Scheme & Syllabus

Bachelor of Vocation - B.Voc.
(Refrigeration & Air Conditioning)

(Revised for Batch 2024, 3rd Sem onwards)

SHAHEED BHAGAT SINGH STATE UNIVERSITY, FEROZEPUR

Department of Mechanical Engineering

Bachelor of Vocation
(B.Voc.)
(Refrigeration & Air Conditioning)

B.Voc. (Refrigeration & Air- Conditioning)

Duration of course* : **3 years**

Eligibility : **10+2 (any stream)**

***Exit Options**

The programme allows exit of a student in an intermediate stage and exit options will be as below:

Exit Point	Duration	Certificate/ Diploma/ Degree offered
First Exit	After 1 year	Diploma in Vocation (D.Voc.)
Second Exit	After 2 years	Advanced Diploma in Vocation (Adv.D.Voc.)
Third Exit	After 3years	Bachelor of Vocation (B.Voc.)

Semester-1

Bachelor of Vocation (B.Voc.) Refrigeration and Air Conditioning (Level 5)								
Course Code	**Title of the course**	**L**	**T**	**P**	**Marks Distribution**		**Total Marks**	**Credits**
					Internal	**External**		
General Academic Components								
BVRC 101C	Fundamentals of Computers	3	1	-	40	60	100	4
BVRC 102C	Basic Electrical & Electronics Engineering	3	1	-	40	60	100	4
BVRC 103C	Computer Lab.	-	-	6	60	40	100	3
BVRC 104C	Thermodynamics in Refrigeration & Air Conditioning	3	1	-	40	60	100	4
Skill Development Components								
BVRC 105C	Basic Heat Transfer	3	1	-	40	60	100	4
BVRC 106C	Heat Transfer Lab.	-	-	2	60	40	100	1
BVRC 107C	Project-I	-	-	-	60	40	100	10
SBS 101C	Introduction to Shaheed Bhagat Singh & his Co-Patriotes	1	0	0	Satisfactory/Non- Satisfactory			0
	Total	**13**	**4**	**8**	**340**	**360**	**700**	**30**

 # Concerned Head of department will assign Project-1 to the faculty member(s) as coordinator with load of 2 hrs/week.

Semester-2

Bachelor of Vocation (B.Voc.) Refrigeration and Air Conditioning(Level 5)								
Course Code	**Course Title**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credits**
		L	**T**	**P**	**Internal**	**External**		
General Academic Components								
BVHU 201C	Communication Skills in English	3	1	-	40	60	100	4
BVRC 201C	Workshop Technology	3	1	-	40	60	100	4
BVRC 202C	Workshop Practice	-	-	6	60	40	100	3
BVRC 203C	RAC Piping System	3	1	-	40	60	100	4
Skill Development Components								
BVRC 204C	Basics of Refrigeration &Air Conditioning	3	1	-	40	60	100	4
BVRC 205C	Refrigeration & Air-conditioning L a b 1	-	-	2	60	40	100	1
BVRC 206C	Project-II	-	-	-	60	40	100	10
	Total	**12**	**4**	**8**	**340**	**360**	**700**	**30**

 # Concerned Head of department will assign Project-II to the faculty member(s) as coordinator with load of 2 hrs/week.

Semester-3

Bachelor of Vocation (B.Voc.) Refrigeration and Air Conditioning(Level 6)								
Course Code	**Title of the course**	**L**	**T**	**P**	**Marks Distribution**		**Total Marks**	**Credits**
					Internal	**External**		
General Academic Components								
BVRC 301C	Environmental Studies	3	-	-	40	60	100	3
BVRC 302C	Refrigeration Systems	4	1	-	40	60	100	5
BVRC 303C	Metrology and Measuring Instruments	3	1	-	40	60	100	4
Skill Development Components								
BVRC 304C	Metrology and Measuring Lab.	-	-	3	60	40	100	1.5
BVRC 305C	Refrigeration & Air Conditioning Lab.-II	-	-	3	60	40	100	1.5
On Job Training (OJT)/Qualification Packs								
BVRC 306C	Safety Tester RACWO (ELE/Q3605) Field Engineer RACW(ELE/Q3105) Cold Storage Technician (FIC/Q7004)	Any one			60	40	100	15
	Total	**10**	**2**	**6**	**300**	**300**	**600**	**30**

***Students are advised to complete required contacts hours for on job training during the semester / at the end of semester.**

**** The on job training (OJT) may be done from Industry/Skill Providers (SKPs)/Sector Skill Councils (SSCs)/Training Centers/Institutes.**

Semester-4

Bachelor of Vocation (B.Voc.) Refrigeration and Air Conditioning(Level 6)								
Course Code	**Title of the course**	**L**	**T**	**P**	**Marks Distribution**		**Total Marks**	**Credits**
					Internal	**External**		
General Academic Components								
BVRC 401C	Air-Conditioning Systems	3	1	-	40	60	100	4
BVRC 402C	Refrigerants	3	1	-	40	60	100	4
Elective-I (Anyone from BVRC 403C and BVRC 404C)								
BVRC 403C	Refrigeration & Air conditioning Standards	3	1	-	40	60	100	4
BVRC 404C	Refrigeration & Air conditioning Equipment	3	1	-	40	60	100	4
Skill Development Components								
BVRC 405C	Refrigeration & Air-Conditioning Lab.-III	-	-	3	60	40	100	1.5
BVRC 406C	Fluid Mechanics Lab	-	-	3	60	40	100	1.5
On Job Training (OJT)/Qualification Packs								
BVRC 407C	One QP to be opted from the QPs mentioned in the Level 6 first semester	Any one			60	40	100	15
	Total	**9**	**3**	**6**	**300**	**300**	**600**	**30**

***Students are advised to complete required contacts hours for on job training during the semester / at the end of semester.**
**** The on job training (OJT) may be done from Industry/Skill Providers (SKPs)/Sector Skill Councils (SSCs)/Training centers/Institutes.**

