



**KALINGA
UNIVERSITY**

SCHEME & SYLLABUS FOR

Bachelor of Vocational Studies (B.Voc.) Refrigeration and Air Conditioning



Kalinga University, Naya Raipur, Chhattisgarh

B. VOC. IN REFRIGERATION AND AIR CONDITIONING

Semester - I							
Subject Code	Subject	L	T / P	Credits	Internal Marks	External Marks	Total
BVRAC101	Communication Skills	3	0	3	30	70	100
BVRAC102	Fundamentals of Information Technology	3	0	3	30	70	100
BVRAC103	Basics of Thermodynamics	3	0	3	30	70	100
BVRAC104	Basics of Air Conditioning	3	0	3	30	70	100
BVRAC105P	Industrial Training/ On Job Training/ Workshop	0	36	18	50	150	200
Total		12	36	30	170	430	600

Semester - II							
Subject Code	Subject	L	T / P	Credits	Internal Marks	External Marks	Total
BVRAC201	Basics of Refrigeration	3	0	3	30	70	100
BVRAC202	Environmental Studies	3	0	3	30	70	100
BVRAC203	Fault Analysis & Repair	3	0	3	30	70	100
BVRAC204	Soldering & De-Soldering of Components & Emergency Actions	3	0	3	30	70	100
BVRAC205P	Industrial Training/ On Job Training/ Workshop	0	36	18	50	150	200
Total		12	36	30	170	430	600

Semester - III							
Subject Code	Subject	L	T / P	Credits	Internal Marks	External Marks	Total
BVRAC301	Refrigeration & Air Conditioning Applications	3	0	3	30	70	100
BVRAC302	Thermodynamics in Refrigeration & Air Conditioning	3	0	3	30	70	100
BVRAC303	Non-conventional Refrigerating System	3	0	3	30	70	100
BVRAC304	Refrigeration & Air-conditioning Material - I	3	0	3	30	70	100
BVRAC305P	Industrial Training/ On Job Training/ Workshop	0	36	18	50	150	200
Total		12	36	30	170	430	600

Semester - IV							
Subject Code	Subject	L	T / P	Credits	Internal Marks	External Marks	Total
BVRAC401	Entrepreneurship Development Programme	3	0	3	30	70	100
BVRAC402	RAC Piping Systems - I	3	0	3	30	70	100
BVRAC403	Refrigeration & Air-conditioning Material - II	3	0	3	30	70	100
BVRAC404	RAC Maintenance - I	3	0	3	30	70	100
BVRAC405P	Industrial Training/ On Job Training/ Workshop	0	36	18	50	150	200
Total		12	36	30	170	430	600

Semester - V							
Subject Code	Subject	L	T / P	Credits	Internal Marks	External Marks	Total
BVRAC501	RAC Piping Systems - II	3	0	3	30	70	100
BVRAC502	RAC Maintenance - II	3	0	3	30	70	100
BVRAC503	RAC Installation Techniques - I	3	0	3	30	70	100
BVRAC504	RAC Safety	3	0	3	30	70	100
BVRAC505P	Industrial Training/ On Job Training/ Workshop	0	36	18	50	150	200
Total		12	36	30	170	430	600

Semester - VI							
Subject Code	Subject	L	T / P	Credits	Internal Marks	External Marks	Total
BVRAC601	RAC Installation Techniques - II	3	0	3	30	70	100
BVRAC602	RAC Standards	3	0	3	30	70	100
BVRAC603	Refrigerants	3	0	3	30	70	100
BVRAC604	Automobile Air Conditioning	3	0	3	30	70	100
BVRAC605P	Industrial Training/ On Job Training/ Workshop	0	36	18	50	150	200
Total		12	36	30	170	430	600



SEMESTER-I

COMMUNICATION SKILLS

BVRAC101

Course Objective:

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

Course outcome:

1. The purpose of this course is to introduce students to the theory, fundamentals and tools of communication
2. To develop vital communication skills which should be integral to personal, social and professional interactions.
3. One of the critical links between human beings.
4. An important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal.
5. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

CONTENTS

Unit I: Introduction:

