Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

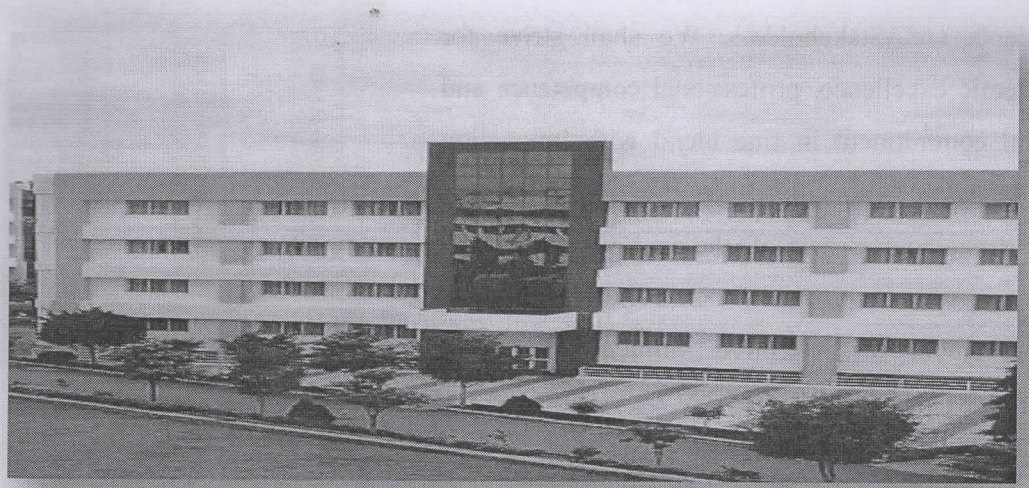
An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

Curriculum Structure and Syllabus

of

B. Voc. Industrial Refrigeration & Air Conditioning

(Regulations 2023)



Effective from Academic Year 2024-25

Chairman
BoS B.Voc. Program
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Institute Vision

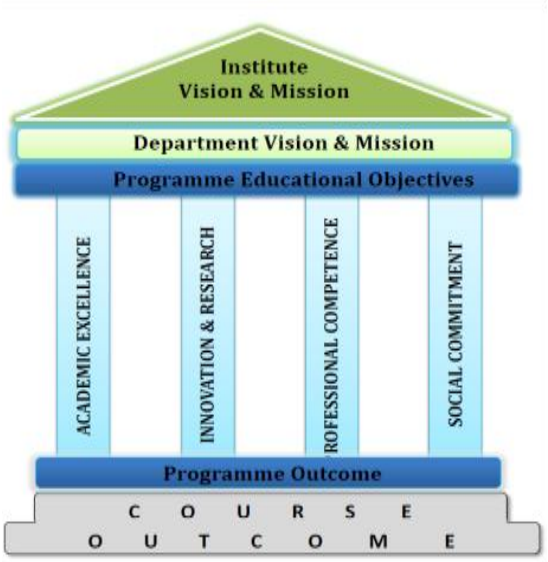
To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



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ABBREVIATIONS

Abbreviations	Course Full Name
MJ	Major Course
MI	Minor Course
MD	Multidisciplinary Course
AEC	Ability Enhancement Course
VAC	Value added Course
SEC	Skill Enhancement Course
FA	Formative Assessment
SA	Summative Assessment

CURRICULUM STRUCTURE

STRUCTURE FOR IST YEAR B. Voc. (INDUSTRIAL REFRIGERATION AND AIR CONDITIONING)

SEMESTER I

B. Voc. Structure	Sem-I		Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Total**
VRC21101	MJ	Major Course I:: Basics of Refrigeration & Air Conditioning	3	-	3	3	25	25	50	-	-	-	100
VRC21201	MI	Minor Course I: Engineering Drawing	3	-	3	3	25	25	50	-	-	-	100
VRC21301	MD	Multidisciplinary Course I: Applied Science	2	-	2	2	20	20	40	-	-	-	80
VRC21401	AEC	Ability Enhancement Course I: Writing skills		2	2	1	-	-	-	50	-	-	50
VRC21501	VAC	Value added Course I: Health & wellness		2	2	1	-	-	-	50	-	-	50
VRC21601	SEC	Internship I: On Job Training: CON/Q1003	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	**20**	70	70	**140**	**100**	**-**	**200**	**580**

SEMESTER II

B. Voc. Structure	Sem-II		Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**ETE**	**TW**	**OR**	**PR**	**Total**
VRC22102	MJ	Major Course II: Soldering, De-Soldering, and Brazing of Components & Emergency actions	3	-	3	3	25	25	50	-	-	-	100
VRC22202	MI	Minor Course II: Basics of Electrical & Electronics	3	-	3	3	25	25	50	-	-	-	100
VRC22302	MD	Multidisciplinary Course II: Applied Mathematics	2	-	2	2	20	20	40	-	-	-	80
VRC22402	AEC	Ability Enhancement Course II: Soft Skills		2	2	1	-	-	-	50	-	-	50
VRC22502	VAC	Value added Course II: IT Tools I		2	2	1	-	-	-	50	-	-	50
VRC22602	SEC	Internship II: On Job Training.	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	**20**	70	70	**140**	**100**	**-**	**200**	**580**

STRUCTURE FOR IIND YEAR B. Voc. (INDUSTRIAL REFRIGERATION AND AIR CONDITIONING)

SEMESTER III

B. Voc. Structure Sem-III			Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VRC23103	MJ	Major Course III: Basics of Fluid Mechanics & Thermodynamics	2	-	2	2	20	20	40	-	-	-	80
VRC23104	MJ	Major Course IV: Basics of Fluid Mechanics & Thermodynamics Lab	-	2	2	1	-	-	-	-	-	50	50
VRC23203	MI	Minor Course III: Engineering Materials	2	-	2	2	20	20	40	-	-	-	80
VRC23204	MI	Minor Course IV: Engineering Materials Lab	-	2	2	1	-	-	-	-	-	50	50
VRC23303	MD	Multidisciplinary Course III: IT Tools II	2	-	2	2	20	20	40	-	-	-	80
VRC23403	AEC	Ability Enhancement Course III: Business Communication I		2	2	1	-	-	-	50	-	-	50
VRC23503	VAC	Value added Course III: Health & Wellness II		2	2	1	-	-	-	50	-	-	50
VRC23603	SEC	Internship III: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**6**	**28**	**34**	20	60	60	**120**	**100**	**-**	**300**	**640**

SEMESTER-IV

B. Voc. Structure Sem-IV			Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Total**
VRC24105	MJ	Major Course V: Refrigeration & Air Conditioning Application	2	-	2	3	25	25	50	-	-	-	100
VRC24106	MJ	Major Course VI: Refrigeration & Air Conditioning Application Lab	-	2	2	1	-	-	-	-	-	50	50
VRC24205	MI	Minor Course V: Metrology & Measuring Instruments	2	-	2	2	20	20	40	-	-	-	80
VRC24404	AEC	Ability Enhancement Course IV: Business		2	2	1	-	-	-	50	-	-	50

		Communication II											
VRC24504	VAC	Value added Course IV: Environmental Science		2	2	1	-	-	-	50	-	-	50
VRC24604	SEC	Project I: Mini Project	-	4	4	2	-	-	-	-	-	50	50
VRC24605	SEC	Internship III: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**4**	**30**	**34**	20	45	45	**90**	**100**	**-**	**300**	**580**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **FA–**Formative Assessment**, SA-**Summative Assessment; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

STRUCTURE FOR IIIRD YEAR B. Voc. (INDUSTRIAL REFRIGERATION AND AIR CONDITIONING)

SEMESTER V

B. Voc. Structure		Sem-V	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VRC25106	MJ	Core Course VI: RAC Piping System	3	-	3	3	25	25	50	-	-	-	100
VRC25107	MJ	Core Course VII: RAC Piping System Lab	-	2	2	1	-	-	-	-	-	50	50
VRC25108	MJ	Core Course VIII: Automobile Air Conditioning	3	-	3	3	25	25	50	-	-	-	100
VRC25109	MJ	Core Course IX: Automobile Air Conditioning Lab	-	2	2	1	-	-	-	-	-	50	50
VRC25206	MI	Pr. Sp. Course VI: Industrial Management	2	-	2	2	20	20	40	-	-	-	80
VRC25606	SEC	Internship V: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**6**	**24**	**30**	20	70	70	**140**	**-**	**-**	**300**	**580**

SEMESTER-VI

B. Voc. Structure		Sem-VI	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VRC26110	MJ	Core Course X: Non-conventional Refrigeration System	3	-	3	**3**	**25**	**25**	**50**	-	-	-	100
VRC26111	MJ	Core Course XI: Non-conventional Refrigeration System Lab	-	2	2	1	-	-	-	-	-	50	50
VRC26207	MI	Pr. Sp. course VII: Process Planning and Cost Estimation	2	-	2	2	20	20	40	-	-	-	80
VRC26607	SEC	Project II: Project	-	8	8	4	-	-	-	50	150	-	200
VRC26608	SEC	Internship VI: On Job Training	-	20	20	10	-	-	-	-	-	200	200
Total			**4**	**30**	**34**	**20**	**45**	**45**	**90**	**50**	**150**	**250**	**630**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **FA–**Formative Assessment**, SA**-Summative Assessment; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

Course Syllabus
Semester-I

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**				**Semester: I**	
Course:	**Basics of Refrigeration & Air Conditioning**				**Code: VRC21101**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

To provide the fundamentals of sensors and signal conditioning.

1. Identify the important modes of heat transfer and their applications
2. Learning the fundamental principles and different methods of refrigeration and air conditioning.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues
4. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Course outcomes:

After learning the course, student will be able to

1. Understand the basic heat conduction, convection and radiation equation for steady, one dimensional thermal systems.
2. Illustrate the fundamental principles of refrigeration , Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems
3. Understand the different types of refrigerant for various applications.
4. Understand vapour absorption system
5. Illustrate the fundamental principles air conditioning system
6. Understand the refrigeration and air conditioning systems for different application

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Mode of Heat Transfer** Conduction:-Law of Conduction, Heat Transfer Through the Wall Convection:-Law of Convection, Type of Convection, Heat Transfer to Composite Wall Radiation: Laws of Radiation, Basic Terminology Used in Radiation. Simple Numerical on Conduction, Convection & Radiation.	7
2	**Introduction to Refrigeration** Definition, Units of refrigeration, Various Methods of Refrigeration. Standard Vapour Compression Cycle, COP of Cycle, Effect of Temperature and Pressure on COP of the cycle. Simple Numerical Problems with the Help of P-H Diagram.	10
3	**Introduction to Refrigerant** Definition, Classification of Refrigerants, Properties of Refrigerant, Qualities of Good Refrigerants, Secondary Refrigerants. Safe Working Conditions with Refrigerants. Impact of Refrigerants on Environments	6
4	**Vapour Absorption System** VAS Cycle of Operation, Lithium Bromide Absorption Refrigeration System, Ammonia Absorption Refrigeration System	6

5	**Introduction to Air Conditioning** Introduction, Meaning of Air Conditioning, Psychrometric & Psychrometric Properties. Psychrometric Chart & Processes. Requirement of Comfort Air Conditioning	10
6	**Application of Refrigeration & Air conditioning** Construction & Working of Household Refrigerator, Summer Air Conditioning System, Winter Air Conditioning System	6

Text Books:

1. Dossat Roy J., *Principles of Refrigeration*, Pearson education, New Delhi,2014.
2. Stoecker W. F. and J. W. Jones, *Refrigeration and Air Conditioning*, Mcgraw hill education,2016.

