

S-01 & 02 June, 2016 AC after Circulars from Circular No.100 & onwards - 13 -

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**CIRCULAR NO. SU/Sci./B.Sc. Syllabi/6/2016**

It is hereby inform to all concerned that, on the recommendations of the Committees/Ad-hoc Boards the Hon'ble Vice-Chancellor has accepted the following revised syllabi in his emergency powers under Section-14[7] of the Maharashtra Universities Act, 1994 on behalf of the Academic Council as mentioned against their names under the Faculty of Science :-

Sr. No.	B.Sc. III Year Revised Syllabi	Semester
[1]	B.Sc. Automobile Technology . [Degree Course],	V & VI
[2]	B.Sc. Workshop Technology [Degree Course],	V & VI
[3]	B.Sc. Refrigeration & Air Conditioning [Degree Course],	V & VI
[4]	B.Sc. Bioinformatics [Degree Course].	V & VI
[5]	B.Sc. Biotechnology [Optional],	V & VI
[6]	B.Sc. Horticulture [Optional],	V & VI
[7]	B.Sc. Dry Land Agriculture [Optional],	V & VI
[8]	B.Sc. Sericulture [Optional],	V & VI

This is effective from the **Academic Year 2016-2017** and onwards as appended herewith.

These syllabi are also available on the University Website www.bamu.ac.in

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,

Aurangabad-431 004.

REF.No.SU/B.Sc./2016/3849-68

Date:- 23-06-2016.

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Director,

Board of College and
University Development.

Copy forwarded with compliments to :-

- 1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.

Copy to :-

- 1] The Controller of Examinations,
- 2] The Section Officer, [B.Sc. Unit],
- 3] The Section Officer, [B.C.S. Unit],
- 4] The Programmer [Computer Unit-1] Examinations,
- 5] The Programmer [Computer Unit-2] Examinations,
- 6] The In-Charge, E-Suvidha Kendra, [Professional Unit], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr. Babasaheb Ambedkar Marathwada University,
- 7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
AURANGABAD**

B. Sc. (REFRIGERATION & AIR CONDITIONING) COURSE

THIRD YEAR

FIFTH & SIXTH SEMESTER

**DR. BABASAHEB AMBEDKAR MARATHWADA
UNIVERSITY, AURANGABAD.**

APPENDIX – ‘A’

**B. Sc. (REFRIGERATION AND AIR CONDITIONING)
THIRD YEAR**

FIFTH SEMESTER

Paper no.	Name of Paper	Max Marks		Min. Marks for passing		Total Mark
		TH	PR	TH	PR	
RAC-501	Entrepreneurship development Program -I	50	--	20	--	50
RAC-502	Refrigerants	50	--	20	--	50
RAC-503	Refrigeration & Air Conditioning Material	50	--	20	--	50
RAC-504	Refrigeration & Air Conditioning Application	50	--	20	--	50
RAC-505	Refrigeration & Air Conditioning Piping System	50	--	20	--	50
RAC-506	Non-Conventional Refrigeration System	50	--	20	--	50
RAC-507	Project-I/Seminar	--	50	--	20	50
RAC-508	Practical-I based on paper 2	--	50	--	20	50
RAC-509	Practical-II based on paper 3	--	50	--	20	50
RAC-510	Practical-III based on paper 4	--	50	--	20	50
RAC-511	Practical –IV based on paper 5	--	50	--	20	50
RAC-512	Seasonal based on paper 6	--	50	--	20	50
Total		300	300	--	--	600

Total marks 300+ 300= 600

**DR. BABASAHEB AMBEDKAR MARATHWADA
UNIVERSITY, AURANGABAD.**

**APPENDIX – ‘A’
B. Sc. (Refrigeration and Air Conditioning)
THIRD YEAR**

R-1878: The following shall be the scheme of examination of the Course.

