

Curriculum of Matric Tech

HVACR

GRADE X

2020



GOVERNMENT OF PAKISTAN

Ministry Of Federal Education and Professional Training, ISLAMABAD

In collaboration with

National Vocational and Technical Training Commission

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Introduction

INTRODUCTION

Pakistan is a developing country with 5th largest population in the world. 64% of our population is below 30 years of age which makes it second youngest country in South Asia. This “youth bulge” provides unique challenges as well as opportunities for the country’s social and economic development. The only remedy is to develop youth of Pakistan through education and training. To control the increasing unemployment, promoting entrepreneurship (self-employment), alleviate poverty and provide skilled manpower for industrial/economic growth, The Govt. of Pakistan has decided to introduce Technical Scheme at Secondary School Certificate (SSC) Level. For this purpose a stream of technical subjects has been selected including HVACR as one of the elective subjects to be taught at that level.

HVACR is a sub discipline of Mechanical Engineering that makes it possible for us to live comfortably in air-conditioned spaces and enjoy a wide variety of foods. HVACR technology is still growing and will continue to grow far into the future. New technicians will need to be aware of the fact that change is inevitable which requires a complete look at the industry.

The curriculum of HVACR is designed to produce middle level human resources in the form of skilled work force equipped with knowledge, skills and attitudes related to the field of HVACR so as to meet the demand of such workforce in the country and abroad to contribute in the national streamline of poverty reduction of Pakistan.

HVACR Technician is a trade person specializing in the installation, repairing and maintenance of Heating Ventilation , Air conditioning and Refrigeration system and the related equipment. HVACR Technician may seek a job or become an entrepreneur. HVACR Technicians work in a variety of settings, including homes, industries, schools, hotels, workshops and hospitals-any type of facility that needs a HVACR system to function.

Working conditions for a HVACR technician may vary by specialization. Generally an HVACR Technician’s work is physically demanding such as climbing ladders and lifting tools and supplies. Occasionally an HVACR technician must work in a cramped space or on scaffolding, and may frequently be bending, or kneeling, to make / connections in awkward locations. He may spend much of their days in outdoor or semi-outdoor noisy and dirty worksites. He may be exposed to the heat, dust, and noise of an industrial plant. He may be called to work in all kinds of adverse weather to make emergency repairs.

Rationale

The Trade of HVACR is a profession that is increasingly getting attention in Pakistan because of the population growth and the resultant immense opportunities in the field not only among the youth, seeking to enter the industry, but also among the adults who wish to polish their skills to develop a career out of it.

On completing the curriculum/course, students should have acquired a set of knowledge and concepts, and have developed a range of technical, personal, interpersonal, organizational and generic skills, that can be applied in various contexts, both within and related to trade of HVACR. Furthermore, this course will stimulate the learners towards entrepreneurship in the industry.

Within this qualification relating to HVACR Technician's interventions in schools, there are important interventions that integrated within school settings. The purpose of this qualification is to strengthen connections between schools and trade, and drawing on the concept of the socio technical network, theories the interactions between the relevant market and school contexts.

HVACR Technician, Matric Tech (9th&10th)

Aims and Objectives

The specific objectives of developing these qualifications are as under:

- Provide students with a smooth transition to work.
- Develops job-readiness & enhance students' trade-specific employable skills and provide opportunities for the development of new skills.
- Provide students with the opportunity to obtain from Level II -IV technical training certification or equivalent in a given trade.
- To set high profile standard professions for the industry to generate standard outputs.
- To validate an individual skill, knowledge and understanding regarding relevant occupations.
- Provide flexible pathways and progressions in training and assessment field.