Reference Books:

1. ARORA C.P., *Refrigeration and Air Conditioning*, Dhanpat Rai and Co.Pvt. Ltd, 2013.
2. Ananthanarayan P. N., *Basic Refrigeration and Air Conditioning*, Tata McGraw hill, 2016.
3. Manohar Prasad, *Refrigeration and Air Conditioning*, New age international Pvt. Ltd., New Delhi, 2015.
4. Khurmi R.S. and Gupta J.K., *A Text Book of Refrigeration and Air Conditioning*, S. Chand & Company, 2018.
5. Arora S.C., and Domkundwar S., *Refrigeration and Air Conditioning Data Book*, Dhanpatrai and Sons, 2012.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					**Semester: I**	
Course: Engineering Drawing					**Course Code: VRC21201**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To develop imagination of physical objects to be represented on paper for engineering communication.
2. To develop the interpretation and manual drawing skills.
3. To develop the physical realization and manual drawing skill

Course Outcomes:

After learning the course, students will be able to

1. Understand the drawing sheets, dimensioning and tolerances
2. Understand and draw the projections of point and line on reference planes, inclined planes.
3. Understand the orthographic projections, first and third angle projections methods, draw orthographic views
4. Understand and draw the Isometric scale, construction of Isometric view of simple objects
5. Understand and draw the development of lateral surfaces of simple solids.
6. Understand and draw the free hand sketches of standard components of machine.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Introduction** Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances – methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances.	7
2	**Projection of Line and Planes** Introduction, Projection of points – points on the different quadrants and on the reference planes. Projection of straight lines (only first angle projection method) – Line on the reference planes - perpendicular to one plane and parallel to other plane – inclined to one plane and parallel to the other plane – parallel to both the planes –inclined to both the planes. Projection of planes (only first angle projection method) - Types of planes, Projection of planes perpendicular to both the reference planes, Perpendicular to one plane and parallel to other plane, Perpendicular to one plane and inclined to the other plane, Inclined to both planes.	8

3	**Orthographic Projections** Reference planes, types of orthographic projections – First angle projections, Third angle projections, methods of obtaining orthographic views by First angle method.	6
4	**Isometric View** Introduction, Isometric scale, construction of Isometric view of simple objects from given orthographic.	8
5	**Development of Lateral Surfaces of Solids** Introduction, Development of lateral surfaces of Cone, Cylinder, Pyramid and Prism.	8
6	**Freehand Sketching and introduction of AutoCAD software** Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, human heights, doors, windows	8

Text Books:

1. Bhatt N.D., and Panchal V.M., *Engineering Drawing, Charotar Publishing House*, 2010.
2. Agrawal B., and Agrawal C M "*Engineering drawing*", Tata McGraw Hill Education Private Limited., 2014.

Reference books:

1. Gill P.S., *Engineering drawing*, S.K. Kataria & Sons., 2016.
2. Gopalakrishnan.K.R., *Engineering Drawing*, (Vol.I and Vol.II), Dhanalakshmi publishers, 1970.
3. Venugopal. K, and Sreekanjana G., *Engineering Graphics*, New Age International Publishers. 2019.
4. Natarajan K. V., *A text book of Engineering Drawing Graphics*. Dhanalakshmi Publishers, 2008.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: I	
Course:	Applied Science				Code: VRC21301	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA 1	FA 2	SA	Total
2	2	2	20	20	40	80

Course Objectives:

To develop an ability of understanding the phenomena with the help of science concepts and relate them to applications.

Course Outcomes:

After learning the course, students will be able to

1. Understand the quality of water, its softening techniques and quality of fuel and its different types.
2. Interpret the optical phenomena - reflection, refraction, polarization with wave nature of light.
3. Understand what is corrosion, its types and its consequences in environment.
4. Summarize production of ultrasonic waves and their applications.

Detailed Syllabus:

Unit	Description	Duration (30Hrs)
1	**Water** Impurities in water, methods of their removal, hardness of water, its types and units. Chemical analysis of water by determination of hardness by EDTA method and its numericals. Disadvantages of hard water in boilers, Water softening techniques: Permutit Water purification by reverse osmosis **Fuel and their Classification** Definition, characteristics, classification into solid, liquid and gaseous fuel. Calorific value of fuels – GCV, NCV and their relation. Coal, its types and their properties, proximate analysis and ultimate analysis. Gaseous fuels- Gaseous fuels: Hydrogen gas as a future fuel, production by steam reforming of methane and coke, storage and transportation. .	8
2	**Optics:** Electromagnetic wave nature of light, electromagnetic spectrum, reflection and refraction of a wave from a plane surface, laws of reflection and refraction, total internal reflection, plane polarized light, Law of Malus.	8
3	**Corrosion** Theory of corrosion. Different types of corrosion: Pitting corrosion, concentration cell corrosion, stress corrosion and soil corrosion. Factors affecting corrosion: nature of metal and nature of environment. Prevention of corrosion by various methods using metallic and non- metallic coatings like – hot dipping, cladding, electroplating and cementation and powder coating.	7
4	**Vibrations &Ultrasonic waves:**	7

	Vibration as simple spring mass system, elementary and qualitative concept of free and forced vibrations, resonance Ultrasonic waves, properties of ultrasonic waves, Productions of ultrasonic waves by magnetostriction and piezo-electric effect,application of ultrasonic in industry	

Text Books:

1. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Co., sixteenth edition ,2016.
2. M. N. Avadhanulu ,P.G. Kshirsagar , A text book of Engineering Physics, S. Chand publication ,revised edition, 2015

Reference books:

1. Wiley Editorial, Engineering Chemistry, Wiley India, 2nd edition, 2012.
2. O.G. Palanna, Engineering Chemistry, Tata McGraw-Hill Education, 2009.
3. R. K. *Gaur*, S. L. *Gupta* , Engineering Physics, Dhanpat Rai Publications, 8th edition ,2001.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: I	
Course: Writing Skills					Code: VRC21401	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	FA 1	FA 2	TW	Total
2	2	1	-	-	50	50

Course Objectives:

1) Understand the aspects and characteristics of effective writing skills.
2) Recognize the importance of effective writing skills in various contexts.
3) Demonstrate proficiency in different types of writing, including descriptive, narrative, persuasive, instructional, and formal business writing.
4) Develop the ability to critically evaluate and revise written work for structure, cohesion, coherence, grammar, correctness, completeness, logic, and other aspects of effective writing.
5) Apply effective writing techniques to communicate ideas clearly, persuasively, and professionally in diverse writing tasks.

Course Outcomes:

After learning the course students will;

1) Understand the essential aspects and significance of effective writing skills across personal, academic, and professional contexts.
2) Demonstrate proficiency in descriptive and narrative writing techniques, employing vivid language and sensory details to engage readers.
3) Develop critical thinking skills by summarizing complex material and providing insightful personal responses.
4) Apply persuasive writing strategies effectively and Produce professional written documents in various communication contexts, including letters and emails.

Detailed Syllabus:

Sr. No	Description
1	**Introduction to Effective Writing Skills** Aspects and characteristics of writing skills. Importance of effective writing Skills.
2	**Effective Writing** Structure, Cohesion and Coherence, Grammar, Correctness, Completeness, Logic and other aspects of effective writing skills
3	**Write a descriptive paragraph:** Write a descriptive paragraph about a person, place, or object. Encourage them to use sensory details and vivid language to create a picture in the reader's mind.
4	**Write a personal narrative:** Write a personal narrative about a memorable event. Use descriptive language, dialogue, and reflection to make the story come alive.
5	**Write a summary and response:** Read an article or essay and write a summary of the main points, followed by a personal response that explains your thoughts and reactions to the piece.

6	**Writing instructions** Writing clear, concise and compete instructions
7	**Write a persuasive letter** Write a persuasive letter to a local or national government representative, expressing your opinions on a current issue or proposing a solution to a problem.
8	**Business email writing:** Write a business email on a given scenario. Write a formal email, using appropriate tone, format, and language.
9	**Report writing assignment:** Write a report on a given topic. Use a clear prompt, a report outline, in a structured and professional format, using appropriate language and terminology.
10	**Job Application/ Cover Letter:** Write a job application in a professional format with all the necessary details.

Instructions:

- The first lab activity is mandatory
- Any six assignments other than the first lab activity to be conducted

References:

1. Seely, John. Oxford Guide to Effective Writing and Speaking. OUP 2nd edition, 2005
2. Goins, Jeff. You Are a Writer (So Start Acting Like One). Tribe Press
3. Brohaugh, William. Write Tight: Say Exactly What You Mean with Precision and Power.
4. Janzer. Anne. The Writer's Process: Getting Your Brain in Gear. Cuesta Park Consulting, 2016
5. King, Stephen. On Writing: A Memoir of the Craft. Scribner, 2010

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					**Semester: I**	
Course: Health and wellness					**Code: VRC21501**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Prepare graduates to become wellness, health, fitness, nutrition education or foodservice professionals.
2. Prepare students for a variety of careers in wellness, fitness, food and nutrition education and foodservice.

Course Outcomes: After learning the course students will be able to;

1. Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
2. Students will be able to think and act ethically in the context of health, nutrition and wellness.

Guideline:

Total: Any 5 experiments/assignments to be conducted

Detailed Syllabus:

Sr.No	**Description**
1	**Psychology of happiness:** What is happiness? What makes us happy? Socio-economic factors and happiness; Positive emotions.
2	**Can we become happier?** Genetic set-point and hedonic adaptation; Sustainable happiness model and intentional activities.
3	**Happiness Activities 1:** Expressing gratitude and positive thinking; Love and kindness; Avoiding overthinking and social comparison.
4	**Happiness Activities 2:** Identifying signature strengths; achieving happiness with “Flow”.
5	**Is happiness sufficient?** The concept of eudaimonic well-being; Self-determination and motivation.
6	**Meaning and purpose in life:** The concept of meaning in life and logo-therapy; Life goals., correlation with program specific case studies.

Reference Books:

1. W. Weiten, and M. A. Lloyd, *Psychology Applied to Modern Life*: Adjustment in the 21st Century, Wadsworth Publishing, 2007
2. R. Harington, *Stress, Health and well-being:* Thriving in the 21st century, Wadsworth Publishing, 2013.
3. I. Boniwell, *Positive psychology in a nutshell*, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, *The how of happiness*, Penguine Press, 2008.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)				**Semester: I**		
Course: On Job Training				**Code: VRC21601**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Objectives:

Student should be interacting with customer to understand their requirement with respect to problem in the appliance

Course Outcomes:

After learning the course students will be able to;

1. Apply the knowledge of HVAC system to troubleshoot the problem and repair it.
2. Engage with customer for service
3. Service, troubleshoot and repair packaged type HVAC ducted system
4. Work effectively at the workplace
5. Apply health and safety practices at the workplace
1.