FIFTH SEMESTER

Paper no.	Name of Paper	Scheme and Pattern of Examination					Total Mark
		Teaching Scheme Periods (1 Hr.)			Duration		
		Theory Per week	Pract. Per week	Total	Theory Hrs.	Pract.	
RAC-501	Entrepreneurship development Program -I	3	--	3	3	--	50
RAC-502	Refrigerants	3	--	3	3	--	50
RAC-503	Refrigeration & Air Conditioning Material	3	--	3	3	--	50
RAC-504	Refrigeration & Air Conditioning Application	3	--	3	3	--	50
RAC-505	Refrigeration & Air Conditioning Piping System	3	--	3	3	--	50
RAC-506	Non-Conventional Refrigeration System	3	--	3	3	--	50
RAC-507	Project-I/Seminar	--	3	3	--	3	50
RAC-508	Practical-I based on paper 2	--	3	3	--	3	50
RAC-509	Practical-II based on paper 3	--	3	3	--	3	50
RAC-510	Practical-III based on paper 4	--	3	3	--	3	50
RAC-511	Practical –IV based on paper 5	--	3	3	--	3	50
RAC-512	Seasonal based on paper 6	--	3	3	--	3	50
Total		18	18	36	--	--	600

RAC-501-ENTREPRENEURSHIP DEVELOPMENT PROGRAM –I

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	--	--	50	Two Hrs.	--

- 1 Introduction to Entrepreneurship, need, importance from national economy and global market.
- 2 Function of Entrepreneur- Contribution to economic growth, regional development, Employment generation, export promotion.
- 3 Different types of enterprises such as SSI, MSI, LSI, Pvt., Ltd., Public Ltd. etc.
- 4 Different types of ownership such as proprietorship, partnership, joint stock, cooperative society, etc.
- 5 Government policies to encourage business and study of various law of business such as excise duty, sales tax, income tax, custom duty, etc.

Term work

The term work shall consist of at least ten assignments based on the above syllabus.

The assessment of the term work will be based on the following criteria

- 1) The record of the assignment submitted.
- 2) The assessment of the term work to be conducted internally.
- 3) Viva vice

Books Recommended

1. Small business management – Iteeinlplf and burgess.
2. Marketing management - Philip Kotler.
3. Entrepreneurial Development (Himalaya Publishing)

RAC-502-REFRIGERENTS

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: Introduction

(10 hrs)

Refrigerants, cooling media and liquid absorbents, azeotropic and zeotropic, numbering of refrigerants.

Unit II: Classification and Properties of Refrigerants

(10 hrs)

Requirement for refrigerant, classification-based on working principle, safety and chemical composition, desirable properties of refrigerants-thermodynamic properties, safe working properties, physical properties etc.

Unit III: Choice of Refrigerant

(10 hrs)

Important refrigerants, secondary refrigerant, anti-freeze solution, selection of refrigerant for required purpose, refrigerant oils and applications.

Unit IV: Application and Future Refrigerants

(10 hrs)

Properties and uses of commonly used refrigerant, green house effect, global warming and future refrigerants.

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.

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.

List of Experiments:

Any seven of the following practical should be performed and recorded in laboratory book

1. Study of use of some refrigerants (R11/R12/R13/R21/R22/R717/R718).
2. Study of nomenclature.
3. Study of classification of refrigerants.
4. Study of changing refrigerant

- a. Replacing R-40 with R-12
- b. Replacing R-22 with R-502
- c. Replacing R-12 with R-22
- 5.** Study of refrigerant oils and applications.
- 6.** Study of methods of recovering refrigerants.
- 7.** Identification of refrigerant cylinders by colour coding and standing pressure.
- 8.** Find out the eutectic temperature of sodium chloride brine.
- 9.** Oil charging of domestic and commercial compressors.
- 10.** Identification of lubricants grades.

RAC-503-REFRIGERATION & AIR CONDITIONING MATERIAL

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: Insulator

(12 hrs)

Introduction, desired properties of ideal insulating material, factors effecting the thermal conductivity, 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, economical thickness of insulation, few insulated systems, low temperature insulations, importance of relative humidity for the selection of the insulations, air distribution for reducing heat lose.

Unit II: Cables and Wiring

(8 hrs)

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 III: Component Material

(8 hrs)

Refrigeration component material, duct material, material used in evaporator, material used incompressor, material used in condenser, material used in expansion valve, different types of valve material, material used in cooling towers, pipeline materials, drying materials, jointing material, synthetic repair materials.

Unit IV: Oils and Lubrication

(8 hrs)

Need of lubrication, types of lubrication, properties of lubrication oils, lubrication systems,selection of refrigerant lubricant, compatibility of lubricant with refrigerant fluid, refrigeration oil with additives, the effect of refrigerant on lubricant density, solvent and cleaning.

Unit V: Tubing (4 hrs)

Soft copper tubing, hard-drawn copper tubing, steel tubing, normal size copper tubing, cuttingtubing, bonding tubing, connecting tubing, flaring tubing.