Semester-5

Bachelor of Vocation (B.Voc.) Refrigeration and Air Conditioning(Level 7)								
Course Code	**Title of the course**	**L**	**T**	**P**	**Marks Distribution**		**Total Marks**	**Credits**
					Internal	**External**		
General Academic Components								
BVRC 501C	Safety in Refrigeration & Air conditioning Systems	4	1	-	40	60	100	5
BVRC 502C	Engineering Materials	3	-	-	40	60	100	3
Elective-II (Any one from BVRC 503C and BVRC 504C)								
BVRC 503C	Economics for Engineers	3	1	-	40	60	100	4
BVRC 504C	Entrepreneurship	3	1	-	40	60	100	4
Skill Development Components								
BVRC505C	Thermodynamics Lab	-	-	3	60	40	100	1.5
BVRC 506C	Refrigeration & Air-Conditioning Lab.-IV	-	-	3	60	40	100	1.5
On Job Training (OJT)/Qualification Packs								
BVRC 507C	AC Specialist Automobile (ASC/Q1416)	Any one			60	40	100	15
	Assembly operator (ELE/Q3501)							
	Total	**10**	**2**	**6**	**300**	**300**	**600**	**30**

***Students are advised to complete required contacts hours for on job training during the semester / at the end of semester.**
**** The on job training (OJT) may be done from Industry/Skill Providers (SKPs)/Sector Skill Councils (SSCs)/Training centers/Institutes.**

Semester-6

Bachelor of Vocation (B.Voc.) Refrigeration and Air Conditioning(Level 7)								
Course Code	**Title of the course**	**L**	**T**	**P**	**Marks Distribution**		**Total Marks**	**Credits**
					Internal	**External**		
General Academic Components								
BVRC 601C	Maintenance of Refrigeration & Air-Conditioning systems	3	1	-	40	60	100	4
BVRC 602C	Industrial Engineering & Management	3	1	-	40	60	100	4
BVRC 603C	Cooling Towers & Air Handling Systems	3	1	-	40	60	100	4
Skill Development Components								
BVRC604C	Project	-	-	6	60	40	100	3
On Job Training (OJT)/Qualification Packs								
BVRC 605C	One QP to be opted from the QPs mentioned in the Level 7 first semester	Any one			60	40	100	15
	Total	**9**	**3**	**6**	**240**	**260**	**500**	**30**

***Students are advised to complete required contacts hours for on job training during the semester / at the end of semester.**
**** The on job training (OJT) may be done from industry/skill Providers (SKPs)/Sector skill councils (SSCs)/Training centers/Institutes.**

First Semester
(Refrigeration and Air Conditioning)

BVRC101C: FUNDAMENTALS OF COMPUTERS

Semester	1					
Course code	BVRC101C					
Course title	Fundamentals of Computers (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

UNIT– I

- What is Computer, Block Diagram (Components),Application of Computer, Booting of Computer System
- Elements of Computer System (Input devices (Keyboard, Scanner, Mouse),
- Output devices–(Printer, Monitor),Storage Devices–(Magnetic Disk, Optical Disks)
- What is Operating System, Types of Operating System (Multitasking, Multi-programming, Multiprocessing)

UNIT– II

- Introduction to Windows Vista
- PartsofWindowsScreen(Desktopicons,Windows(ApplicationWindow,Document window)
- Introduction to MS Office
- Introduction to MS Word (Word 2003)
- Parts of Word Window(Title Bar, Menu Bar)
- Opening, Closing and saving a word Document
- Font Dialog Box
- Page Setup
- Editing a word document (Cut,Copy,Paste,Bold,Italic, Underline)
- Print Dialog Box
- Creating aTable, Operations on Table in MS Word

TEXT BOOKS:

1. Computers Fundamentals and Architecture by B.Ram
2. William Stallings, Operating System, Pearson Education
3. Norton, Introduction to Computers, McGraw Hill

REFRENCES BOOKS:

1. P C Software for Windows by R K Taxali
2. P C Software Bible by S.Jaiswal
3. Computers Today: Suresh K.Basandra
4. Operating System :Achyut S.Godbole
5. Understanding Computer Fundamentals &Dos By G.K.Iyer
6. MS-Office Interactive course by Greg Perry, Techmedia
7. MS Office Complete Reference TMH Publication.

BVRC102C: BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Semester	1					
Course code	BVRC102C					
Course title	Basic Electrical & Electronics Engineering (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

UNIT–I

Nature of Electricity, A brief review of various applications of electricity, Introduction to DC and AC circuits, difference between Alternating current & Direct current, Ohm's Law- statement, Circuit elements & their Characteristics - Resistor, capacitor & inductance, Voltage-Current relations for resistor, inductor, capacitor , Kirchhoff's Current and Voltage Law, Ideal sources – equivalent resistor, current division, voltage division, Electrical quantities- Charge, Current, Voltage, Power, Electrical Energy, Electrical Potential and their units

UNIT– II

Introduction to simple magnetic circuits, Concept of Faraday's laws of Electromagnetic induction, production of alternating e.m.f. – single phase system

UNIT– III

Basic principles and classification of Indicating instruments, Analog and Digital multimeter & Voltmeter, Measurement of Power ,energy & resistance, Control and Protection devices- Relays, Circuit Breaker, fuses MCB, LCB.

UNIT– IV

Difference between conductors, insulators and semi conductors, Formation of p & n type semiconductors**;** P-N junction Diode, ideas of- LDR; Electronic instruments– Analog multimeter & Digital voltmeter, Physical quantities measured with digital and analog multimeter.