Objectives

After completing this, the students will be able to:

- Perform routine skilled and semi-skilled tasks to carry out a variety of HVACR installations
- Repair of equipment, facilities and system.
- Perform maintenance jobs and assist other team members in the assigned preventive maintenance.
- Perform their duties in an efficient manner
- Establish a standardized and sustainable system of Refrigeration and Air conditioning training in the institutes / colleges / schools of Pakistan.
- Improve the professional competence of Refrigeration and Air conditioning industr

Grade - X

Chapter 1					
Domestic HVACR Units 40 Periods 16 =(T), 24 = (P)					
Theme/Content	Student Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Refrigerator	The student will be able to: <ul style="list-style-type: none"> • define refrigerator • understand functions of refrigerator • learn construction of refrigerator • describe the types of refrigerator • learn parts of refrigerator • understand electric wiring diagram of refrigerator 	<ul style="list-style-type: none"> • Draw electrical wiring diagram • Identify different parts of refrigerator • Check working of the refrigerator 	Periods (T) Periods(P)	Refrigerator and its parts, AVO meter, Tool kit	Classroom/ Labs
Water Cooler	<ul style="list-style-type: none"> • define water cooler • learn function of water cooler • understand construction of water cooler • describe the types of water cooler • learn parts of water cooler • understand electric wiring diagram of water cooler 	<ul style="list-style-type: none"> • Draw electrical wiring diagram of water cooler • Identify different parts of water cooler system • Check working of the Water Cooler 	Periods (T) Periods(P)	Water Cooler and its parts, AVO meter, Tool Kit	Classroom/ Labs
Deep Freezer	<ul style="list-style-type: none"> • define deep freezer • learn functions of deep freezer • understand construction of deep freezer • describe the types of deep freezer • learn parts of deep freezer • understand electric wiring diagram of deep freezer 	<ul style="list-style-type: none"> • Draw electrical wiring diagram of deep freezer • Identify different parts of deep freezer • Check working of the deep freezer 	Periods (T) Periods(P)	Deep Freezer and its parts, Clamp meter, Tool kit.	Classroom/ Labs

Air Conditioner	<ul style="list-style-type: none"> define air conditioner types of air conditioner understand function of window air conditioner understand construction of window air conditioner understand electrical wiring diagram of window air conditioner learn working of split air conditioner construction of split air conditioner understand electrical wiring diagram of split air conditioner understand pump down of split air conditioner. 	<ul style="list-style-type: none"> Draw electrical wiring diagram of window Air conditioner. Identify different parts of window air conditioner. Check working of the window air conditioner. Draw electrical wiring diagram of Split Air conditioner. Identify different parts of split air conditioner. Check working of the split air conditioner. Perform pump down of the split air conditioner. 	Periods (T) Periods(P)	Air Conditioner and its parts, AVO meter, Clamp on meter, Tool Kit	Classroom/ Labs
Maintenance of Domestic HVACR System	<ul style="list-style-type: none"> understand servicing of domestic HVACR system understand gas welding process understand leakage testing techniques in domestic HVACR system understand evacuation process in domestic HVACR system understand gas charging process in domestic HVACR system 	<ul style="list-style-type: none"> Perform servicing of refrigerator Perform servicing of air conditioner Detect leakage in a refrigeration unit Perform vacuum of refrigeration unit Charge refrigerant in a refrigeration unit 	Periods (T) Periods(P)	Refrigerator Air Conditioner	Classroom/ Labs

Chapter 2					
Commercial HVACR Units 24 Periods 8 =(T), 16 = (P)					
Theme/Content	Student Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Commercial Air Conditioning System	The student will be able to: <ul style="list-style-type: none"> define commercial air conditioning system learn the types of commercial air conditioning system know about the components of 	<ul style="list-style-type: none"> Identify the types of commercial air conditioning system Prepare visit report of HVACR Plant Identify the types of commercial air conditioning system 	Periods (T) Periods(P)	stationary	Classroom/ Labs

	commercial air conditioning system <ul style="list-style-type: none"> understand the importance of commercial air conditioning system understand the difference between domestic and commercial air conditioning system 	<ul style="list-style-type: none"> Identify the components of commercial air conditioning system 			
Commercial Refrigeration System	<ul style="list-style-type: none"> define commercial refrigeration system learn the types of commercial refrigeration system know about the components of commercial refrigeration system understand the importance of commercial refrigeration system understand the difference between domestic and commercial refrigeration system 	<ul style="list-style-type: none"> Prepare visit report of refrigeration Plant and record the readings Identify the types of commercial refrigeration system Match the observed readings of equipment with the Log sheet Identify the types of commercial refrigeration system Identify the components of commercial refrigeration system 	Periods (T) Periods(P)	Resistor, Capacitor, Battery, Multimeter	Classroom/ Labs