Guidelines:

Students will take on job training in the industry in the domain of Refrigeration and air conditioning as per the following job description and personal attributes.

Job Role: Field Engineer

	Job Description
	The individual at work interacts with customers to install the appliance and diagnose the problem to assess possible causes of malfunction. Once the problem and causes have been identified, the individual rectifies minor problems or replaces faulty modules for failed parts or recommends factory repairs for bigger faults
	Personal Attributes
	The individual must be willing to work in the field and travel through the day from one customer's premise to another. Punctuality, amenable behaviour, patience, good interpersonal relationship building, trustworthiness, integrity, and critical thinking are important attributes.

Course Syllabus
Semester-II

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**				**Semester: II**	
Course:	**Soldering, De-Soldering, and Brazing of Components & Emergency actions**				**Code: VRC22102**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To understand the different processes of Soldering, De-Soldering, and Brazing.
2. To have the knowledge applications and safety of Soldering, De-Soldering, and Brazing.

Course Outcomes:

After learning the course, students will be able to

1. Understand the concept of Soldering, De-Soldering, and Brazing.
2. Describe the tooling of Soldering, De-Soldering, and Brazing.
3. Describe the procedure of Soldering, De-Soldering, and Brazing.
4. Understand the different applications of Soldering, De-Soldering, and Brazing.
5. Understand the Safety Precautions in Soldering, De-soldering, and Brazing.
6. Study the emergency actions.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Introduction of Soldering, De-soldering, and Brazing:** Principle of brazing and soldering, Difference between both the processes, Methods of soldering & brazing, Need of de-soldering, Methods of de-soldering	7
2	**Soldering, de-soldering, and Brazing Tooling:** Soldering tools, Brazing tools, Different types of soldering guns related to temperature and wattages, Types of tips, Different solder materials and their grading, Types of fluxes and its role in joining process, De-soldering basic components, De-soldering stations and their specifications,	7
3	**Procedure of Soldering, De-soldering, and Brazing:** Basic operational steps of soldering such as work preparation, Preparation of joint, Fluxing, and tinning, Basic steps of de-soldering, Basic operational steps of brazing such as brazing joints and surfacepreparation	8
4	**Soldering and Brazing Applications** Soldering: PCB Applications, Types of PCB, soldering asci components on PCB, Check for cold continuity of PCB, broken tracks on printed wire assemblies & discrete components mounted circuit boards, Join the broken PCB track and test, Introduction of SMD Components, Identification of loose/dry solder. Brazing: Carbide tips on tools, heat exchangers, pipe fittings, electrical parts, join dissimilar metals, porous metal components	8

5	**Safety Precautions in Soldering, De-soldering, and Brazing:** Safety precautions while Soldering &de-soldering, safety precaution while brazing, Safety tools and equipment's.	8
6	**Emergency Actions** Minimum Requirements, Reporting Emergencies, Emergency exits, Primary and secondary evacuation routes, Locations of fire extinguishers, Fire alarm pull stations' location, Assembly points, Medical Services	7

Text Books

1. Hajra Choudhury, *Elements of Workshop Technology Volume I*, Media Promoters and Publishers, 2013.
2. Hajra Choudhury, *Elements of Workshop Technology Volume II*, Media Promoters and Publishers, 2014.
3. Khanna O.P., *Welding technology*, Dhanpat Rai Publications Ltd., 1993.

Reference Books

1. Lankester J.F., *Soldering, welding, and brazing*, George Allen and Unwin, 1970.
2. Richard L. L., *Welding & Welding Technology*, MCGraw Hill Education Pvt. Ltd., 2018.

Program:	B. Voc. (Industrial Refrigeration & Air Conditioning)				Semester: II	
Course:	Basics of Electrical & Electronics				Code: VRC22202	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA1	FA2	SA	Total
3	3	3	25	25	50	100

Course Objectives:

1. To build strong conceptual understanding and fundamentals of basic electrical circuit, single phase and polyphase AC systems.
2. To impart basic knowledge for conceptual understanding of DC and AC machines
3. To acquire the basic knowledge of digital and analog electronics.
4. Familiarize students with various electrical measuring instruments and drives used in electrical and electronics engineering

Course Outcomes: After learning the course, students will be able to

1. Understand fundamental concepts of electrical engineering, DC circuits and work power and energy.
2. Apply the knowledge of single phase and three phase circuits to determine unknown electrical quantities.
3. Demonstrate the constructional features and operational details of DC and AC machines
4. Understand the concept of a number system and logic gates to implement any logic function.
5. Understand the characteristics and applications of Zener diodes, PN junction diode, LED and Photo diode.
6. Describe the different types of electrical drives and instruments used for voltage, current, and power measurements in various industrial applications.

Detailed Syllabus:

Unit	Description	Duration (45 Hrs)
1	**Elementary Concepts:** Concept of Potential difference. Current and resistance. Series and parallel circuits, Voltage and current dividers, Power and energy calculations, Ohm's law, Kirchhoff's Law, SI units of work Power and Energy, Conversion of energy from one form to another (Electricity bill verification as an activity)	7
2	**Single phase and poly phase A. C. circuits:** Generation of single phase sinusoidal A.C. voltages, AC quantities, phasor representation, Pure R, Pure L, and Pure C circuits, impedance, admittance, concept of active, reactive, apparent power and power factor. **(Verification of power factor for RL and RC circuit on multisim)** Polyphase A.C. Circuits: Introduction to 3 phase supply and its necessity, balance three phase system, relation between line and phase quantities (with phasor diagram), power in three phase circuits for star and delta connection **(Verification of line and phase values for star and delta on simulation platform)**	7

3	**DC and AC machines** **DC Machines:** Construction, working principle of D.C. generator, emf equation of DC generator (derivation not expected), working principle of D.C. motor, types of D.C. motor, Back emf (Numerical), Industrial applications. **(Demonstration of machine parts)** **AC Machines:** Single phase transformers: Construction, operating principle, emf equation, voltage and current ratios. Losses, Efficiency and regulation, Autotransformer. **(Understating of direct loading test on single phase transformer)**	8
4	**Fundamentals of Digital Electronics: Number System:** Introduction to number system, Conversion of number systems, Binary Code, 1's complement and 2's complement, Introduction to Digital Electronics: Basic logic Gates, Boolean Postulates/laws, De-Morgan Theorems. **(Verification of logic gates on digital trainer kit)**	7
5	**Basics of Semiconductor:** The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED, Photodiode **(Demonstration of above devices on Virtual labs)**	8
6	**Measuring instrument and drives:** Measurement of Voltage, Current, and Power, Study of Energy meters, Use of CT and PT for measurement of power /energy in single phase and three phase Drives: Advantages of electrical and electronic drives, individual and group drive, selection of drives depending on load characteristics. **(Case study on selection of drive)**	8

Text Books:

1. J. Nagrath and Kothari (PHI learning Pvt.Ltd). "*Theory and problems of Basic Electrical Engineering*, Eastern Economy Edition.
2. Ashfaq Husain. "*Fundamentals of Electrical Engineering*", 4 th Edition, Dhanpat Rai & Co.),
3. V. N. Mittal and Arvind Mittal,. "*Basic Electrical Engineering*", 2 nd Edition, McGrawHill.
4. V.K. Mehta. "*Basic Electrical Engineering*", 1 st Revised Edition ,S. Chand & Co. Pvt. Ltd. NewDelhi.
5. R.P. Jain, Modern Digital Electronics, Prentice Hall of India,New Delhi 4 th edition

Reference Books:

1. D. C. Kulshreshta . "Basic Electrical Engineering" ,1 st Edition ,Tata McGraw hill.
2. B. L. Theraja and A. K. Theraja S. A textbook of Electrical Technology Vol I S. Chand

Co. Pvt. Ltd. New Delhi,1 st Edition.

3. B. L. Theraja and A. K. Theraj . A textbook of Electrical Technology Vol II , S. Chand & amp; Co. Pvt. Ltd. New Delhi,1 st Edition
4. Edward Hughes. “Electrical Technology”, 10 th Edition ,Pearson.Ltd. K. Sawhney Publisher: Dhanpat Rai Publications,” A Course in Electrical and Electronic Measurements and Instrumentation.
5. R. L. Boylestad & Louis Nashlesky Electronic Devices Circuit Theory, Pearson Education.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: II	
Course: Applied Mathematics					Code: VRC22302	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA 1	FA 2	SA	Total
2	2	2	20	20	40	80

Course Objectives: This course aims at enabling students,

1. To familiarize with concepts and techniques in Elementary Calculus and Matrices.
2. To get acquainted with statistic and probability techniques.

Course Outcomes: After learning the course, students will be able to

1. Understand concepts of determinants and matrices and apply to solve simultaneous
2. linear equation system.
3. Solve differentiation and integration of different types of functions.
4. Understand the concepts related to algebra of vectors.
5. Apply statistic and probability techniques on different types of numerical data.

Detailed Syllabus:

Unit	Description	Duration (30 Hrs)
1.	**Linear Algebra:** Determinants: Definition and expansion of determinants of order 2 and 3, Cramer's rule to solve simultaneous equations in 2 and 3 unknowns Matrices: Definition of a matrix of order m X n and types of matrices, Algebra of matrices, Transpose of a matrix, Minor, cofactor of an element of a matrix, Adjoint of matrix and inverse of matrix by Adjoint method, Solution of simultaneous equations containing 2 and 3 unknowns by matrix inversion method.	7
2.	**Calculus:** **Differentiation:** Definition of derivatives, notations, Derivatives of standard functions, Rules of differentiation, Differentiation of Trigonometric, Exponential and Logarithmic function, Application of Derivatives: Geometrical meaning of derivative, tangent and normal, Maxima and minima. **Integration:** Definition of integration as anti-derivative. Integration of standard function, Rules of integration.	8
3.	**Vectors and Three-Dimensional Geometry:** Introduction to Three-Dimensional Geometry, Vectors: Definition of vector, position vector, Algebra of vectors (Equality, addition, subtraction and scalar multiplication) Dot (Scalar) product with properties, Vector (Cross) product with properties.	7
4.	**Statistics and Probability:** Measures of central tendency (mean, medium & mode) for ungrouped and grouped frequency distribution, Measures of Dispersion: range, mean deviation, standard deviation, Variance and coefficient of variation. Probability: Random Experiments and Events, Definition of probability, Addition and multiplication theorems of probability.	8

	Total	**30**

Text Books:

1. J.K. Tyagi, S. K. Tyagi, Applied Mathematics-I, Khanna Publishing House, 1st Edition, 2012
2. Reena Garg, Engineering Mathematics,, Khanna Publishing House. 1st Edition, 2021

Reference Books:

