

REFRIGERATION AND AIR CONDITIONING TECHNOLOGY SCHEME OF STUDIES

1ST YEAR

			T	P	C	Page
Gen	111	Islamiat & Pak Studies	1	0	1	1
Eng	122	Technical English	2	0	2	10
Math	113	Applied Mathematics-I	3	0	3	13
Phy	122	Applied Physics	1	3	2	19
Ch	112	Applied Chemistry	1	3	2	26
MT	111	Technical Drawing	0	3	1	32
ET	113	Applied Electricity	2	3	3	35
COMP	122	Computer Applications	1	3	2	43
RACT	113	Principles of Refrigeration	2	3	3	48
RACT	123	Workshop Practice-I	0	9	3	55
		-Basic Electronics Applied to HVAC&R	0	3	1	
		-Metal Shop		0	3	1
		-Machine Shop/Welding Shop		0	3	1
Total:			13	27	22	

2ND YEAR

Gen	211	Islamiat & Pak. Studies	1	0	1	57
Math	223	Applied Mathematics-II	3	0	3	64
Mgm	232	Industrial Management & Human Relations	2	0	2	70
Phy	212	Applied Physics	1	3	2	78
RACT	214	Principle of Air-Conditioning	3	3	4	86
RACT	223	Applied Thermodynamics & Low Pressure Boiler	2	3	3	92
RACT	233	Engg. & Arch. Drawing	1	6	3	98
RACT	243	Advance Refrigeration	3	0	3	104
RACT	253	Workshop Practice-II	1	6	3	112
Total:			17	21	24	

3RD YEAR

Gen	311	Islamiat & Pak. Studies	1	0	1	120
Mgm	311	Business Management & Industrial Economics	1	0	1	127
Mgm	321	Business Communication	1	0	1	133
RACT	314	Air Conditioning Systems Design	3	3	4	137
RACT	322	Water & Air Distribution	2	0	2	144
RACT	334	Control & Instrumentation	3	3	4	150
RACT	342	Industrial Refrigeration & Air Cond.	2	0	2	160
RACT	352	Technical Project	0	6	2	164
RACT	363	Heat Transfer & Ref. Calculation	3	0	3	166
RACT	373	RAC W/shop Practice-III	0	9	3	172
Total:			16	21	23	

Eng-112ENGLISH

Total contact hours

Theory	64	T	P	C
Practical	0	2	0	2

AIMSAt the end of the course, the students will be equipped with cognitive skill to enable them to present facts in a systematic and logical manner to meet the language demands of dynamic field of commerce and industry for functional day-to-day use and will inculcate skills of reading, writing and comprehension.

COURSE CONTENTS

ENGLISH PAPER "A"

1 PROSE/TEXT **16 hours**

1.1 First eight essays of Intermediate English Book-II

2 CLOZE TEST **4 hours**

2.1 A passage comprising 50-100 words will be selected from the text. Every 11th word or any word for that matter will be omitted. The number of missing word will range between 5-10. The chosen word may or may not be the one used in the text, but it should be an appropriate word.

ENGLISH PAPER "B"

3 GRAMMAR **26 hours**

3.1 Sentence Structure.

3.2 Tenses.

3.3 Parts of speech.

3.4 Punctuation.

3.5 Change of Narration.

3.6 One word for several

3.7 Words often confused

4. COMPOSITION **8 hours**

4.1 Letters/Messages

4.2 Job application letter

4.3 For character certificate/for grant of scholarship

4.4 Telegrams, Cablegrams and Radiograms, Telexes, Facsimiles

4.5 Essay writing

4.6 Technical Education, Science and Our life, Computers, Environmental Pollution, Duties of a Student.

5. TRANSLATION

5.1 Translation from Urdu into English.

For Foreign Students: A paragraph or a dialogue.

4 hours

6 hours

RECOMMENDED BOOKS

1. Intermediate English Book-II.

2. An English Grammar and Composition of Intermediate Level.

3. A Hand Book of English Students By Gatherer.

Eng-112ENGLISH

INSTRUCTIONAL OBJECTIVES

PAPER-A

1. DEMONSTRATE BETTER READING, COMPREHENSION AND VOCABULARY

- 1.1 Manipulate, skimming and scanning of the text.
- 1.2 Identify new ideas.
- 1.3 Reproduce facts, characters in own words
- 1.4 Write summary of stories

2. UNDERSTAND FACTS OF THE TEXT

- 2.1 Rewrite words to fill in the blanks recalling the text.
- 2.2 Use own words to fill in the blanks.