06

Theory of Communication, Types and modes of Communication, Mediums and channels of communication, barriers to communication, English as a Global language, the Lingua Franca, Social influences on English

Unit II: Language of Communication:

06

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication, Varieties of English, Language, Accent, Dialect, Colloquialism, Historical influences on English

Unit III: Speaking Skills:

06

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech, Regional influences on English, Convergence and divergence, Linguistic Imperialism,

Unit IV: Reading and Understanding-

06

Close Reading, Reading analysis of a text - Audience and purpose, Content and theme, Tone and Mood, stylistic devices, structure Comprehension- Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit V: Writing Skills

06

Documenting Report Writing Making notes Letter writing, Writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters .It will enhance Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note taking etc. While, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

Reference Books:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. Ranjana Kaul, Dr. Brati Biswas

FUNDAMENTALS OF INFORMATION TECHNOLOGY

BVRAC102

Unit I: Computer characteristics

06

Speed, storage, accuracy, diligence; Digital signals, Binary System, ASCII; Historic Evolution of Computers; Classification of computers: Microcomputer, Minicomputer, mainframes, Supercomputers; Personal computers: Desktop, Laptops, Palmtop, Tablet; Hardware & Software; Von Neumann model.

Unit II: Hardware

06

CPU, Memory, Input devices, output devices. Memory units: RAM (SDRAM, DDR RAM, RDRAM etc. feature wise comparison only); ROM-different types: Flash memory; Auxiliary storage: Magnetic devices, Optical Devices; Floppy, Hard disk, Memory stick, CD, DVD, CD/DVD-Writer; Input devices - keyboard, mouse, scanner, speech input devices, digital camera, Touch screen Voice Input, Joystick, Optical readers, bar code reader; Output devices: Display device, size and resolution; CRT, LCD, LED; Printers: Dot-matrix, Inkjet, Laser; Plotters, Sound cards & speaker.

Unit III: Software

06

System software, Application software; concepts of files and folders, Introduction to Operating systems, Different types of operating systems: single user, multitasking, time-sharing multi-user; Booting, POST; Basic features of two GUI operating systems: Windows & Linux (Basic desk top management); Programming Languages, Compiler, Interpreter, Databases; Application software: Generic Features of Word processors, Spread sheets and Presentation software; Generic Introduction to Latex for scientific typesetting; Utilities and their use; Computer Viruses & Protection, Free software, open source.

Unit IV: Computer Networks and Internet

06

Connecting computers, Requirements for a network: Server, Workstation, switch, router, network operating systems; Internet: brief history, World Wide Web, Websites, URL, browsers, search engines, search tips; Internet connections: ISP, Dial-up, cable modem, WLL, DSL, leased line Wireless and Wi-Fi connectivity ; email, email software features (send receive, filter, attach, forward, copy, blind copy); characteristics of web-based systems, Web pages, Web Programming Languages.

Unit-V: Information Technology And Society

Indian IT Act, Intellectual Property Rights, issues. Application of information Technology in Railways, Airlines, Banking, Insurance, Inventory Control, Financial systems, Hotel management, Education, Video games, Telephone exchanges, Mobile phones, Information kiosks, special effects in Movies.

Programming Concepts & Techniques: Program Concept, Characteristics of Programme, Stages in Program Development, Tips for Program Designing, Programming Aids, Algorithms, Pseudo code, Notations, Design, Flowcharts, Symbols, Rules, compiler & Interpreter. Introduction to programming techniques, Top-down & Bottom-up approach, Unstructured, & Modular programming, Cohesion, Coupling, Debugging, Syntax & Logical Errors, Linking and Loading, Testing and Debugging, Documentation.

Reference Books:

1. Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
3. Handbook of Computer Fundamentals, N.S. Gill, Khanna Publishing House

BASICS OF THERMODYNAMICS

BVRAC103

Unit I:

06

Steam Generators: Types of steam generators - Fire tube, water tube boilers, boiler mountings and accessories, Equivalent evaporation, boiler efficiency, elements of power plant.

Reciprocating Steam Engines: Working principles, classification, a brief idea and concept only.

Steam Turbines: Classification, principle of operation of Impulse reaction steam turbines.