1. H. K. Dass, Applied Mathematics for Polytechnics, CBS Publishers, India, 11th Edition, 2019
2. Dr. P. K. Shrivastava, Applied Mathematics – I,, Vayu Education of India, 2016
3. H. K. Dass, Dr. R. Verma, Rajesh Verma, Introduction to Engineering Mathematics, Vol. I, S. Chand Publication, 2018
4. H. K. Dass, Dr. R. Verma, Rajesh Verma, Introduction to Engineering Mathematics, Vol. II, S. Chand Publication, 9th Edition, 2019

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: II	
Course: Soft Skills					Code: VRC22402	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	FA 1	FA 2	TW	Total
2	2	1	-	-	50	50

Objectives:

1. Analyze the significance of soft skills, particularly language proficiency, in personal and professional contexts, emphasizing their role in effective communication and interpersonal relationships.
2. Evaluate the distinction between soft skills and hard skills, discerning their respective importance and applicability in diverse situations.
3. Apply advanced listening strategies and techniques to enhance comprehension and communication effectiveness in various contexts.
4. Synthesize information from diverse texts through proficient reading skills, summarizing content accurately and concisely.
5. Create and deliver structured and engaging verbal presentations, utilizing effective speaking techniques to convey ideas convincingly and adaptively to different audiences

Course Outcomes:

After learning the course students will be able to;

1. **Understand** the importance of listening and reading skills
2. **Write** well developed paragraphs and instructions
3. **Develop** skills required for public speaking
4. **Present** themselves effectively in different contexts

Detailed Syllabus:

Sr	Description
1	**Introduction to Soft Skills with special reference to language skills** Importance, need of soft skills, Soft Skills V/s hard skills
2	**Listening Skills** Importance, Types and techniques for effective listening. Assignment:Listen and summarize the content.
3	**Reading Skills** Tips for effective reading, Types of reading. Assignment: Read the given article/text and summarize in your own words
4	**Speaking Skills 1 – Self Introductions** Tips for effective public speaking Assignment: Self introductions and describing job profiles.
5	**Speaking Skills 2 – Group Discussions** Assignment: Dos and Don'ts of a Group Discussion
6	**Speaking Skills 3 – Presentations** Assignment: Presenting ideas and thoughts before an audience.

7	**Communication Skills** Types of communication and barriers to communication. Assignment: Role play
8	**Time Management** Time Management prioritizing, urgency and importance, categorizing tasks as high, medium, or low priority, developing a structured daily, weekly, or monthly schedule to manage time efficiently. Assignment: Create a visual schedule or checklist for daily tasks, including schoolwork, chores, and free time.
9	**Problem-Solving Skills** Basics of problem solving, critical thinking, brainstorm ideas and try different approaches to find solutions, Steps in problem solving.

Instructions:

- First lab activity is mandatory
- Any six assignments other than first lab activity to be conducted

References:

1. Rao Prasad N D V, English Grammar and Composition, S. Chand and Co. Pvt.Ltd, 2017.
2. Salaria R.S., and Kumar K.B., Effective Communication Skills, Khanna book publishing co. (P)Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., English For Practical Purposes, Macmillan Publication,
    a. 2016.
4. Mishra S., and Muralikrishna C., Communication Skills for Engineers, Pearson India Publication, 2011.
5. Bhatia V., Business Communication, Khanna book publishing co. (P)Ltd, 2013.

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**				**Semester: II**	
Course:	**IT Tools I**				**Code: VRC22502**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Course Objectives:

1. To understand use of computer-based system in communication and fundamentals of Internet
2. To learn and understand MS office world using simple tools.

Course Outcomes: After learning the course, students will be able to

1. Demonstrate the computer components and how they are used for communication and networking.
2. Comprehend the use of MS office and Internet Communication

Guideline:

Total : 6 experiments/assignments to be conducted

Detailed Syllabus:

Sr No	**Description**
1	Study of Basic Computer fundamentals.
2	Demonstrate and Study of different types of computer networks and internet.
3	Create and manage professional documents using MS word.
4	Create and manage data using MS excel.
5	Create and manage presentation using power point.
6	Study of Internet Communication: Email, Social Media, etc.

Text Books:

1. Kumar B., *Mastering MS Office: Concise Handbook with screenshots*, V&S Publishers, 2017.
2. Orchids, *Microsoft Office 2007*, MS Office Series, 2018
3. Jain S., Kartika Geeta, *Microsoft Office 2010 Training Guide*, BPB Publications 2015.
4. Kurose James F., and Ross Keith W., *A Computer Networking: A top-down approach featuring the internet*, Pearson Publication, 2017.
5. Thareja Reema, *Fundamentals of Computers*, Oxford University Press, 2019.

Reference Books:

1. Ed Tittel, and Muthukumaran B., *Computer Networking*, Schaum's Outlines, TATA Mcgraw Hill Publications, 2006.
2. Peter Norton, *Introduction to Computers*, Tata Mcgraw Hill Publication, 2005.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)						**Semester: II**
Course: On Job Training				**Code: VRC22602**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Objectives:

Student should be interacting with customer to understand their requirement with respect to problem in the appliance

Course Outcomes:

After learning the course students will be able to;

1. Apply the knowledge of HVAC system to troubleshoot the problem and repair it.
2. Engage with customer for service
3. Service, troubleshoot and repair packaged type HVAC ducted system
4. Work effectively at the workplace
5. Apply health and safety practices at the workplace

Guidelines:

Students will take on job training in the industry in the domain of Refrigeration and air conditioning as per the following job description and personal attributes.

Job Role: Field Engineer

	Job Description
	The individual at work interacts with customers to install the appliance and diagnose the problem to assess possible causes of malfunction. Once the problem and causes have been identified, the individual rectifies minor problems or replaces faulty modules for failed parts or recommends factory repairs for bigger faults
	Personal Attributes
	The individual must be willing to work in the field and travel through the day from one customer's premise to another. Punctuality, amenable behaviour, patience, good interpersonal relationship building, trustworthiness, integrity, and critical thinking are important attributes.

Course Syllabus
Semester-III

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					**Semester: III**	
Course: Basics of Fluid Mechanics & Thermodynamics					**Code: VRC23103**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	FA 1	FA 2	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Properties of Fluid & Measuring Instruments** Pressure, Density, Specific Weight, Specific Gravity, Viscosity, Newton's law of viscosity, Surface Tension, Capillarity, Compressibility, Numerical on pressure, density, SP. Weight, viscosity, surface tension, capillarity. Manometers, Bourdon tube pressure gauge, Viscometer, Pitot tube	7
2	**Basic Fundamental of Fluid Mechanics** Introduction to fluid & Non fluids, Pascal's Law, Hydrostatic law, Buoyancy & floatation, Classification of fluids & regimes of flow, Continuity equation, Bernoulli's equation, Simple numerical on continuity equation & Bernoullis equation.	8
3	**First Law of thermodynamics & Application** Basic of Thermodynamics, Zeroth Law, First law for closed systems and open systems, Limitations of 1st law of thermodynamics.	8
4	**Second Law of thermodynamics & Application** Second law statements: Kelvin Plank and Clausius statement. PMMI and PMMII. Refrigerator, Heat pump, Heat Engine.	7

Text Book

1. *Fluid Mechanics*, - Dr. R.K. Bansal - Laxmi Publication (P) Ltd. New Delhi
2. *Hydraulics and Fluid* Mechanics - Modi P. N. and Seth S. M - Standard Book House.
3. *Introduction to Fluid Mechanics and Fluid Machines* – S K Som and G Biswas - TATA McGraw –Hill
4. *Engineering Thermodynamics*-P. K. Nag-Tata McGraw Hill Publications
5. *Thermal Engineering*- Mahesh M. Rathore Tata McGraw-Hill

Reference Books:

1. *Mechanics of Fluids* - Merle C. Potter, David C. Wiggert and Bassem Ramadan– Cengage Learning
2. *Fluid Mechanics*, - Cengel & Cimbla - TATA McGraw –Hill
3. *Introduction to Fluid Mechanics*, Robert W. Fox, Alan T. McDonald, John W. Mitchell, John Wiley
4. *Thermodynamics an engineers approach*-Y. Cengel & Boles- Tata McGraw-Hill

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					**Semester: III**	
Course: Basics of Fluid Mechanics Thermodynamics Laboratory					**Code: VRC23104**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Guidelines: -

1. Total experiments to be conducted are four from Part A and four from Part B
2. Total : 6 experiments/assignments to be conducted

Detailed Syllabus:

Assignment No.	**Description**
	Part A Fluid Mechanics
1	Determination of pressure using manometers (minimum two)
2	Determination of fluid viscosity and its variation with temperature.
3	Determination of Metacentric height of floating object.
4	Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.
5	Verification of modified Bernoulli's equation
	Part B Thermodynamics
6.	Determination of Calorific value of solid fuel using Bomb Calorimeter
7.	Application of first law to open systems using day to day examples
8.	Application of first law to open systems
9.	Trial on reciprocating air compressor to determine volumetric efficiency

Text Book

1. *Fluid Mechanics,* - Dr. R.K. Bansal - Laxmi Publication (P) Ltd. New Delhi
2. *Hydraulics and Fluid Mechanics* - Modi P. N. and Seth S. M - Standard Book House.
3. *Introduction to Fluid Mechanics and Fluid Machines* – S K Som and G Biswas - TATA McGraw –Hill

Reference Books:

1. *Mechanics of Fluids* - Merle C. Potter, David C. Wiggert and Bassem Ramadan– Cengage Learning
2. *Fluid Mechanics,* - Cengel & Cimbla - TATA McGraw –Hill
3. *Introduction to Fluid Mechanics,* Robert W. Fox, Alan T. McDonald, John W. Mitchell, John Wiley

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**				**Semester: III**	
Course:	**Engineering Materials**				**Code: VRC23203**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

Students are expected to study,

1. Material structure and property relationship.
2. Ferrous, Nonferrous metals and alloys.
3. Heat treatment of metals and alloys.
4. Selection of material

Course outcomes:

After learning the course, students will be able to

1. Correlate structure and properties of metals, polymers and ceramics.
2. Understand the heat treatment process of steel.
3. Select appropriate ferrous, non-ferrous alloy for given application.
4. Select the appropriate material for given application.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Introduction to materials** Classification of materials, structure of metals, polymers and ceramics, structure & property relationship, Introduction to composites and their properties. Mechanism of elastic & plastic deformation (slip and twinning)	7
2	**Heat treatment** Iron-iron carbide equilibrium diagram, critical temperatures, structure & property relationship, classification, and application of steels, Time Temperature Transformation diagrams, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalizing, Hardening & Tempering, quenching media.	8
3	**Ferrous and non-ferrous metal** Definition, classification, properties and applications of Ferrous and non-ferrous alloys, (Steels – types, composition, properties and applications) Non-ferrous Alloys - Copper, Aluminium, Lead, Tin, Zinc, Nickel, Magnesium alloys.	8
4	**Material selection** Ashby chart, calculation of performance index, material comparison matrix, IS or Unified designations of materials.	7

Text Books:

1. Dr. V. D. Kodgire, 2017. *Material Science and Engineering*, 42nd Edition, Everest publishing house.
2. W. D. Callister, 2018. *Introduction to Material Science and Engineering*, 10th Edition John Wiley.