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RECOMMENDED BOOKS:

1. Fundamental of Electrical and Electronic Engineering by B.LTheraja; S.Chand and Company, New Delhi.
2. Basic Electronic and Electrical Engineering by Bhattacharya S K, Pearson Education.
3. Basic Electronic and Electrical Engineering by D.P.Kothari, I .J.Nagrath ; McGraw Hill Education Private Limited.
4. Principles of Electrical Engineering by Gupta BR; S.Chand and Company, New Delhi

BVRC 103C: COMPUTER LAB

Semester	1					
Course code	BVRC 103C					
Course title	Computer Lab (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	6	60	40	3

Practical based on Fundamentals of Computer based on contents studied in theory class (Fundamentals of Computers - BVRC-101C) on:

- MS Word and
- Window10

BVRC 104C: THERMODYNAMICS IN REFRIGERATION & AIR CONDITIONING

Semester	1					
Course code	BVRC 104C					
Course title	Thermodynamics in Refrigeration &Air Conditioning (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Unit– I

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

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

Applications of Thermodynamics: Carnot cycle, refrigerator and heat pump, refrigeration, equipments used in refrigeration, 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
4. A Textbook of Thermal Engineering RS Khurmi JK Gupta S. Chand Publishing

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BVRC 105C: BASIC HEAT TRANSFER

Semester	1					
Course code	BVRC 105C					
Course title	Basic Heat Transfer (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Unit-I

Basics of heat transfer; convection, radiation; Definition of conduction; Thermal conductivity; overall heat transfer coefficient of Composite Wall; heat transfer coefficient of Lagged Pipe; Thermal Conductivity of given Metal Rod.

Unit-II

Introduction to Natural and Forced Convection; heat transfer coefficient of Pin-Fin Determination of heat transfer coefficient of Natural Convection; Determination of heat transfer coefficient of Forced Convection

Unit-III

Introduction to radiation; Determination of Stefan Boltzman Constant; Determination of Emissivity of test plate.

Unit-IV

Determination of effectiveness and overall heat transfer coefficient using Parallel and Counter flow Heat Exchanger; Determination of heat transfer coefficient in drop and film wise condensation; Determination of Critical Heat flux; Study of heat pipe and its demonstration.

TEXT BOOKS:

1. Heat and mass transfer by PK Nag
2. A Textbook of Thermal Engineering RS Khurmi and JK Gupta S. Chand Publishing

REFERENCE BOOKS:

1. Thermal Engineering by A.S. Sarao Satya Prakashan

BVRC 106C: HEAT TRANSFER LAB

Semester	1					
Course code	BVRC 106C					
Course title	Heat Transfer Lab (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	2	60	40	1

LIST OF EXPERIMENTS

1. Determination of Thermal conductivity of insulation powder
2. Determination of Thermal Conductivity of given Metal Rod
3. Determination of heat transfer coefficient of Pin-Fin (Natural and Forced Convection)
4. Determination of heat transfer coefficient of Natural Convection
5. Determination of Stefan Boltzman Constant
6. Determination of effectiveness and overall heat transfer coefficient using Parallel and Counter flow Heat Exchanger
7. Studyof heat pipe and its demonstration

BVRC 107C: PROJECT-I

Semester	1					
Course code	BVRC 107C					
Course title	Project-I (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	#	60	40	10

Candidates will make a project related to refrigeration. After making the project, he/she is supposed to have practical knowledge about different parts used in different refrigeration units (domestic & commercial); work related to dismantling & assembly of various parts used in different refrigeration units.

A detailed report will have to be submitted after making the project.

 # Concerned Head of Department will assign Project-I to faculty member(s) as coordinator with Load of 2 hrs/week.

Second Semester
(Refrigeration and Air Conditioning)

BVHU 201C: COMMUNICATION SKILLS IN ENGLISH

Semester	2					
Course code	BVHU 201C					
Course title	Communication Skills in English (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Unit–I

Reading Skills: Reading Tactics and strategies; Reading purposes–kinds of purposes and associated comprehension; Reading for direct meanings; Reading for understanding concepts, details, coherence, logical progression and meanings of phrases/ expressions.

Activities:

a) Active reading of passages on general topics
b) Comprehension questions in multiple choice format
c) Short comprehension questions based on content and development of ideas

Unit-II

Writing Skills: Guidelines for effective writing; writing styles for application, resume, personal letter, official/ business letter, memo, notices etc.; outline and revision.

Activities:

a) Formatting personal and business letters
b) Organizing the details in a sequential order
c) Converting a biographical note into a sequenced resume or vice-versa
d) Ordering and sub-dividing the contents while making notes.
e) Writing notices for circulation/ boards

SUGGESTED BOOKS:

1. Applying Communication Theory for Professional Life: A Practical Introduction by Dainton and Zelley
2. Communication Skills : Sanjay Kumar and Pushap Lata
3. On writing well: William Zinsser

BVRC 201C: WORKSHOP TECHNOLOGY

Semester	2					
Course code	BVRC 201C					
Course title	Workshop Technology (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Introduction to workshop, Maintenance of workshop tools and machinery, Safety precautions ,Usage of various gauges to measure length, mass, volume, speed, temperature and pressure, diameter of wire by wire gauge, external and internal diameter by vernier caliper, micrometer, screw gauge, pressure by pressure gauge, etc.

- Apart from this general study, contents covered for various shops will be as under:

1. Carpentry Shop: Introduction to various types of woods and carpentry tools.
2. Sheet Metal Shop: Practice of measuring, marking, cutting, bending, folding, riveting, soldering, etc.
3. Electrical Shop: Practice of wire joints, soldering and de–soldering, brazing, familiarization of voltmeter, ammeter, multi meter, etc.
4. Welding Shop: Practice of various joints by Arc Welding, Gas Welding, TIG, MIG and Gas cutting. Types of flames, fluxes, filler rods. Soldering.
5. Machine Shop: Introduction and Practice on Lathe machine, Drilling machines.
6. Fitting shop: Introduction to various types of marking & measuring tools, cutting tools, drilling & tapping practice.