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. Turnquistand Alfred F. Bracciano, The goodheart-willcoxcompany,INC.

List of Experiments:

Any eight of the following practical should be performed and recorded in laboratory book

1. Identification of types of copper tubes (dia 3 mm, 6 mm, 12.5mm)
2. Identification of types of brazing rod and its composition.
3. Identification of oil and grease removals, fire hazard of the removals.
4. Familiarization of joining material, gasket, pipe joint.
5. Introduction of various insulating material, properties, fire hazard, etc.
6. Soldering and Brazing – types of brazing, preparation, purging. applying flux, applying heat.
7. Pipe Bending – Introduction to tools and different bends, pipe cutting.
8. Electrical requirement – introduction and familiarization with electrical symbols, circuit diagram of the RAC system.
9. Introduction to gas welding set, simple gas welding, arc welding.
10. Identification and testing of resistor, diodes and transistors.
11. Identification of refrigerant cylinder by color coding and standing pressure – types of Cylinder.
12. Technique of glass wool filling method in conventional refrigerant.

RAC-504- REFRIGERATION & AIR CONDITIONING APPLICATION

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: Food Preservation (8 hrs)

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 (8 hrs)

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

Unit III: Ice-Manufacturing (8 hrs)

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 (8 hrs)

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 (8 hrs)

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. A 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.

List of Experiments:

1. Study of various methods of food freezing.
2. Study of cold storage.
3. Study of experimental Ice plant.
4. Study of railway air conditioning.
5. Technical reports on visit to refrigeration and air conditioning establishments. (any one)

RAC-505– REFRIGERATION & AIR CONDITIONING PIPING SYSTEM

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content:

Unit I: Codes, Standards and Specifications (6hrs)

Piping codes, ASME codes and standards, ASTM Specifications, ASME Boiler pressure vessel codes, ASME B31-Code for pressure piping, piping material specifications, material–chemical composition, mechanical strength, testing, dimensions and tolerances examinations, testing of piping system and valves, fabrications.

Unit II: Piping Components (6hrs)

Pipe–seamless, welded pipes, pipe sizes, dimensional specifications, material specifications, pipe ends, pipe fittings–elbows, tees, flanges, butt welded end fittings, socket welded and threaded end fittings, flanged joints, weld neck flanges, socket weld flanges, threaded flanges, blind flanges, bolts and gaskets, pipe support, 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 III: Pipe Size Calculations (8hrs)

Viscosity, Reynolds number, friction factor, Darcy Weisback friction factor, friction factor for laminar and turbulent flows, equivalent pipe length, hydraulic radius, compressible flow, pipe sizing, pipe sizing formulae, pipeline wall thickness calculation, Hazen William equation, Darcy Weisback equation, total pressure required to transport– friction head, elevation head and minimum delivery pressure, elements of total dynamic head–static head, pressure head, velocity head, friction head, pump power required, cavitation in pumps, NPSH required and NPSH available for pumps.

Unit IV: Pipe Stress Analysis (8hrs)

Objectives and definition of stress analysis, piping loads– primary, secondary, sustained loads, occasional loads, static and dynamic loads, piping stresses–primary, secondary, pipe span calculations flexibility analysis–expansion loops and expansion joints, concept of thermal expansion, providing flexibility in piping, types of expansion loops, expansion joint –types, application and selection.

Unit V: Fabrication, Assembly and Erection(6hrs)

Fabrications materials for piping systems, fabrication drawings, fabrication activities–cutting, beveling, forming, bending, welding, brazing and soldering, galvanizing, protection of carbon steel in corrosive services, corrosion allowance, internal galvanizing of pipe, pipe cladding. Assembly–alignment, flanged joints, threaded joints.

Unit VI: Inspection and Testing (6hrs)

Examinations methods, visual examination, magnetic particle examination, liquidpenetrant examination, radiographic examination, ultrasonic examinations, 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. ASHRAE handbook, 2002.

List of Experiments:

Any six of the following practical should be performed and recorded in laboratory book

1. Study of piping codes, ASME codes and standards, ASTM Specifications.
2. Study of Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material specifications, pipe ends.
3. Study of pipe fittings–elbows, tees, flanges, butt welded end fittings, socket welded and threaded end fittings.
4. valves–gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve codes and standard, valve size, pressure class rating.
5. Study of pipeline wall thickness calculation.
6. Study of NPSH required and NPSH available for pumps.
7. Study of piping load and piping stresses.
8. Study of different leak detection methods.
9. Checking the performance of air ducting system.

