GOVERNMENT OF TAMILNADU
DIRECTORATE OF TECHNICAL EDUCATION, CHENNAI
STATE PROJECT COORDINATION UNIT
(Established under Canada India Institutional Cooperation Project)

CURRICULUM

Course Name	**AC, REFRIGERATOR AND WASHING MACHINE SERVICING**
Course Code	ME/2020/002
Course Duration	120 Hours
Minimum Eligibility Criteria	ITI/10th/+2/Diploma/Graduates
Pre-requisites (if any)	-
Course Objectives	Training module has been designed for the participants to • Learn the fundamental principles and different methods of Refrigeration and Air Conditioning. • Study the various refrigeration cycles and evaluate the performance using Mollier charts and refrigerant tables. • Study the different refrigerants with respect to properties, applications and environmental concern. • Understand the basic air conditioning processes on psychometric charts, cooling load calculations for human comfort, its applications and industrial air conditioning. • Study the various equipment-operating principles and safety controls employed in refrigeration and air conditioning system. • Study the different types of washing machines and functions of sensor system.
Course Outcomes	At the end of training, the participants will be able to • Explain the concept of air refrigeration system and the components of refrigeration equipments. • Illustrate the working of VCR, VAR and cryogenic refrigeration system with problems on VCR systems. • Outline the refrigeration flow controls, refrigerants, lubricants and applications of refrigeration system. • Explain the properties of humid air with the help of psychometric chart and comfort air-conditioning. • Diagnose and carry out the fault and service of domestic Refrigerator and Air Conditioner • Explain the working principle of manual and semi-automatic machines.
Expected Job Roles	Domestic Refrigerator, Air Conditioners and Washing Machine Technician.

TEACHING AND SCHEME OF EXAMINATION						
Course Code	Course Name	Hours		Assessment Marks		Duration of the Examination
				Min	Max	
ME/2020/002	**AC, REFRIGERATOR AND WASHING MACHINE SERVICING**	Theory	50	10	20	3 Hours
		Practical	70	40	80	
		Total	120	50	100	

ME/2020/002 - AC, REFRIGERATOR ANDWASHING MACHINE SERVICING

DETAILED SYLLABUS

Unit No.	Modules	No. of Hours	
		Theory	Practical
I	**Introduction to electricity**:	**10 Hours**	
1.1	Definition and until of current – voltage – power – energy – resistance. Series and parallel circuits – ammeter – voltmeter – wattmeter – energy meter – merger.	05	
1.2	Functions of capacitors – fuse – trippers – cutout-tools – materials. Rules – safety precautions – symbols.		
1.3	Understanding – purpose – general purpose tools – measuring instrument working with such tools. Understanding R & AC tools, pipes.		
1.4	**Practical:** ➢ Identification of Electric circuit board. ➢ Handling of electrical equipments.		05
II	**Refrigerants and types:**	**40 Hours**	
2.1	Primary and secondary refrigerants – types of refrigerants – applications – CFCs and ozone problem – ECO – friendly refrigerants – insulating material.	20	
2.2	Types of refrigeration ice refrigeration – evaporative refrigeration – air expansion refrigeration – throttling refrigeration – steam – jet refrigeration, thermoelectric refrigeration - (sample explanation).		
2.3	Vapour compression refrigeration system parts and their functions – demo of test unit at lab. Vapour absorption system of refrigeration – Electrolux refrigeration – advantages – disadvantages – descriptions of domestic.		

2.4	Compressor functions – air cooled – water cooled – tube – in tube – shell and tube – shell and coil condensers – cooling towers – natural draft – mechanical draft – Evaporators – functions types – flooded type and dry type –tube in tube in tube –tank type – shell and tube – shell and coil evaporators.		
2.5	**Practical:** ➢ Dismantle, identify the components, service and assemble of the following a) Hermetically Sealed Compressor b) Domestic Refrigerator ➢ Exercise on tube cutting, Swaging, flaring and bending ➢ Safety Practices and Demonstration of Refrigeration and Air Conditioning equipments ➢ 5S and Maintenance Procedures of R & AC Equipments		20
III	**Expansion Devices** :	**10 Hours**	
3.1	functions – capacity tube – automatic – thermostatic valves – purposes of thermostatic functions – drier – Stainer – accumulator, liquid receiver – defrosting purpose and methods.	05	
3.2	Commercial refrigerating units, bottle cooler – deep freeze – water cooler – safety ice cream unit – plate ice unit – ice candy unit – combination cooler – general maintenance procedure.		
3.3	**Practical:** ➢ Identify the fault and service the expanses devices ➢ Dismantle, identify the components, service and assemble the Water Cooler / Bottle Cooler		05
IV	**Air Conditioning:**	**30 Hours**	
4.1	Air – condition – factors controlled in air- conditioning types – window type AC – split AC system – package AC system – maintenance procedure – heat load calculation.	15	
4.2	Centralized AC plant – direct expansion system – water cooled system – Air handling units – air ducts – installation and maintenance, procedure.		
4.3	Electrical parts – relay, running capacitors – overload protector – relay types – high pressure and low pressure cut out.		
4.4	Lubrication oil – properties and types – oil charging – leak testing methods gas charging procedure – general troubles in R & AC System.		