RECOMMENDED BOOKS:

1. Basic Workshop Practice Manual by T Jeya poovan; Vikas Publishing House (P) Ltd. New Delhi
2. Workshop Technology by Manchanda Vol.I,II, III India Publishing House,Jalandhar.
3. Workshop Technology I, II, III, by SK Hajra, Choudhary and A K Chaoudhary.
4. Workshop Technology by B.S.Raghuwanshi, Dhanpat Rai and Co.,New Delhi

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BVRC 202C: WORKSHOP PRACTICE

Semester	2					
Course code	BVRC 202C					
Course title	Workshop Practice (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	6	60	40	3

To prepare jobs related to:

- Welding
- Electrical work
- Lathe machine
- Sheet Metal/soldering
- Foundry
- Heat treatment
- Fitting shop

BVRC 203C: RAC PIPING SYSTEM

Semester	2					
Course code	BVRC 203C					
Course title	RAC Piping System (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Unit I

Codes, Standards and Specifications: Piping codes, ASME codes and standards, ASTM Specifications.

Unit II

Piping Components: Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material, specifications, pipe ends, pipe fittings, pipe support.

Unit III

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 IV

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

RECOMMENDED BOOKS

1. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
2. The fundamentals of piping design by Peter Smith.
3. Handbook of Air conditioning and refrigeration by Shan KWang, McGraw-hill international edition, Singapore.
4. Refrigeration and Air Conditioning by RS Khurmi.
5. ASHRAE handbook, 2002

BVRC 204C: BASICS OF REFRIGERATION & AIR CONDITIONING

Semester	2					
Course code	BVRC 204C					
Course title	Basics of Refrigeration &Air Conditioning (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Unit-I

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

Unit-II

Refrigeration Systems: Refrigeration Cycles: Refrigeration, carnot cycle of refrigeration (ideal cycle), Bell-Coleman cycle of refrigeration, their COP Representation of these cycles in P- V, T-S and P-H diagrams. No numerical problems. **Unit–III**

Introduction of Air-Conditioning: Its meaning and general application. Psychrometry: Definition, Composition of air, Daltons law of partial pressure, Gas and Vapour mixture, dry air, wet air, Saturated air, Dry bulb temperature, Wet bulb temperature, Wet bulb depression, Dew point, Dew point depression, Specific humidity, relative humidity, absolute humidity, enthalpy of air.

Unit-IV

Psychromety: Specific humidity, Degree of saturation, Relative humidity, Absolute humidity, Humid specific volume and humid specific heat, Enthalpy of moist air.

Unit-V

Vapour Absorption Refrigeration System: Vapour absorption refrigeration system, its principles, different types Vapour absorption refrigeration system.

TEXT BOOKS:

1. Refrigeration and Air-Conditioning,Domkundwar, Arora & Domkundwar, Dhanpat Rai and Co.
2. Refrigeration and Conditioning, Manohar Prasad, New Age International Publishers
3. Refrigeration and Air Conditioning, R.K. Rajput, S. Chand Publishing
4. Refrigeration and Air Conditioning, R.S. Khurmi and J.K. Gupta, S. Chand Publishing
5. Basic Refrigeration and Air Conditioning, P. N. Ananthanarayan, Tata McGraw Hill
6. Refrigeration and Conditioning, C.P. Arora, McGraw Hill Education

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BVRC 205C: REFRIGIRATION & AIR-CONDITIONING LAB.-I

Semester	2					
Course code	BVRC 205C					
Course title	Refrigeration & Air-conditioning Lab - I (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	2	60	40	1

LIST OF EXPERIMENTS

1. To studythe vapour compression System.
2. Operation of a vapour compression system using refrigeration trainer.
3. To study various components of an air-conditioner.
4. Operation of an air-conditioner, using air-conditioner trainer.
5. To studycentralized air- conditioning plant.
6. To Studythe various control devices e.g. Thermostat, Relays & dryers etc.

BVRC 206C: PROJECT-II

Semester	2					
Course code	BVRC 206C					
Course title	Project-II (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	#	60	40	10

Candidates will make a project related to air-conditioning. After making the project, he/she is supposed to have practical knowledge about different parts used in different air-conditioning units (domestic & commercial); work related to dismantling & assembly of various parts used in different air-conditioning units.

A detailed report will have to be submitted after making the project.

#Concerned Head of Department will assign Project-II to faculty member(s) as coordinator with Load of 2 hrs/week.

Third Semester
(Refrigeration and Air Conditioning)

BVRC 301C: ENVIRONMENTAL STUDIES

Semester	3					
Course code	BVRC 301C					
Course title	Environmental Studies (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	0	0	40	60	3

1. **The Multidisciplinary Nature of Environmental Studies**: Definition, scope & Need for public awareness.
2. **Natural Resources and Associated Problems**:
   Natural Resources, Forest Resources, Water Resources: Use and exploitation; Land Recourses: Land as a resource, land degradation.
3. **Environmental Ethics**:
   Issues and possible solutions.
4. **Water Conservation**:
   Rain water harvesting, water shed management.
5. **Urban Problems Related to Energy:**
   Fromunsustainable to sustainable development.
6. **Social Issues and Environment**:
   Environmental Protection Act, Wasteland reclamation. Air (prevention and Control of Pollution) Act, Water (prevention and Control of Pollution) Act.
7. **Public Awareness**:
   Issues involved in enforcement of environmental legislation.

