

Math 223 APPLIED MATHEMATICS

Total Contact Hours	T	P	C
Theory 96 Hours	3	0	3

Pre-requisite: Must have completed Mathematics I.

AIMS The students will be able to:

1. Solve problems of Calculus and Analytic Geometry.
2. Develop mathematical skill, attitudes and logical perception in the use of mathematical instruments.
3. Apply principles of Differential Calculus to work out rate measures, velocity, acceleration, maxima & minima values
4. Use Principles of Integral Calculus to compute areas & volumes.
5. Acquire proficiency in solving technological problems with mathematical clarity and insight.

COURSE CONTENTS

- | | |
|--|----------------|
| 1. FUNCTIONS & LIMITS. | 6 Hours |
| 1.1 Constant & Variable Quantities | |
| 1.2 Functions & their classification | |
| 1.3 The concept of Limit | |
| 1.4 Limit of a Function | |
| 1.5 Fundamental Theorems on Limit | |
| 1.6 Some important Limits | |
| 1.7 Problems | |
| 2. DIFFERENTIATION | 6 Hours |
| 2.1 Increments | |
| 2.2 Differential Coefficient or Derivative | |
| 2.3 Differentiation ab-initio or by first Principle | |
| 2.4 Geometrical Interpretation of Differential Coefficient | |
| 2.5 Differential Coefficient of X^n , $(ax + b)^n$ | |
| 2.6 Three important rules | |
| 2.7 Problems | |
| 3. DIFFERENTIATION OF ALGEBRAIC FUNCTIONS | 9 Hours |
| 3.1 Explicit Functions | |
| 3.2 Implicit Functions | |
| 3.3 Parametric forms | |

3.4	Problems	
4.	DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS	6 Hours
4.1	Differential Coefficient of Sin x, Cos x, Tan x from first principle.	
4.2	Differential Coefficient of Cosec x, Sec x, Cot x	
4.3	Differentiation of inverse Trigonometric functions.	
4.4	Problems.	
5.	DIFFERENTIATIONS OF LOGARITHMIC & EXPONENTIAL FUNCTIONS	6 Hours
5.1	Differentiation of ln x	
5.2	Differentiation of Log a^x	
5.3	Differentiation of a^x	
5.4	Differentiation of e^x	
5.5	Problems	
6.	RATE OF CHANGE OF VARIABLES.	6 Hours
6.1	Increasing and decreasing functions	
6.2	Maxima and Minima values	
6.3	Criteria for maximum & minimum values	
6.4	Methods of finding maxima & minima	
6.5	Problems	
7.	INTEGRATION	9 Hours
7.1	Concept	
7.2	Fundamental Formulas	
7.3	Important Rules	
7.4	Problems	
8.	METHODS OF INTEGRATION	9 Hours
8.1	Integration by substitution	
8.2	Integration by parts	
8.3	Problems	
9.	DEFINITE INTEGRALS	6 Hours
9.1	Properties	
9.2	Application to area	
9.3	Problems	
10.	DIFFERENTIAL EQUATIONS	6 Hours
10.1	Introduction	
10.2	Degree and Order	
10.3	First order differential equation	

10.4Solution
10.5Problems

- 11. PLANE ANALYTIC GEOMETRY & STRAIGHT LINE** **6 Hours**
- 11.1 Coordinate System
 - 11.2 Distance Formula
 - 11.3 The Ratio Formula
 - 11.4 Inclination and slope of a line
 - 11.5 The slope Formula
 - 11.6 Problems
- 12. EQUATIONS OF STRAIGHT LINE** **6 Hours**
- 12.1 Some important Forms
 - 12.2 General Form
 - 12.3 Angle Formula
 - 12.4 Parallelism & Perpendicularity
 - 12.5 Problems
- 13. EQUATIONS OF CIRCLE** **6 Hours**
- 13.1 Standard form of Equation
 - 13.2 Central form of Equation
 - 13.3 General form of Equation
 - 13.4 Radius & Coordinates of the centre
 - 13.5 Problems
- 14. STATISTICS** **9 Hours**
- 14.1 Concept of mean, median and mode
 - 14.2 Standard deviation
 - 14.3 Laws of probability
 - 14.4 Problems

REFERENCE BOOKS

1. Thomas Finny- Calculus and Analytic Geometry
2. Ghulam Yasin Minhas - Technical Mathematics Vol - II, Ilmi Kitab Khana, Lahore.
3. Prof. Riaz Ali Khan- Polytechnic Mathematic Series Vol I & II, Majeed Sons, Faisalabad
4. Prof. Sana Ullah Bhatti - Calculus and Analytic Geometry, Punjab Text Book Board, Lahore.

INSTRUCTIONAL OBJECTIVES

1.USE THE CONCEPT OF FUNCTIONS AND THEIR LIMITS IN SOLVING SIMPLE PROBLEMS.

- 1.1 Define a function.
- 1.2 List all type of functions.
- 1.3 Explain the concept of limit and limit of a function.
- 1.4 Explain fundamental theorems on limits.
- 1.5 Derive some important limits.
- 1.6 solve problems on limits.

2.UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT

- 2.1 Derive mathematical expression for a differential coefficient.
- 2.2 Explain geometrical interpretation of differential coefficient.
- 2.3 Differentiate a constant, a constant associated with a variable and the sum of finite number of functions.
- 2.4 Solve related problems.

3.USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS OF ALGEBRAIC FUNCTIONS.

- 3.1 Differentiate ab-initio x^n and $(ax + b)^n$.
- 3.2 Derive product, quotient and chain rules.
- 3.3 Find derivatives of implicit functions and explicit functions.
- 3.4 Differentiate parametric forms, functions w.r.t another function and by rationalization.
- 3.5 Solve problems using these formulas.

4.USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS INVOLVING TRIGONOMETRIC FUNCTIONS.

- 4.1 Differentiate from first principle $\sin x, \cos x, \tan x$.
- 4.2 Derive formula Derivatives of $\sec x, \operatorname{cosec} x, \cot x$.
- 4.3 Find differential coefficients of inverse trigonometric functions
- 4.3 Solve problems based on these formulas.

5.USE RULES OF DIFFERENTIATION TO LOGARITHMIC AND EXPONENTIAL FUNCTIONS.

- 5.1 Derive formulas for differential coefficient of Logarithmic and exponential functions.
- 5.2 Solve problems using these formulas.

6.UNDERSTAND RATE OF CHANGE OF ONE VARIABLE WITH RESPECT TO ANOTHER.

- 6.1Derive formula for velocity, acceleration and slope of a line.
- 6.2Define an increasing and a decreasing function, maxima and minima values, point of inflexion.
- 6.3Explain criteria for maxima and minima values of a function.
- 6.4Solve problems involving rate of change of variables.

7.USE RULES OF INTEGRATION IN SOLVING RELEVANT PROBLEMS.

- 7.1Explain the concept of integration.
- 7.2State basic theorems of integration.
- 7.3List some important rules of integration.
- 7.4Derive fundamental formulas of integration.
- 7.5Solve problems of integration based on these rules/formulas.

8.UNDERSTAND DIFFERENT METHODS OF INTEGRATION

- 8.1List standard formulas of Integration.
- 8.2Integrate a function by substitution method.
- 8.3Find integrals by the method of integration by parts.
- 8.4Solve problems using these methods.

9.UNDERSTAND METHODS OF SOLVING DEFINITE INTEGRALS.

- 9.1Define definite integral.
- 9.2List properties of definite integrals.
- 9.3Find areas under the curves using definite integrals.
- 9.4Solve problems of definite integrals.

10.USE DIFFERENT METHODS OF INTEGRATION TO SOLVE DIFFERENTIAL EQUATIONS

- 10.1Define a differential equation, its degree and order
- 10.2Explain method of separation of variables to solve differential equation of first order and first degree.
- 10.3Solve differential equations of first order and first degree

11.UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY.

- 11.1Explain the rectangular coordinate system.
- 11.2Locate points in different quadrants.
- 11.3Derive distance formula.
- 11.4Prove section formulas.
- 11.5Derive Slope Formula
- 11.6Solve problem using these formulas.

12.USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.

- 12.1Define a straight line.

- 12.2 Write general form of equation of a straight line.
- 12.3 Derive slope intercept and intercept forms of equations of a straight line.
- 12.4 Derive expression for angle between two straight lines.
- 12.5 Derive conditions of perpendicularity and parallelism of two straight lines.
- 12.6 Solve problems involving these equations/formulas.

13. SOLVE TECHNOLOGICAL PROBLEMS USING EQUATIONS OF CIRCLE.

- 13.1 Define a circle.
- 13.2 Describe standard, central and general forms of the equation of a circle.
- 13.3 Convert general form to the central form of equation of a circle.
- 13.4 Derive formula for the radius and the coordinates of the center of a circle from the general form.
- 13.5 Derive equation of the circle passing through three given points.
- 13.6 Solve problems involving these equations.

14. UNDERSTAND THE BASIC CONCEPT OF STATISTICS.

- 14.1 Define mean, median and mode
- 14.2 Explain standard deviation
- 14.3 State laws of probability
- 14.4 Calculate the above mentioned quantities using the proper formula.

Mgm-232 INDUSTRIAL MANAGEMENT AND ECONOMICS

T	P	C
2	0	2

Total Contact Hours

Theory 64 Hours

AIMS The student will be able to:-

1. Develop the management skill.
2. Understand principles of management & Economics.
3. Develop psychological approach to solve the labour problems in the industrial set-up.