4.5	**Practical:** ➢ Dismantle, identify the components, service and assemble of the following a) Window Type Air Conditioner b) Spilt Type Air Conditioner ➢ Gas charging process with equipment. ➢ Trace the Refrigerant leak testing		15
V	**Washing machine:**	**30 Hours**	
5.1	Washing M/c: different types of machines, washing techniques, parts of manual, semi automatic and fully automatic machines,	15	
5.2	basic working principle of manual, semi automatic and fully automatic machines, study the working of motors, different types of timers, power supply circuits.		
5.3	**Practical:** ➢ Dismantle, identify the components, service and assemble of the Washing machine ➢ Trace the fault and service the washing machine		15
	Total Theory and Practical hours	**60**	**60**
	Total hours	**120**	

HARDWARE REQUIREMENT

S. NO.	LIST OF TOOLS /EQUIPMENTS
1.	Working models of the following with Arrangements for conducting tests • Vapour Compression Refrigerator test rig • Domestic Refrigerator • Water cooler • Window Air Conditioner • Split Air Conditioner • Cooling tower • Manual washing machine • Semi and fully automatic washing machine
2.	Working model of the following to conduct Experiments • Thermostat units • Cut off units • Thermostatic expansion valve unit • Automatic expansion valve unit • Sealed compressor with experimental setup • Sensor board.

3.	Tools: • Mechanics tool set • Tube cutter • Tube bender type • Tube bender spring • Swaging tool • Flaring block • Flaring nut • Pinching tool • Capillary tube testing gauge • Blow Lamp • Copper Tube
4.	SERVICE TOOLS: • Gas cylinder with receiver valve and key • Charging System • Blow lamp • Stem key • Spring remover • Service valve • 't' connector • High pressure gauge • Compound gauge • Leak detector • Soldering and Brazing kit. • Multimeters, etc. • Washing Machine Break / Bearing Removing Tools • Washing Machine Tub nut Spanner Wrench • Washing Machine Inner Tub spring removal tool • Coupler Repair Tool • Spin Hub Spanner Wrench • Seal Installation Tool Kit, etc.,

REFERENCE BOOKS

S. NO.	NAME OF THE BOOK	AUTHOR	PUBLISHER
01	Refrigeration and Air Conditioning	P.L.Ballaney	Khanna Publishers, New Delhi., 15th Edition, 2009.
02	Refrigeration and Air Conditioning	V.K.Jain	S.Chand & Co, New Delhi. 6th Edition , 2009.
03	A Course in Refrigeration and AirConditioning	Domkundwar	Dhanpat Raj &Co Publishers, New Delhi. 8th Edition, 2009.

04	Principles of refrigeration	Dossat	Pearson Education, New Delhi, 2002.
05	Home Refrigeration and AirConditioning	Audel	Theo. Audel &Co., Publishers, NewYork, 1998.
06	Refrigeration and AirConditioning	Dr.Sadhu singh	Khanna Publishing
07	Basic Refrigeration and Air Conditioning	PN.Ananthanarayan	McGraw Hill Education (India) Pvt.Ltd, New Delhi
08	Practical Refrigeration and Air Conditioning	Dr.M.Adhithiyan Dr.S.C.Laroiya	New Age International Pvt.Ltd, Chennai

ASSESSMENT AND CERTIFICATION

S. No.	Criteria for Assessment
1.	A trainee will be assessed based on the performance in End Examination for Theory and Practical conducted internally in the Project Polytechnic College for a duration of 3 hours
2.	A trainee must have 75% of attendance to appear for End examination in Theory and Practical.
3.	The assessment for theory part will be based on the marks scored in the end examination on the knowledge bank of questions (1 word/objective type questions)
4.	The assessment for practical part will be based on the marks scored in the end examination conducted by the Project Polytechnic and assessed by the Examiners approved by Strategic Plan Implementation Committee (SPIC) of the project polytechnic.
5.	The passing criteria for successful completion of training is every trainee should score 50% of marks in theory and practical examination.
6.	On successful completion of training , Certificate will be issued to the participants by the Directorate of Technical Education through the Project Polytechnics.

END EXAMINATION

ALLOCATION OF MARKS

S.NO	Description	Max.Marks
1.	Theory Examination	20
2.	Practical Examination	
	a) Aim and Procedure	20
	b)Demonstration / Execution	25
	c) Result & Viva Voce	15
	d)Record	20
	Total Marks	**100**

THEORY MODEL QUESTION PAPER

ME/2020/002 - AC, REFRIGERATOR AND WASHING MACHINE SERVICING

(Maximum Marks: 20)

(N.B: Answer any **Twenty** questions) **20x1= 20 Marks**

1. Write is the purpose of Voltmeter.
2. Write any two Functions of capacitors.
3. What are the insulating materials used in Refrigerator.
4. Write the purpose of Condenser.
5. Write the purpose of Compressor.
6. Write the purpose of Evaporator.
7. Write the purpose of Capillary tube.
8. Write any two types of condenser.
9. Write any two types of Compressor.
10. Write any two types of expansion device.
11. What is the purpose of thermostatic switch?
12. Write any two types of Air conditioning system.
13. What is the purpose of over load protector?
14. How to trace the Refrigerant leak testing
15. Write any two types of motors used in Refrigerator.
16. Write any two types of washing Machine.
17. What is the purpose of timers used in washing machine?
18. How to trace the fault of washing machine?
19. Write any two types of draining system in washing machine.
20. How to use leak detector?
21. Write the purpose of Multi meter.
22. How to use Capillary tube testing gauge?
23. Write the purpose of cooling tower.
24. Write the purpose of Capacitor.
25. Write the purpose of relay.