REFERENCES BOOKS:

1. Agarwal, K.C.2001. Environmental Biology, Nidhi Publications Ltd.Bikaner.
2. Bharucha, E.2005. Text book of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav,H.& Bhosale, V.M.1995.Environmental Protection and Laws. Himalaya Publication

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BVRC 302C: REFRIGERATION SYSTEMS

Semester	3					
Course code	BVRC 302C					
Course title	Refrigeration Systems (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	4	1	0	40	60	5

1. **History and Fundamentals of Refrigeration:**
   Temperature, pressure measurements, Refrigeration systems and terms, symbols of various . refrigeration devices.
2. **Ideal Basic Refrigeration Cycle:**
   Thermodynamic analysis of cycle
3. **Refrigeration Plant main components:**
   Compressor, Condenser, Expansion valve, Evaporation system, Practical significance
4. **Installation of Refrigeration Equipment:**
   Maintenance, Service and Repair of Refrigeration Equipment, Refrigerant Safety Logs
5. **Refrigeration plants**
   Ice Plant, Cold storage, Chilling plant

RECOMMENDED BOOKS

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, NewDelhi
3. Refrigeration and Air Conditioning by R.S. Khurmi, S.Chand & Company, New Delhi
4. Refrigeration and Air Conditioning by R.K.Rajput, S. Chand Publishing, New Delhi

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BVRC 303C: METROLOGY AND MEASURING INSTRUMENTS

Semester	3					
Course code	BVRC 303C					
Course title	Metrology and Measuring Instruments (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Introduction to Metrology**:
   Need, Elements, Work piece, Instruments, Environment and their effect on Precision and Accuracy, Errors: Errors in Measurements, Types, Control, Types of standards, Limits, fits and tolerances. Hole Basis & Shaft Basis system. Transducers. In linear measurement V-Blocks, Calipers, Vernier callipers

2. **Linear Measuring Instruments:**
   Evolution,Types,Classification,Limitgauges,gaugedesignterminology,procedure,concepts of interchange ability and selective assembly, Angular measuring instruments; Types, Bevel protractor, clinometers, angle gauges, spirit levels, sine bar, Angle alignment telescope, Autocollimator and applications.
3. **Basic Concept of Lasers**:
   Advantages of lasers, laser Interferometers, types, DC and AC Lasers interferometer and applications, Straightness, Alignment. Basic concept of CMM: Types of CMM, Constructional features, Probes, Accessories, Software and applications, Basicconcepts of Machine Vision System, Element and applications.
4. **Principles and Methods of Straightness:**
   Flatness measurement, thread measurement, gear measurement, surface finish measurement, Roundness measurement and applications. Metrology of gears & screw threads.

REFERENCES BOOKS:

1. Gupta. I.C., "Engineering Metrology", Dhanpat Rai Publications, 2005.
2. Jain R.K."Engineering Metrology", Khanna Publishers, 2009.
3. Vinay Kulkarni, Metrologyand Measurement, Tata McGrawHill
4. N.V.Raghavendra, Engineering Metrology and Measurement

BVRC 304C: METROLOGY AND MEASURING LAB

Semester	3					
Course code	BVRC 304C					
Course title	Metrology and Measuring Lab (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	3	60	40	1.5

LIST OF EXPERIMENTS

1. Measurement of angle with the help of sine bar.
2. Use of comparators for measurement
3. To measure the pitch, angle and form of thread of a screw thread using profile projector
4. Use of linear measuring instrument such as Vernier caliper and micrometer.
5. Use of height gauge and Vernier calipers.
6. Measurement of Thread Parameter byusing toolmaker's microscope.
7. Measurement of surface roughness of a surface.
8. Use of feeler, wire, radius and fillet gauges for checking of standard parameters.

BVRC 305C: REFRIGERATION & AIR CONDITIONING LAB-II

Semester	3					
Course code	BVRC 305C					
Course title	Refrigeration & Air-Conditioning Lab-II (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	3	60	40	1.5

LIST OF EXPERIMENTS

1. To change refrigerant into service cylinder from storage cylinder.
2. To evaluate the refrigeration system.
3. To pump down the system.
4. To purge air from the system.
5. To locate the leaks in a system.
6. To charge the system.
7. To check the oil level in the compressor.
8. Tracing the common faults in R&A.C units and their remedies.

Fourth Semester
(Refrigeration and Air Conditioning)

BVRC 401C: AIR CONDITIONING SYSTEMS

Semester	4					
Course code	BVRC 401C					
Course title	Air Conditioning Systems (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Introduction:**
   Meaning of air conditioning, comfort air conditioning, industrial air conditioning. Compressors: Introduction, Types Hermetic, Semi Hermetic open compressors. Reciprocating, Centrifugal & Rotary Compressors: construction features and volumetric Efficiencies. Multi-cylinder. Compression & Capacity control. Alternatives refrigerants for the refrigeration & air-conditioning
2. **Compressor Lubrication:**
   Methods of Lubrication & the properties of a Lubricating oil Identifications of sources of problem in operation Value failure, Shaft Seals 3- way Values cylinder to head gaskets.
3. **Condensers:**
   Definition, Basic Principle, Types of Condenser: Air cooled Condenser, Water-cooled Condenser, Evaporative Condenser and their Constructional features. Comparison between Waters & Air cooled condenser & their Advantages & disadvantages.
4. **Expansion Devices:**
   Types of expansion devices
5. **Evaporators:**
   Types of Evaporators, heat transfer in evaporators
6. **Cooling Load:**
   Cooling Load and heat gains, cooling load for a whole building

RECOMMENDED BOOKS

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpat rai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
3. Refrigeration and Air Conditioning by R.S. Khurmi,S.Chand & Company, New Delhi
4. Refrigeration and Air Conditioning by R.K.Rajput,S.Chand Publishing,NewDelhi

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BVRC 402C: REFRIGERANTS

Semester	4					
Course code	BVRC 402C					
Course title	Refrigerants (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Introduction:**
   Refrigerants,cooling media and liquid absorbents, numbering of refrigerants.
2. **Classification and Properties of Refrigerants**:
   Requirement for refrigerant, classification-based on working principle, desirable properties of refrigerants- thermodynamic properties, safe working properties, physical properties etc. Refrigerant effect on global warming. Global warming potential of refrigerants
3. **Choice of Refrigerant**:
   Important refrigerants, secondary refrigerant, anti-freeze solution, selection of refrigerant for required purpose, Classification based on application of Refrigerant.
4. **Application of Refrigerants:**
   Refrigerant oils and applications, Properties and uses of commonly used refrigerant