Reference Books:

1. George E. Dieter, 2017. *Mechanical Metallurgy*, 3rd Edition, McGraw-Hill.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)						**Semester: III**
Course: Engineering Materials Lab						**Code: VRC23204**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

Students are expected to study,

1. The mechanical behaviors of materials.
2. The effect of heat treatment process and various material characterization techniques

Course Outcomes:

The Students will be able to,

1. **Examine and analyze** the mechanical behavior of materials by testing the samples referring to appropriate standards.
2. **Prepare** specimen**, observe** and **analyze** microstructure.
3. **Measure** and **analyze** effect of heat treatment on properties of materials.

Detailed Syllabus: Conduct any 6 Experiments from the following list

Assignment No.	**Description**
1.	Tension test for ductile material on Universal Testing Machine.
2.	Compression test for brittle material on Universal Testing Machine.
3.	Impact testing of materials (Charpy and Izod tests for different materials)
4.	Perform torsion test (determine the modulus of rigidity of the material)
5.	Hardness test: Brinell, Vickers. Rockwell, etc.
6.	Conduct the Non-destructive testing of materials: Dye penetrant, magnaflux.
7.	Evaluate the effect of heat treatment on given materials. (Determine the relative hardness after heat treatment of the materials)
8.	Specimen preparation and microscopic examination of given sample.

Text Books:

1. Dr. V. D. Kodgire, 2017. *Material Science and Engineering*, 42nd Edition, Everest publishing house.
2. W. D. Callister, 2018. *Introduction to Material Science and Engineering*, 10th Edition John Wiley.

Reference Books:

1. George E. Dieter, 2017. *Mechanical Metallurgy*, 3rd Edition, McGraw-Hill.

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**				**Semester: III**	
Course:	**IT Tools II**				**Code: VRC23303**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To develop advanced skills in using word processing and spreadsheet software for complex tasks and automation.
2. To introduce students to digital multimedia tools for image, audio, video editing, and screencasting.

Course outcomes:

After learning the course, students will be able to

1. Use word processors to Create and manage long documents with tables of contents, indexing, cross-references, and footnotes.
2. Utilize advanced spreadsheet features like VLOOKUP, nested functions, data validation, scenarios, and basic macros/VBA.
3. Perform basic image editing, audio/video editing, screen recording, and use online multimedia tools.
4. Collaborate effectively using cloud storage, file sharing, online office suites, and project management tools.

Detailed Syllabus:

Sr. No.	**Description**	**Duration (30 Hrs)**
1	**Advanced Word Processing** Working with long documents (Table of contents, indexing, cross-references, footnotes), Using mail merge for bulk emails/letters, collaborating on documents (Track changes, comments), Protecting and securing documents	8
2	**Advanced Spreadsheet Features** Advanced functions (VLOOKUP, IF, Nested IFs, etc.), Data validation and data entry forms, Scenarios and goal seek analysis, Introduction to macros and VBA	8
3	**Digital Multimedia** Image editing basics, Audio/video editing introduction, Screen recording and screencasting, Online multimedia tools, online video conferencing tools (google meet/Microsoft team/Zoom App etc.)	8
4	**Collaboration and Cloud Tools** Cloud storage (Google Drive, OneDrive), File sharing and collaboration, Online office suites, Introduction to project management tools, AI-based Automation (Zapier, Co-Pilot)	6

Text Books:

1. Shelly Cashman Series. 2019. *Office 365 & Office 2019 Introductory*, 1st Edition, Cengage Learning, Boston.
2. Jennifer Duffy. 2018. *Multimedia Foundations: Core Concepts for Digital Design*, 2nd Edition, Focal Press, Burlington.

Reference Books:

1. Joan Lambert and Joyce Cox. 2013. *Microsoft Word 2013 Step by Step*, Microsoft Press,

Redmond.
2. Curtis Frye. 2013. *Microsoft Excel 2013 Step by Step*, Microsoft Press, Redmond.
3. David W. Beskeen, et al. 2015. *Microsoft Office 2016 Illustrated Introductory*, First Course, Cengage Learning, Boston.
4. Katherine Murray. 2018. *Modern Desktop Environments for Virtual, Cloud, and Mobile Users*, Pearson Education, London.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: III	
Course: Business Communication - I					Code: VRC23403	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	FA 1	FA 2	TW	Total
2	2	1	-	-	50	50

Objectives:

1. Analyze the role and significance of business communication in professional and personal contexts.
2. Evaluate various types of communication and identify principles and barriers affecting effective communication.
3. Demonstrate effective interpersonal communication skills including active listening, empathy, and conflict resolution.
4. Apply non-verbal communication techniques, including body language, to enhance communication effectiveness in business scenarios.
5. Develop proficiency in professional business correspondence, including writing formal letters and resumes, and demonstrate persuasive communication skills in mock business meetings.

Course Outcomes:

After learning the course students will be able to;

1. **Apply** knowledge of fundamentals of communication in given situations
2. **Communicate** effectively using non-verbal codes
3. **Write** professional letters
4. **Demonstrate** business and social skills.

Detailed Syllabus:

Sr	Description
1	**Role and importance of Business Communication** Introduction to the art of Business Communication, Role and importance in professional and personal life, Ice-breaking activities for various scenarios, Professional Greetings, Making & Responding to Requests.
2	**Introduction to Business Communication** Types of Communication, Principles and Barriers to Communication, Overcoming Barriers to communication **Assignment:** Explain different types of communication. Provide examples of barriers to communication from your own experiences and suggest ways to overcome it.
3	**Talking about opinions and perceptions** Get recognized in the crowd: Introducing self in business environment Understand purpose of introduction, tailor self-introduction for gaining attention, find out USP (individuality, skills etc) and emphasize, assertive and expressive, Express opinions confidently in business environment, Speak with purpose, use persuasive communication.

4	**Non-Verbal communication &Body Language** Importance of Non-Verbal Communication, Non-Verbal Codes, Kinesics, Haptics, Proxemics, Chronemics, Para-language, Artifacts **Assignment:** Case Study of the role of body languagein a givensituation
5	**Interpersonal Communication Skills** Developing active listening and empathy skills in business interactions, Managing conflict and difficult conversations in the workplace
6	**Business Correspondence** Art of writing Business Letters (Understand different formats, writing with purpose, difference between day-to-day language and formal language)Write a professional resume or CV. Use a professional format. Highlight skills, experiences, and qualifications relevant to the target job or industry. **Assignment:**Developing formal business letters for different purposes
7	**Mock Business Meetings** Self- Grooming, Art of persuasion, Techniques of Short Speech & Effective Delivery of Extempore & Debate.
8	**Professional Etiquette and Networking** Understanding and practicing professional etiquette in various business settings, Building and maintaining professional relationships through networking.
9	**Emotional & Social Skills** Situational Conversations & Rapport Building through Role Play, Emotional Intelligence: Testing and Improving EI **Assignment:** Provide step by step solutions in the form of practical examples for the given case studies.

Instructions:

- All assignments are suggestive however, course teacher may devise another assignments to evaluate students
- First lab activity is mandatory

References:

1. Rao Prasad N D V, *English Grammar and Composition*, S. Chand and Co. Pvt.Ltd, 2017.
2. Salaria R.S., and Kumar K.B., *Effective Communication Skills*, Khanna book publishing co. (P)Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., *English For Practical Purposes*, Macmillan Publication,
4. 2016.
5. Mishra S., and Muralikrishna C., *Communication Skills for Engineers*, Pearson India Publication, 2011.
6. Bhatia V., *Business Communication*, Khanna book publishing co. (P)Ltd, 2013.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					**Semester: III**		
Course : Health and wellness II					**Code:VRC23503**		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**-**	**IE-1**	**IE -2**	**TW**	**Total**
2	2	1	-	-	-	50	50

Course Objectives:

1. Prepare graduates to become wellness, health, fitness, nutrition education or foodservice professionals
2. Prepare students for a variety of careers in wellness, fitness, food and nutrition education and foodservice

Course Outcomes: After learning the course students will be able to

1. Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
2. Students will be able to think and act ethically in the context of health, nutrition and wellness.

Guideline: Total: Any 5 practical assignments to be conducted.

Detailed Syllabus:

Sr. No.	**Description**
1	Positive psychology: what do you understand by positive psychology? What are benefits of positive psychology.
2	Identifying strengths: what do you understand by strengths? Classification of strengths, developmental assests. Identifying your personal strengths.
3	Living well at every stage: what is resilience? positive youth development, Life tasks of adulthood
4	Self efficacy: Definition, the neurobiology of self efficacy, self efficacy's influence in life arenas.
5	Mnemonics: method of loci, peg word system, key word method, Recall of Name, Recall of words.
6	Optimism: learned optimism -Seligman, primary prevention, primary enhancement.

Reference Books:

1. W. Weiten, and M. A. Lloyd, *Psychology Applied to Modern Life*: Adjustment in the 21st Century, Wadsworth Publishing, 2007
2. R. Harington, *Stress, Health and well-being: Thriving in the 21st century*, Wadsworth Publishing, 2013.
3. I. Boniwell, *Positive psychology in a nutshell*, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, *The how of happiness*, Penguine Press, 2008.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)				**Semester:** - III		
Course: On Job Training (QP Quality Manager / ELE Q7902)				**Code: VRC23603**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1. Identify the customer needs and concerns
2. Carry out Advanced Product Quality Planning (APQP)

Course outcomes:

After learning the course, students will be able to

1. ELE/N7906: Manage quality in the product design process
2. ELE/N7907: Manage the supplier relationship and receipt inspection process
3. ELE/N7908: Manage quality in the production process and final output
4. ELE/N7909: Manage recruitment, training and drive quality initiatives for projects
5. ELE/N9905: Work effectively at the workplace
6. ELE/N1002: Apply health and safety practices at the workplace

Guidelines: Students will do On Job Training (Industry/In house) in the domain of Industrial refrigeration and air conditioning as per the following job description and personal attributes.

Job Role: Quality Manager / ELE Q7902

Job Description

A Quality Manager - Electronics is responsible for managing quality in all organizational operations. It starts from ensuring the quality of components received from the supplier to the quality of final output, including the quality of the production process. The individual also recruits, trains and manages a team of quality inspectors and supervisors, apart from driving quality initiatives in the organization to ensure it remains competitive in the market.

Personal Attributes

The individual in this job role must possess strong leadership, management, analytical and problem solving abilities. The person must be adept at using various computer applications for efficient data and record management. The individual must have good communication skills, attention to detail and a strong sense of quality in all the activities

Reference Books:

1. Quality Manager / ELE Q7902, Version No. 1, NSQF Level 6, Electronics Sector Skill Council of India, New Delhi

Course Syllabus
Semester-IV

Program:B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: IV
Course: Refrigeration and Air Conditioning Applications					Code: VRC24105
Teaching Scheme			Evaluation Scheme		
Lecture	Hours	Credit	IE	IE	SA	Total
3	3	3	25	25	50	100

Course Objectives:

1. To understand the working and constructions of various applications in Refrigeration and Air conditioning
2. To understand the various measuring and controlling devices used on these applications.