COURSE CONTENTS

PART I

- | | |
|--|--------------|
| 1. INDUSTRIAL PSYCHOLOGY. | 3 Hrs |
| 1.1 Brief history. | |
| 1.2 Definition. | |
| 1.3 Nature and scope. | |
| 2. MOTIVATION | 3 Hrs |
| 2.1 Definition. | |
| 2.2 Types (Financial and non financial motives). | |
| 2.3 Conflict of motives. | |
| 3. INDUSTRIAL ACCIDENTS | 3 Hrs |
| 3.1 Psychological causes. | |
| 3.2 Objective causes. | |
| 3.3 Prevention | |
| 4. WORK APPRAISAL | 3 Hrs |
| 4.1 Importance | |
| 4.2 Techniques | |
| 5. INDUSTRIAL MANAGEMENT | 3 Hrs |
| 5.1 Introduction | |
| 5.2 Functions of Management. | |
| 5.3 Subdivision of Management | |
| 5.4 Objectives of Industrial management. | |
| 6. PLANNING | 3 Hrs |
| 6.1 The concept. | |
| 6.2 Importance of planning | |

6.3	Steps in planning.	
6.3	Principals of planning.	
7.	PLANT LOCATION AND LAYOUT	3 Hrs
7.1	Plant location.	
7.2	Selection of plant location.	
7.3	Types of factory building.	
7.4	Plant layout.	
7.5	Factors affecting it.	
7.6	Process and product layout.	
7.7	Plant location and layout of a factory.	
8.	PERSONNEL SELECTION.	3 Hrs
8.1	Recruitment of employees.	
8.2	Training.	
8.3	Effects of training on production and product cost.	
9.	WAGE PAYMENT PLANS.	2 Hrs
9.1	Importance	
9.2	Principles	
9.3	Important plans	
9.4	Effects on production cost.	
10.	TYPES OF PRODUCTION.	2 Hrs
10.1	Job, batch, flow and mass production.	
10.2	Types of production and cost consecrations.	
11.	WORKING CONDITIONS.	3 Hrs
11.1	Importance.	
11.2	Consideration.	
11.3	Effects on efficiency and per unit cost.	
12.	TIME AND MOTION STUDY.	3 Hrs
12.1	The concept	
12.2	Importance of work study for management.	
12.3	Sequence of motion study.	
12.4	Principles of motion study.	
12.5	Steps to time study.	
12.6	Determination of operations time.	
13.	QUALITY CONTROL.	3 Hrs
13.1	The concept.	
13.2	Advantages of quality control.	

- 13.3 Methods.
- 14. ROLE OF FOREMAN IN MANAGEMENT. 2 Hrs**
- 14.1 Foreman's abilities.
- 14.2 Duties.
- 14.3 Functions.
- 15. FOREMAN'S KNOWLEDGE OF COST ECONOMICS. 3 Hrs**
- 15.1 Concept of cost Economics.
- 15.2 Elements of cost.
- 15.3 Cost accounting methods.
- 16. PRODUCTIVITY. 3 Hrs**
- 16.1 The concept.
- 16.2 Importance
- 16.3 Factors affecting productivity.
- PART-II**
- 17. ECONOMICS 2 Hrs**
- 17.1 Definition: Adam Smith, Alfred Marshall, Professor Robins
- 17.2 Nature and scope
- 17.3. Importance for foreman and technicians.
- 17.4 Basic concepts in economics (utility, marginal, Income, Wealth, saving, Investment).
- 18. DEMAND AND SUPPLY. 2 Hrs**
- 18.1 Definition
- 18.2 Law of Demand
- 18.3 Definition of Supply.
- 18.4 Law of Supply.
- 19. FACTORS OF PRODUCTION. 2 Hrs**
- 19.1 Land
- 19.2 Labour
- 19.3 Capital
- 19.4 Organization
- 20. BUSINESS ORGANIZATION 3 Hrs**
- 20.1 Sole proprietorship.
- 20.2 Partnership
- 20.3 Joint Stock Company.

21.	SCALE OF PRODUCTION.	2 Hrs
	21.1 Meaning and its determination.	
	21.2 Large scale production.	
	21.3 Small scale production.	
22.	LAWS OF RETURN.	2 Hrs
	22.1 Law of increasing return.	
	22.2 Law of constant return.	
	22.3 Law of diminishing return.	
23.	ECONOMICS SYSTEMS	2 Hrs
	23.1 Free economic system.	
	23.2 Centrally controlled economy.	
	23.3 Mixed economic system.	
24.	MONEY	2 Hrs
	24.1 Barter system and its inconveniences.	
	24.2 Definition of money and its functions.	
25.	BANK	2 Hrs
	25.1 Definition	
	25.2 Functions of a commercial bank.	
	25.3 Central bank and its functions.	
26.	CHEQUE	2 Hrs
	26.1 Definition	
	26.2 Characteristics and kinds of cheques.	
	26.3 Dishonour of cheque.	
27.	FINANCIAL INSTITUTION	2 Hrs
	27.1 IMF	
	27.2 IDBP	
	27.3 PIDC	

BOOKS RECOMMENDED:

1. Business Organization by Nisar-ud-Din Aziz Publisher, Lahore.
2. An Introduction to Modern Economics By S.M. Akhtar, Publishes United Ltd. Lahore.
3. Nizam-e-Sanaat Aur Insani Rawabat by Ghulam Hussain (Ilmi Kitab Khana, Urdu Bazar, Lahore.
4. The process of Management by Andrew R. Megill Willian M New Man.
5. Factory and Production Management by K.G.Lockyer.

INSTRUCTIONAL OBJECTIVES

- 1. KNOW INDUSTRIAL PSYCHOLOGY.**
 - 1.1 Describe brief history of Industrial Psychology.
 - 1.2 Define Industrial Psychology.
 - 1.3 Describe nature and scope of industrial psychology.

- 2. UNDERSTAND MOTIVATION.**
 - 2.1 Define motivation.
 - 2.2 Describe financial and non financial motives.
 - 2.3 Explain conflict of motives.

- 3. UNDERSTAND THE CAUSES OF INDUSTRIAL ACCIDENTS.**
 - 3.1 Explain psychological causes of industrial accidents.
 - 3.2 Explain objective causes of industrial accidents.
 - 3.3 Explain preventive measures of industrial accidents.

- 4. UNDERSTAND WORK APPRAISAL.**
 - 4.1 Explain importance of work appraisal.
 - 4.2 Explain work appraisal techniques.

- 5. UNDERSTAND INDUSTRIAL MANAGEMENT.**
 - 5.1 Explain management.
 - 5.2 Describe functions of management.
 - 5.3 Enlist subdivision of management.
 - 5.4 Explain objectives of industrial management.

- 6. UNDERSTAND PLANNING.**
 - 6.1 Define planning.
 - 6.2 Describe the importance of planning.
 - 6.3 Identify the steps in planning.
 - 6.4 Enlist principles of planning.

- 7. UNDERSTAND THE METHODS OF PLANT LOCATION AND LAYOUT.**
 - 7.1 Explain plant location.
 - 7.2 Explain criteria for selection of plant location.
 - 7.3 Describe types of buildings.
 - 7.1 Explain plant layout.
 - 7.2 Explain factors affecting layout.
 - 7.3 Describe process and product layout.
 - 7.4 Prepare layout of an ideal Printing press.

8. UNDERSTAND THE EFFECTS OF TRAINING.

- 8.1 Describe the recruitment procedure of employees in an industrial concern.
- 8.2 Explain training.
- 8.3 Identify the kinds of training.
- 8.4 State the effects of training on production and product cost.

9. UNDERSTAND WAGE PAYMENT PLANS.

- 9.1 Explain importance of wage payment plans.
- 9.2 State the principles of wage payment plan.
- 9.3 Describe briefly standard time plan, straight piece rate, differential piece rates.
- 9.4 State the effects of incentive plans on total cost and labour cost.

10. UNDERSTAND TYPES OF PRODUCTION ALONG WITH THEIR IMPACTS ON COST.

- 10.1 Describe types of production.
- 10.2 State the effects of production types on cost.

11. UNDERSTAND WORKING CONDITION ALONG WITH EFFECTS ON EFFICIENCY.

- 11.1 Explain importance of working condition.
- 11.2 Describe consideration i.e. Air-conditioning Ventilation, Lighting and Noise.
- 11.3 State the effects of good working condition on efficiency and per unit cost.

12. UNDERSTAND ABOUT TIME AND MOTION STUDY.

- 12.1 Explain the concept of time & motion..
- 12.2 Describe the importance of work study.
- 12.3 Explain the sequence of motion study.
- 12.4 Identify the principles of motion study.
- 12.5 Describe the steps of time study.
- 12.6 Explain the determination of operations time.

13. UNDERSTAND THE EFFECTS OF QUALITY CONTROL.

- 13.1 Explain quality control.
- 13.2 Identify the advantages of quality control.
- 13.3 Describe methods of quality control.

14. UNDERSTAND THE ROLE OF FOREMAN IN AN INDUSTRIAL UNDERTAKING.

- 14.1 Explain abilities of Foreman.
- 14.2 Enlist duties of Foreman.
- 14.3 Describe functions of Foreman as middle management.

- 15. UNDERSTAND THE TERM COST ACCOUNTING.**
15.1 Explain concept of cost accounting.
15.2 Explain elements of cost.
15.3 State the principles of cost accounting.
- 16. UNDERSTAND THE TERM PRODUCTIVITY.**
16.1 Determine the term productivity.
16.2 Describe importance of productivity.
16.3 State the factors affecting productivity.
- 17. UNDERSTAND THE IMPORTANCE OF ECONOMICS.**
17.1 State definition of economics given by Adam Smith, Alfred Marshall and Professor Robins.
17.2 Explain nature and scope of economics.
17.3 Describe importance of study economics for technicians.
17.4 Define basic terms, utility, income, wealth, saving, investment and value.
17.5 Explain the basic terms with examples.
- 18. UNDERSTAND LAW OF DEMAND AND LAW OF SUPPLY.**
18.1 Define demand
18.2 Explain law of demand with the help of schedule and diagram.
18.3 State assumptions and limitation of law of demand.
18.4 Define supply
18.5 Explain law of supply with the help of schedule and diagram
18.6 State assumptions and limitation of law of supply.
- 19. UNDERSTAND FOUR FACTORS OF PRODUCTION.**
19.1 Define the four factors of production
19.2 Explain labour and its features.
19.3 Describe capital and its peculiarities.
- 20. UNDERSTAND FORMS OF ORGANIZATION.**
20.1 Describe sole proprietorship, its merits and demerits.
20.2 Explain partnership, its advantages and disadvantages.
20.3 Describe joint stock company, its merits and demerits.
20.4 Distinguish between public limited company and private limited company.
- 21. UNDERSTAND SCALE OF PRODUCTION.**
21.1 Explain scale of production and its determination.
21.2 Describe large scale production and its merits.
21.3 Explain small scale of production, its advantages and disadvantages.