Chapter 3

Central Air Conditioning System

40 Periods 16 =(T), 24 = (P)

Theme/Content	Student Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Central Air Conditioning System	The student will be able to: <ul style="list-style-type: none"> define central air conditioning system learn the types of central air conditioning system know about the components of central air conditioning system understand the importance of central air conditioning system understand the working 	<ul style="list-style-type: none"> Identify types of central air conditioning system Identify the components of central air conditioning system Prepare visit report of refrigeration Plant and record the readings Match the observed readings of equipment with the Log sheet Enlist the types of central air conditioning system 	Periods (T) Periods(P)		Classroom/ Labs

	principles of central air conditioning system				
Maintenance and servicing	<ul style="list-style-type: none"> know about good servicing practices understand maintenance manual understand the importance of preventive maintenance and servicing know about techniques of diagnosing and troubleshooting of central air conditioning system 	<ul style="list-style-type: none"> Select tools, equipment and related accessories according to job requirements Prepare Schedule for maintenance Perform preventive maintenance as per manual Prepare Trouble shooting chart 	Periods (T) Periods(P)		Classroom/ Labs

Chapter 4

Preparation and Estimation

30 Periods 10 =(T), 20 = (P)

Theme/Content	Student Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Planning and Estimation	<ul style="list-style-type: none"> plan the work as per drawing / diagram understand the importance of estimation learn list preparation of materials as per job specification and drawing learn calculate cost of materials learn calculation of labour cost learn calculation of time (hrs) estimation for completion of the work present the cost estimate to the client or supervisor 	<ul style="list-style-type: none"> Interpret the drawing Perform material estimation as per drawing Calculate labour cost as per description Calculate time (hrs) estimation for completion of the work Prepare complete estimation for the client/supervisor 	Periods (T) Periods(P)	Resistor, Capacitor, Battery, Multimeter	Classroom/ Labs

Chapter 5

Maintenance and Servicing

36 Periods 12 =(T), 24 = (P)

Theme/Content	Student Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Maintenance of HVACR Equipment	The students will be able to: <ul style="list-style-type: none"> define maintenance understand importance of maintenance understand types of maintenance understand the maintenance schedule learn appropriate tools, & equipment for required maintenance 	<ul style="list-style-type: none"> Select the required tools and equipment for maintenance Enlist the types of maintenance Enlist the maintenance schedule Carryout the desired maintenance 	Periods (T) Periods(P)		Classroom/ Labs
Servicing of HVACR Equipment	<ul style="list-style-type: none"> define servicing understand importance of servicing understand the servicing schedule learn relevant tools, & equipment for required servicing follow the service schedule as per manual 	<ul style="list-style-type: none"> Select the relevant tools and equipment for servicing Interpret manual for servicing schedule Perform servicing schedule as per manual 	Periods (T) Periods(P)	Resistor, Capacitor, Battery, Multimeter	Classroom/ Labs

Chapter 6

Entrepreneurship

12 Period 04 (T) 08 (P)

Themes	Students' Learning Outcomes	Activities	Duration	Tools	Workplace
Introduction to Entrepreneurship	The students will be able to: <ul style="list-style-type: none"> define entrepreneurship know key concepts of entrepreneurship 	<ul style="list-style-type: none"> Group Presentation on entrepreneurship A session with guest speaker (entrepreneur) 	Periods (T) Periods(P)		
Introduction with Tour Guide Business.	<ul style="list-style-type: none"> learn about tour guide role in tourism business learn how to start your own business at local level 	<ul style="list-style-type: none"> Group Discussion Mockup activity on “how to start a business” 	Periods (T) Periods(P)		

Assessment and Evaluation

Assessment is the practice of collecting evidence of student learning. It aims at improving learning and teaching as well as recognizing the achievement of students. It determines students' progression through their learning experiences and enables them to demonstrate that they have achieved the intended learning outcomes. The assessment is aligned with curriculum aims, design and learning processes.