RECOMMENDED BOOKS

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S. Domkundwar, Dhanpat Rai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
3. Refrigeration and Air Conditioning by R.S. Khurmi,S.Chand & Company,New Delhi
4. Refrigeration and Air Conditioning by R.K Rajput, S. Chand Publishing, New A course in Refrigeration and Air Conditioning by S.C.Arora and S. Domkundwar, Dhanpat rai and sons, Delhi

BVRC 403C: REFRIGERATION & AIR CONDITIONING STANDARDS

Semester	4					
Course code	BVRC 403C					
Course title	Refrigeration & Air conditioning Standards (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

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

2. **Procedure of Standard Development:**
   Levels of standard, main standardization, organizations, i.e. ISO- international organization for standardization, IEC-international electro technical commission and others international and national organizations.
3. **Existing Standards:**
   Main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential) alternatives, ISO, IEC, ECS (European Committee for Electrical Technical Standardization).
4. **Adoption of International Standards at National Level:**
   National standardization bodies, national ozone units, accreditation bodies, national ,RAC associations, the process of adoption.

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
3. Refrigerant Tables and Charts Including Air Conditioning Data CP Kothandaraman by New Age International Publication
4. Refrigeration and Air-Conditioning Data Book Domkundwar by Dhanpat Rai and Company

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BVRC 404C: REFRIGERATION & AIR CONDITIONING EQUIPMENTS

Semester	4					
Course code	BVRC 404C					
Course title	Refrigeration & Air-Conditioning Equipments (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Portable Air Conditioning**

Car air conditioner Bus air conditioner Train air conditioner. Inverter Technology. Selection of type and capacity of Room air conditioner, location of A/C- window, indoor unit. Split A/C location of outdoor unit, piping layout, consideration of slope in window/split A/Cs, draining
in indoor unit of split A/C, installation of piping.

2. **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, Refrigeration

component material types, duct material, material used in evaporator, material used in compressor, material used in condenser. Introduction, desired properties of ideal insulating material, factors affecting the thermal conductivity.

3. Food Preservation Equipments

Need of refrigeration in food preservation, Equipment used for food preservation in: Domestic Applications: Refrigerator. Specifications and features of various refrigerators. Commercial Applications: Introduction and application of deep freezers, display controls, ice cube machines. breweries dispensing machines etc. Industrial Applications: Introduction and application of cold Storage, ice plants, ice cream machines, milk and vegetable storage cold room.

4. Fans and Blowers

Types, Applications of fans and blowers used in different RAC equipments, fan rating and selection.

Recommended Books

1. Refrigeration and Air Conditioning C. P. Arora TMH
2. Refrigeration and Air conditioning Domkondwar Khanna
3. Refrigeration and Air conditioning Balleney Khanna
4. Ref and Air Conditioning Gupta & Prakash New Chand.

Reference 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

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BVRC 405C: REFRIGERATION & AIR CONDITIONING LAB -III

Semester	4					
Course code	BVRC 405C					
Course title	Refrigeration & Air Conditioning Lab -III (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	3	60	40	1.5

LIST OF EXPERIMENTS

1. To study basic components of air-conditioning system using test rig.
2. Experiment on air-conditioning test rig & calculation of various performance parameters.
3. To study the room air conditioner using open air-conditioner system of lab.

4. To study cooling and dehumidifying coils and apparatus dew point of coil.
5. To study heating coils and its bye-pass factor.
6. To find out the cooling load for given large building.
7. To Studythe range of psychrometric processes with air washers equipment.

BVRC 406C: FLUID MECHANICS LAB

Semester	4					
Course code	BVRC 406C					
Course title	Fluid Mechanics Lab **(**Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	3	60	40	1.5

LIST OF EXPERIMENTS

1. To determine the Metacentric height of a floating vessel under loaded and unloaded condition.
2. To study the flow through the variable duct and to verify the Bernoulli's equation.
3. To determine the coefficient of discharge for a venturimeter.
4. To determine the coefficient of discharge for an orifice meter.
5. To determine the coefficient of discharge for a V-notch or a rectangular Notch.
6. To determine the head losses in a pipe line due to sudden expansion, sudden contraction or bend.
7. To study the transition from laminar to turbulent flow and to determine lower critical Reynolds number.

Fifth Semester
(Refrigeration and Air Conditioning)

BVRC 501C: SAFETY IN REFRIGERATION & AIR CONDITIONING

Semester	5					
Course code	BVRC 501C					
Course title	Safety in Refrigeration & Air Conditioning (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	4	1	0	40	60	5

1. **Introduction to Industrial Safety:**
   Need for safety, safety legislation: acts and rules, safety standards and codes; accident sequence theory, causes of accidents, accident prevention and control techniques, plant safety inspections.
2. **Safety Components:**
   Safety on the Job: Personal safety, protective clothing and equipment, harmful Substances, safe work, practices, safety when working with electricity, refrigeration safety.
3. **Types of Accidents:**
   Safety for RAC Engineers: Types of accident, physical injuries from mechanical causes, use of tools and handling precautions.
4. **Precautions against Injuries in RAC:**
   Injuries in RAC and Precaution: Refrigerant cylinder, corrosion, refrigerants and other gases Construction materials, fire fighting precautions, breathing, toxic gases, and precaution for the same.

TEXT BOOKS:

1. Air conditioning Systems principles, equipments and Services", Joseph Moravek, Prentice Hall
2. "HVAC Handbook", Part I and II, ISHRAE
3. "Industrial refrigeration Hand Book", Wilbert F. Stoecker

BVRC 502C: ENGINEERING MATERIALS

Semester	5					
Course code	BVRC 502C					
Course title	Engineering Materials (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	0	0	40	60	3

1. ELECTRICAL ENGINEERING MATERIALS

Conducting Materials: Properties of good conducting materials, Brief idea about & conductivity Resistivity.