- 22. UNDERSTAND LAWS OF RETURN.**
22.1 Explain law of increasing return
22.2 Explain law of constant return
22.3 Explain law of diminishing return
- 23. UNDERSTAND DIFFERENT ECONOMIC SYSTEMS.**
23.1 Describe free economic system and its characteristics.
23.2 Explain centrally planned economic system, its merits and demerits.
23.3 State mixed economic system and its features.
- 24. UNDERSTAND MONEY**
24.1 Explain barter system and its inconveniences.
24.2 Define money.
24.3 Explain the factors of money.
- 25. UNDERSTAND BANK AND ITS FUNCTIONS.**
25.1 Define bank.
25.2 Describe commercial bank and its functions.
25.3 State central bank and its functions.
- 26. UNDERSTAND CHEQUE AND DISHONOR OF CHEQUE.**
26.1 Define cheque.
26.2 Enlist the characteristics of cheque.
26.3 Identify the kinds of cheque.
26.4 Describe the causes of dishonor of a cheque.
- 27. UNDERSTAND FINANCIAL INSTITUTIONS.**
27.1 Explain IMF and its objectives.
27.2 Explain organisational setup and objectives of IDBP.
27.3 Explain organisational setup and objectives PIDC.

Phy-212 APPLIED MECHANICS

Total Contact Hours		T	P	C	
Theory	32 Hours		1	3	2
Practical	96 Hours				

- AIMS**
1. Apply the concepts of Applied Physics to understand Mechanics
 2. Apply laws and principles of Mechanics in solving technological problems
 3. Use the knowledge of App. Mechanics in learning advance technical courses.
 4. Demonstrate efficient skill of practical work in Mechanics Lab.

COURSE CONTENTS

- 1. MEASUREMENTS** **2 Hrs**
 - 1.1 Review: Dimensional formula of Equations of Motion
 - 1.2 Review: Systems of measurement, S.I. Units, conversion
 - 1.3 Significant Figures
 - 1.4 Degree of accuracy

- 2. EQUILIBRIUM OF CON-CURRENT FORCES** **3 Hrs**
 - 2.1 Concurrent forces
 - 2.2 Addition and Resolution of Vectors
 - 2.3 Toggle Joint, Hanging Chains
 - 2.4 Roof Trusses, Cranes.
 - 2.5 Framed structures

- 3. MOMENTS AND COUPLES:** **2 Hrs**
 - 3.1 Principle of Moments - Review
 - 3.2 Levers
 - 3.3 Safety valve
 - 3.4 Steel yard
 - 3.5 Parallel forces, couple
 - 3.6 Torque

- 4. EQUILIBRIUM OF NON CONCURRENT FORCES:** **3 Hrs**
 - 4.1 Non-concurrent forces
 - 4.2 Free body diagram
 - 4.3 Varignon's theorem
 - 4.4 Conditions of total Equilibibrium.
 - 4.5 Ladders

- 5. MOMENT OF INERTIA:** **3 Hrs**

5.1	Review: Rotational Inertia	
5.2	Moment of Inertia, Theorems	
5.3	Moment of Inertia of symmetrical bodies	
5.4	M.I. of Fly wheel with applications	
5.5	Energy stored by Fly wheel	
6.	FRICTION:	2 Hrs
6.1	Review: Laws of friction	
6.2	Motion of body along an inclined plane (up & down)	
6.3	Rolling friction & Ball Bearings	
6.4	Fluid Friction, Stokes' Law	
7.	WORK, ENERGY AND POWER	3 Hrs
7.1	Work-Energy relationship	
7.2	Work done by variable force.	
7.3	Power	
7.4	I.H.P, B.H.P and Efficiency	
7.5	Dynamometer.	
8.	TRANSMISSION OF POWER:	3 Hrs
8.1	Belts, Ropes.	
8.2	Chains.	
8.3	Gears.	
8.4	Clutches, functions and types with application	
9.	MACHINES:	3 Hrs
9.1	Efficiency of machines	
9.2	Inclined plane - Review	
9.3	Reversibility of machines	
9.4	Single purchase crab	
9.5	Double purchase crab.	
9.6	Worm and worm wheel.	
9.7	Differential Screw Jack.	
9.8	Differential Pulley, Wheel and Axle	
10.	VIBRATORY MOTION:	2 Hrs
10.1	S.H.M. - Review	
10.2	Pendulums	
10.3	Speed Governors.	
10.4	Helical spring.	
10.5	Cams	
10.6	Quick return motion	

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| 11. ELASTICITY: | 3 Hrs |
| 11.1 Three Moduli of Elasticity | |
| 11.2 Loaded Beams, Types of Beam & Loads | |
| 11.3 Bending Stress | |
| 11.4 S.F & B.M diagram | |
| 11.5 Torsion and Torsional Stresses | |
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| 12. SIMPLE MECHANISM: | 1 Hr |
| 12.1 Introduction | |
| 12.2 Kinematic link or Element | |
| 12.3 Kinematic pair and types. | |
| 12.4 Kinematic chains and types. | |
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| 13. VELOCITY IN MECHANISM: | 2 Hrs |
| 13.1 Introduction. | |
| 13.2 Instantaneous centre. | |
| 13.3 Instantaneous velocity. | |
| 13.4 Velocity of a link by instantaneous centre method. | |
| 13.5 Relative velocity of two bodies in the straight line | |
| 13.6 Velocity of a link by relative velocity method. | |

INSTRUCTIONAL OBJECTIVES

1.USE THE CONCEPTS OF MEASUREMENT IN PRACTICAL SITUATIONS/PROBLEMS

- 1.1 Explain Dimensional formula
- 1.2 Explain systems of measurement
- 1.3 Use concept of significant figures and degree of accuracy to solve problems

2.USE THE CONCEPT OF ADDITION AND RESOLUTION OF VECTORS TO PROBLEMS ON EQUILIBRIUM INVOLVING CONCURRENT FORCES

- 2.1 Describe concurrent forces
- 2.2 Explain resolution of vectors
- 2.3 Use the analytical method of addition of vectors for solving problems.
- 2.4 Use the graphical method of addition of vectors for solving problems.
- 2.5 Solve problems on forces with emphasis on roof trusses, cranes simple frames and framed structures.

3.USE THE PRINCIPLE OF MOMENTS AND CONCEPT OF COUPLE TO SOLVE PROBLEMS.

- 3.1 Describe the principle of moments.
- 3.2 Use the principle of moments to solve problems on compound levers, safety valve, steel-yard.
- 3.3 Describe couple and torque.
- 3.4 Use the concept to solve problems on torque.

4.USE THE LAWS OF TOTAL EQUILIBRIUM OF FORCES TO SOLVE PROBLEMS INVOLVING FORCES IN EQUILIBRIUM.

- 4.1 Distinguish between concurrent and non-concurrent forces.
- 4.2 Prepare a free body diagram of an object or a structure.
- 4.3 Explain Varignon's theorem.
- 4.4 Explain the second condition of equilibrium.
- 4.5 Use laws of total equilibrium to solve problems on forces involving framed structure and ladders.

5.USE CONCEPTS OF MOMENT OF INERTIA TO PRACTICAL SITUATIONS AND PROBLEMS.

- 5.1 Explain moment of inertia.
- 5.2 Explain the theorems of Parallel and perpendicular Axis.
- 5.3 Describe the M.I. of regular bodies

- 5.4 Explain M.I. of Fly wheel
- 5.5 Explain Energy stored by Fly Wheel
- 5.6 Use these concepts to solve simple problems.

6. UNDERSTAND THE CONCEPTS AND LAWS OF SOLID AND FLUID FRICTION.

- 6.1 Define Coefficient of friction between a body placed on an inclined plane and the surface.
- 6.2 Explain motion of a body placed on an inclined plane
- 6.3 Calculate the force needed to move a body up and down an inclined plane.
- 6.4 Explain rolling friction and use of ball bearings.
- 6.5 Describe fluid friction and Stoke's law.

7. UNDERSTAND WORK, ENERGY AND POWER.

- 7.1 Derive work-energy relationship
- 7.2 Use formulae for work done by a variable force to solve problems.
- 7.3 Explain Power, I.H.P, B.H.P and efficiency.
- 7.4 Describe dynamometers.
- 7.5 Use the concepts to solve problems on power and work-energy

8. UNDERSTAND TRANSMISSION OF POWER THROUGH ROPES AND BELTS.

- 8.1 Describe the need for transmission of power.
- 8.2 Describe methods of transmission of power.
- 8.3 Describe transmission of power through ropes and belts.
- 8.4 Write formula for power transmitted through ropes and belts.
- 8.5 Describe transmission of power through friction gears and write formula.
- 8.6 Describe transmission of power through chains and toothed wheels/gears.
- 8.7 Use the formulae to solve/problems on transmission of power.
- 8.8 Describe types and function of clutches with applications

9. USE THE CONCEPTS OF MACHINES TO PRACTICAL SITUATIONS.

- 9.1 Explain theoretical, actual mechanical advantage and efficiency of simple machines.
- 9.2 Use the concept to calculate efficiency of an inclined plane.
- 9.3 Describe reversibility of machines.
- 9.4 Calculate the efficiency of:
 - i. Single purchase crab.
 - ii. Double purchase crab.
 - iii. Worm and worm wheel.
 - iv. Differential screw jack, Diff. Pulley, Wheel and Axle.
- 9.5 Use the formulae to solve the problems involving efficiency, M.A of the above machines.

10. USE THE CONCEPTS OF VIBRATORY MOTION TO PRACTICAL SITUATIONS.

- 10.1 Define vibratory motion giving examples.
- 10.2 Describe circular motion and its projection on diameter of the circular path.
- 10.3 Relate rotatory motion to simple vibratory motion.
- 10.4 State examples of conversion of rotatory motion to vibratory motion and vice versa.
- 10.5 Describe speed governors, cams quick return motion.
- 10.6 Derive formulae for position, velocity and acceleration of a body executing S.H.M.
- 10.7 Use the concept of S.H.M to helical springs.
- 10.8 Use the concept S.H.M to solve problems on pendulum.