Evaluation is an integral part of teaching-learning process. It involves gathering information through various assessment techniques, making valuable judgment and sound decisions. Assessment provides information and teaching about students' achievement in relation to learning objectives. With this information, the teacher makes informed decisions about what should be done to enhance the learning of students or to improve teaching methods. Assessment must be:

- mainly open-ended, allowing for discussion and revision of new understanding.
- tolerant of divergent thinking of students and promote the notion of no "one right answer".
- presented in alternative mode, not just paper-and-pencil responses to limiting questions.
- designed to foster analysis, comparison, generalization, prediction, and modification according to the grade and development level.
- capable of promoting collaboration and team effort in demonstration of competence.
- ongoing and cumulative, showing growth over time.

Formative (Internal) Assessment

Internal assessment refers to the assessment practices employed as part of the learning and teaching process. It is an ongoing process throughout the session and uses Test — Feedback — Adjust cycle repeatedly to improve students' performance and efficiency in learning and teaching. In designing internal assessment for the subject, teachers should maintain a proper balance between the formative and summative functions of assessment. It should be comprehensive to cover all the objectives as per curriculum. A diversity of assessment modes should be adopted so that students are given opportunities to develop and demonstrate the full range of learning outcomes of the curriculum, including those of knowledge, skills, values and attitudes.

Methods for Internal/Formative Assessment

Following tasks can help in formative assessment.

- Assignments
- Quizzes
- Tests
- Group discussions
- Oral/multimedia presentations
- Worksheets
- Online interactive activities
- Role play
- Demonstration
- Practical exercises

Feedback on students' work in all the above tasks must be prompt, effective, and efficient assessment should have questions setting that specifically help in finding out knowledge, understanding and skills.

Summative /External Assessment

Summative assessment will be managed by concerned Board of Intermediate and Secondary Education. It will be composed of two parts.

1) Theory Assessment /Written examination: The theory examination is suggested to consist of a wide variety of questions. Its overall weight age should be 40 %. It should be based on the curriculum rather than textbook. The assessment should be designed to examine the candidate's understanding of the whole syllabus and should test the range of abilities according to Bloom Taxonomy.

2) Practical Assessment/Practical examination: This is designed to test Practical skills of students. Its overall weight age should be 60%. It will comprise of written exam (10%), practical (70 %) and viva/oral exam (20%).

A standards-referenced approach will be adopted for grading and reporting student performance. The purpose of this approach is to recognize what each student can do in the subject at the end of the 2-year secondary school level education. The performance of each student will be matched against a set of performance standards, rather than comparing to the performance of other students. It makes the implicit standards explicit by providing specific indication of individual student performance. Descriptions will be provided for the set of standards.

Guidelines for Writing a Textbook

A textbook is an important teaching and learning resource and one of the most extensively used resources in classrooms. To reflect national needs and aspirations the needs and aspirations, the textbooks should be written in accordance with this curriculum. This curriculum meets not only the general aims and objectives but also fulfills the specific requirements of the individual subject. As the textbook serves as a framework for teaching, the author/authors should consider the following features:

- A textbook must include an introduction to the textbook, explaining how to use the textbook
- The textbook must be in line with the National Curriculum, covering all SLOs of each theme or concept.
- Content and illustrations must be culturally, contextually and age appropriate.
- All text and material must be accurate, up-to-date and error-free.
- The continuity of the concepts, their integration and logical development should be ensured.
- Horizontal and vertical overlapping of the concepts should be avoided.
- The textbook should be informative and interactive with questions to be put at suitable intervals to provoke the students to think.
- The language used should be simple, clear, straight forward, unambiguous, and easily comprehensible by the students of the level.

- Simple questions may be asked within the chapter, which requires students to recall, think, and apply what they have just learnt as well as to reinforce the learning of the concepts and principle.
- The examples and applications should be from everyday life and be supportive of our cultural values.
- Photographs and illustrations should be clear, labeled, and supportive of the text. Tables, flow charts and graph may be given wherever needed.
- Key points at the end of each chapter should provide a summary of the important concepts and principles discussed in the chapter.
- End-of-the-Chapter exercises must include a variety of assessment styles based on levels of Bloom's Taxonomy. These should encourage students to think, develop skills, and use information for a variety of purposes.
- Textbooks should be free from all kinds of biases including, gender, religion, occupation, social background etc.
- To make the students self-learner use of IT based resources may be encouraged. Relevant internet links and other online resources may be included.
- Glossary of the new vocabulary must be included.