Unit II:

06

Steam Condensers: Principle of operation, classification, a brief concept, condenser details, applications

Air Compressors: Definition and their use, Difference between reciprocating and rotary compressors, their types and working, Inter cooling in two stage compression volumetric efficiency, Compressor lubrication. Simple numerical problems.

Unit III:

06

Internal Combustion (I.C.) Engines: Meaning and classification of I.C. engines, I.C. engines mechanism, -four stroke cycle engine and two stroke cylinder engine mechanism. Knowledge of important parts, their functions and terminology, positions of operating piston, its stroke or stroke length, Swept volume and clearance volumes, Cylinder volumes and Compression ratio.

Air standard cycles for I.C. engines-Otto and Diesel cycle and also Dual cycle, expression for their efficiencies, Concept of mean effective pressure and specific fuel consumption (Simple Numerical Problems). Brief idea of engine lubricating and cooling system.

Unit IV:

06

Basic Thermodynamics: Definition, concept of thermodynamic system and surroundings, closed system, open system, isolated system thermodynamics, definition of work, Zeroth law of thermodynamics, First law of thermodynamics for cyclic and noncyclical processes, Idea of internal energy and enthalpy, Applicability of first law on various thermodynamics processes, simple numerical problems.

Unit V:

06

Steady state flow process, its equation and its applications: Second law of thermodynamics, Thermodynamics concept of perpetual motion machine of first order and that of second order, Concept of heat engine, heat pump and refrigerator, Carnot cycle efficiency for heat engine and C.O.P for refrigerator and heat pump, Entropy: Its physical concept and significance.

Reference Books:

1. Thermal Engineering: Khurmi & Gupta
2. Thermal Engineering: AS Sarao

BASICS OF AIR CONDITIONING

BVRAC104

Unit I:	06
Introduction: Its meaning and general application. Psychrometry: Definition, Composition of air, Daltons law of partial pressure, Gas and Vapour mixture, Dry and Wet bulb temperature, Wet bulb depression, Dew point, Dew point depression, Saturated air	
UNIT II:	06
Specific humidity, Degree of saturation, Relative humidity, Absolute humidity, Humid specific volume and humid specific heat, Enthalpy of moist air	
UNIT III:	06
Use of psychometric charts and tables, Sensible heating and cooling, Humidification and dehumidification and their methods, Simple numerical problems concerning above	
Unit IV:	06
Heat Load: Brief idea of various types of heat loads, Sensible and latent heat loads. Sensible hat factor	
Unit V:	06
Room Air Conditioning: Brief idea of room air conditioning, Window types packaged air conditioner. Central air conditioning system, Round the year air conditioning	

Reference Books:

1. Refrigeration & Air Conditioning, Sadhu Singh, Khanna Publishing House
2. Refrigeration and Air Conditioning: A Sarao
3. Refrigeration and Air Conditioning: RS Khurmi

INDUSTRIAL TRAINING/ ON JOB TRAINING/ WORKSHOP BVRAC105P

SEMESTER-II

BASICS OF REFRIGERATION

BVRAC201

Unit I: 06

Introduction: Its meaning and application, unit of refrigeration; various methods of refrigeration.

Unit II: 06

Refrigeration Systems: Refrigeration Cycles: Refrigeration, carnot cycle of refrigeration (ideal cycle), Bell-Coleman cycle of refrigeration, their COP and Conditions for its highest value, Temperature limitations. Representation of these cycles, in P-V, T-S and P-H diagrams and also their flow diagrams, Simple numerical problems

Unit III: 06

Vapour compression system: Standard vapour compression cycle, wet and dry compression, Effect of sub cooling and super heating, Effect of temperature and pressure on COP of the cycle. Simple numerical problems with the help of P-H diagram. Concept of house hold refrigerator working on vapour compression cycle.

Unit IV: 06

Vapour Absorption System: Cycle of operation, Construction and working of refrigerator based on this system. Simple numerical problems (Simple line diagram)

Unit V:

Refrigerants: Definition, classification & properties of few important refrigerants such as Ammonia, Sulphur-Di-Oxide (SO₂).