11. UNDERSTAND BENDING MOMENTS AND SHEARING FORCES.

- 11.1 Define three types of stresses and moduli of elasticity.
- 11.2 Describe types of beams and loads.
- 11.3 Explain shearing force and bending moment.
- 11.4 Use these concepts to calculate S.F and B.M in a given practical situation for point loads, uniformly distributed loads.
- 11.5 Prepare S.F and B.M diagram for loaded cantilever and simply supported beams.
- 11.6 Describe torsion and torsional stresses giving formula

12. UNDERSTAND SIMPLE MECHANISMS.

- 12.1 Define simple mechanisms.
- 12.2 Define kinematics.
- 12.3 Explain kinematic link or element.
- 12.4 Explain kinematic chains.
- 12.5 Distinguish between types of kinematic chains.

13. UNDERSTAND THE METHOD OF FINDING VELOCITY IN MECHANISMS.

- 13.1 Explains relative velocity.
- 13.2 Explain instantaneous center.
- 13.3 Explain instantaneous velocity.
- 13.4 Explain the method of finding velocity of a link by:
 - i. Relative velocity method.
 - ii. Instantaneous center method.

Phy-212 APPLIED MECHANICS

LIST OF EXPERIMENTS

1. Find the weight of the given body using Law of Polygon of forces.
2. Find unknown forces in a given set of concurrent forces in equilibrium using Grave-sands apparatus
3. Set a jib crane and analyse forces in its members
4. Set a Derrick Crane and analyse forces in its members
5. Study forces shared by each member of a Toggle Joint
6. Set a Roof Truss and find forces in its members
7. Verify Principle of Moments in a compound lever
8. Calibrate a steelyard
9. Find the Reactions at the ends of a loaded beam
10. Use Reaction of Beams apparatus to study resultant of Parallel forces
11. Find the Moment of Inertia of a Flywheel
12. Find the angle of reaction for a wooden block placed on an inclined plane
13. Find the B.H.P. of a motor
14. Study the transmission of Power through friction gears
15. Study the transmission of power through belts
16. Study the transmission of Power through toothed wheels
17. Study the function of clutches
18. Find M.A. and Efficiency of worm and worm wheel
19. Find M.A. and efficiency of differential wheel and axle
20. Find the efficiency of a screw
21. Find the efficiency of a differential pulley
22. Study conversion of rotatory motion to S.H.M. using S.H.M. Model/Apparatus
23. Study conversion of rotatory motion to vibratory motion of the piston in a cylinder
24. Study the reciprocating motion
25. Study the working of cams
26. Study the quick return motion
27. Compare the Elastic constants of the given wires
28. Verify Hooke's Law using Helical Spring
29. Find the coefficient of Rigidity of a wire using Maxwell's needle
30. Find the coefficient of Rigidity of a round bar using torsion apparatus
31. Find the coefficient of Rigidity of a rectangular bar using Deflection of Beam Apparatus
32. Determine S.F. and B.M. in a loaded cantilever (Point Loads)
33. Determine S.F. and B.M. in a simply supported Beam (Point Loads)
34. Determine S.F. and B.M. in a simply supported Beam (Point loads and uniformly distributed load)

35. Determine S.F. and B.M. in a simply supported Beam (Point loads and uniformly distributed)
36. Study working and function of link mechanism of different types

BOOKS RECOMMENDED:

1. Applied Mechanics by R.S. Khurmi
2. Applied Mechanics by A.P.S Sahihney & Prakash D. Manikpyny.
3. Applied Mechanics by Inchley and Morley
4. Theories of Machines by R.S. Khurmi and J.K. Gupta.
5. Applied Mechanics by Junarker.
6. Engineering Science Vol-I by Brown and Bryant
7. Practical Physics by Mehboob Ilahi Malik & Ikram-ul-Haq
8. Experimental Physics Note Book by M. Aslam Khan & M. Akram Sandhu
9. Experimental Mechanics (Urdu Process) by M. Akram Sandhu

RACT-214 PRINCIPLES OF AIR-CONDITIONING.

Total contact hours			T	P	C
Theory 96 hours	3	3	4		
Practical 96 hours					

- Prerequisites.** 1. knowledge of fundamentals of science.
 2. Knowledge of principles of Refrigeration.

AIMS 1. At the end of the course the students will be able to understand fundamentals of air conditioning, properties of air, Psychometric charts, psychrometric calculation, comfort and effective temperature, Air conditioning methods, state and quantity of supply air, humidification and dehumidification of air.

2. Understand psychometric and perform heat load calculation, and calculation for the conditioned air supply.

1 INTRODUCTION TO AIR CONDITIONING. 2 Hours

- 1.1 Physiological basis of comfort-air conditioning.
- 1.2 Classification of Air Conditioning systems.
- 1.3 Importance of Air Conditioning in various industries

2. REVIEW OF BASIC PRINCIPLES 2 Hours

- 2.1 S.I. units.
- 2.2 Temperature.
- 2.3. Pressure.
- 2.4 Heat.
- 2.5 Work, Energy, Power.
- 2.6 Density, Specific volume.
- 2.7 Area, Volume, velocity.

3. THE HEAT ENERGY. 6 Hours

- 3.1 Sensible heat.
- 3.2 Latent heat.
- 3.3 Total heat.
- 3.4 Specific heat.
- 3.5 Relationship of pressure, Temperature and volume.

4. PSYCHOMETRIC PROPERTIES OF AIR 15 Hours

- 4.1 The composition of air.
- 4.2 Water vapor in the air.
- 4.3 Use of steam table.

- 4.4 The laws of gases.
 - 4.5. The general gas law.
 - 4.6 Dalton's law of partial pressure.
 - 4.7 Dry bulb temperature (DBT).
 - 4.8 Wet bulb temperature (WBT).
 - 4.9 Dew point temperature (DPT).
 - 4.10 Specific humidity (Sp.H or W).
 - 4.11 Relative humidity (RH) and percentage humidity.
 - 4.12 Specific volume (Sp. Vol).
 - 4.13 Enthalpy(h).
- 5. AIR AND HUMAN COMFORT. 12 Hours**
- 5.1 Air temperature and human health.
 - 5.2 Body temperature.
 - 5.3 Ventilation requirement.
 - 5.4 COMFORT health index (CHI).
 - 5.5 COMFORT zone
 - 5.6 COMFORT chart.
 - 5.7 Effective temperature.
 - 5.8 Factors of A.C design.
- 6. ENERGY CONSERVATION. 6 Hours**
- 7. PSYCHOMETRIC CHARTS 10 Hours**
- 7.1 Psychometric chart.
 - 7.2 Dry bulb lines.
 - 7.3 Wet bulb lines.
 - 7.4 Dew point temperature.
 - 7.5 Specific humidity lines.
 - 7.6 Relative humidity lines.
 - 7.7 Specific volume lines.
 - 7.8 Enthalpy lines.
 - 7.9 Saturation lines.
- 8. PSYCHOMETRIC PROCESSES. 12 Hours**
- 8.1 Cooling.
 - 8.2 Heating.
 - 8.3 Humidifying
 - 8.4 Dehumidifying
 - 8.5 Cooling and Humidifying.

- 8.6 Cooling and dehumidifying.
- 8.7 Heating and humidifying.
- 8.8 Heating and dehumidifying.
- 8.9 Air mixing processes.
- 8.10 Sensible heat ratio (SHR)
- 8.11 By pass factor (BF)
- 8.12 Apparatus dew point (ADP)
- 8.13 Standard design conditions. (SRDC)

9. CALCULATION ON PSYCHOMETRIC PROCESSES. 18 Hours

From topic 7-1 to 7-13

10. CALCULATION FOR THE CONDITIONED AIR SUPPLY. 12 Hours

- 10.1 Heating or cooling with air
- 10.2 Moisture calculations.
- 10.3 Sensible heat, Latent heat and Total heat calculations.
- 10.4 Dry bulb temperature and humidity.
- 10.5 By passed return air.
- 10.6 By passed outdoor air.
- 10.7. By passed mixed air.
- 10.8 The air conditioning cycle.

REFERENCE BOOKS.

- 1. Train Air, conditioning manual.
- 2. Principles of Refrigeration by R.J. Dossat.
- 3. Carrier system design Manual.
- 4. Air conditioning and Refrigeration by Norman Harries.
- 5. Modern Refrigeration and Air conditioning by Alehouse.
- 6. Principles of Air conditioning by Lang.
- 7. Basic Air Conditioning by Schweitzer.

RACT 214 PRINCIPLE OF AIR-CONDITIONING.

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the student will be able to:

- 1. UNDERSTAND THE IMPORTANCE OF AIR-CONDITIONING.**
 - 1.1 Define comfort air conditioning .
 - 1.2 Enlist the types of air-conditioning.
 - 1.3 Explain the importance of air conditioning in industries.

- 2. UNDERSTAND THE BASIC TERMS AND UNITS.**
 - 2.1 Explain the SI units.
 - 2.2 Define temperature and conversion.
 - 2.3 Define pressure, atmosphere pressure, gauge pressure.
 - 2.4 Define heat (enthalpy) and its units.
 - 2.5 Differentiate work, power and energy.
 - 2.6 Define density, specific volume.
 - 2.7 Define area, volume, velocity.

- 3. UNDERSTAND THE HEAT ENERGY AND ITS TYPES.**
 - 3.1 Define sensible heat.
 - 3.2 Define latent heat.
 - 3.3 Define total heat.
 - 3.4 Explain the specific heat and its types.
 - 3.5 Illustrate relationship of pressure, temperature and volume.
 - 3.6 solve problems on sensible heat and latent heat.

- 4. UNDERSTAND THE PRINCIPLES OF PSYCHROMETRY.**
 - 4.1 Explain the ratio of gases and water vapour in the air.
 - 4.2 Explain the steam table.
 - 4.3 State law of gases and general gas law.
 - 4.4 Define Dalton's law of partial pressure.
 - 4.5 Define, DB, WB, DP temperature with units.
 - 4.6 Define Sp.H, RH, Sp.vol and enthalpy with units.