RAC-506-NON-CONVENTIONAL REFRIGERATION SYSTEM

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	SW	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	--

Course content

Unit I: Vapour Absorption Refrigeration System (20 hrs)

Principle of absorption system, comparison between vapour compression system and vaporabsorption system, theory of binary mixtures

a. Aqua-ammonia vapour absorption system, theory of mixtures, temperature concentration diagram, enthalpy concentration diagram, processes used in aqua-ammonia absorption system, adiabatic mixing, separation, throttling process, vapour absorption system its components, working principle and mathematical analysis

b. Lithium-bromide- water absorption system its components, working principle, and mathematical analysis

Unit II: Steam Jet Refrigeration System (12 hrs)

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

Unit III: Thermo-Electric Refrigeration System (8 hrs)

Introduction, thermo-electric effects, seebeck effect, peltier effect, thomson effect.

Recommended books:

1. A 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 P.L.Ballaney, Khanna publishers, New Delhi.
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi.

List of Experiments:

1. To study working principle of steam jet refrigeration system.
2. To perform a trial on Vapor Absorption test rig.
3. Technical report on visit to Lithium-bromide vapor absorption plant.(any one)

PROJECT – I / SEMINAR

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
--	40(3hrs/week)	-	50	--	50	--	Three Hrs.

Every individual student shall work on a recent topic selected or assigned from any engineering/allied/applied fields for the seminar of academic or industrial interest. It is expected that the student has to collect information on a topic which is not covered in curriculum of the under graduate course. Student has to refer hand book, research journals, reference books, proceeding of conference through library or internet and record of references considered for seminar is to preserved in hard copy or soft copy, which shall be produced at the time of seminar.

The report of seminar should be submitted in printed volume duly certified by guide, HOD and Principal in prescribed format given below. The student should deliver a seminar talk at least for 20 minutes based on the work done by him/her. The performance will be judged by his guide and another expert appointed by HOD.

INSTRUCTIONS TO PREPARE REPORT AND PPT

1. Seminar report shall be typed on A-4 size white bond paper.
2. Typing shall be with line spacing of 1.5 using black inkjet print on one side of the paper.
3. Margins a) Left 37.5mm b) Right, Top and Bottom 25mm.
4. Page number – At the bottom center aligned 12 point font size.
5. Header and Footer (12 point font size – Times New Roman)
 - a) Header – Right side at top stating title of the seminar.
 - b) Footer – Right side at bottom stating institute name.
6. Font
 - a) Main title font – 14 point – bold – Times New Roman – Upper case
 - b) Sub title font – 12 point – bold - Times New Roman – Title case
 - c) Text font - 12 point – normal - Times New Roman – Running
 - d) Graph / Figure / Table titles – 12 point – normal - Times New Roman – Title case
7. Graph / Figure / Table: - shall be located at the center along with its title and Graph No. / Figure No. / Table No. If Graph / Figure / Table or any information is copied from any of the references, reference no. is to be shown at the end of its title / statement in square bracket superscripted form
8. Seminar report shall consists of at least following contents
 - a. First page.
 - b. Certificate.
 - c. Acknowledgement.
 - d. Index page (Chapter wise)
 - e. Graph index (Graph no., Title, Page no.)

- f. Figure index (Figure no., Title, Page no.)
 - g. Table index (Table no., Title, Page no.)
 - h. Introduction /Abstract of seminar.
 - i. Literature review.
 - j. Core content of seminar.
 - k. Merits and demerits of subject.
 - l. Future scope.
 - m. Conclusion.
 - n. References.
 - o. Appendix
 - p. Compact Disc.
9. Format of seminar report
- a. First page (Title page) and cover of seminar report.

