditioner plants.  |

## LIST OF EQUIPMENTS

### Pr. No. 1

#### SERIES & PARALLEL CIRCUITS :

|    |  |        |
|----|--|--------|
| 1. | D.C. Ampere-meter P.M.M.C. Type (8-14) | 3 Nos. |
| 2. | D.C. Voltmeter P.M.M.C. Type (0-30V)   | 3 "    |
| 3. | Multimeter (Std. Size)                 | 3 "    |
| 4. | A.C. Ampere-meter M.I. Type (0-1A)     | 3 "    |
| 5. | A.C. Ampere-meter M.I. Type (0-30A)    | 3 "    |
| 6. | A.C. Voltmeter M.I. Type (0-300V)      | 3 "    |
| 7. | A.C. Voltmeter M.I. Type (0-100V)      | 3 "    |
| 8. | A.C. Ampere-meter M.M.I. Type (0-15A)  | 1 No.  |

|                   |                         |        |
|-------------------|-------------------------|--------|
| <u>Pr. No. 2:</u> | Noon Tester (100v-500v) | 6 Nos. |
|-------------------|-------------------------|--------|

|        |   |       |
|--------|---|-------|
| Pr. 9. | Welding Transformer & necessary accessories | 1 No. |
|--------|---|-------|

### No. 3:

|     |                            |             |        |
|-----|----------------------------|-------------|--------|
| 10. | Electric Soldering Iron    | 240V / 65W  | 6 Nos. |
| 11. | ----- do -----             | 240V / 125W | 6 Nos. |
| 12. | Brazing unit complete set. |             | 1 Set  |

|            |                        |       |
|------------|------------------------|-------|
| Pr. No. 4: | 13. Megger 500V / 200M | 1 No. |
|------------|------------------------|-------|

#### Other Tools & Equipments :

|    |                    |        |
|----|--------------------|--------|
| 1. | Tube cutter        | 2 Nos. |
| 2. | Pressure gauge     | 2 "    |
| 3. | Gas Leak Detector. | 1 No.  |
| 4. | Hand Valve         | 2 Nos. |
| 5. | Bending tools      | 2 Nos. |

### Equipment

|    |  |        |
|----|--|--------|
| 1. | Refrigerator                                   | 1 No.  |
| 2. | Air Conditioner                                | 2 Nos. |
| 3. | Water Cooler                                   | 1 No.  |
| 4. | Open compressors with motor                    | 1 No.  |
| 5. | Cut-section model of Mermitically sealed unit. | 1 No.  |

Other Materials / Equipments :-

- |   |        |
|---|--------|
| 1. Motor starting & overload relay                          |        |
| 2. Fin type air-cooled condenser (Radiator)                 | 2 Nos. |
| 3. Auto-variac (0-265Volts / 8A)                            | 2 Nos. |
| 4. D.C. power supplier 30V/1A                               | 4 Nos. |
| 5. Oxygen cylinder  |        |
| 6. Acetylene cylinder or Gas welding set<br>LP Gas cylinder | 1 No.  |
| 7. Gas charging set   |        |
| 8. Vacuum pump etc.   |        |
| 9. Thermostat   |        |
| 10. Cut-out   |        |
| 11. Relays  |        |
| 12. Expansion valve, Copper tubes of varies diameter        |        |

**BOOKS**

|                                    |   |                         |
|------------------------------------|---|-------------------------|
| Refrigeration & Air-conditioning   | - | WF Steder               |
| Mechanical Refrigeration           | - | Spark & Dillio          |
| Principle of Air-conditioning      | - | V Paul Lang             |
| Refrigeration Servicing            | - | Paul Galbr              |
| Principle of Refrigeration         | - | Warren Plarch           |
| Basic Air-conditioning             | - | G Schwitzer & A. Ebeing |
| Hand Book of Refrigeration         |   |                         |
| Hand Book of Air-conditioning      |   |                         |
| Principles of Refrigeration        | - | Dossat                  |
| Also see books in Marathi & Hindi. |   |                         |

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