- 5. KNOW THE PRINCIPLES INVOLVED IN THE AIR AND HUMAN COMFORT.**
 - 5.1 State the effect of air temperature on human health.
 - 5.2 State the ventilation requirement for human comfort.
 - 5.3 Trace comfort health index and comfort zone.
 - 5.4 Trace the comfort chart and effective temperature.

- 5.5 State factors of design.
- 6. UNDERSTAND ENERGY CONSERVATION.**
- 6.1 Define energy conservation.
 - 6.2 Name the kinds of energy which can be conserved.
 - 6.3 State the methods of energy conservation.
 - 6.4 Explain the methods of energy conservation applicable to RAC.
- 7. KNOW THE ROLE OF PSYCHOMETRIC CHART.**
- 7.1 Trace the lines of DB, WB, DPT, sp humidity, RH, Sp. volume, sat. lines on psychometric chart.
 - 7.2 Explain the form of lines and their units.
- 8. UNDERSTAND PROCESSES INVOLVED IN PSYCHOMETRIC CHART.**
- 8.1 Trace cooling and heating process on psychometric chart.
 - 8.2 Trace humidifying and dehumidifying processes.
 - 8.3 Explain the cooling and humidifying cooling and dehumidifying processes.
 - 8.4 Explain heating and humidifying process.
 - 8.5 Explain the air-mixing process and trace on psychometric chart.
 - 8.6 Describe sensible heat ratio and by pass factor.
 - 8.7 Explain apparatus dew point and standard design conditions.
- 9. UNDERSTAND THE PSYCHOMETRIC PROCESSES CALCULATIONS.**
- 9.1 Solve problem with the help of Psychometric chart.
- 10. UNDERSTAND THE CONDITIONED AIR SUPPLY CALCULATIONS.**
- 10.1 Solve problems relating heating of air, cooling of air and moisture contents.
 - 10.2 Calculate latent heat, quantity of air and condition of the air supply.
 - 10.3 Calculate the quantity of bypassed return air, bypassed out door air and sensible heat ratio.
 - 10.4 Illustrate the air conditioning cycle.

RACT-214 REFRIGERATION AND AIR CONDITIONING TECHNOLOGY

PRINCIPLE OF AIR-CONDITIONING

LIST OF PRACTICAL (TOTAL 96 HOURS)

1. Calculate different process on psychometric chart and use of steam table .
2. Observe the dry bulb and wet bulb temperature of RAC laboratory by the help of sling Psychrometer.
3. Note the relative humidity of a room with hydrometer.
4. Check the velocity of air in SI and FPS system of an air conditioner by Anemometer and calculate the cubic meter per second and CFM at inlet and discharge grill.
5. Check Static pressure and velocity pressure of air duct with the help of manometer.
6. Related problem solving.

RACT-223 THERMODYNAMICS AND LOW PRESSURE BOILER.

Total contact hours			T	P	C
Theory	64 hours	2	3	3	
Practical	196 hours				

Prerequisites Knowledge of Fundamental applied science and applied mathematics.

AIMS 1.To enable the student to acquire basic knowledge of thermodynamics applied to air conditioning, heating and expansion of gases, Laws of perfect gases, air cycles and reversibility.

2.To familiarize the students with the basic knowledge of low pressure boiler, application of boiler in air conditioning, its controls and chemical treatment of boilers., water and feed water tanks.

1. THERMODYNAMICS PROCESSES 14 Hours

- 1.1 Introduction of absolute temperature, gases and vapour.
- 1.2 Energy equation of a gas.
- 1.3 Change in internal energy.
- 1.4 Graphical representation of work done by a gas.
- 1.5 Methods of heating and expansion of gases.
- 1.6 Constant volume process, constant pressure process ISO thermal process Hyperbolic process, Isentropic process Polytropic process ($Pv^n = C$), Free expansion, throttling, process.
- 1.7 Problem solving.

2. AIR CYCLES. 10 Hours

- 2.1 Air cycle and reversibility.
- 2.2 Cycle of operation.
- 2.3 Air standard cycle and its efficiency.
- 2.4 Reversible and irreversible process.
- 2.5 Cannot's cycle and its efficiency.
- 2.6 Joule's cycle and its efficiency.
- 2.7 Mean effective pressure.
- 2.8 Problem solving.

3. RECIPROCATING AIR COMPRESSOR. 10 Hours

- 3.1 Air compressors.
- 3.2 Classification of compressors.
- 3.3 Effect of the type of compression.
- 3.4 Cold water spray method.
- 3.5 Multistage compressor method.
- 3.6 Single stage compressor and Multistage compressors,

- 3.7 Work done per cycle and horse power required, using PV diagram and heat entropy chart method.
- 3.8 Efficiency of a compressor, volumetric efficiency.
- 3.9 Condition for maximum efficiency.

4. PROPERTIES OF FLUID AND FLOW OF FLUID. 8
Hours

- 4.1 Properties of fluid.
- 4.2 The four stage of substance.
- 4.3 Properties of vapour.
- 4.4 Equation of continuity.
- 4.5 Pressure head, velocity head, datum head, and total head.
- 4.6 Bernoullies theorem.
- 4.7 Flow through orifices. Coefficients due to contraction, velocity, and discharge.
- 4.8 Losses of head due to friction, sudden enlargement, sudden contraction, obstruction, bends and elbows etc.
- 4.9 Problem solutions.

5. BOILERS. 12 Hours

- 5.1 Definition of boiler.
- 5.2 Classification and types of boilers.
- 5.3 Low pressure boilers.
- 5.4 Difference between high pressure and low pressure boilers.
- 5.5 Fitting and accessories of boilers.
- 5.6 Application of low pressure boilers in air conditioning.
- 5.7 Types of boilers used in air conditioning.
- 5.8 Importance of boilers in winter and summer air conditioning.
- 5.9 Role of feed tank.
- 5.10 Types and uses of steam traps in air conditioning.
- 5.11 Controls used in low pressure boilers, Multiple timer,
- 5.12 Safety valves, flame detection devices, (Photo cell).
- 5.13 Adjustment of flame with the help of linkage of reversing motor.

6. WATER TREATMENT. 6 Hours

- 6.1 Importance of Water Treatment in air-conditioning.
- 6.2 Chemical treatment of boilers.
- 6.3 Blow down procedure of boiler.
- 6.4 Use of chemical by-pass Feeder for Steam/Hot water lines. Condensate tank and Feed Water tank for boilers.
- 6.5 Use of Water Softener in air-conditioning.

7. ELECTRICAL CIRCUITS.

4 Hours

- 7.1 Elementary electric circuit diagram of low pressure boiler panel.
- 7.2 Actual electric circuit diagram of low pressure boiler panel.
- 7.3 General features and remedies of low pressure boiler.

REFERENCE BOOKS.

- 1. Thermodynamics by R.S. Khurmi
- 2. Heat Engines by D.A. Low.
- 3. ASHRAE Handbook- Equipment, System and Application volume.

RACT-223 THERMODYNAMICS AND LOW PRESSURE BOILER

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the students will be able to:

- 1. UNDERSTAND THE THERMODYNAMICS PROCESSES.**
 - 1.1 Define absolute temperature, units of heat, pressure, gases and vapour.
 - 1.2 Explain Energy equation of a gas.
 - 1.3 State Change in internal energy.
 - 1.4 Represent graphically the work done by a gas.
 - 1.5 Describe Methods of heating and expansion of gases.
 - 1.6 Explain heating and expanding processes of the gases.
 - 1.7 Solve problems on energy equation heating processes.

- 2. UNDERSTAND THE PRINCIPLES OF AIR CYCLES.**
 - 2.1 State Air cycle and reversibility.
 - 2.2 Describe Cycle of operation.
 - 2.3 Explain Air standard cycle and its efficiency.
 - 2.4 Describe Reversible and irreversible process.
 - 2.5 Explain Cannot's cycle and its efficiency.
 - 2.6 Explain Joule's cycle and its efficiency.
 - 2.7 State Mean effective pressure.
 - 2.8 Solve Problems

- 3. UNDERSTAND THE RECIPROCATING AIR COMPRESSORS.**
 - 3.1 Explain Air compressors.
 - 3.2 Classify compressors.
 - 3.3 State the Effect of the type of compression.
 - 3.4 State Cold water spray method.
 - 3.5 Explain Multistage compressor method.
 - 3.6 Define Single stage compressor and Multistage compressors,
 - 3.7 Explain Work done per cycle and horse power required, using PV diagram and heat entropy chart method.
 - 3.8 Define volumetric Efficiency of a compressor.
 - 3.9 Explain Conditions for maximum efficiency.

- 4. UNDERSTAND THE PROPERTIES OF FLUID AND FLOW OF FLUID.**
 - 4.1 State Properties of fluid.
 - 4.2 Define four stages of substance.
 - 4.3 State Properties of vapour.

- 4.4 Explain Equation of continuity.
 - 4.5 Define Pressure head, velocity head, datum head, and total head.
 - 4.6 Explain Bernoullies theorem.
 - 4.7 Describe Flow through orifices/Coefficients due to contraction, velocity, and discharge.
 - 4.8 Explain Loss of head due to friction, sudden enlargement, sudden contraction, obstruction, bends and elbows.
 - 4.9 Solve Problems.
- 5. UNDERSTAND THE BOILER AND ITS TYPES.**
- 5.1 Define boiler.
 - 5.2 Classify of boilers.
 - 5.3 State Low pressure boilers.
 - 5.4 Differentiate between high pressure and low pressure boilers.
 - 5.5 Identify Fitting and accessories of boilers.
 - 5.6 Explain the Application of low pressure boilers in air conditioning.
 - 5.7 Enlist the Types of boilers used in air conditioning.
 - 5.8 Explain the importance of boilers in winter and summer air conditioning.
 - 5.9 State the Role of feed tank.
 - 5.10 Explain the Types and uses of steam traps in air conditioning.
 - 5.11 Explain the Controls used in low pressure boilers, Multiple timer,
 - 5.12 State the Safety valves, flame detection devices, (Photo cell).
 - 5.13 Explain the Adjustment of flame with the help of linkage of reversing motor.
- 6. UNDERSTAND THE IMPORTANCE OF WATER TREATMENT.**
- 6.1 Explain the Importance of Water Treatment in air-conditioning.
 - 6.2 State the Chemical treatment of boilers.
 - 6.3 Explain the Blow down procedure of boiler.
 - 6.4 Describe the Use of chemical by-pass Feeder for Steam/Hot water lines. Condensate tank and Feed Water tank for boilers.
 - 6.5 Explain the use of Water Softener in air-conditioning
- 7. UNDERSTAND THE ELECTRICAL CIRCUITS OF BOILER CONTROL PANEL.**
- 7.1 Describe Elementary electric circuit diagram of low pressure boiler panel.
 - 7.2 Draw Actual electric circuit diagram of low pressure boiler panel.
 - 7.3 Explain General features and remedies of low pressure boiler.