Course Outcome:

Students will be able to

1. To understand working of domestic refrigerator and controlling devices
2. To understand working of water cooler and controlling devices
3. To evaluate COP of ICE plant
4. To understand working of window air conditioner and controlling devices
5. To understand working of split air conditioner and controlling devices
6. To understand working of Central air conditioner and controlling devices

Detailed Syllabus:

Unit	Description	Duration (45 Hrs)
1	**Domestic Refrigerator** Components of refrigerator, Construction & Working of refrigerator, Primary & Secondary refrigerant, Installation, Check list for maintenance. Frosting & Defrosting, COP, Simple Numerical on refrigerator, Measuring & Controlling devices	8 Hr
2	**Water Cooler** Components of Water Cooler, Construction & Working of water cooler, Installation, Check list for maintenance, COP, Measuring & Controlling devices	7 Hr
3	**Ice Plant** Components, Construction & Working of ice plant, Pull down test, ice formation test, CoP, Simple numerical on plant capacity calculation, Measuring & Controlling devices	8 Hr
4	**Split Air Conditioner** Components of split air conditioner, Construction & Working of split air conditioner, Installation, Check list for maintenance. Difference between Winter A/C & Summer A/C, Measuring & Controlling devices	8 Hr

5	**Central Air Conditioner** Components of central air conditioner, Construction & Working of central air conditioner, Installation, Types of duct, ducting material, method of joining duct. Heat loss through ducts, Measuring & Controlling devices	7 Hr
6	**Cold storage system** Component, working and applications of cold storage system.	7 Hr

Text Books:

1. Arora *C.P. Refrigeration & Air Conditioning*, Tata McGraw-Hill.
2. Khurmi R.S. & Gupta J.K. *Refrigeration & Air Conditioning*, Eurasia Publishing House Pvt.Ltd New Delhi, 1994.
3. Arora & Domkundwar, *Refrigeration & Air Conditioning*, Dhanpatrai & Company, New Delhi.

Reference books:

1. Manohar Prasad **,** *Refrigeration & Air Conditioning*, Willey Eastern Ltd.,1983.
2. Ballaney P.L.*Refrigeration & Air Conditioning*, Khanna Publications, New Delhi, 1994

Program:	**B. Voc. (Industrial refrigeration & Air-conditioning)**				**Semester: IV**	
Course:	**Refrigeration And Air Conditioning Applications Lab**				**Code: VRC24106**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Lab Objectives:

1. To determine performance of various refrigeration and air conditioning devices
2. To analyze VCC cycle using open-source software
3. To conduct field visit and acquaint students with industrial practices

Lab Outcomes:

Students will be able to

1. Determine COP for Various applications in Refrigeration and Air conditioning
2. Analyze VCC cycle using coolpack software
3. Understand and relate theory and industrial practices through visit

List of Practical's

1. Test on Vapour Compression System Test Rig.
2. Test on Mini Air Conditioning System Test Rig.
3. Test on Ice Plant Test Rig
4. Test on Heat Pump Test Rig.
5. Analysis of Refrigeration and Air Conditioning System using Cool Pack Software.
6. Installation & Maintenance of Air conditioners.
7. Charging & leakage detection in RAC system
8. Visit to Air Conditioning Plant.
9. Visit to Refrigeration Plant.

Text Books:

1. Arora C.P. *Refrigeration & Air Conditioning*, Tata McGraw-Hill, 3rd edition, 2017
2. Khurmi R.S. & Gupta J.K. *Refrigeration & Air Conditioning*, Eurasia Publishing House Pvt.Ltd New Delhi,5th edition, 2011.

Reference books:

1. Manohar Prasad**,** *Refrigeration & Air Conditioning*, Willey Eastern Ltd.3rd edition, 2015.
2. Ballaney P.L. *Refrigeration & Air Conditioning*, Khanna Publications, New Delhi,19th edition,1994

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**				**Semester: - IV**	
Course:	**Metrology and Measuring Instruments**				**Code: VRC24205**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. Understand various basic principles of engineering metrology and methods of measurement.
2. Identify and interpret various comparators, optical and interferometry measurement setups.

Course outcomes:

After learning the course, students will be able to

1. Understand appropriate measurement standards and principles.
2. Identify and explain appropriate method of measurements.
3. Interpret the need and classify comparators with their details.
4. Summarize the optical and interferometry measuring instruments.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs.)**
1	**Basic Principles of Engineering Metrology** Introduction, need, accuracy, precision, errors in measurement, Abbe's principle, standards of measurements: material, wavelength, line and end standards	
2	**Methods of measurements** **Linear measurements:** scaled instruments, vernier instruments, micrometer instruments, slip gauges. **Angular measurements**: protractor, sine bar, angle gauges, spirit level, optical instruments. **Calibration of measuring instruments** **Measurement of complex profiles: Terminologies-** Gear and threads, measurement of gear geometry using gear tooth caliper, and measurement of screw thread parameters using profile projector and floating carriage micrometer.	8
3	**Comparators** Introduction, functional requirements, classification, mechanical comparators, mechanical-optical comparators, electrical comparators, pneumatic comparators.	7
4	**Optical Measurement and Interferometry** Tool makers microscope, profile projector, interferometry, types of interferometers, scales, gratings and reticles	7

Text Books:

1. Jain R. K., *Engineering Metrology*, Khanna Publication.
2. N. Raghavendra, L. Krishnamurthy., *Engineering Metrology*, Oxford University Press, 2013.

Reference Books:

1. ASTME, *Handbook of Industrial Metrology*, Prentice Hall of India Ltd.
2. Connie Dotson, *Fundamentals of Dimensional Metrology*, Thomson, 4th Edition.

Program: B. Voc. (Industrial Refrigeration & Air Conditioning)					Semester: IV	
Course: Business Communication - II					Code: VRC24404	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	FA 1	FA 2	TW	Total
2	2	1	-	-	50	50

Objectives:

1. Analyse effective strategies for handling customer inquiries and complaints in a timely and courteous manner to maintain customer satisfaction.
2. Evaluate various digital and visual communication tools for their suitability in business contexts, and apply them effectively to enhance communication impact.
3. Explore the concept of social networking for professional purposes, including the creation of a comprehensive LinkedIn profile, to expand professional connections and opportunities.
4. Develop interview skills through research, preparation, and practice, including crafting tailored responses to common interview questions and formulating insightful questions for the interviewer.
5. Apply storytelling techniques to craft compelling narratives for business communication, and understand the importance and structure of common business documents in various contexts, including negotiation simulations and business plan presentations.

Course Outcomes:

After learning the course students will be able to;

1. **Demonstrate** the skills of handling customer and clients
2. **Use** digital tools effectively to present or communicate as per situation
3. **Appear** confidently for business meetings and interviews
4. **Write** professional drafts and proposals.

Detailed Syllabus:

Sr No	Description
1	**Introduction** Introduction to Business Communication and its importance.
2	**Handling Customer Inquiries and Complaints** Strategies for responding to customer inquiries promptly and courteously, Techniques for addressing customer complaints effectively to maintain customer satisfaction **Assignment**: Develop a comprehensive response plan for handling customer inquiries and complaints, focusing on promptness, courtesy, and satisfaction maintenance.
3	**Digital and Visual Communication Tools** Utilizing digital tools and platforms for effective business communication. **Assignment**: Create a visually engaging presentation or document using digital tools, demonstrating effective communication techniques to enhance impact.
4	**Social Networking** Content: What is Social networking; networking through social media platforms like LinkedIn, Indeed, for professional purposes. **Assignment**: Create and launch a full-fledged LinkedIn profile with all relevant details.

	Submit printouts of LinkedIn Bio, Qualifications and Other important sections.
5	**Interview Skills** Researching the company and role, practicing responses to common questions, and preparing questions to ask the interviewer. **Assignment:** Develop a set of interview questions tailored to a specific job role, considering both traditional and behavioral-based questions.
6	**Business Storytelling** Crafting compelling stories and using storytelling techniques for business communication.
7	**Understanding Business Documents** Introduction to common business documents (e.g., invoices, receipts).
8	**Negotiation Simulation:** Negotiation exercise, practicing persuasive communication, active listening, and conflict resolution skills. **Assignment:** Compose a pitch /oral presentation on the given topic and submit the write-up of the same. (Evaluation will be based on both oral and written content.)
9	**Business Plan: Writing & Presentation** Content: Elevator pitch, Business plan proposal, presenting a business proposal **Assignment**: Create a basic business plan proposal and present it in the form of an Elevator pitch.
10	**Advanced Business Writing Skills** Techniques for writing business documents, such as proposals, executive summaries, and business plans, Incorporating data and research into written communication effectively **Assignment**: Create proposal for business purpose in a professional format.

Instructions:

- All assignments are suggestive however; course teacher may devise other assignments to evaluate students.
- Any five assignments are mandatory

References:

1. Rao Prasad N D V, English Grammar and Composition, S. Chand and Co. Pvt. Ltd, 2017.
2. Salaria R.S., and Kumar K.B., Effective Communication Skills, Khanna book publishing co. (P)Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., English For Practical Purposes, Macmillan Publication,
4. 2016.
5. Mishra S., and Muralikrishna C., Communication Skills for Engineers, Pearson India Publication, 2011.
6. Bhatia V., Business Communication, Khanna book publishing co. (P)Ltd, 2013.

Program:	**B. Voc. (Industrial Refrigeration & Air Conditioning)**					**Semester: - IV**
Course:	**Environmental Science**					**Code: VRC24504**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

To study components of the environment, their function, quality, issues related to the environment, the effect of quality degradation on human beings, and their solutions.

Course Outcomes:

After learning the course, students will be able to

1. Measure atmospheric metrological parameters and interpret the results.
2. Determine water quality parameters and interpret the results.
3. Distinguish different component of the environment and their function and sustainable development.

Detailed Syllabus:

Assignment No.	**Description**
	Any Five experiments from assignments 1 to 9.
1	**Experiment Name –** Measurement and interpretation of metrological parameters of the atmosphere. **Content** Use a weather sensor or weather station to measure metrological parameters such as temperature, wind direction, wind speed, humidity, rainfall, air pressure, solar radiation, etc**.**
2	**Experiment Name –** Determine the water quality of a given location using a water monitoring kit. **Content** Determine the water quality, such as pH, Temperature, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Turbidity, etc., of a given location using a water monitoring kit. Compare results with BIS standards.
3	**Experiment Name –** Determine total hardness of water sample. **Content** Determine total hardness of various types of water samples. Compare results with standards and write observations/conclusions.
4	**Experiment Name –** Prepare water audit report of the college/house/locality/colony/ industry. **Content** Prepare a water audit report of the college/house/locality/colony/ industry for water quantity and quality with observations and recommendations.
5	**Experiment Name –** Visit a Water Treatment Plant (WTP) or Sewage Treatment Plant (STP). **Content**

	Study various unit's operations and processes of water and wastewater treatment.
6	**Experiment Name –** Inspect solid and liquid discharge of the college/colony/industry and develop a management plan. **Content** Inspect solid and liquid discharge of the college/colony/industry and develop a management plan with schematic diagrams and photographs.
7	**Experiment Name –** Determine the noise level to find out its direct exposure to communities. **Content** Determine noise level using a sound level meter or noise dosimeter at various locations. Compare the results with standards and write observations/conclusions.
8	**Experiment Name –** Propose a model for pollutant removal. **Content** Propose a model for the treatment or removal of any type of contaminant or pollutant from water/ wastewater/air/soil. Demonstrate the mechanism of working and its application.
9	**Assignment Name –** Calculate environmental footprint. **Content** Calculate environmental footprint such as water footprint/ carbon footprint/ energy footprint, etc.