Reference Books:

1. Refrigeration & Air Conditioning, Sadhu Singh, Khanna Publishing House
2. Refrigeration and Air Conditioning: A Sarao
3. Refrigeration and Air Conditioning: RS Khurmi

ENVIRONMENTAL STUDIES

BVRAC202

Unit I: Introduction to Environmental Studies

06

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development.

Ecosystems

What is an ecosystem? Structure and function of the ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

- a) Forest ecosystem
- b) Grassland ecosystem
- c) Desert ecosystem
- d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit II: Natural Resources : Renewable and Non--renewable Resources

06

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit III: Biodiversity and Conservation

06

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega--biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity : In--situ and Ex--situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit IV: Environmental Pollution

06

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit V: Human Communities and the Environment

06

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36--37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29--64). Zed Books.
8. McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzuhl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. Tripathi 1992.
14. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press.

FAULT ANALYSIS & REPAIR

BVRAC203

Unit I: Fault Classification, Identification & Rectification

08

Classification of fault, Identification of fault, Rectification of fault, Repairing/Replacing Module

Unit II: Analysis for the different types of equipment

08

- Refrigerators
- Air Conditioning

Unit III: Hardware and Software Fault Analysis

07

Hardware and Software Fault analysis based on hardware and software components, Diagnostic and Testing Methods

Unit IV: Visual Inspection

07

- Earth Continuity Test
- Insulation Resistance Test

Recommended Text and Reference Books:

1. R. S. Khandpur, Troubleshooting Electronic Equipment, McGraw-Hill Education
2. Philip Kiameh Electronic Equipment Handbook McGraw-Hill Education

SOLDERING & DE-SOLDERING OF COMPONENTS & EMERGENCY ACTIONS BVRAC204

Unit I:

06

Soldering of Basic Components

- Soldering Tools
- Different types of Soldering Guns related to Temperature and wattages, types of tips
- Solder materials and their grading
- Soldering and De-Soldering Stations and their Specifications
- Preparing Component for Soldering
- PCB Applications
- Types of PCB

Unit II:

06

De-Soldering of Basic Components

- Check for cold continuity of PCB
- Identification of loose/dry solder, broken tracks on printed wire assemblies & discrete components mounted circuit boards
- Join the broken PCB track and test
- De-Soldering using Pump and wick

Unit III:

06

Introduction to SMD Components(Soldering)

- Identification of 2, 3, 4 terminal SMD components
- Soldering the SMD components on the PCB
- Make the necessary settings on SMD soldering station to solder various ICs of different packages by choosing proper clamping tools
- Identify various connections and the setup required for SMD soldering station

Unit IV:

Introduction to SMD Components(De-Soldering)

- De solder the SMD components from the given PCB
- Make the necessary settings on SMD soldering station to de solder various ICs of different packages by choosing proper clamping tools
- Make a panel board using different types of switches for a given application
- Identification of crimping tools for various IC packages
- Reliable Soldering Practices

Unit V:

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

Recommended Text and Reference Books:

1. Bruce R. Archambeault and James Drewniak, PCB Design for Real-World EMI Control, Springer Science
2. Kraig Mitzner, Complete PCB Design Using OrCad Capture and Layout, Newnes Pub

INDUSTRIAL TRAINING/ ON JOB TRAINING/ WORKSHOP BVRAC205P

SEMESTER-III

REFRIGERATION & AIR CONDITIONING

APPLICATIONS

BVRAC301

Unit I: Food Preservation

06

Introduction, factors contributing to food spoilage, causes of food spoilage, methods of food preservation, freezing method of food preservation, preservation of food with direct contact of liquid N₂, freeze drying, preservation of different products, cold storage and commercial cabinets.