Insulating Materials: (a) Plastic insulating materials-definition and classification, thermosetting and thermoplastic materials, their applications and commercial names & uses in industry. (b) Various insulating materials-mica asbestos, ceramic materials, glass, their properties and applications.

Semiconductor Materials: Characteristics and applications of semiconductor materials **Non-Metallic Materials**-Timber. Preservation of timber, Defects of timber, Surface treatment

Miscellaneous Materials: Important properties, characteristics and use of the following materials:
Abrasives, Asbestos, Cork, Mica, Refractory

2. MECHANICAL ENGINEERING MATERIALS:

Non-Ferrous Metals**:** Aluminum, Zinc, Copper, Silver-Trade names; Physical, mechanical and electrical properties and use.
Base metal with principal alloy in elements- Aluminum Alloys, Copper Alloys, Nickel Alloys

3. CIVIL ENGINEERING MATERIALS:

General idea of raw materials, properties and uses of Bricks, lime, cement Foundation:(i) Bearing capacity of soil and its importance, need of foundation for machines (ii) Foundations for heavy, light and vibrating machines (iii) Concrete proportion, mixing w/c ratio, workability RCC and its use.

BOOKS RECOMMENDED:

1. Engineering Mechanics, M.P. Poonia & D.S. Bedi, Khanna Publishing House
2. Civil Engineering Construction Materials, S.K.Sharma,Khanna Publishing House
3. Engineering Materials: Dhanpat Rai &Sons
4. Electrical Engineering Materials: Madan Publishers

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BVRC 503C: ECONOMICS FOR ENGINEERS

Semester	5					
Course code	BVRC 503C					
Course title	Economics for Engineers (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Demand Functions:**
   Demand function; Law of demand; Determinants and exceptions to the law of demand; Price elasticity of demand and its importance; Income elasticity o f demand; Cross price elasticity of demand; Determinants of price elasticity, Market mechanism; equilibrium and its stability.
2. **Production Functions:**
   Production function – short run & long run; Short run – theory of production; Long run– Returns to scale; Theory of costs – short run and long run cost curves Economic Concept of profit.
3. **Investment & Project Management:**
   Concept of investment Evaluating Capital Projects; (a) Payback Period Method (b) Net Present Value Method (c) Internal Rate of Return Method.
4. **Planning:**
   Mixed Economy and relevance of planning; Globalization; Gross Domestic Product and its growth; Inflation; Business Cycle and real estate business in India; Foreign Direct Investment.

TEXT BOOKS:

1. Samuelson & Nordhaus, Economics, Sixteenth Edition, Tata McGraw Hills.
2. Mankiw, Gregory N., Principles of Economics Sixth Edition.
3. A.N. Agarwal, Indian Economy: Problem of Development and Planning, New AgeInternational.

BVRC 504C: ENTREPRENEURSHIP

Semester	5					
Course code	BVRC 504C					
Course title	Entrepreneurship (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Introduction:**
   Definition, aim, Conceptual definition of entrepreneurs and entrepreneurship, Historical development of entrepreneurship, Entrepreneurial practice.
2. **Small Businesses:**
   The importance of small business, Entrepreneurial economy, Entrepreneurship and Economic Development, Type of Entrepreneurship, Entrepreneur and small business, Features and types of businesses and entrepreneurs.
3. **Role of Entrepreneurship:**
   The role of entrepreneurship in economic development, Terms of entrepreneurship, Innovation and entrepreneurship, Entrepreneurship and small business, The life cycle of a small company, Forms ofentrepreneurial organization, Sources of capital.
4. **Entrepreneurial Projects:**
   Entrepreneurial project: an entrepreneurial venture and entrepreneurial development chain. Defining the business concept, Writing a business plan, Basics of Venture Marketing, Fundamentals of entrepreneurial management, Technical and technological analysis of entrepreneurial projects.

TEXT BOOKS:

1. Entrepreneurship Development, Jagroop Singh & Ankur Mahajan, Kalayani Publishers.
2. Entrepreneurship Development & Management, RK Singhal, S.K. Kataria and Sons
3. Entrepreneurship Development & Management, Vasant Desai & Kulveen Kaur, Himalayan Publishing House.

REFERENCE BOOKS:

1. Entrepreneurship Development, By: Khanka S.S., S. Chand Publishers.

BVRC 505C: THERMODYNAMICS LAB

Semester	5					
Course code	BVRC 505C					
Course title	Thermodynamics Lab (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	3	60	40	1.5

LIST OF EXPERIMENTS

1. Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines using actual engines or models.
2. To study actual valve timing diagram of a 4 stroke petrol and diesel engines andits impact on the performance of engine.
3. Determine the brake power, indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine running at constant speed (Morse Test).
4. To study construction, working & applications of low pressure boilers/ high pressure boilers with help of the models.
5. To study a boiler trial for estimation of equivalent evaporation and efficiency of a fire tube / water tube boiler.
6. Study of working, construction, mountings and accessories of various types of boilers.
7. To study of various types of steam condensers with help of the models.

BVRC 506C: REFRIGERATION & AIR CONDITIONING LAB - IV

Semester	5					
Course code	BVRC 506C					
Course title	Refrigeration & Air Conditioning Lab - IV (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	3	60	40	1.5

LIST OF EXPERIMENTS

1. Leak detection in refrigeration system bydifferent methods.
2. Air removal and charging of a refrigeration unit.
3. Testing of a refrigeration system to find out: (a) Refrigerating capacity (b) C.O.P.