Guideline for planning and writing a chapter

The textbook author may decide the titles of each chapter and can choose to cover students' learning outcomes (SLOs) from any themes in developing the content of the chapter. The textbook author must also keep in mind that a number of SLOs cannot be addressed in the text (as if this is done it would lead students to simply memorize the text and not serve the realization of the curriculum). These SLOs could be realized through questions and practical activities within and at the end of the chapter exercises.

- Learning outcomes must be given at beginning of each chapter.
- Decide on key ideas, facts, concepts, skills, and values that can be developed.
- Illustrations must clearly convey the desired concept.
- Activities must demand from students to do inquiry and problem solving according to grade level.
- Ensure that the content is up to date, accurate and developmentally appropriate.
- Contents must be in line with chapter outcomes.
- Language must be consistent, culturally appropriate, and grammatically correct (as if talking to a group).
- Language must engage and hold reader's attention.
- Recall previous learning, where possible.
- Structure the writing so that the sentence is simple, paragraphs deal with single ideas etc.
- Interesting information in the form of tidbits, fact file, point to ponder etc. must be given.
- Write a summary/concept map at end of each chapter, reviewing key knowledge and skills.
- End-of-chapter exercises
- Recall and integrate previous learning
- Engage students and develop their creativity
- Move from lower to higher order thinking

- Focus on multiple intelligences
- Keep the text contextually relevant in line with local teaching and learning.
- Provide website links for further research

Guidelines for Writing Learner Workbook

Workbooks are books that contain writing activities and exercises that build upon each chapter in the textbook. Workbook exercises help students to develop conceptual understanding of the concepts dealt with in the text, to develop skills and to apply knowledge to new situations. Basic features of a workbook A workbook should have:

- Various exercises and activities for each chapter, topic, subtopic.
- Exercises and activities that will enable student to develop and practice the content knowledge, skills and higher order thinking.
- Accurate and variety of exercises.
- Clear illustrations/ examples/ explanations to show what students are supposed to do, and/or what product looks like.
- Exercises and activities with a variety of purposeful, stimulating, challenging and innovative items to encourage students to review and practice the knowledge and skills they have learnt.
- Exercises that include both constructed and restricted response items.
- Activities, which requires readily available, acceptable, and affordable materials and resources.

Basic Requirements for Lab (Tools/Equipment)

Trade: - HVACR (40 Trainee)

1. Adjustable screw wrench,
2. Air Conditioner and its parts,
3. AVO meter, Tool kit
4. Battery,
5. Box spanner screw drivers,
6. Capacitor,
7. Clamp on meter, Tool Kit
8. Compressor,
9. Condenser,
10. Copper Tubes,
11. Deep Freezer and its parts,
12. Digital Air Flow / Velocity meter
13. Digital Capacitor analyzer,
14. Digital Clamp-on Ampere Meter,
15. Digital Optical Taco meter,
16. Digital pressure gauges set,
17. Electric Screw driver set,
18. Electronic leak detector,
19. Evaporator,
20. Flaring and swaging tool kit,
21. General toolkit
22. Hammer,

23. Laser temperature measuring device,
24. Leak testing equipment,
25. Locking, pliers
26. Manifold,
27. Multimeter
28. Pressure Gauges,
29. Ratchet wrench Open ended spanner set,
30. Reamer,
31. Recovery cylinder,
32. Recovery unit,
33. Refrigerant control Valves
34. Refrigerants Chart
35. Refrigerants,
36. Refrigeration system,
37. Refrigerator and its parts,
38. Resistor,
39. Spirit level,
40. Swaging Tool,
41. Thermometer,
42. Tube Bender,
43. Tube Cutter,
44. Tube Vice
45. Water Cooler and its parts