(Institute logo)

Seminar Report

on

“Title of Seminar”

By

Name of student

Submitted in partial fulfillment of the requirement for the degree of
Bachelor of Science (Refrigeration & Air-Conditioning)

Name of Institute

Year -----

b. Certificate

(Institute logo)

CERTIFICATE

This is to certify that the seminar report entitled

“Title of Seminar”

Submitted by

Name of student

has completed as per the requirement of Dr. Babasaheb
AmbedkarMarathwada University in partial fulfillment of Degree of
B.Sc.(Refrigeration & Air-Conditioning)

Guide

Head of Department

Principal

Name of Institute

Year----

c. Acknowledgement:- Acknowledgement shall consist of student's opinion related to the seminar topic and his gratitude towards his guide, other staff, social members and his friends those who have really helped him to complete seminar report.

d. Chapter Index: - Shall have title as "INDEX" in bold - 14 point aligned at top center and page consisting of table with three columns as

Chapter No., Chapter particulars, and Page No. Chapter No. and Page No shall be aligned at center of cell and chapter particulars left aligned in the cell.

e. Graph Index / Figure Index / Table Index: - Shall have title as "GRAPH INDEX / FIGURE INDEX / TABLE INDEX" in bold – 14 point center aligned at top of page. Page consisting of three column table as Graph No. / Figure No. / Table No. in first column, Title of Graph / Figure / Table in second column and Page No. in third column. (Similar to chapter index.)

10. Sketches:-Shall be drawn on separate sheet, center aligned with Figure No. and Title of sketch at its bottom.

11. Table shall preferably be typed in text format only with table no. and its title at the top, centrally aligned.

12. Standard mathematical symbols and notations shall be used.

13. The last item on Index should be references.

14. Compact Disc (C.D.) consisting of soft copy of seminar report, PPT, and supporting literature shall be affixed at back cover of report.

15. Presentation shall be made with help of Power point.

a. Preferably each slide shall have plain white or faint yellow or navy blue or maroon colored back ground with contrast matching font.

b. Each slide shall be numbered and header - footer shall be added similar to report.

c. Figure / Graph / Table shall be labeled with Figure No. / Graph No. / Table No. and with reference nos. shown in seminar report

d. Only brief points are to be highlighted on slides

e. Information copied from references shall be numbered with reference number.

f. Points are not to be read directly from slide at the time of presentation.

g. Presentation shall be based on Figure, Graph, Table, Charts and points etc.

h. First slide shall be identical to cover page of report.

i. Second slide should contain introduction / abstract of seminar and content of presentation with bullets.

j. Third slide shall focus on literature review.

k. Fourth slide on wards core content of presentation shall be discussed.

l. Slides at the end shall consist of merits, demerits, future scope, conclusion and references.

The Practical work marks for seminar will be allotted based on the following

1. Seminar Report 10 Marks
2. Literature Review 08 Marks
3. Technical Content 10 Marks

4. Presentation Skill(Aids used) 14 Marks

5. Question Answer 08 Marks Total 50 Marks

**DR. BABASAHEB AMBEDKAR MARATHWADA
UNIVERSITY, AURANGABAD.**

**APPENDIX – ‘A’
B. Sc. (Refrigeration & Air-Conditioning)
THIRD YEAR**

SIXTH SEMESTER

Paper no.	Name of Paper	Max Marks		Min. Marks for passing		Total Mark
		TH	PR	Theory	Practical	
RAC-601	Entrepreneurship development program -II	50	--	20	--	50
RAC-602	Refrigeration & Air Conditioning Maintenance	50	--	20	--	50
RAC-603	Refrigeration & Air Conditioning Installation Techniques	50	--	20	--	50
RAC-604	Refrigeration & Air Conditioning Standard	50	--	20	--	50
RAC-605	Selection of Equipment & Assembly	50	--	20	--	50
RAC-606	Refrigeration & Air Conditioning Safety	50		20		50
RAC-607	Project II	--	50	--	20	50
RAC-608	Practical-I based on paper 2	--	50		20	50
RAC-609	Practical-II based on paper 3	--	50	--	20	50
RAC-610	Practical-III based on paper 4	--	50	--	20	50
RAC-611	Practical –IV based on paper 5	--	50	--	20	50
RAC-612	Seasonal based on paper 6	--	50	--	20	50
Total		300	300	--	--	600

Total marks 300 + 300= 600

**DR. BABASAHEB AMBEDKAR MARATHWADA
UNIVERSITY, AURANGABAD.**

APPENDIX – ‘A’

**B. Sc. (Refrigeration & Air Conditioning)
THIRD YEAR**

R-1878 : The following shall be the scheme of examination of the Course.