Unit II: Commercial Applications

06

Introduction, air-conditioning of houses, offices, hotels and restaurants, air-conditioning of departmental stores, air-conditioning of theatres and auditoriums, hospitals and medical applications

Unit III: Ice-Manufacturing

06

Introduction, principles of ice production, different methods of ice manufacturing, treatment of water for making ice, brines, freezing tanks, ice cans, quality of ice

Unit IV: Industrial Applications

06

Introduction, importance of RH in different industries, ice-cream manufacturing, refrigeration for breweries, selection of refrigerant for breweries, use of liquid N₂ for fabric, quality, air conditioning in textile and photographic industries

Unit V: Transport Air Conditioning

06

Introduction, automobile air conditioning, railway air-conditioning, marine air conditioning, aircraft air conditioning

Recommended books:

1. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
2. course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

Reference books:

1. Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India) (P) limited, New Delhi
2. Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi

THERMODYNAMICS IN REFRIGERATION & AIR CONDITIONING BVRAC302

Unit I:

08

Definition of thermodynamic terms: System, surroundings, Types of systems, intensive and extensive properties, Thermal equilibrium, Thermodynamic processes: isothermal, isobaric, isochoric, adiabatic, polytropic, throttling, free-expansion; Temperature: different scales of temperature, instruments used for measuring temperature, reversible and irreversible processes, first and second law of thermodynamics.

Unit II:

08

Heat, work, various methods of heat flow: conduction, convection, radiation, specific heat, sensible heat, latent heat of vapour & fusion, specific heat of gases & units of heat, melting and boiling point, absolute temperature, difference between heat and temperature, condensation, vaporization.

Unit III:

07

Applications of Thermodynamics: Carnot cycle, refrigerator and heat pump, refrigeration, equipments used in refrigeration

Unit III:

07

Application of RAC, methods of refrigeration, terminology of refrigeration, definition of TON as applied to refrigeration, C.O.P., refrigeration effect.

Reference Books:

1. Refrigeration & Air-Conditioning, By - S. Domkundwar; Dhanpat Rai & Sons
2. Refrigeration & Air-Conditioning, By - S.C. Arora; Dhanpat Rai & Sons
3. A Course in Thermodynamics, By - P.L. Batlaney; Khanna Publishers

NON-CONVENTIONAL REFRIGERATING SYSTEM

BVRAC303

Unit I:	06
Vapour Absorption Refrigeration System: Principle of absorption system, comparison between vapour compression system and vapor absorption system, theory of binary mixtures	
Unit II:	06
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	
Unit III:	06
Vapour absorption system its components, working principle and mathematical analysis, b. Lithium-bromide- water absorption system its components, working principle, and mathematical analysis	
Unit IV:	06
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	

Thermo-Electric Refrigeration System: Introduction, thermo-electric effects, Seebeck effect, Peltier effect, Thomson effect

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

REFRIGERATION & AIR-CONDITIONING MATERIAL – I BVRAC304

Unit I:	06
Introduction, desired properties of ideal insulating material, factors effecting the thermal conductivity	
Unit II:	06
Types of insulating material., reflective insulating blinds, laprock – a thermal acoustic and fire insulation, natural insulator, new transparent heat insulator, heat transfer through insulation used for A.C	
Unit III:	06
Thickness of insulation, few insulated systems, low temperature insulations, importance of relative humidity for the selection of the insulations, air distribution for reducing heat lose.	
Unit IV:	06
Cables and Wiring: Cryocables, economics of cryocables, A.C. super conducting cables, liquid N2 cooled cables, Liquid H2 cooled cables, super magnet, electric generator, minimal insulated cables, installing cables	
Unit V:	06
Component Material: Refrigeration component material, duct material, material used in evaporator, material used in compressor, material used in condenser.	

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

Reference books

1. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC

INDUSTRIAL TRAINING/ ON JOB TRAINING/ WORKSHOP BVRAC305P

SEMESTER-IV

ENTREPRENEURSHIP

DEVELOPMENT PROGRAMME

BVEMS401

Unit I:

06

To make the students understand about entrepreneurs and different classifications. Entrepreneur and entrepreneurship - Definition; traits and features; classification; Entrepreneurs; Women entrepreneurs; Role of entrepreneur in Entrepreneurs in India, Create an awareness about EDP. Entrepreneurial development programme concept; Need for training; phases of EDP; curriculum & contents of Training Programme; Support systems, Target Groups; Institutions conducting EDPs in India and Kerala.

Unit II:

06

General awareness about identification of project financing new enterprises; Promotion of a venture; opportunity Analysis Project identification and selection; External environmental analysis economic, social, technological and competitive factors; Legal requirements for establishment of a new unit; loans; Over run finance; Bridge finance; Venture capital; Providing finance in Approaching financing institutions for loans.