Consumable or Training Materials

S.No	Specification	Quantity
1	Filling of oxygen Gas cylinder	3 Cylinder
2	Filling of fan Gas cylinder	28 kg
3	Silver soldering Rod (chandi Rod)	02 kg
4	Brass Rod (Petal Rod)	02 kg
5	Copper Tube dia 1"/4 (50 feet / Coil)	04 koil
6	Copper Tube dia 5"/16 (50 feet / Coil)	04 koil
7	Capillary Tube dia 0.031"	02 koil
8	Gastric Sheet (4'x6')	02 sheet
9	Seal Threading Tap	10 nos
10	Majic defoxi (small size)	10 nos
11	wooden Board (10"x12" single)	06 doz
12	single way switch (5A open)	10 doz
13	Two Way Switch (5A Open)	08 doz
14	Batten Holder Baculite	12 doz
15	Two Pin socket (5A open)	08 doz
16	Cut out fuse (10 A Porcelain)	08 doz
17	Electric LAMP (Bulb 100 w)	06 doz

18	Electric Lam (Bulb 200w)	02 doz
19	Electric Call bell (Bizzes 220v/5W)	06 doz
20	Push button (5A open)	06 doz
21	Fuse wire (5A)	06 reel
22	P.V.C WIRE (3/.029")	04 coil
23	P.V.C WIRE (1/.044")	04 coil
24	Insulation Tap (Nitto) 3"/4	30 nos
25	Wooden Screw 1"/2, 3"/4	10 pkt / each
26	Hand Hack Saw Blade (Double Edge)	10 doz
27	M.S Flat (64mmx8mm)	100 kg
28	Mobil Oil	10 Litr
29	Cotton Waist Cleaning Cloth	50 kg
30	Detergent Soap	02 doz
31	Thermostat switch cooler water	12 nos
32	Thermostat for Refrigerator	12 nos
33	Thermostat for A.C	12 nos
34	Amperage type relay Cap type 1/4, 1/3, 1/5, 1/6, 1/8 (6 No each)220v	30 nos
35	Overload 1/8, 1/6, 1/5, 1/4, 1/3 (220v)	30 nos
36	Electronic Relay (Denfas)	12
37	Electronic Relay two point	12
38	Current Relay for 110v Refrig	12
39	Over load for 110v = (1/4, 1/3) Refrig	12
40	starting capacitor 80/110 uf	12
41	Starting capacitor 138/182 uf	12
42	Running capacitor 50 uf	12
43	Running capacitor 60 uf	12
44	Timer for Refrigerator 220v	12
45	Bi metal fuse 12 no 220v Elect	24
46	Timer for 110v Refrigerator	6
47	Fan capacitor 2, 2.5, 3, 3.5 μ F	25
48	copper tub 1"/2	3 coils (50')
49	Protentional Relay	12
50	Split Control circuit with display	12
51	Sensor for Split A.C	60
52	F-134a Gas cylinder	2 cylinders
53	F-22 Gas	2 Cylinder
54	G-I pipe 1"/2 dia	4 length
55	G-I pipe 3"/4 dia	4 length
56	G-I union 1"/2	12

57	G-I Tee	12
58	G-I Socket	12
59	P.V.C wire 7/044	2 coils
60	Three pin shoe 20 A	12
61	Power Plug 2, A	2 dozen
62	Circuit Breaker 20 A	2 dozen
63	Three Pin Shoe 5A	2 dozen
64	Two Pin Shoe 5A	2 dozen
65	Flair nuts 1/4"	3 nos
66	Union 1/4"	3 nos
67	Flair nuts 5"/16	3 nos
68	union 5/6"	3 nos
69	Flour mint 1"/2	3 nos
70	union 1/2"	3 nos
71	compressor out 1349	4 lit
72	Kit kat fuse 20 A	2 dozen
73	Liquid service valve 1/4" Split A.C	2 dozen
74	Suction service valve for	2 dozen
75	Filter dryer	3 dozen
76	Nut and Bolt (M10)	2 pkt
77	Nut and Bolt (M12)	3 pkt
78	Nut and Bolt (M14)	3 pkt
79	Flexible cable (copper) wire 110-76	1 coil
80	Arab flax insulation 1"/4,1/2",3/8"	3 dozen
81	Arab flax insulation 5/8", 3"/4 for tub	3 dozen