SIXTH SEMESTER

Paper no.	Name of Paper	Scheme and Pattern of Examination					Total Mark
		Teaching Scheme Periods (1 Hr.)			Duration		
		Theory Per week	Pract. Per week	Total	Theory Hrs.	Pract.	
RAC-601	Entrepreneurship development program -II	3	--	3	3	--	50
RAC-602	Refrigeration & Air Conditioning Maintenance	3	--	3	3	--	50
RAC-603	Refrigeration & Air Conditioning Installation Techniques	3	--	3	3	--	50
RAC-604	Refrigeration & Air Conditioning Standard	3	--	3	3	--	50
RAC-605	Selection of Equipment & Assembly	3	--	3	3	--	50
RAC-606	Refrigeration & Air Conditioning Safety	3	--	3	3	--	50
RAC-607	Project II	--	3	3	--	3	50
RAC-608	Practical-I based on paper 2	--	3	3	--	3	50
RAC-609	Practical-II based on paper 3	--	3	3	--	3	50
RAC-610	Practical-III based on paper 4	--	3	3	--	3	50
RAC-611	Practical –IV based on paper 5	--	3	3	--	3	50
RAC-612	Seasonal based on paper 6	--	3	3	--	3	50
Total		18	18	36	--	--	600

RAC-601-ENTREPRENEURSHIP DEVELOPMENT PROGRAMME-II

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	---	50	--	--	50	Two Hrs.	--

- 1 Concept & Philosophy of Entrepreneurship Evolution and development
- 2 Important qualities for an entrepreneur such as leadership, communication skill, deal making, frustration tolerance, hard work, persuasion etc.
- 3 Setting up new venture, search for new ideas, project identification, project report and business planning.
- 4 Study of various causes of failure of business and precaution to be taken to avoid failures.
- 5 Introduction to marketing concept, Definition, scope, objectives, marketing techniques.

Term work

The term work shall consist of at least ten assignments based on the above syllabus.

The assessment of the term work will be based on the following criteria

- 1) The record of the assignment submitted.
- 2) The assessment of the term work to be conducted internally.
- 3) Viva vice

Books Recommended

- 1) Small business management – Iteeinlplf and burgess.
- 2) Marketing management - Philip Kotler.
- 3) Entrepreneurial Development (Himalaya Publishing)

RAC-602-REFRIGERATION & AIR CONDITIONING MAINTENANCE

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: RAC Tools (10 hrs)

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.

a. 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

b. Specialist tools and accessories: flexible charging line, bending springs, pipe tube cutter, fin combs, soldering and brazing equipment's, vacuum pump, charging cylinders, electric test lamps, jumper lead, welding goggles.

Unit II: Piping and Jointing Work (4 hrs)

Copper pipe, steel pipe, pipe joints, pipe bending.

Unit III: Servicing Techniques (6 hrs)

Burn out repair, capillary tube cleaning, charging the system, compressor work, expansion valve(thermostatic), servicing, hermetic compressor motors (stating problems), repairing leaks, sealed system connections.

Unit IV: Installation Techniques (8 hrs)

Checking the charge, electrical circuits (servicing), evacuation of the system, installation and location of main components, leak detection methods, non-condensable gas the system, pipe installation work, pumping down the system, purging the system, starting the plant, using a system analyzer, transferring and handling liquid refrigerant.

Unit V: Electrical Fault Finding (6 hrs)

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 VI: Mechanical Fault Finding (6 hrs)

Fault analysis by temperature and pressure, methods of confiring the fault, finding the fault when the compressor is not running, abnormal noise problem, domestic system faults.

Recommended books:

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

2. 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-hillinternational edition, Singapore.
2. Refrigeration and Air Conditioning Technology by William C. Whitman, William M. Johnson and John A. Tomczyk, Delmar Thomson learning, USA

List of Experiments:

Any four of the following practical should be performed and recorded in laboratory book

1. Dismantling & assembling of hermetic compressors like, reciprocating, rotary, wobble, swash plate & scroll type compressors. Identify the parts and rectify the defects.
2. Familiarization with condensers used in refrigerators, bottle coolers, visible coolers, Deep freezer, window and split A.C, Cleaning, flushing and servicing of air cooled condenser, leak testing of condenser.
3. Study the construction and working of window A.C, care and routine maintenance, installation procedure.
4. Practice in cutting, bending and flaring, swaging and brazing of copper tube.
5. Testing new evaporator coils for leak, choke & repairing and cleaning of fins.
6. Testing condenser coils for leak, choke & repairing, de-scaling of water cooled condenser.