Unit III:

06

To identify different Discuss opportunities in small business; Small business Enterprise - Identifying the Business opportunity in various sectors - formalities for setting up of a small business enterprise

Unit IV: **06**

Institutions supporting small business enterprise - EDII (Entrepreneurship Development Institute of India), SLDO (Small Industries Development Organization NSIC (National small Industries Corporation Ltd. (CNSIC) NIESBUD (National Institute for Entrepreneurship and small Business Development) Sickness in small business enterprise causes and remedies.

Unit V: **06**

To understand about a project report relating to a small business; Project formulation - Meaning of a project report significance contents formulation planning commissions guidelines for formulating a project report - specimen of a project report, problems of entrepreneurs case studies of entrepreneurs.

Recommended Text and Reference Books:

1. Clifton, Davis S. and Fylie, David E. , Project Feasibility Analysis, John Wiley, New York, 1977.
2. Desai A. N., Entrepreneur and Environment, Ashish, New Delhi, 1990.
3. Drucker, Peter, Innovation and Entrepreneurship, Heinemann, London, 1985
4. Jain Rajiv, Planning a Small Scale Industry: A guide to Entrepreneurs, S. S. Books, Delhi, 1984
5. Kumar S. A. , Entrepreneurship in Small Industry, Discovery, New Delhi, 1990
6. McClelland, D. C. and Winter, W. G. , Motivating Economic Achievement, Free Press, New York, 1969

RAC PIPING SYSTEMS – I

BVRAC402

Unit I:	06
Codes, Standards and Specifications: Piping codes, ASME codes and standards, ASTM Specifications	
Unit II:	06
ASME Boiler, Pressure vessel codes, ASME B31-Code for pressure piping, mechanical strength, testing of piping system and valves, fabrications.	
Unit III:	06
Piping Components: Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material, specifications, pipe ends, pipe fittings, pipe support	
Unit IV:	06
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.	

Unit V:

Viscosity, Reynolds number, friction factor, Darcy Weisback friction factor, friction factor for laminar and turbulent flows, equivalent pipe length, hydraulic radius, compressible, flow

Recommended Books

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

Reference Books:

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

REFRIGERATION & AIR-CONDITIONING

MATERIAL – II

BVRAC403

Unit I: Component Material: Material used in expansion valve, different type of valve material	06
Unit II: Material used in cooling towers, pipeline materials, drying materials, jointing, material, synthetic repair materials.	06
Unit III: Oils and Lubrication: Need of lubrication, types of lubrication, properties of lubrication oils, lubrication systems	06
Unit IV: Selection of refrigerant lubricant, compatibility of lubricant with refrigerant fluidrefrigeration oil with additives, the effect of refrigerant on lubricant density, solvent and cleaning.	06
Unit V: Tubing: Soft copper tubing, hard-drawn copper tubing, steel tubing, normal size copper tubing, Cutting tubing, bonding tubing, connecting tubing, flaring tubing.	06

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

Reference books

1. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC

RAC MAINTENANCE – I

BVRAC404

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

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
3. Electric controls for Refrigeration and Air Conditioning by B.C. Langley, D.B. Taraporevala sons and co. pvt.ltd., Bombay

Reference books

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore
2. Refrigeration and Air Conditioning by P.L.Ballaney, Khanna publishers, New Delhi
3. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC
4. Refrigeration and Air Conditioning Technology by William C. Whitman, William M. Johnson and John A. Tomczyk, Delmar Thomson learning, USA

INDUSTRIAL TRAINING/ ON JOB TRAINING/ WORKSHOP BVRAC405P

SEMESTER-V

RAC PIPING SYSTEMS – II

BVRAC501

Unit I:	06
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.	
Unit II:	06
Pipe Stress Analysis: Objectives and definition of stress analysis, piping loads, piping stresses-primary, secondary, pipe span, calculations flexibility analysis–expansion loops and expansion joints, concept of thermal expansion, providing flexibility in piping	
Unit III:	06
Assembly and Erection: Fabrications materials for piping systems, fabrication drawings, fabrication processes, Assembly-alignment, flanged joints, threaded joints,	
Unit IV:	06
Piping System Testing: Examinations methods, visual examination, magnetic particle examination, Liquid penetrant examination, radiographic examination, ultrasonic examinations,	
Unit V:	06
Testing–leak, test, preparation for leak test, hydrostatic leak test, pneumatic leak test, sensitive leak test, examination of welds	