Text Books:

1. *Water Supply Engineering,* S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).
2. *Environmental Science: A Practical* Manual Author: G. Swarajya Lakshmi ISBN: 9788178002286

Reference Books:

1. *Standard Methods for examination of water and wastewater,* Mary Franson, American Public Health Association.
2. *IS 10500:2012* Drinking water specifications.
3. *IS 3025: 2013,* Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.
4. *Water Supply and Sanitary Engineering,* G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).

Program: B. Voc. (Industrial refrigeration & Air conditioning)				**Semester:** IV		
Course: Mini Project				**Code: VRC24604**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
4	**4**	**2**	**-**	**-**	**50**	**50**

Guidelines to the Students:

1. **Group Size:** The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of the work.
2. **Selection and approval of Topic:** Topic should be related to real life application/Thrust areas in the above application fields but not limited to.

Note: The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal/external guides. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

Detailed Syllabus:

Task	**Description**
	A Project based learning approach will be followed for this course and hence the experiments will be a small project built by the students in the following application fields (Thrust areas). **The application fields (Thrust areas) are as follows:** Cold storage for Agricultural, Health and Hygiene, Industry refrigeration & air condition applications, Automobile cooling, Cold chain in Logistics & Transportation, Energy, etc. **Design of VCR System**

Program:B. Voc. (Industrial Refrigeration & Air Conditioning)				**Semester:** - IV		
Course:	**On Job Training (**QP Quality Manager / ELE Q7902)			**Code: VRC24605**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1. Identify the customer needs and concerns
2. Carry out Advanced Product Quality Planning (APQP)

Course outcomes:

After learning the course, students will be able to

1. ELE/N7906: Manage quality in the product design process
2. ELE/N7907: Manage the supplier relationship and receipt inspection process
3. ELE/N7908: Manage quality in the production process and final output
4. ELE/N7909: Manage recruitment, training and drive quality initiatives for projects
5. ELE/N9905: Work effectively at the workplace
6. ELE/N1002: Apply health and safety practices at the workplace

Guidelines: Students will do On Job Training (Industry/In house) in the domain of Industrial refrigeration and air conditioning as per the following job description and personal attributes.

Job Role: Quality Manager / ELE Q7902

Job Description

A Quality Manager - Electronics is responsible for managing quality in all organizational operations. It starts from ensuring the quality of components received from the supplier to the quality of final output, including the quality of the production process. The individual also recruits, trains and manages a team of quality inspectors and supervisors, apart from driving quality initiatives in the organization to ensure it remains competitive in the market.

Personal Attributes

The individual in this job role must possess strong leadership, management, analytical and problem solving abilities. The person must be adept at using various computer applications for efficient data and record management. The individual must have good communication skills, attention to detail and a strong sense of quality in all the activities

Reference Books:

- Quality Manager / ELE Q7902, Version No. 1, NSQF Level 6, Electronics Sector Skill Council of India, New Delhi

Course Syllabus
Semester-V

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**				**Semester: V**	
Course:	**RAC Piping System**				**Code: VRC25106**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. Introduction to refrigeration piping standards
2. Understanding about pipe fittings and flow through pipes

Course outcomes:

After learning the course, students will be able to

1. Understand the piping codes
2. Understand the piping codes for the boiler system
3. Understand the components involved in piping system
4. Identify and Select pipe material as per the application
5. Analyse flow through pipes
6. Evaluate pipe sizing

Detailed Syllabus:

Unit	Description	Duration (45 Hrs)
1	**Introduction to piping codes** Need, types, Comparison between code and standard, ASHRAE building management & construction codes, Standards and Specifications: Piping codes, ASME codes and standards, ASTM Specifications, TEMA C	7
2	**Piping codes for boiler system and Air conditioning and refrigeration** ASME Boiler, Pressure vessel codes, ASME B31.3 code for pressure piping, ASME Sec VIII Div1 mechanical strength, testing of piping system and valves, fabrications., Insulation IS14164 or ASTMC 680, Vibration-IS12075, Safety Code - ASHRAE 15, ASHRAE 147, Noise - AHRI575-2008	7
3	**Introduction of piping system** Piping Components: Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material, specifications, pipe ends, pipe fittings, pipe support, piping layout, safety and maintenance	7
4	**Pipe fittings** 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. Schedule for pipe as per grade**,** pipe fitting tools, pipe joining methods, testing	8
5	**Flow through pipe** Viscosity, Types of flow, dimensionless number, significance, Reynolds number, friction factor, Darcy Weisback friction factor, friction factor for	8

	laminar and turbulent flows, equivalent pipe length, hydraulic radius, compressible flow	
6	**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.Application study – Physical measurement on-site	8

Text Books:

1. Fluid Mechanics, - Dr. R.K. Bansal - Laxmi Publication (P) Ltd. New Delhi
2. Hydraulics and Fluid Mechanics - Modi P. N. and Seth S. M - Standard Book House.
3. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas - TATA McGraw –Hill

Reference Books:

1. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
2. The fundamentals of piping design by Peter Smith.
3. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore.
4. ASHRAE handbook, 2002

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**				**Semester: V**	
Course:	**RAC Piping System Lab**				**Code: VRC25107**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA1**	**FA2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Study of piping codes, ASME codes and standards, ASTM Specifications
2. Study different valves, pipe sizing calculations

Course Outcomes:

After learning the course, students will be able to

1. Understand piping codes
2. Select pipe fittings and material as per compliance
3. Study different valves used in piping system
4. Study of NPSH required for pumps
5. Study of different leak detection methods

Detailed Syllabus:

Assignment	**Description**
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 different leak detection methods
8	Checking the performance of the air ducting system

Text Books:

1. Fluid Mechanics, - Dr. R.K. Bansal - Laxmi Publication (P) Ltd. New Delhi
2. Hydraulics and Fluid Mechanics - Modi P. N. and Seth S. M - Standard Book House.
3. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas - TATA McGraw –Hill

Reference Books:

1. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
2. The fundamentals of piping design by Peter Smith.

3. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore.
4. ASHRAE handbook, 2002

Program:	**B. Voc. (B. Voc. (Industrial Refrigeration & Airconditioning))**				**Semester: V**	
Course:	**Automobile Air Conditioning (AAC)**				**Code: VRC25108**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

To understand the concept of air conditioning system and its working principle used in automobiles and to apply these concept for repair and maintenance.

Course outcomes:

After learning the course, students will be able to

1. Identify various components of Vehicle Air conditioning and heating system.
2. Apply the knowledge of different refrigerants for selection in various air conditioning and heating system.
3. Analyze the heat load for various air conditioning and heating system.
4. Understand the duct system, Air flow, and control equipment used in Air conditioning system.
5. Diagnose various faults in air conditioning system by using suitable tools and instruments.
6. Understanding the different types of air conditioning and heating system.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Automobile Air Conditioning**: Introduction to Automobile Air Conditioning Methods of refrigeration. Vapour compression refrigeration system, Automobile air conditioning, air conditioning for passengers, isolated vehicles, Refrigerated transport vehicles, applications related with very low temperatures.	7
2	**Refrigerant used in Automobile AC:** Refrigerants in Automobile AC, Importance of Refrigerant, Classification, properties, selection criteria, nomenclature, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants, applications of refrigerants, refrigerants used in automobile air conditioning, New age refrigerant for AAC	7
3	**Heat Load Analysis**: Design Automobile AC system, Load Calculations & Analysis, Design considerations for achieving desired inside/room conditions with respect to prevailing outside/environment conditions. Factors affecting/contributing towards the load on refrigeration & air conditioning systems, Cooling & heating load calculations, Load calculations for automobiles, Effect of air conditioning load on engine	8
4	**Air Distribution Systems: Distribution** ducting, sizing, supply / return air ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculations, Air Routing & Temperature Control, Objectives of the dashboard re-circulating unit, automatic temperature control, controlling flow, control of air handling systems & air flow , evaporator care	8
5	**AC Service & Control Air Conditioning Service**: Air conditioner maintenance & service , removing & replacing Components, Compressor	8

	service, Testing, Diagnosis & troubleshooting of air conditioning system, Refrigerant charging procedure &. Servicing of heater system, Common controls in Automobile AC such as thermostats, humidistat, control dampers, pressure cut outs, relays. Reading chart and identification of pre and post differentiation in readings with respect to set parameters.	
6	**Automobile Air Conditioning System Layouts:** Classification of Automobile layouts, central and unitary air conditioning systems, System components, Switches and electrical wiring circuit.	7

Text Books:

1. Warren Farnell and James D. Halderman, "Automotive Heating, Ventilation, and Air Conditioning systems", Classroom Manual, Pearson Prentice Hall, 2004 .

Reference Books:

1. Refrigeration and Air Conditioning, Sadhu Singh, Khanna Publishing House
2. Automobile Mechanics, A.K. Babu, Khanna Publishing House

Program:	**B. Voc. (Industrial Refrigeration & Air-Conditioning)**	**Semester: V**
Course:	**Automobile Air Conditioning Lab**	**Code: VRC25109**

Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA1**	**FA2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To understand the concept of air conditioning system and its working principle used in automobiles and to apply these concepts for repair and maintenance.
2. Student should be able to know the working of different conventional and non-conventional refrigeration system, its application.

Course Outcomes:

After learning the course, students will be able to

1. Understand heat load capacity of AC vehicle and design the system as per requirement.
2. Apply knowledge of air conditioning system during installation in vehicle.
3. Analyze fault in automobile AC and knowledge to repair it.
4. Charge the automobile AC system.
5. Understand the concept of non-conventional refrigeration system.

Detailed Syllabus:

Assignment	**Description**
1	**Study the load requirement of AC in the vehicle** Understand the factors affecting the cooling load of an automobile AC system. Calculate the cooling capacity required for efficient air conditioning.
2	**Refrigerant Handling & Fixing Common AC Problems** Use a leak detector or soap solution to find leaks. Learn how to recover, evacuate, and recharge refrigerant using an AC machine. Check for low cooling, strange noises, or weak airflow. Inspect compressor, condenser, expansion valve, and blower motor.
3	**Select the components for Automobile AC System** Identify and understand the function of each component in an automobile AC system. Analyze & compare different types of AC components used in modern vehicles.
4	**Retrofitting to a New Refrigerant** Remove old refrigerant and clean the system. Replace O-rings, drier, and compressor oil.
5	**Performance Testing of an Automobile AC System** Measure the temperature at various points (evaporator inlet, outlet, cabin air, etc.). Check pressure readings at the low-pressure and high-pressure sides using AC manifold gauges. Calculate the coefficient of performance (COP) and cooling efficiency.