4. Determination of psychrometric properties of air with the help of a sling psychromotor and aspiration psychrometer.
5. Determination of bye pass factor of a cooling coil.
6. Determination of humidifying efficiency of a evaporative cooler.
7. Determination of cooling load for a specified situation.
8. Study of the following system by visit: (a) Ice Plant (b) Cold storage plant (c) Control air-conditioning system.

Sixth Semester
(Refrigeration and Air Conditioning)

BVRC 601C: MAINTENANCE OF REFRIGERATION & AIR CONDITIONING SYSTEMS

Semester	6					
Course code	BVRC 601C					
Course title	Maintenance of Refrigeration & Air Conditioning Systems (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

Unit I

RAC Tools: Engineering hand tools: spanners, screwdrivers, pliers, hammers, brazing, welding, flaring tool, tube bender, wood saws, electrical hand drill, sheet metal snips, Allen keys pop riveter, chisels, pulley extractors, Center punch, wire brush, drill bits, oil can.

Unit II

Measuring Equipments: 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

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

Pipe installation work: pumping down the system, purging the system, starting the plant.

Unit V

Refrigerant Handling: Using a system analyzer, transferring and handling liquid refrigerant.

TEXT BOOKS:

1. Refrigeration & Air-Conditioning, Domkundwar,Arora and Domkundwar, Dhanpat Rai & Co.
2. Refrigeration and Conditioning, Manohar Prasad, New Age International Publishers
3. Refrigeration and Air Conditioning, R.K. Rajput, S. Chand Publishing
4. Refrigeration and Air Conditioning, R.S. Khurmi and J.K. Gupta, S. Chand Publishing
5. Basic Refrigeration and Air Conditioning, P. N. Ananthanarayan, Tata McGraw Hill
6. Refrigeration and Conditioning, C.P. Arora, McGraw Hill Education

REFERENCE BOOKS:

2. ASHRAE Handbook, Fundamentals, 2013
3. Carrier Handbook of Air Conditioning System Design, 2017
4. Principles of Refrigeration, Roy J. Dossat, Wiley Eastern Limited
5. Air Conditioning Applications and Design, W. P. Jones, Elsevier
6. Refrigeration and Conditioning, W.F. Stoecker, McGraw Hill
7. Refrigeration and Conditioning, Richard Charles Jordan, Gayle B. Priester, Prentice-Hall

BVRC 602C: INDUSTRIAL ENGINEERING & MANAGEMENT

Semester	6					
Course code	BVRC 602C					
Course title	Industrial Engineering & Management (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Basics of Management:**
   Management – Definition, Henry-Fayol's principles of management, Business organization Types, Functions of Management, Maslow's Theory of Motivation, Process of Communication Barriers for effective communication. Economics related to engineering, costing and accountings, operation & research.

2. **Materials Management:**
   Definition, functions & Objectives. Purchase procedure – Comparative statement, purchase order. Inventory Management – Definition, functions of Inventory Control.

3. **Plant Maintenance:**

   Plant maintenance – Definition, Types of Maintenance-Preventive maintenance-Break down Maintenance-Advantages and disadvantages-Total Productive Maintenance- Meaning benefits of TPM, Supply chain management, the management of flow of goods & services between business & location.

4. **Social Issues & Environment:**
   Environment-Definition and scope; Solid waste management: causes, effects and control measures; Climate change: global warming, acid rain, ozone layer depletion.

TEXT/ REFERENCE BOOKS:

1. T.R.Banga & SC Sharma. Industrial Organization and Engineering Economics; Khanna. Publishers
2. K.K.Ahuja. Industrial management and organizational behavior.
3. O.P.Khanna; Industrial management and engineering economics.
4. K.Aswathappa and Sreedhar Bhatt. Production and operations management, Himalaya publishers.

BVRC 603C: COOLING TOWERS & AIR HANDLING SYSTEMS

Semester	6					
Course code	BVRC 603C					
Course title	Cooling Towers &Air Handling Systems (Theory)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	3	1	0	40	60	4

1. **Cooling Towers**

   Brief rundown of how cooling towers operate, including knowledge about circulation of hot water, distribution of water through cooling tower, airflow, importance of heat exchangers for a cooling tower operation, lost water make-up etc.

2. **Maintenance of Cooling Towers**

   Introduction of regular inspections, Cleaning etc.

3. **Material used in Cooling Towers**

   Basic knowledge of material used for Structure, Fill Media, distribution System, fans, Drift Eliminators, basins, louvers etc.

4. **Maintenance of pH Level in Cooling Towers**

   Basic knowledge about Regular Monitoring, Adjusting pH Levels, Buffering Agents, corrosion Inhibitors, Cleaning and De-scaling etc.

5. **Basic Knowledge of operation & Maintenance of Air Handling Units**

   Brief introduction about Air Intake, Filtering, Pre-Heating or Pre-Cooling, Humidification and Dehumidification, Fan Operation etc.

6. **Types of Cooling Towers**

   Introduction of Natural Draft Cooling Tower, Induced Draft Cooling Tower, Forced Draft Cooling Tower, counter flow and cross flow cooling tower.

RECOMMENDED BOOKS

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpat rai and sons, Delhi
2. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC
3. Refrigeration and Air Conditioning by R.S. Khurmi, S.Chand & Company, New Delhi
4. Refrigeration and Air Conditioning by R.K Rajput, S. Chand Publishing,

BVRC 604C: PROJECT

Semester	6					
Course code	BVRC 604C					
Course title	Project (Practical)					
Scheme and Credits	L	T	P	Internal Marks	External Marks	Credits
	0	0	6	60	40	3

Candidates will make a project related to maintenance of refrigeration & air conditioning. After making the project, he/she is supposed to have practical knowledge about different parts used in different refrigerat ing & air conditioning units (domestic & commercial) and maintenance related activities of refrigerating & air- conditioning units. A detailed report will have to be submitted after making the project.

#Concerned Head of Department will assign Project to faculty member(s) as coordinator with Load of 6 hrs/week.