Recommended Books

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

Reference books:

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

RAC MAINTENANCE - II

BVRAC502

Unit I:	06
Checking the charge, electrical circuits (servicing), evacuation of the system, installation, and location of main components, leak detection methods	
Unit II:	06
Servicing Techniques: Piping and Joining Work, Burn out repair, capillary tube cleaning	
Unit III:	06
Charging the system, compressor work expansion valve (thermostatic), servicing, hermetic compressor motors (stating problems) repairing leaks, sealed system connections.	
Unit IV:	06
Electrical Fault Finding: Compressor motor fails to start, compressor motors tries to start but does not run, compressor motor starts but does not reach running speed, thermostat failure type, pressure cut-out failure, wiring and collection faults	
Unit V:	06
Mechanical Fault Finding: Fault analysis by temperature and pressure, methods of confirming the fault, finding the fault when the compressor is not running, abnormal noise problem, domestic system faults	

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
3. Electric controls for Refrigeration and Air Conditioning by B.C. Langley, D.B. Taraporevala sons and co. pvt.ltd., Bombay

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3. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC
4. Refrigeration and Air Conditioning Technology by William C. Whitman, William M. Johnson and John A. Tomczyk, Delmar Thomson learning, USA

RAC INSTALLATION TECHNIQUES – I

BVRAC503

Unit I: Introduction: Installation operation, adding oil, testing for leak detection	06
Unit II: Evacuation and dehydration, removing air, charging of the system, through suction valve, through discharge valve	06
Unit III: Installation of Room Air-Conditioner: Selection of proper location, providing proper slope and provision for to drain water	06
Unit IV: Ventilation arrangement for window air conditioner, wiring diagram for installation for room air, conditioner	06
Unit V: Installation of split air conditioner, providing arrangement for pipes and pipe, pipe insulations	06

Recommended books

1. Air conditioning: procedures and installation by V. Paul Lang, CBS publishers & distributors, Delhi
2. Refrigeration Technicians pocket book by F.H. Meredith, Butterworths

RAC SAFETY

BVRAC504

Unit I:

06

Introduction to Industrial Safety: History and development of safety movement, need for safety, safety legislation: acts and rules, safety standards and codes, safety policy: safety organization and responsibilities and authorities of different levels, accident sequence theory, causes of accidents, accident prevention and control techniques, plant safety inspections, job safety analysis and investigation of accidents, first aid.

Unit II:

06

Overview of Standard: ANSI/ASHRAE Standard, ANSI/ASME boiler and pressure vessel code, refrigeration, piping code, boiler and pressure vessel code, safety for refrigerant-containing components and accessories, nonelectrical, uniform mechanical code, basic national mechanical code

Unit III:

06

Safety on the Job: Personal safety, protective clothing and equipment, harmful substances, safe work, practices, safety when working with electricity, refrigeration safety.

Unit IV:

06

Safety for RAC Engineers: Types of accident, physical injuries from mechanical causes, use of tools and handling precautions, electrical injuries, electrical safety rules

Unit V:

06

Injuries in RAC and Precaution: Refrigerant cylinder, corrosion, burn and other scalds, refrigerants and other gases Construction materials, fire fighting precautions, breathing, toxic gases, asphyxiation and precaution for the same.