RACT-223 THERMODYNAMICS AND LOW PRESSURE BOILER

LIST OF PRACTICAL

1. Solve problems on temperature, pressure measurements & heating of gases.
2. Solve the problems on gas laws and work done by a gas.
3. Solve the problems on gas laws and methods of heating of gases.
4. Study of P.V and T.S diagram, thermodynamic reversibility of air cycle.
5. Solve the problems on cannot's cycle, Joule's cycle, air standard efficiency of these cycles and mean effective pressure.
6. Study of reciprocating air compressors and solve problems on efficiency and other conditions of compressor.
7. Study of properties of fluids and vapors, problems on continuity of flow, Bernoulli's theorem and losses of head due to friction, sudden enlargement, sudden contraction and obstruction etc.
8. Draw the neat labelled, free hand sketches of different types of boilers, fittings.
9. Draw the neat labelled, free hand sketches of different types of boilers showing its mountings.
10. Sketch the boiler mountings and accessories.
11. Solve the problems on steam, boiler hours power and boiler efficiency.
12. Study of water treatment plants, sketch the diagrams.
13. Solve the problems on water treatment.
14. Study of controls used in low pressure boiler, multiple timer, safety release valves, photocells and flame adjustment.
15. Study of elementary and actual electric circuit diagrams of low pressure boilers.

RACT-233 ENGINEERING AND ARCHITECTURAL DRAWING

Total contact hours

Theory	32 hours	T	P	C	
Practical	192 hours		1	6	3

Pre-requisites Fundamental knowledge of technical drawing

AIMSThe course has been designed to give the technicians enough appreciation and understanding of engineering and architectural drawing so as to enable them to;

- a. Read and interpret engineering & architectural drawings.
- b. Execute simple working drawings.
- c. Give a sound foundation for understanding the installations, working drawings of air conditioning system designs
- d. Know the drawings of building symbols.

1. ENGINEERING DRAWING 8 Hours

- 1.1 Orientation to Engineering and architectural drawing.
- 1.2 Sectional views and its types.
- 1.3 Sketching and Drawings in Isometric and orthographic projections of simple components.
- 1.4 Representation of inclined and curved surfaces.
- 1.5 Development of surfaces like truncated pipes, intersection of two pipe, square and rectangular ducts.

2. PIPING, PIPE FITTINGS, VALVES & SYMBOLS 16 Hours

- 2.1 Pipes and ducts hanging methods with roof and walls.
- 2.2 Types of wall brackets and roof clamps.
- 2.3 Pipes and piping system.
- 2.4 Types of pipes like welded, seamless, concrete and ceramics.
- 2.5 Pipe fittings, valves and their types like globe, gate, check, cock, and relief etc.
- 2.6 Graphical representation of pipe fitting symbols.
- 2.7 Study and use of screwed, flanged and welded ends pipe connections.
- 2.8 Identification of piping and ducting by color code system and Greek alphabets.
- 2.9 Pipe lines drawings, using pipe fitting symbols (single line and double line).
- 2.10 Electrical symbols and electrical circuits.
- 2.11 Graphical symbols used in plumbing and HVAC & R systems.

3. ARCHITECTURAL DRAWING 8 Hours

- 3.1 Description of soil, RCC walls, and building plans
- 3.2 Type of Doors and windows

- 3.3 Types of residential, Public, Educational, Industrial and commercial buildings.
- 3.4 Elevation, plans and sectional views of buildings.

RECOMMENDED BOOKS:

- 1. Fundamental of Pipe drafting By Charles M. Thomson.
- 2. ASHRAE Hand Book- Fundamental Volume 1977.
- 3. First Year Engineering Drawing By A. C. Parkinson.
- 4. Building Construction By Arrora.

RACT-233 ENGINEERING AND ARCHITECTURAL DRAWING

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the students will be able to:

1.UNDERSTAND THE CONCEPT OF ENGINEERING & ARCHITECTURAL DRAWING AND DRAW ISOMETRIC, ORTHOGRAPHIC, SECTIONAL VIEWS AND DEVELOPMENT OF SURFACES.

- 1.1 Explain the role of Engineering & Architectural Drawing.
- 1.2 Explain sectional views and their types .
- 1.3 State sectional views.
- 1.4 Explain Isometric Projections.
- 1.5 Method Isometric Projections.
- 1.6 Explain Orthographic Projections.
- 1.7 State the Orthographic Projections.
- 1.8 Explain inclined and curved surfaces.
- 1.9 Methods the development of inclined and curved surfaces.

2.UNDERSTAND THE PIPES, PIPE FITTINGS, VALVES, PIPES/DUCTS HANGING SYSTEM AND THE SYMBOLS USED IN HVAC AND R INSTALLATIONS.

- 2.1. Explain the pipes and duct hanging methods with roof and walls.
- 2.2 Explain the wall brackets and roof clamps.
- 2.3 Explain the types of pipes and their uses.
- 2.4 Enlist the names and the use of pipe fittings.
- 2.5 Explain the types of pipe ends connections.
- 2.6 State graphical symbols of pipe fittings.
- 2.7 State pipe line drawings.
 - i) Single line piping.
 - ii) Double line piping.
- 2.8 Enlist the types of valves.
- 2.9 Explain the use of valves in piping system.
- 2.10 Identify the piping and ducting system by color code.
- 2.11 Identify the piping and ducting system by Greek Alphabets.
- 2.12 Identify electrical components by their symbols.
- 2.14Method of graphical symbols of components used in plumbing and HVAC & R systems.

3.UNDERSTAND THE WORKING DRAWINGS OF BUILDING PLANS, EVALUATION, SECTION, BUILDING PLANNING AND CONSTRUCTION.

- 3.1 Explain the soil and its types.
- 3.2 Explain the types of doors and windows.
- 3.3 State the metter of drawing symbols of doors and windows.
- 3.4 Explain the types of building.
- 3.5 State the metter of drawing the elevations, plans and sectional views of buildings.

RACT-233 ENGINEERING AND ARCHITECTURAL DRAWING

INSTRUCTIONAL OBJECTIVES.

1. 1. To enable the students to understand architectural drawings of different buildings.
2. The students will be able to read and understand the working drawings of building plans, elevation and sections.
3. They will be able to visualize the problems regarding running of ducts, pipes, electrically installations and equipments, etc.
4. The students will be able to understand the building planning and construction, installation symbols used for refrigeration and air conditioning installations.

Pre-requisites. Symbols of inclined and curved surfaces.

LIST OF PRACTICAL

192 HOURS

1. DEVELOPMENT OF DIFFERENT SURFACES.

- 1.1 Inclined and curved surfaces.
- 1.2 Tee joints.
- 1.3 pipe joints.
- 1.4 Symbols of components/equipment used in HVAC & R Systems.

2. DRAW.

- 2.1 Orthographic drawings.
- 2.2 Single line.
- 2.3 Double Line.
- 2.4 Drawing of Electrical Symbols.
- 2.5 Draw isometric views.

3. DRAWING OF ELECTRICAL CIRCUITS.

- 3.1 Simple electrical circuits.
- 3.2 Two bulbs in series and parallel.
- 3.3 Schematic drawing of simple electrical circuit.
- 3.4 A.C single phase motor start and symbols. line diagram.
- 3.5 Domestic water cooler's circuit.
- 3.6 Domestic window-type air conditioners circuit.
- 3.7 Split type air-conditioner.
- 3.8 Vapor compression Water and Air-cooled Chillers.
- 3.9 Absorption type Air Conditioning units.

- 4. DRAW PLAN, ELEVATION, AND SECTIONS OF BUILDINGS.**
 - 4.1 Showing doors, windows and other arch symbols etc.
 - 4.2 Different types of buildings.

- 5. DRAW SYMBOLS FOR PLUMBING AND HVAC DUCTING SYSTEM.**
 - 5.1 Identification of piping and ducting by colour and alphabets.
 - 5.2 To draw the diagram of pipings and their fixtures.

- 6. SKETCHING OF VENTS, GLOBE, GATE, CHUCK AND STOP VALVES.**

RACT-243 ADVANCE REFRIGERATION

Total contact hours	T	P	C
Theory 96 hours	3	0	3

Prerequisites. Knowledge of Principles of refrigeration.

AIMS 1.The aims of the course are to help the students to the advance theory of refrigeration, application of actual refrigeration system, special installations and design feature of cold storage.

2.Acquire knowledge of the different refrigeration installations, causes of food spoilage, their remedies and problems in handling cold storage.

3. Design cold storage by means of calculations.

1. CONVENTIONAL VAPOR COMPRESSION SYSTEM. 9 Hours

- 1.1 Types of compression system.
- 1.2 Conventional compression system using automatic expansion valve as refrigerant control.
- 1.3 Compression system using thermostatic expansion valve as refrigerant control.
- 1.4 Low side float valve with reciprocating and rotary compressor.
- 1.5 High side float valve and capillary tube system.

2. WATER CHILLER. 9 Hours

- 2.1 Double pipe.
- 2.2 Baudlot and tank type cooler.
- 2.3 Shell and tube chiller.
- 2.4 Dry expansion chiller.
- 2.5 Spray type chiller.
- 2.6 Direct and indirect system.
- 2.7 Secondary Refrigerants.
- 2.8 Brine.
- 2.9 Antifreeze solution.
- 2.10 Cryogenic Fluids.
- 2.11 Cryogenic applications.

3. DEFROSTING. 6 Hours

- 3.1 Defrosting intervals.
- 3.2 Methods of defrosting.
- 3.3 Water defrosting.
- 3.4 Electric defrosting.

