Quest for Excellence

MAHARASHTRA INSTITUTE OF TECHNOLOGY, AURANGABD

An Autonomous Institute Affiliated toDr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra (India)

Syllabus of Bachelor of Vocation

In

Refrigeration and Air Conditioning

Under Choice Based Credit System (CBCS)

Under Faculty of Science and Technology

(Effective from 2022-23 and onwards)

Curriculum for B. Voc Refrigeration and Air-conditioning

NSQF Level -5										Semester -I
Sr. No.	Course Code	Course Title	Credit	Contact Hr/Wk		Evaluation Scheme				ESE hour
				L	P	MSE	TA	ESE	Total	
Theory										
1.	VRA101	Basics of Refrigeration	3	3	-	10	15	25	50	1.5
2.	VRA102	Basics of Air Conditioning	3	3	-	10	15	25	50	1.5
3.	VRA103	Engineering Material	3	3	-	10	15	25	50	1.5
4.	VRA104	Soldering & De-Soldering of components and emergency actions	3	3	-	10	15	25	50	1.5
Lab/Practical										
5.	VRA121	Metrology and Measuring Instruments Lab	1.5	-	2	-	25	25	50	-
6.	VRA122	Heat Transfer Lab	1.5	-	2	-	25	25	50	-
On Job Training (OJT)/Qualification Packs*										
7.	VRA131	Field Technician-AC(ELE/Q3102)	15	-	7-8 weeks	--	50	150	200	-
	VRA132	Field Technician-Refrigeration(ELE/Q3103)								
	VRA133	Field Engineer-RACW(ELE/Q3105)								
*Any one On-Job-Training as per guidelines of AICTE & SSC for the given skill sets for 150 Marks External Assessment by NSDC/SSC										

NSQF Level -5										Semester -II
Sr. No.	Course Code	Course Title	Credit	Contact Hr/Wk		Evaluation Scheme				ESE hour
				L	P	MSE	TA	ESE	Total	
Theory										
1.	VRA151	Industrial Management	3	3	-	10	15	25	50	1.5
2.	VRA152	Total Quality Management	3	3	-	10	15	25	50	1.5
3.	VRA153	Entrepreneurship	3	3	-	10	15	25	50	1.5
4.	VRA154	Refrigeration & Air Conditioning Applications	3	3	-	10	15	25	50	1.5
Lab/Practical										
5.	VRA171	Basic Electrical and Electronics Lab	1.5	-	2	-	25	25	50	-
6.	VRA172	Refrigeration and Air-conditioning lab.	1.5	-	2	-	25	25	50	-
On Job Training (OJT)/Qualification Packs*										
7.	VRA181	One more QP to be opted from QPs mentioned in the level 5 first semester	15	-	7-8 weeks	--	50	150	200	-
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Curriculum for B. Voc Refrigeration and Air-conditioning

NSQF Level -6										Semester -I
Sr. No.	Course Code	Course Title	Credit	Contact Hr/Wk		Evaluation Scheme				ESE hour
				L	P	MSE	TA	ESE	Total	
Theory										
1.	VRA201	RAC Piping Systems- I	3	3	-	10	15	25	50	1.5
2.	VRA202	Refrigeration & Air-conditioning Material -I	3	3	-	10	15	25	50	1.5
3.	VRA203	Refrigerants	3	3	-	10	15	25	50	1.5
4.	VRA204	RAC Standards	3	3	-	10	15	25	50	1.5
Lab/Practical										
5.	VRA221	RAC Material Lab	1.5	-	2		25	25	50	-
6.	VRA222	RAC Systems Installation and its Maintenance Lab. -I	1.5	-	2		25	25	50	-
On Job Training (OJT)/Qualification Packs*										
7.	VRA231	Safety Tester –RACWO(ELE/ Q3605)	15	-	7-8 weeks	--	50	150	200	-
	VRA232	Field Engineer– RACW(ELE/Q3105)								
	VRA233	Cold Storage Technician FIC/Q7004)								
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NSQF Level -6										Semester -II
Sr. No.	Course Code	Course Title	Credit	Contact Hr/Wk		Evaluation Scheme				ESE hour
				L	P	MSE	TA	ESE	Total	
Theory										
1.	VRA251	RAC Piping Systems-II	3	3	-	10	15	25	50	1.5
2.	VRA252	Refrigeration& Air-conditioning Material-II	3	3	-	10	15	25	50	1.5
3.	VRA253	RAC Maintenance-I	3	3	-	10	15	25	50	1.5
4.	VRA254	RAC Installation Techniques -I	3	3	-	10	15	25	50	1.5
Lab/Practical										
5.	VRA271	RAC SystemsInstallation and its Maintenance Lab. -II	1.5	-	2	-	25	25	50	-
6.	VRA272	RAC Piping Systems Lab	1.5	-	2	-	25	25	50	-
On Job Training (OJT)/Qualification Packs*										
7.	VRA281	One more QP to be opted from QPs mentioned in the level 6 first sem	15	-	7-8 week	--	50	150	200	-
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Curriculum for B. Voc Refrigeration and Air-conditioning