RAC-603- REFRIGERATION AND AIR CONDITIONING INSTALLATION TECHNIQUES

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: Introduction (10 hrs)

Installation operation, adding oil, testing for leak detection, evacuation and dehydration, removing air, charging of the system, through suction valve, through discharge valve.

Unit II: Installation of Room Air-Conditioner (10 hrs)

Selection of proper location, providing proper slope and provision for to drain water, ventilation arrangement for window air conditioner, wiring diagram for installation for room air conditioner, installation of split air conditioner, providing arrangement for pipes and pipe insulations.

Unit III: Commercial Installations of Refrigeration Systems (10 hrs)

Ice manufacturing plant, milk dairy plant, ice bank, cold storage plant.

Unit IV: Commercial Installation of Air Conditioning Systems (10 hrs)

Office air conditioning, hotel air conditioning, central air conditioning, automobile air conditioning.

Recommended books:

1. Air conditioning: procedures and installation by V.Paul Lang, CBS publishers & distributors, Delhi.

Reference books:

1. Refrigeration technicians pocket book by F.H.Meredith, Butterworths.
2. Air conditioning installation and maintenance by Ernest Tricomi, D.B.Taraporevala sons & co.pvt.limited.

List of Experiments:

Any four of the following practical should be performed and recorded in laboratory book excluding industrial visit.

1. Study of evacuation and dehydration.
2. Study of installation and location of main components.
3. Study of installation of split air conditioner.
4. Study of typical automotive air conditioning system- installation- operation.
5. Locating leaks in refrigeration system.

6. Charging of refrigeration system.
7. Detail report on visit to one of the commercial refrigeration system.(any one)
8. Layout of air-conditioning plant, ice plant, cold storage etc.

PAPER-604-REFRIGERATION & AIR CONDITIONING STANDARD

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: Introduction (8 hrs)

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

Unit II: Development of Standards (8 hrs)

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: Existing Standards (8 hrs)

Main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential)alternatives, ISO, IEC, ECS (European Committee for Electro Technical standardization).

Unit IV: Adoption of International Standards at National Level (8 hrs)

National standardization bodies, national ozone units, accreditation bodies, national RACassociations, the process of adoption.

Unit V: Use of International Standards (8 hrs)

In designing of refrigeration and air conditioning equipment, selection of materials related torefrigeration 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.

List of Experiments:

Any five of the following practical should be performed and recorded in laboratory book

1. Study of different types of international classification of standards for refrigeration and air conditioning.
2. Study of ISO- international organization for standardization, IEC-international electro technical commission and others international and national organizations.
3. Study of main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential) alternatives.
4. Study of adoption of international standards at national level.
5. Study of use of international standards in designing of refrigeration and air conditioning equipment.
6. Study of safety issues related to refrigeration and air conditioning

PAPER-605-SELECTION OF EQUIPMENT & ASSEMBLY

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	Three Hrs

Course content

Unit I: Compressor (13 hrs)

Reciprocating compressor-hermetically sealed compressor, condensing units, performance, volumetric efficiency, performance of the ideal compressor, power requirement, refrigeration capacity, C.O.P and volume flow rate per kw of refrigeration, effect of condensing temperature, performance of actual reciprocating compressor, actual volumetric efficiency, compression efficiency, compressor discharge temperature and capacity control.

Unit II: Condensers (7 hrs)

Required condensing capacity, condensing coefficient, fouling factor, de-superheating, condenser design, Wilson plots, air and non-condensable.

Unit III: Evaporators (7 hrs)

Boiling in the shell, boiling inside tubes, evaporator performance, pressure drop in tubes, frost.

Unit IV: Expansion Devices (13 hrs)

Purpose and types of expansion devices, capillary tubes, selection of a capillary tube, analytical computation of pressure drop in a capillary tube, calculating the length of an increment, choked flow, graphical method of capillary-tube selection, constant-pressure expansion valve, float valves, superheat-controlled (thermostatic) expansion valve, manufacturers ratings of thermostatic expansion valves, electric expansion valves, application.

Recommended books:

1. Refrigeration and Air Conditioning by Wilbert F. Stoecker and Jerold W. Jones, McGraw-hill international edition, Singapore
2. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore.

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.

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

List of Experiments:

Any five of the following practical should be performed and recorded in laboratory book.