3.5	Hot gas defrosting.	
3.6	Re-evaporator coils.	
3.7	Deforesting multiple evaporator systems.	
3.8	Reverse cycle defrosting.	
3.9	Heat bank defrosting.	
3.10	Vapor defrosting.	
4.	METHODS OF OBTAINING ULTRA-LOW TEMPERATURE .	6
	Hours	
4.1	Cascade System.	
4.2	Two stage and multistage system.	
4.3	Multi temperature system.	
4.4	Two stage systems with rotary booster.	
4.5	Brine cooler.	
5.	TRANSPORT REFRIGERATION AND AIR CONDITIONING.	6
	Hours	
5.1	Truck refrigeration.	
5.2	Marine refrigeration.	
5.3	Automobile (car) air-conditioning.	
5.4	Railway car air conditioning.	
5.5	Air craft air conditioning.	
6.	COMMERCIAL SYSTEM APPLICATION.	6 Hours
6.1	Reach-in-cabinet.	
6.2	Walk-in-cabinet.	
6.3	Florist cabinet.	
6.4	Display cases, single duty, double duty cases.	
6.5	Ice cream cabinet.	
6.6	Automatic ice maker and its types.	
6.7	Milk vending machine.	
7.	FOOD PRESERVATION.	9 Hours
7.1	Principles of Food preservation.	
7.2	Deterioration and spoilage.	
7.3	Enzymes.	
7.4	Micro-organisms.	
7.5	Bacteria.	
7.6	Yeasts.	
7.7	Molds.	
7.8	Control of spoilage agents.	

- 7.9 Preservation of food by refrigeration (low temperature) and by high temperature
- 8. REFRIGERATED STORAGE. 9 Hours**
- 8.1 Refrigerated storage.
 - 8.2 Storage conditions.
 - 8.3 Storage temperature.
 - 8.4 Humidity and air motion.
 - 8.5 Mixed storage.
 - 8.6 Product condition on entering storage.
 - 8.7 Product chilling and pre-cooling.
 - 8.8 Relative humidity and air velocity in chill rooms.
 - 8.9 Freezing and frozen storage.
 - 8.10 Aspiration and heat load calculations
- 9. FREEZING METHODS. 6 Hours**
- 9.1 Freezing methods and preparing food stuff before preservation.
 - 9.2 Air blast freezing.
 - 9.3 Indirect contact freezing.
 - 9.4 Immersion freezing.
 - 9.5 Quick freezing , Sharp freezing and their comparison.
 - 9.6 Packing material and containers.
- 10. FOOD PRODUCTS. 6 Hours**
- 10.1 Cold storage practice for vegetables.
 - 10.2 Cold storage practice for fruits.
 - 10.3 Cold storage practice for meat, fish , poultry , milk and their products.
- 11. COOLING LOAD CALCULATIONS. 6 Hours**
- 11.1 Cooling load.
 - 11.2 Equipment running time.
 - 11.3 Cooling load calculations.
 - 11.4 Wall gain load.
 - 11.5 Air change load.
 - 11.6 Product load.
 - 11.7 Miscellaneous load.
- 12. FACTORS DETERMINING THE LOAD. 9 Hours**
- 12.1 Factors determining the wall gain load.
 - 12.2 Determination of "U" factor.
 - 12.3 Temperature differential across cold storage walls.
 - 12.4 Temperature differential across ceilings and floors.

- 12.5 Effect of solar radiation.
- 12.6 Calculating the wall gain load.
- 12.7 Calculating the air change load.

13. PRODUCT LOAD.

6 Hours

- 13.1 Calculating the product loads.
- 13.2 Chilling rate factor.
- 13.3 Product freezing and storage.
- 13.4 Respiration heat.

14. MISCELLANEOUS LOAD.

3 Hours

- 14.1 Calculating the miscellaneous load.
- 14.2 Use of safety factor.
- 14.3 Short method of load calculations.
- 14.4 Metric calculations.
- 14.5 Customary problems.

REFERENCE BOOKS.

1. Principles of Refrigeration by R.J.Dossot.
2. Modern refrigeration and Air conditioning by Althous.
3. Ashrae Guide 1977.

RACT-243 ADVANCE REFRIGERATION.

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the students will be able to:

1. UNDERSTAND THE CONVENTIONAL COMPRESSION SYSTEM.

- 1.1 Enlist the type of compression system.
- 1.2 Explain conventional compression system using automatic expansion valves.
- 1.3 Explain conventional compression system using thermostatic expansion valve.
- 1.4 Explain low and high side float valve with reciprocating compressor.
- 1.5 Explain low and high side float valve with Rotary compressor.

2. UNDERSTAND THE PRINCIPLE OF OPERATION, CONSTRUCTION AND UTILIZATION OF WATER CHILLER IN COMMERCIAL AND INDUSTRIAL REFRIGERATION.

- 2.1 Enlist the type of water chiller.
- 2.2 Explain the working principle of double pipe water chiller.
- 2.3 Explain the working principle of Baudlot and tank type coolers.
- 2.4 Explain the working principle/operation of shell and tube chiller.
- 2.5 Explain the working principle/operation of Dry expansion chiller.
- 2.6 Explain the working principle/operation of spray type chiller.
- 2.7 Distinguish between direct and indirect system.
- 2.8 State the use of secondary refrigerants.
- 2.9 Enlist the function and purpose of brine solution.
- 2.10 Define antifreezing solution.
- 2.11 Describe cryogenic fluid.
- 2.12 Explain application of cryogenics.

3. UNDERSTAND THE METHODS OF DEFROSTING.

- 3.1 Explain the purpose of defrosting.
- 3.2 Identify the different types of defrosting method.
- 3.3 Explain water defrosting method.
- 3.4 Explain Electric defrosting method.
- 3.5 Explain Hot gas defrosting method.
- 3.6 Describe re-evaporator coils.
- 3.7 Explain defrosting multiple evaporator system.
- 3.8 Illustrate reverse cycle defrosting.
- 3.9 State heat bank defrosting.
- 3.10 State vapor defrosting.

- 4. UNDERSTAND THE METHODS OF ULTRA-LOW TEMPERATURE.**
 - 4.1 Explain Cascade system.
 - 4.2 Explain the two stage and multistage system.
 - 4.3 Explain the multi temperature system.
 - 4.4 Explain the two stage system with rotary booster.
 - 4.5 Explain brine coolers.

- 5. UNDERSTAND THE DIFFERENT TYPES OF TRANSPORT REFRIGERATION AND AIR CONDITIONING SYSTEMS.**
 - 5.1 State the purpose of transport refrigeration and air-conditioning.
 - 5.2 Explain truck refrigeration.
 - 5.3 Explain marine refrigeration.
 - 5.4 Explain automobile (car) air conditioning.
 - 5.5 Explain railway car air conditioning.
 - 5.6 Explain air craft air conditioning.

- 6. UNDERSTAND THE USE OF COMMERCIAL SYSTEM APPLICATION.**
 - 6.1 Enlist commercial type of refrigerating units.
 - 6.2 Explain the use and function of reach-in-cabinet.
 - 6.3 Explain the use and function of walk-in-cabinet.
 - 6.4 State the use and function of florist cabinet.
 - 6.5 Differentiate between single duty display cases and double duty display cases.
 - 6.6 Identify the different components of ice cream cabinet.
 - 6.7 Identify different component of automatic ice maker.
 - 6.8 Explain milk vending machine.

- 7. UNDERSTAND THE FOOD PRESERVATION METHODS.**
 - 7.1 Describe the Principles and importance of food product preservation.
 - 7.2 Describe deterioration and spoilage of food.
 - 7.3 Define enzymes, micro-organisms, bacteria, yeast and mold.
 - 7.4 Explain the control of spoiling agents.

- 8. UNDERSTAND THE REFRIGERATED STORAGE TECHNIQUES.**
 - 8.1 Explain refrigerated space.
 - 8.2 Enlist the storage conditions of meat products.
 - 8.3 Enlist the storage temperature of different vegetables.
 - 8.4 Describe humidity and air motion.
 - 8.5 Explain relative humidity and air motion in chill rooms.
 - 8.6 Explain Aspiration of heat.

9 UNDERSTAND THE FREEZING METHODS, PREPARING FOOD STUFF BEFORE PRESERVATION AND PACKING MATERIALS.

- 9.1 Enlist the methods of freezing and preparing of food product before preservation.
- 9.2 Explain air blast freezing.
- 9.3 State indirect contact freezing.
- 9.4 State immersion freezing.
- 9.5 Differentiate between quick freezing and sharp freezing.
- 9.6 Explain packing materials.

10. UNDERSTAND THE COLD STORAGE PRACTICES FOR DIFFERENT TYPES OF VEGETABLE, FRUITS, MEATS, MILK AND THEIR PRODUCTS.

- 10.1 Explain the methods of cold storage practice for vegetable.
- 10.2 Explain the methods of cold storage practice for fruits.
- 10.3 Explain the methods of cold storage practice for meat/poultry.
- 10.4 Explain the methods of cold storage practice for fisheries and milk products.

11. CALCULATE THE COOLING LOAD.

- 11.1 Enlist the factors while calculating cooling load of any type of cold storage.
- 11.2 State equipment running time.
- 11.3 Calculate the wall gain load.
- 11.4 Calculate the air change load.
- 11.5 Calculate the product load.
- 11.6 Calculate the miscellaneous load.

12. UNDERSTAND THE FACTORS FOR DETERMINING THE HEAT LOAD.

- 12.1 Identify the factors determining the wall gain load.
- 12.2 Calculate U factor.
- 12.3 Explain the temperature differential across cold storage wall.
- 12.4 Explain the temperature differential across ceiling and floor.
- 12.5 Explain the effect of solar radiation.
- 12.6 Calculate the wall gain radiation.
- 12.7 Calculate the air gain load.

13. CALCULATE THE PRODUCT LOAD.

- 13.1 Manipulate product load.
- 13.2 Describe chilling rate factor.
- 13.3 Explain respiration heat.

14.CALCULATE THE COOLING LOAD OF MISCELLANEOUS PRODUCTS OF COLD STORAGE FONT (CAPITAL.