NSQF Level -7										Semester -I
Sr. No.	Course Code	Course Title	Credit	Contact Hr/Wk		Evaluation Scheme				ESE hour
				L	P	MSE	TA	ESE	Total	
Theory										
1.	VRA301	RAC Maintenance-II	3	3	-	10	15	25	50	1.5
2.	VRA302	RAC Installation Techniques-II	3	3	-	10	15	25	50	1.5
3.	VRA303	Automobile Airconditioning	3	3	-	10	15	25	50	1.5
4.	VRA304	Non-conventional Refrigerating System	3	3	-	10	15	25	50	1.5
Lab/Practical										
5.	VRA321	Automobile AC Lab.	1.5	-	2	-	25	25	50	-
6.	VRA322	AC components and Assembly Laboratory	1.5	-	2	-	25	25	50	-
On Job Training (OJT)/Qualification Packs*										
7.	VRA331	AC Specialist– Automobile (ASC/Q1416)	15	-	7-8 weeks	--	50	150	200	-
	VRA332	Assembly Operator(ELE/Q3501)								
	-	-								

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NSQF Level -7										Semester -II
Sr. No.	Course Code	Course Title	Credit	Contact Hr/Wk		Evaluation Scheme				ESE hour
				L	P	MSE	TA	ESE	Total	
Theory										
1.	VRA351	RAC Safety	3	3	-	10	15	25	50	1.5
2.	VRA352	Process Planning and Cost Estimation	3	3	-	10	15	25	50	1.5
Lab/Practical										
3.	VRA371	Project	9	-	4	-	100	100	200	-
On Job Training (OJT)/Qualification Packs*										
4.	VRA381	One more QP to be opted from QPs mentioned in the level 7 first semester	15	-	7-8 weeks	--	50	150	200	-

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	**VRA201: RAC Piping Systems-I**	**Semester-I**

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Explain the different types of components required for piping.
2.	Use of different valves for piping
3.	Apply different equations for pipe flows

Unit	Course Content	Hours
Unit 1	**Codes Standards and Specifications:** Piping Codes, ASME Codes and Standards , ASTM Specifications	(02)
Unit 2	ASME Boiler, Pressure vessel codes, ASME B31-Code for pressure piping, mechanical strength, testing of piping system and valves, fabrications	(07)
Unit 3	**Piping Components:** Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material, specifications, pipe ends, pipe fittings, pipe support	(07)
Unit 4	valves–gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve, codes and standard, valve size, pressure class rating.	(07)
Unit 5	Viscosity, Reynolds number, friction factor, Darcy Weisbach friction factor, friction factor for laminar and turbulent flows, equivalent pipe length, hydraulic radius, compressible, flow	(07)

Reference Book

Sr. No.	Book	Author	Publisher
1	Hand book of Air conditioning and refrigeration	Shan K Wang	McGraw -hill international edition, Singapore
2.	Piping and Pipeline Calculations Manual	J. Phillip Ellenberger	Butterworth-Heinemann
3.	Fundamentals of piping design	Peter Smith	Gulf Publishing Company

Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

1. Six questions.
2. Question no 1 is compulsory and should cover complete syllabus of the respective course for 10 marks.
3. Remaining five questions will be of 5 marks each.

Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	VRA202: Refrigeration and Air-conditioning Material-I	Semester-I

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Identify different types of insulating materials
2.	Explain different types of cables and wiring
3.	Use of different types of insulating material

Unit	Course Content	Hours
Unit 1	**Insulator:** Introduction, desired properties of ideal insulating material, factors effecting the thermal conductivity.	(06)
Unit 2	Types of insulating material., reflective insulating blinds, laprock – a thermal acoustic and fire insulation, natural insulator, new transparent heat insulator, heat transfer through insulation used for A.C	(06)
Unit 3	economical thickness of insulation, few insulated systems, low temperature insulations, importance of relative humidity for the selection of the insulations, air distribution for reducing heat lose.	(06)
Unit 4	**Cables and Wiring:** Cryocables, economics of cryocables, A.C. super conducting cables, liquid N2 cooled cables, Liquid H2 cooled cables, super magnet, electric generator, minimalinsulated cables, installing cables	(06)
Unit 5	**Component Material:** Refrigeration component material, duct material, material used in evaporator, material used in compressor, material used in condenser	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1	Hand book of Air conditioning and refrigeration	Shan K Wang	McGraw -hill international edition, Singapore
2.	Refrigeration and Air Conditioning data book		New Age International Publications

Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	**VRA203: Refrigerants**	**Semester-I**

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Classify different types of refrigerants.
2.	Understand the different properties of refrigerants.
3.	Use different types of refrigerants for specific purpose

Unit	Course Content	Hours
Unit 1	**Introduction:** Refrigerants, cooling media and liquid absorbents, azeotropic and zeotropic, numbering of refrigerants.	(06)
Unit 2	**Classification and Properties of Refrigerants:** Requirement for refrigerant, classification- based on working principle, safety and chemical composition, desirable properties of refrigerants-thermodynamic properties, safe working properties, physical properties etc	(06)
Unit 3	**Choice of Refrigerant:** Important refrigerants, secondary refrigerant, anti-freeze solution, selection of refrigerant for required purpose,	(06)
Unit 4	**Application of Refrigerants:** refrigerant oils and applications, Properties and uses of commonly used refrigerant	(06)
Unit 5	Green house effect, Global warming, Future Refrigerants	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1	A course in Refrigeration and Air Conditioning	S.C. Arora and Domkundwar	Dhanpatrai and sons, Delhi
2.	Refrigeration and Air Conditioning	Manohar Prasad	New Age International Limited, New Delhi
3.	Hand book of Air conditioning and refrigeration	Shan K Wang	McGraw -hill international edition, Singapore

Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

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Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	**VRA204: RAC Standards**	**Semester-I**

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Understand the different RAC standards
2.	Explain the different RAC standards
3.	Use of different RAC standards.

Unit	Course Content	Hours
Unit 1	**Introduction:** Meaning of IS, need of IS, international classification of standards for refrigeration and air conditioning, various national and international standards for heating, ventilation and air conditioning	(06)
Unit 2	Procedure of Standard development, levels of standard, main standardization, organizations, i.e. ISO- international organization for standardization, IEC-international electro technical commission and others international and national organizations	(06)
Unit 3	**Existing Standards:** Main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential) alternatives, ISO, IEC, ECS (European Committee for Electrical Technical Standardization)	(06)
Unit 4	**Adoption of International Standards at National Level:** National standardization bodies, national ozone units, accreditation bodies, national RAC associations, the process of adoption	(06)
Unit 5	**Use of International Standards:** In designing of refrigeration and air conditioning equipment, selection of materials related to refrigeration and air conditioning, safety issues related to refrigeration and air conditioning, industrial and field applications.	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1	International Standards in Refrigeration and Air Conditioning	-	UNEP (United Nations Environment Program)
2.	ASHRE hand book for Refrigeration and Air Conditioning	-	ASHRE hand book for Refrigeration and Air Conditioning
3.	Refrigeration and Air Conditioning data book	-	New Age International Publications

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Pattern of Question paper:

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For 25 Marks Paper:

1. Six questions.
2. Question no 1 is compulsory and should cover complete syllabus of the respective course for 10 marks.
3. Remaining five questions will be of 5 marks each.

Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level -6	**VRA221:RAC Material Lab**		**Semester-I**
Teaching Scheme		Examination Scheme	
Practical	02 Hours/week	TA	25 Marks
Credits	1.5	ESE/PE	25 Marks

Sr.No.	**List of Experiments**
	Any **eight** of the following practical should be performed and recorded in laboratory book 1. Identification of types of copper tubes (dia. 3 mm, 6 mm, 12.5mm) 2. Identification of types of brazing road and its composition 3. Identification of oil and grease removals, fire hazard of the removals 4. Familiarization of joining material, gasket, pipe joint 5. Introduction of various insulating material, properties, fire hazard, etc. 6. Soldering and Brazing – types of brazing, preparation, purging. applying flux, applying heat. 7. Pipe Bending – Introduction to tools and different bends, pipe cutting. 8. Electrical requirement – introduction and familiarization with electrical symbols, circuit diagram of the RAC system 9. Introduction to gas welding set, simple gas welding, arc welding 10. Identification and testing of resistor, diodes and transistors 11. Identification of refrigerant cylinder by color coding and standing pressure – types of cylinder 12. Technique of glass wool filling method in conventional refrigerant.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level -6	**VRA222:RAC System Installation and it's maintenance Lab-I**	**Semester-I**

Teaching Scheme		Examination Scheme	
Practical	02 Hours/week	TA	25 Marks
Credits	1.5	ESE/PE	25 Marks

Sr.No.	**List of Experiments**
	1. Handling, use and familiarization with refrigeration tools and accessories such as: (a) Tube cutter (b) Tube bender [spring type] (c) Flaring tool (d) Swaging tool (e) Pinch offtools (f) Service valve wrench (g) Service valve (h) Adjustable wrench (i) Spanner set (j) Allen Key (k) Gauges (l) Blow lamp (m) Service cylinder (n) Gauge manifold (o) Wheel puller (p) Vacuum pump (q) Halide torch (r) Practicing of related operations. 2. Study of the following units: (a) Domestic refrigerator (b) Water cooler (c) Room Air conditioner (d) Evaporative cooler (e) Experimental ice plant. 3. Experimental ice plant. 4. Study of the following components and controls: (a) Compressor: open type and sealed types (b) Thermostatic expansion valve (c) Surface condenser (d) Different types of evaporators (e) Solenoid valve (f) Thermostat for refrigeration (g) H.P. and L.P. cut out (h) Gil safety switch (i) Strainers and driers.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level -6	**On Job Training/Qualification Packs***		**Semester-I**
Teaching Scheme		Examination Scheme	
Practical	7-8 weeks	TA	50 Marks
Credits	15	ESE/PE	150 Marks

VRA231	Safety Tester-RACWO(ELE/Q3605)
VRA232	Field Engineer-RACW(ELE/Q3105)
VRA233	Cold Storage Technician-(FIC/Q7004)

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	**VRA251: RAC Piping System-II**	**Semester-II**

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Understand the need of stress calculation in piping design
2.	Classify different methods of testing
3.	Design piping system

Unit	Course Content	Hours
Unit 1	**Pipe Size Calculations:** Pipe sizing, pipe sizing formulae, pipeline wall thickness calculation, elements of total dynamic head–static head, pressure head, velocity head, friction head,Pump power required, Cavitations in pumps, NPSH required and NPSH available for pumps.	(06)
Unit 2	**Pipe Stress Analysis:** Objectives and definition of stress analysis, piping loads, piping stresses-primary, secondary, pipe span, calculations flexibility analysis–expansion loops and expansion joints, concept of thermal expansion, providing flexibility in piping.	(06)
Unit 3	**Assembly and Erection:** Fabrications materials for piping systems, fabrication drawings, fabrication processes, Assembly-alignment, flanged joints, threaded joints	(06)
Unit 4	**Piping System Testing:** Examinations methods, visual examination, magnetic particle examination, Liquid penetrant examination, radiographic examination, ultra sonic examinations	(06)
Unit 5	Testing–leak, test, preparation for leak test, hydrostatic leak test, pneumatic leak test, sensitive leak test, examination of welds	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1.	The fundamentals of piping design	Peter Smith	Gulf Publishing Company
2.	Piping and Pipeline Calculations Manual	J. Phillip Ellenberger	Butterworth-Heinemann
3.	Hand book of Air conditioning and refrigeration	Shan K Wang	McGraw -hill international edition, Singapore

Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should

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cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

1. Six questions.
2. Question no 1 is compulsory and should cover complete syllabus of the respective course for 10 marks.
3. Remaining five questions will be of 5 marks each.

Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	VRA252: Refrigeration and Air-conditioning Material-II	Semester-II

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Classify the different materials used in RAC system.
2.	Understand the different properties of lubricating oil.
3.	Select different types of Tubing.

Unit	Course Content	Hours
Unit 1	**Component Material:** Material used in expansion valve, different type of valve material	(06)
Unit 2	Material used in cooling towers, pipeline materials, drying materials, jointing, material, synthetic repair materials.	(06)
Unit 3	**Oils and Lubrication:** Need of lubrication, types of lubrication, properties of lubrication oils, lubrication systems	(06)
Unit 4	Selection of refrigerant lubricant, compatibility oflubricant with refrigerant fluid,refrigeration oil with additives, the effect of refrigerant on lubricant density, solvent and cleaning.	(06)
Unit 5	**Tubing:** Soft copper tubing, hard-drawn copper tubing, steel tubing, normal size copper tubing, Cutting tubing, bonding tubing, connecting tubing, flaring tubing.	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1.	A course in Refrigeration and Air Conditioning	S.C. Arora & S. Domkundwar	Dhanpatrai and sons, Delhi
2.	Modern Refrigeration and Air Conditioning	Andrew D. Althouse, Turnquist Bracciano	The good heart-willcox company, INC

Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

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3. Remaining five questions will be of 5 marks each.

Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	**VRA253: RAC Maintenance-I**	**Semester-II**

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Understand the working of different tools used in RAC System
2.	Classify different tools used in RAC System
3.	Carry out different types of maintenance of RAC System

Unit	Course Content	Hours
Unit 1	**RAC Tools:** Engineering hand tools: spanners, screwdrivers, pliers, hammers, brazing, welding, flaring tool, tube bender, hammer, wrenches, shock wrenches, files, hacksaws, wood saws, electrical hand drill, sheet metal snips, Allen keys pop riveter, chisels, pulley extractors, Center punch, wire brush, drill bits, oil can, knife, inspection lamp, bolt extractor	(06)
Unit 2	Measuring equipment's- steel tape measure, feeler gauge, Caliper, micrometer, engineers levels, pocket type of thermometer, sling psychomotor, system analyzers, temperature analyzers, electronic leak detector, voltmeter, clamp-on ammeter	(06)
Unit 3	**Specialist tools and accessories:** flexible charging line, bending springs, pipe tube cutter, fin combs, soldering and brazing equipments, Vacuum pump, charging cylinders, electric test lamps, jumper lead, welding goggles	(06)
Unit 4	Pipe installation work, pumping down the system, purging the system, starting the plant	(06)
Unit 5	Using a system analyzer, transferring and handling liquid refrigerant	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1.	A course in Refrigeration and Air Conditioning	S.C. Arora & Domkundwar	Dhanpatrai and sons, Delhi
2.	Electric controls for Refrigeration and Air Conditioning	B.C. Langley, D.B. Taraporevala	sons and co. pvt.ltd., Bombay
3.	Hand book of Air conditioning and refrigeration	Shan K Wang	McGraw -hill international edition, Singapore

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Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

1. Six questions.
2. Question no 1 is compulsory and should cover complete syllabus of the respective course for 10 marks.
3. Remaining five questions will be of 5 marks each.

Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level-6	**VRA254: RAC Installation Techniques-I**	**Semester-II**

Teaching Scheme		Examination Scheme	
Lectures	03 hrs/Week	MSE	10 Marks
Practical	-	TA	15 Marks
Total Credits	03	ESE	25 Marks
		Duration of ESE	1.5 hours

Course Outcomes (CO)

Students will be able to

1.	Differentiate different installation techniques used in RAC System
2.	Understand the procedure of installation
3.	Carry out installation of RAC system individually.

Unit	Course Content	Hours
Unit 1	**Introduction:** Installation operation, adding oil, testing for leak detection	(06)
Unit 2	Evacuation and dehydration, removing air, charging of the system, through suction valve, through discharge valve.	(06)
Unit 3	**Installation of Room Air-Conditioner:** Selection of proper location, providing proper slope and provision for to drain water	(06)
Unit 4	Ventilation arrangement for window air conditioner, wiring diagram for installation for room air, conditioner	(06)
Unit 5	Installation of split air conditioner, providing arrangement for pipes and pipe, pipe insulations	(06)

Reference Book

Sr. No.	Book	Author	Publisher
1.	Air conditioning: procedures and installation	V. Paul Lang	CBS publishers & distributors, Delhi
2.	Refrigeration Technicians pocket book	F.H. Meredith	Butterworths
3.	Hand book of Air conditioning and refrigeration	Shan K Wang	McGraw -hill international edition, Singapore

Pattern of Question paper:

Question paper shall be based on all 5 units in the syllabus. Question number 1 is compulsory and shall be of objective nature (Multiple Choice Questions, fill in the blanks etc.) and should cover the entire syllabus. Students must solve any THREE questions from remaining five questions based on each unit.

For 25 Marks Paper:

1. Six questions.
2. Question no 1 is compulsory and should cover complete syllabus of the respective course for 10 marks.
3. Remaining five questions will be of 5 marks each.

Any Three questions of 5 marks each from remaining questions are to be solved.

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B.Voc. (Refrigeration and Airconditioning)

NSQF Level -6	**VRA271:RAC System Installation and it's maintenance Lab-II**	**Semester-II**

Teaching Scheme			Examination Scheme	
Practical	02 Hours/week		TA	25 Marks
Credits	1.5		ESE/PE	25 Marks

Sr.No.	**List of Experiments**
	1. Leak detection in refrigeration system by different methods. 2. Air removal and charging of a refrigeration unit. 3. Testing of a refrigeration system to find out: (a) Refrigerating capacity (b) Power input (c) C.O.P. 4. Determination of psychrometric properties of air with the help of a sling psychrometer and aspiration psychrometer. 5. Determination of bye pass factor of a cooling coil. 6. Determination of humidifying efficiency of a evaporative cooler. 7. Determination of cooling load for a specified situation. 8. Study of the following system by visit: (a) Ice Plant (b) Cold storage plant (c) Control air conditioning system

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

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NSQF Level -6	**VRA272:RAC Piping System Lab**		**Semester-II**
Teaching Scheme		Examination Scheme	
Practical	02 Hours/week	TA	25 Marks
Credits	1.5	ESE/PE	25 Marks

Sr.No.	**List of Experiments**
	Any **six** of the following practical should be performed and recorded in laboratory book: 1. Study of piping codes, ASME codes and standards, ASTM Specifications 2. Study of Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material specifications, pipe ends 3. Study of pipe fittings–elbows, tees, flanges, butt welded end fittings, socket welded and threaded end fittings 4. valves–gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve codes and standard, valve size, pressure class rating. 5. Study of pipeline wall thickness calculation 6. Study of NPSH required and NPSH available for pumps 7. Study of piping load and piping stresses 8. Study of different leak detection methods 9. Checking the performance of air ducting system

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

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NSQF Level -6	**On Job Training/Qualification Packs***		**Semester-II**
Teaching Scheme		Examination Scheme	
Practical	7-8 weeks	TA	50 Marks
Credits	15	ESE/PE	150 Marks
VRA281	One more QP to be opted from QPs mentioned in the level 6 first semester		

*Any one On-Job-Training as per guidelines of AICTE & SSC for the given skill sets for 150 Marks External Assessment by NSDC/SSC

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