1. To study hermetically sealed compressor, condensing units, performance, volumetric efficiency, performance of the ideal compressor and power requirement.
2. To study different types of condensers and condenser design.
3. To study different types of evaporators and , evaporator performance, pressure drop in tubes, frost.
4. To study selection of expansion valves, and capillaries for various refrigeration and air conditioning applications.
5. Find out the heat rejection factor of condenser, condenser capacity, efficiency and effect of fouling factor.
6. Capillary bore checking, performance test conducted by test rig (consisting of capillary tube and thermostatic expansion valve) for finding C.O.P.
7. Familiarization of capillary selection guide.

RAC-606- REFRIGERATION AND AIR CONDITIONING SAFETY

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	SW	TW	Total	Theory	Practical
40(3hrs/week)	40(3hrs/week)	50	50	--	100	Two Hrs.	--

Course content

Unit I: Introduction to Industrial Safety (10 hrs)

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: Overview of Standard (10 hrs)

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: Safety on the Job (8 hrs)

Personal safety, protective clothing and equipment, harmful substances, safe work practices, safety when working with electricity, refrigeration safety.

Unit IV: Safety for RAC Engineers (6 hrs)

Types of accident, physical injuries from mechanical causes, use of tools and handling precautions, electrical injuries, electrical safety rules.

Unit V: Injuries in RAC and Precaution (6 hrs)

Refrigerant cylinder, corrosion, burn and other scalds, refrigerants and other gases, construction materials, firefighting 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

List of Experiments:

Any six of the following practical should be performed and recorded in laboratory book

1. Study of Safety legislation: Acts and rules.
2. Study of Safety standards and codes used in RAC.
3. Study of protective clothing and equipment's used in RAC.
4. Study of electrical safety rules.
5. Study of refrigerant and other gases, codes and safety.
6. Study of different types of fire extinguisher.
7. Demonstration of fire extinguisher used in refrigeration and air conditioning.
8. Different gas cylinder handling procedure.
9. Handling of HC refrigerants and safety observations.

PROJECT – II

Teaching Scheme Hours		Evaluation Scheme				Duration for Exam	
Th.	Pr.	Th. Ex.	PR	TW	Total	Theory	Practical
--	40(3hrs/week)	-	50	--	50	--	Three Hrs.

1. Student/s shall have to continue with the projects approved in last semester.
2. It is recommended to follow schedule of activities planned and accordingly have to work for completion of project under the guidance of allotted teacher.
3. Regular monitoring and guidance is expected to complete project in specified duration.
4. Student/s will have to prepare report of project similar to the seminar report with hard binding and golden embossing. Report shall consist of at least contents as that of seminar report.
5. Pre-demonstration session shall be arranged at the term end, in order to observe completion of project, corrections, proofreading of report shall be done by guide and committee. Suggestions are to be given for minor improvements in the project/project report. (If any)
6. Projects / Project report must be ready in all respect at the time of final dissertation.

Practical examination shall be based on final demonstration / presentation. Performance and Percentage of theme achieved.

Instructions:

1. The project report shall be typed on A-4 size white bond paper.
2. Typing shall be with spacing of 1.5 or 2.0 using black ribbon or carbon on one side of the paper.
3. Margins:- (i) Left 37.5 mm. (ii) Right, top and bottom 25 mm.
4. Binding:- Hard with golden embossing on the front cover of blue colour or soft comb binding with transparent front cover and non transparent plastic blue/black cover.
5. From: cover in case of hard bound report: It should be identical to first title page.
6. Format for title page (First Page)

Report of the project on

(Title of Project)

By

(Name of student)

Submitted in partial fulfillment of the requirements for the degree of Bachelor of Science

(Refrigeration and Air Conditioning)

Department o

(Name of the college)

7. Format for Certification page (i.e. Second page)

CERTIFICATE

This is to certify that the project entitled

"Title of Project"

Submitted by

(Name of Student/s).

is completed as per the requirements of the Dr. BabasahebAmbedkarMarathwada University in
partial fulfillment of

Degree of B.Sc. (Refrigeration and Air Conditioning)

For the academic year-----

Guide

Head of Department

Principal

8. The third page would be for acknowledgements which would be followed by index page.

9. Sketches should be drawn on separate sheet (minimum A4 size) and be inserted at proper places. The sketches should be drawn in black ink and be numbered.

10. Tables should preferably type in the text only.

11. The mathematical symbol should be typed or neatly written so as to match darkness of the text.

12. The last item on the index should be references

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