- 14.1 Calculate the miscellaneous load.
- 14.2 Explain the short method load calculations.
- 14.3 Apply metric system for calculating the cooling load.

RACT-253 RAC WORKSHOP PRACTICE - II

Total contact hours

Theory	32 Hours	T	P	C	
Practical	192 Hours		1	6	3

Prerequisites Understand the servicing, trouble shooting of domestic refrigeration machines and their remedies.

AIMS 1. At the end of the course, the students will have acquired the ability of repair, servicing, maintenance and installation of parts used in domestic refrigeration machines and air conditioning equipment.

- 2. Trouble shooting in refrigeration machines and suggest their remedies.
- 3. Understand electric circuits of refrigeration machines and window air conditions.

1. REPAIRING, SERVICING AND RECHARGING DOMESTIC REFRIGERATION MACHINES. 6 Hours

- 1.1 Mechanical parts of domestic refrigeration machines.
- 1.2 Replacing & Installation of parts.
- 1.3 Leak detection methods.
- 1.4 Evacuation methods.
- 1.5 Charging & re-charging methods.

2. CONSTRUCTION FEATURES OF CABINET OF DOMESTIC REFRIGERATION MACHINES. 5 Hours

- 2.1 Refrigeration body.
- 2.2 Deep freezer.
- 2.3 Display cabinet and its types.
- 2.4 Window Air conditioner.
- 2.5 Water Cooler.

3. CIRCUIT DIAGRAM OF ELECTRICAL COMPONENTS OF DOMESTIC REFRIGERATION MACHINES. 5 Hours

- 3.1 Refrigerator.
- 3.2 Deep Freezer.
- 3.3 Display cabinet.
- 3.4 Window type air conditioner.

- 3.5 Water Cooler.
- 4. TESTING METHODS OF ELECTRICAL COMPONENTS 6 Hours**
 - 4.1 Compressor terminals.
 - 4.2 Relay and its types.
 - 4.3 over load.
 - 4.4 Fan motor.
 - 4.5 Capacitors.
- 5. TROUBLE SHOOTING AND REMEDIES 8 Hours**
 - 5.1 Compressor windings.
 - 5.2 Burn-out overload, fan motors and relays.
 - 5.3 Damage of thermostats & timer.
- 6. GASKET & ITS MATERIAL 2 Hours**
 - 6.1 Gasket types and their materials.
 - 6.2 Sizing procedure.
 - 6.3 Uses and importance of gaskets.

BOOK: Modern refrigeration and air conditioning by Althous

RACT 253 RAC WORKSHOP PRACTICE - II

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the students will be able to:

1.UNDERSTAND THE PROCEDURE OF REPAIRING, SERVICING AND CHARGING DOMESTIC REFRIGERATION MACHINE.

- 1.1 Enlist mechanical parts of a refrigerator.
- 1.2 Describe the mechanical parts of a refrigerator.
- 1.3 Explain the procedure of replacing different parts of domestic refrigeration machines.
- 1.4 State leak detecting methods.
- 1.5 Explain evacuation methods.
- 1.6 Explain re-charging methods of domestic refrigeration machines.
- 1.7 Explain the procedure of oil charging in domestic refrigeration machines.

2.UNDERSTAND THE CONSTRUCTION OF THE CABINET OF THE DOMESTIC REFRIGERATION MACHINES.

- 2.1 Explain the constructions features of refrigerator body.
- 2.2 Explain the construction features of deep-freezer body.
- 2.3 Explain the construction features of different display cabinet.
- 2.4 Explain the construction features of window type air conditioner.
- 2.5 Explain the constructions features of water cooler.

3. SKETCH THE ELECTRICAL COMPONENTS OF DOMESTIC REFRIGERATION MACHINES.

- 3.1 Draw the wiring circuit of a refrigerator.
- 3.2 Draw the wiring circuit of a display cabinet.
- 3.3 Draw the wiring circuit of water cooler.
- 3.4 Draw the wiring circuit of deep freezer.
- 3.5 Draw the wiring circuit of a window type air conditioner.

4. UNDERSTAND THE TESTING PROCEDURE OF ELECTRICAL COMPONENTS.

- 4.1 Describe the testing method of compressor terminal.
- 4.2 Describe the testing method of different types of relays.
- 4.3 Describe the testing method of over load.
- 4.4 Describe the testing method of Fan motor.
- 4.5 Describe the testing method of Capacitors.

5. UNDERSTAND AND DIAGNOSE THE COMMON TROUBLES IN THE REFRIGERATION MACHINES.

- 5.1 State the various causes to burnout the compressor windings.
- 5.2 State the various common causes to burnout the overload fan motor and relays.
- 5.3 Explain the causes of damage of a thermostat & Timer.

6. KNOW THE USE AND IMPORTANCE OF GASKET IN COMPRESSOR.

- 6.1 State the types of gasket and their material.
- 6.2 Describe the sizing procedure.
- 6.3 State the uses and importance of gaskets.

RACT-253 WORKSHOP PRACTICE - II

Prerequisites. Workshop Practice - I

- Aims.** 1.To provide practice of refrigerating and air conditioning equipment repair, maintenance, service and their installations.
- 2.To locate trouble shooting in refrigerating and air conditioning equipment and suggest their remedies.
- 3.To acquaint with the electric circuits of refrigeration and air conditioning equipments.

LIST OF PRACTICALS

196 Hours

1. SERVICING PROCEDURES OF REFRIGERATOR AND AIR

24

Hours

CONDITIONERS.

- 1.1 Internal service operations.
- 1.1.1 Locating and repairing refrigerant leaks.
 - 1.1.2 Purging, charging and discharging refrigerant.
 - 1.1.3 Cleaning or replacing refrigerant flow controls.
 - 1.1.4 Replacing a motor compressor
 - 1.1.5 Replacing filter-drier, high side.
 - 1.1.6 Installing filter-drier, low side.
 - 1.1.7 Evacuating.
 - 1.1.8 Adding oil
 - 1.1.9 Replacing evaporators.
- 1.2 External service operations of refrigerator and air conditioner. 24 Hours
- 1.2.1 Cabinet hardware.
 - 1.2.2 Cleaning
 - 1.2.3 Noise.
 - 1.2.4 **Electrical circuits.**
 - 1.2.4.1 Motor controls.
 - 1.2.4.2 Light circuit.
 - 1.2.4.3 temperature controls.
 - 1.2.4.4 heaters.
 - 1.2.4.5 fan motors.

- 1.2.5 **Mechanical.** **18 Hours**
 - 1.2.5.1 pressure control
 - 1.2.5.2 humidity controls.
 - 1.2.5.3 valves.
 - 1.2.5.4 pipings.

2. TESTING PROCEDURES OF REFRIGERATOR AND AIR CONDITIONER.

- 2.1 **Mechanical.** 6 Hours
 - 2.2.1 parts of motor compressor
 - 2.1.2 Condensers.
 - 2.1.3 Evaporators.
 - 2.1.4 Refrigerant flow control 18 Hours
 - 2.1.4.1 Capillary tubes.
 - 2.1.4.2 Automatic expansion valve.
 - 2.1.4.3 Thermostatic expansion valve.
 - 2.1.5 Pipings accessories.
 - 2.1.6 Filter driers.
 - 2.1.7 Accumulators
 - 2.1.7 Oil separator.
 - 2.1.8 Pressure regulators.
 - 2.1.9 Temperature regulators.
 - 2.1.10 Mufflers.
- 2.2 Electrical components of refrigerator air conditioner and deep freezer. 24 Hours
 - 2.2.1 Overload protectors.
 - 2.2.2 Motor starting relays.
 - 2.2.2.1 current (magnetic)
 - 2.2.2.2 potential (Voltage)
 - 2.2.2.3 thermal (hot-wire)
 - 2.2.2.4 solid state electronic
 - 2.2.3 Timers.
 - 2.2.4 Temperature controls.
 - 2.2.5 Fans
 - 2.2.6 Switches.
 - 2.2.7 Heaters.

3.ELECTRICAL COMPONENTS OF REFRIGERATOR, AIR CONDITIONER AND DEEP FREEZER. 18 Hours

- 3.1 Refrigerators.
- 3.2 Freezers.
- 3.3 Drinking fountains/ Water Coolers.
- 3.4 Beverage coolers.
- 3.5 Window type room air conditioners.

4. TROUBLE SHOOTING AND REPAIR OF DOMESTIC COOLING EQUIPMENT. 36 Hours

- 4.1 Electrical.
 - 4.1.1 Compressor will not start no burns.
 - 4.1.2 Compressor will not start-burns intermittently cycling
 - 4.1.3 Compressor starts, motor will not get starts
 - 4.1.4 Compressor starts and runs but cycles on protector.
 - 4.1.5 Starting capacitors burned out.
 - 4.1.6 Running capacitors burned out.
 - 4.1.7 Motor controls defective.
 - 4.1.7.1 Low side pressure motor control.
 - 4.1.7.2 high side safety motor control
 - 4.1.8 Relays burnt- out
 - 4.1.9 Defective heaters.
 - 4.1.10 Defective switches.

- 4.2 Mechanical 24 Hours
 - 4.2.1 Shortage of refrigerant.
 - 4.2.2 Loose compression.pumping
 - 4.2.3 Leaking
 - 4.2.4 Moisture in the refrigerant circuit.
 - 4.2.5 Refrigerant control restricted.
 - 4.2.6 Faulty gasket seal.
 - 4.2.7 Stuck motor compressor.
 - 4.2.8 Presence of oil in the evaporator.

REFERENCE BOOKS.

- Alehouse, A., Turnquist C. and Bracciano, A. Modern. Refrigeration and air conditioning, the Goodheart. Willcox Co., Inc., U.S.A., 1961
- Dossat, R.J. Principles of Refrigeration, John Wiley and sons Inc., Tokyo Japan, 1961
- Harris, N.C., Conde, D.F., Modern Air Conditioning, McGraw Hill Book Co., USA, 1974.
- Mc. quisition F.c., Parker, J.D., Heating, Ventilating, jand Analysis and Design, John Wiley and sons, Inc., USA, 1977.
- Schmaltzier, Gerald and Eveling A., Basic Air conditioning., Hjayden Book Co., Inc., USA, 1971.