Text Books:

1. Kirpal Singh. 2011. *Automobile Engineering* Volume II, 13th Edition, Standard Publishers Distributors, New Delhi, India.
2. Deshpande, P.S. 2013. *Automotive Air-conditioning and Refrigeration*, 1st Edition, Nirali Prakashan, Pune, India.
3. Srinivasan, N. & Shanmugam, N. 2010. *Automobile Air Conditioning*, 1st Edition, Tata McGraw-Hill, New Delhi, India.
4. Halderman, J.D. 2017. *Automotive Heating and Air Conditioning*, 6th Edition, Pearson Education, Boston, MA.

Reference Books:

1. Arora, C.P. 2000. *Refrigeration and Air Conditioning*, 3rd Edition, Tata McGraw-Hill, New Delhi, India.
2. Khurmi, R.S. & Gupta, J.K. 2017. *Refrigeration and Air Conditioning*, 2nd Edition, S. Chand Publishing, New Delhi, India.
3. Ramalingam, K.K. 2006. *Automobile Engineering*, 1st Edition, Scitech Publications, Chennai, India.
4. Cengel, Y.A. & Boles, M.A. 2015. *Thermodynamics - An Engineering Approach*, 8th Edition, McGraw Hill Education, New York, NY.

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**				**Semester: V**	
Course:	**Industrial Management**				**Code: VRC25206**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To understand the different sector of Industrial Engineering.
2. To have the knowledge of wages and incentive policies.

Course outcomes:

After learning the course, students will be able to

1. Understand the concept of Industrial engineering.
2. Describe the Private and Public sector concept and Identify their functions.
3. Understand the different wages, incentives policies.
4. Study the different material management skills in industry.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Introduction to Industrial Management:** Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis.	7
2	**Public Sector and Private Sector** Public sector enterprise, Privet sector enterprise, merits and demerits of public sector industry and private sector industry. Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments.	8
3	**Wages & Incentives:** Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee's state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman.	7
4	**Material Management and Industrial Practices:** Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards Plant Department: Production, Engineering Design, Quality Purchase Inventory	8

Text Books:

1. Sharma S.C., 2022, *Industrial Engineering & Management*, 2nd Edition, Khanna Publishing House, India

Reference Books:

1. Martand T. Telsang, 2018, *Industrial Engineering and Production Management, 3rd Edition, S. Chand Publication, India*

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**				**Semester: V**	
Course:	**On Job Training (ELE/Q9801)**				**Code: VRC25606**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. Students should carry out initiation and planning and resource management and necessary approval at the beginning of a project.
2. Students should manage the project execution along with monitoring, controlling and closure of the project.

Course outcomes:

1. Carry out project initiation and Planning
2. Participate in resource planning and procurement
3. Obtain the necessary approvals
4. Manage the project execution, monitor and control the project
5. Carry out project closure

Guidelines

Students will take on job training in the industry in the domain of IRAC as per the following job description and personal attributes.

Job Description

A Project Manager - Electronics is responsible for planning, overseeing and leading projects from ideation to completion. This includes liaison with the project stakeholders and third-party vendors to ensure timely and successful delivery of projects. The individual may be responsible for managing multiple projects according to the size of the organization

Personal Attributes

The individual must have managerial, organisational and problem-solving skills. The person must have good written and verbal communication skills with the ability to multi-task and coordinate with multiple parties simultaneously to achieve the work objectives.

Course Syllabus
Semester VI

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**	Semester: VI
Course:	**Non-conventional Refrigerating System (NCRS)**	Code: **VRC26110**

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA 1	FA 2	SA	Total
3	**3**	**3**	**20**	**25**	**50**	**100**

Course Objective

Student should be able to know the working of different non-conventional refrigeration system, its application

Course Outcome:

After learning this course students will able to

1. Understand working of Lithium bromide vapour absorption system.
2. Understand working of aqua ammonia vapour absorption system
3. Understand types and working of evaporative cooling system
4. Understand the steam jet refrigeration system
5. Understand thermo electric refrigeration system
6. Understand types and working of radiant cooling system

Detailed Syllabus:

Unit	Description	Duration (45 Hrs)
1	**Vapour Absorption Refrigeration System** Principle of absorption system, comparison between vapour compression system and vapor absorption system, theory of binary mixtures, Its components, working principle, b. Lithium-bromide- water absorption system its components, working principle, and mathematical analysis	8
2	**Aqua-ammonia vapour absorption system** Theory of mixtures, temperature concentration diagram and enthalpy concentration diagram, processes used in aqua-ammonia absorption system, adiabatic mixing, separation, throttling process,	7
3	**Evaporative Cooling System(ECS)** Construction and working of ECS, Direct indirect ECS, performance analysis	7
4	**Steam Jet Refrigeration System** Introduction, steam jet refrigeration system, components of steam jet refrigeration system, advantage and limitation of steam jet refrigeration system, performance of steam jet refrigeration system	8
5	**Thermo-Electric Refrigeration System** Introduction, thermo-electric effects, Seebeck effect, Peltier effect, Thomson effect, Concept of desiccant wheel	7
6	**Radiant cooling system** Types of radiant cooling system, layout, construction and working of system, Performance analysis of system	8

Books:

Reference Books:

1. ISHRAE standard book for Refrigeration and Air Conditioning
2. ASHRE hand book for Refrigeration and Air Conditioning
3. Refrigeration and Air Conditioning, Sadhu Singh, Khanna Publishing House
4. International Standards in Refrigeration and Air Conditioning , UNEP (United Nations Environment Program)
5. Refrigeration and Air Conditioning data book, New Age International Publication

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**			**Semester:** VI		
Course:	**Non-conventional Refrigerating System Lab**			**Code: VRC26111**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Course Objective

Student should be able to know the working of different conventional and non-conventional refrigeration system, its application.

Course Outcome:

After learning this course students will able to

1. Understand the concept of non-conventional refrigeration system
2. Application of non-conventional AC system in residential/commercial facility.

Guidelines:

1. Total : 8 experiments/assignments to be conducted

Detailed Syllabus:

1. Trial on Electrolux refrigerator
2. Trial on evaporative cooling system
3. Case study of Desiccant wheel
4. Case study of radiant cooling system
5. Case study on Direct Indirect Evaporative cooling system
6. Case study on thermoelectric refrigeration system.
7. Industrial visit to Radiant cooling air conditioning facility
8. Industrial visit to Vapour absorption based air conditioning facility

Books:

Reference Books:

1. ISHRAE standard book for Refrigeration and Air Conditioning
2. ASHRE hand book for Refrigeration and Air Conditioning
3. Refrigeration and Air Conditioning, Sadhu Singh, Khanna Publishing House
4. International Standards in Refrigeration and Air Conditioning , UNEP (United Nations Environment Program)
   Refrigeration and Air Conditioning data book, New Age International Publication

Program:	B. Voc. (Industrial Refrigeration & Air-conditioning)		Semester: VI			
Course:	Process Planning and Cost Estimation		Code: VRC26207			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA1	FA2	SA	Total
2	2	2	20	20	40	80

Course Objectives:

To introduce the process planning concepts to make cost estimation for various products after process planning.

Course outcomes:

After learning the course, students will be able to

1. Select the process, equipment and tools for various industrial products.
2. Prepare process planning activity chart.
3. Explain the concept of cost estimation.
4. Estimate time requirement for execution of project.

Detailed Syllabus:

Unit	Description	Duration (30 Hrs)
1	**Introduction to Process Planning** Process Planning—Definition, Purpose, Concept, Objectives, Scope and Information required to do Process Planning, Preparing Operation Planning Sheet	8
2	**Process Planning activities** Process Planning Procedure, Approaches of Process Planning, Manual Process Planning, Computer Aided Process Planning, Factors Affecting Selection Process, Machine Capacity, Determination of Man, Machine and Material Requirements, Factors Influencing Choice of Machinery	7
3	**Introduction to Cost Estimation** Reasons for doing Estimates, Importance of Estimating, Objectives or Purpose of Estimating, Functions of Estimating, Cost Accounting of Costing, Importance of Costing, Aims of Cost Accounting, Difference Between Cost Estimating and Cost Accounting, Cost of Product (Ladder of Cost) Production Cost Estimation, Determination of Material Cost, Mensuration in Estimating	9
4	**Assembly & Installation Time Calculation** Time calculation: Study of RAC requirement, design of RAC System, Selection of RAC components & material, Fabrication of ducts and distribution system, installation of RAC System, Testing of RAC System.	6

Text Books:

1. M. Adithian and B. S. Pabla, Estimation and Costing, Konark publishers Pvt. Ltd., 1989.
2. A. K. Chitale and R. C. Gupta, Product Design and Manufacturing, Prentice Hall Pvt. Ltd.., 2005

Reference Books:

1. Namua Singh, System Approach to computer integrated Design and Manufacturing, John Wiley & Sons, Inc.,1996.
2. Joseph G Monks, Operation Management, Theory & Problems, McGraw Hill Book Company, 1987.
3. T. R. Banga and S. C. Sharma, Estimations and Costing, Khanna Publishers,1988.
4. G. B. S. Narang and V. Kumar, Production and Costing, Khanna Publishers, 1995.
5. "HVAC Handbook", Part I and II, ISHRAE

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**				**Semester: VI**	
Course:	**Project**				**Code: VRC26607**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
8	**8**	**4**	**50**		**150**	**200**

Objectives:

1. To provide an opportunity of designing and building complete systems or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them get confidence by planning and carrying out the project's work plan and to complete the same through observations, discussions successfully, and the decision-making process.
5. To get visibility in the industry to Project and Project Group

Course Outcome:

After learning this course students will able to

1. Demonstrate sound academic fundamentals to formulate and analyze complex Mechanical engineering problems.
2. Provide creative/ innovative solutions for complex engineering problems.
3. Design Mechanical systems/products/processes for providing solutions to environmental issues/ needs of society/Industry/ safety issues.
4. Apply modern modeling and simulation techniques/ computing tools.
5. Work effectively as a team member / Leader in order to manage the project work and finance.
6. Write a report on the research work and present it effectively

Based on learning in the vocational degree, a project to be taken up by the student strengthening his/ her vocational skills

Program:	**B. Voc. (Industrial Refrigeration & Air-conditioning)**				**Semester: VI**	
Course:	**On Job Training (ELE/Q9801)**				**Code: VRC26608**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. Students should carry out initiation and planning and resource management and necessary approval at the beginning of a project.
2. Students should manage the project execution along with monitoring, controlling and closure of the project.

Course outcomes:

1. Carry out project initiation and Planning
2. Participate in resource planning and procurement
3. Obtain the necessary approvals
4. Manage the project execution, monitor and control the project
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A Project Manager - Electronics is responsible for planning, overseeing and leading projects from ideation to completion. This includes liaison with the project stakeholders and third-party vendors to ensure timely and successful delivery of projects. The individual may be responsible for managing multiple projects according to the size of the organization

Personal Attributes

The individual must have managerial, organisational and problem-solving skills. The person must have good written and verbal communication skills with the ability to multi-task and coordinate with multiple parties simultaneously to achieve the work objectives.