Recommended books

1. "Air conditioning Systems principles, equipments and Services", Joseph Moravek, Prentice Hall

Reference books

1. "HVAC Handbook", Part I and II, ISHRAE
2. "Industrial refrigeration Hand Book", Wilbert F. Stoecker

INDUSTRIAL TRAINING/ ON JOB TRAINING/ WORKSHOP BVRAC505P

SEMESTER-VI

RAC INSTALLATION TECHNIQUES – II

BVRAC601

Unit I:	06
Commercial Installations of Refrigeration Systems: Ice manufacturing plant, ice bank	
Unit II:	06
Commercial Installations of Refrigeration Systems: Cold storage plant, milk dairy plant	
Unit III:	06
Commercial Installation of Air Conditioning Systems: Office air conditioning, Hotel air conditioning	
Unit IV:	06
Central air conditioning, Designs, Factors of consideration for Central AC	
Unit V:	06
Automobile air conditioning: Need, Types, Selection of AC System, Ducts	

Recommended books

1. Air conditioning: procedures and installation by V. Paul Lang, CBS publishers & distributors, Delhi
2. Refrigeration Technicians pocket book by F.H. Meredith, Butterworths

RAC STANDARDS

BVRAC602

Unit I:

06

Introduction: Meaning of IS, need of IS, international classification of standards for refrigeration and air conditioning, various national and international standards for heating, ventilation and air conditioning

Unit II:

06

Procedure of standard development, levels of standard, main standardization, organizations, i.e. ISO-international organization for standardization, IEC-international electro technical commission and others international and national organizations

Unit III:

06

Existing Standards: Main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential) alternatives, ISO, IEC, ECS (European Committee for Electrical Technical Standardization)

Unit IV:

06

Adoption of International Standards at National Level: National standardization bodies, national ozone units, accreditation bodies, national RAC associations, the process of adoption

Unit V:

06

Use of International Standards: In designing of refrigeration and air conditioning equipment, selection of materials related to refrigeration and air conditioning, safety issues related to refrigeration and air conditioning, industrial and field applications.

Recommended books

1. International Standards in Refrigeration and Air Conditioning , UNEP (United Nations Environment Program)
2. Refrigeration and Air Conditioning data book, New Age International Publication

Reference books

1. ISHRAE standard book for Refrigeration and Air Conditioning
2. ASHRE hand book for Refrigeration and Air Conditioning

REFRIGERANTS

BVRAC603

Unit I:	06
Introduction: Refrigerants, cooling media and liquid absorbents, azeotropic and zeotropic, numbering of refrigerants.	
Unit II:	06
Classification and Properties of Refrigerants: Requirement for refrigerant, classification-based on working principle, safety and chemical composition, desirable properties of refrigerantsthermodynamic properties, safe working properties, physical properties etc	
Unit III:	06
Choice of Refrigerant: Important refrigerants, secondary refrigerant, anti-freeze solution, selection of refrigerant for required purpose	
Unit IV:	06
Application of Refrigerants: refrigerant oils and applications, Properties and uses of commonly used refrigerant	
Unit V:	06
Greenhouse effect, Global warming, Future Refrigerants like Hydrofluoro-Olefines	

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi
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Reference books

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AUTOMOBILE AIR CONDITIONING

BVRAC604

Unit I:

06

Introduction: Methods of refrigeration. Vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, Refrigerated transport vehicles, applications related with very low temperatures,

Study of Psychometric charts: Psychometric properties, tables/charts, psychometric processes, comfort charts, factors affecting comfort, effective temperature, ventilation requirements.

Unit II:

06

Refrigerants & AC Systems: Importance of Refrigerant- Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants; applications of refrigerants, refrigerants used in automobile air conditioning, Air Conditioning Systems- Classification, layouts, central / unitary air conditioning systems, System components, Switch and electrical wiring circuit.

Unit III:

06

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

Unit IV:

06

Air Distribution: Air Distribution Systems- Distribution ducting, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculations

Electronic control: Air Routing & Temperature Control - Objectives of the dashboard recirculating unit, automatic temperature control, controlling flow, control of air handling systems & air flow through - evaporator care

Unit V:

06

AC Service & Control: Air Conditioning Service- Air conditioner maintenance & service -removing & replacing Components. Compressor service, Testing, Diagnosis & trouble shooting of air conditioning system, Refrigerant gas charging procedure &. Servicing of heater system, Air Conditioning Control - Common controls such as thermostats, humidistat, control dampers, pressure cut outs, relays.

Recommended books

1. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
2. Electric controls for Refrigeration and Air Conditioning by B.C. Langley, D.B. Taraporevala sons and co. pvt.ltd., Bombay

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