PAPER-B

3. APPLY THE RULES OF GRAMMAR IN WRITING AND SPEAKING

- 3.1 Use rules of grammar to construct meaningful sentences containing a subject and a predicate.
- 3.2 State classification of time, i.e present, past and future and use verb tense correctly in different forms to denote relevant time.
- 3.3 Identify function words and content words.
- 3.4 Use marks of punctuation to make sense clear.
- 3.5 Relate what a person says in direct and indirect forms.
- 3.6 Compose his writings.
- 3.7 Distinguish between confusing words.

4. APPLY THE CONCEPTS OF COMPOSITION WRITING TO PRACTICAL SITUATIONS

- 4.1 Use concept to construct applications for employment, for character certificate, for grant of scholarship.
- 4.2 Define and write telegrams, cablegrams and radiograms, telexes, facsimiles
- 4.3 Describe steps of a good composition writing.
- 4.4 Describe features of a good composition.
- 4.5 Describe methods of composition writing
- 4.6 Use these concepts to organize facts and describe them systematically in practical situation.

5. APPLIES RULES OF TRANSLATION

- 5.1 Describe confusion.
- 5.2 Describe rules of translation.

5.3 Use rules of translation from Urdu to English in simple paragraph and sentences.

Math-113 APPLIED MATHEMATICS-I

T	P	C
3	0	3

Total Contact Hours

Theory 96 Hours.

Pre-requisite: Must have completed a course of Elective Mathematics at Matric level.

AIMS: After completing the course the students will be able to

1. Solve problems of Algebra, Trigonometry, vectors, Mensuration, Matrices and Determinants.
2. Develop skill, mathematical attitudes and logical perception in the use of mathematical instruments as required in the technological fields.
3. Acquire mathematical clarity and insight in the solution of technical problems.

COURSE CONTENTS

- 1. QUADRATIC EQUATIONS 6 Hours**
 - 1.1 Standard Form
 - 1.2 Solution
 - 1.3 Nature of roots
 - 1.4 Sum & Product of roots
 - 1.5 Formation
 - 1.6 Problems
- 2. ARITHMETIC PROGRESSION AND SERIES. 3 Hours**
 - 2.1 Sequence
 - 2.2 Series
 - 2.3 nth term
 - 2.4 Sum of the first n terms
 - 2.5 Means
 - 2.6 Problems
- 3. GEOMETRIC PROGRESSION AND SERIES. 3 Hours**
 - 3.1 nth term
 - 3.2 Sum of the first n terms
 - 3.3 Means
 - 3.4 Infinite Geometric progression
 - 3.5 Problems
- 4. BINOMIAL THEOREM 6 Hours**
 - 4.1 Factorials

- 4.2 Binomial Expression
 - 4.3 Binomial Co-efficient
 - 4.4 Statement
 - 4.5 The General Term
 - 4.6 The Binomial Series
 - 4.7 Problems.
- 5. PARTIAL FRACTIONS 6 Hours**
- 5.1 Introduction
 - 5.2 Linear Distinct Factors Case I
 - 5.3 Linear Repeated Factors Case II
 - 5.4 Quadratic Distinct Factors Case III
 - 5.5 Quadratic Repeated Factors Case IV
 - 5.6 Problems
- 6. FUNDAMENTALS OF TRIGONOMETRY 6 Hours**
- 6.1 Angles
 - 6.2 Quadrants
 - 6.3 Measurements of Angles
 - 6.4 Relation between Sexagesimal & circular system
 - 6.5 Relation between Length of a Circular Arc & the Radian Measure of its central Angle
 - 6.6 Problems
- 7. TRIGONOMETRIC FUNCTIONS AND RATIOS 6 Hours**
- 7.1 Trigonometric functions of any angle
 - 7.2 Signs of trigonometric Functions
 - 7.3 Trigonometric Ratios of particular Angles
 - 7.4 Fundamental Identities
 - 7.5 Problems
- 8. GENERAL IDENTITIES 6 Hours**
- 8.1 The Fundamental Law
 - 8.2 Deductions
 - 8.3 Sum & Difference Formulae
 - 8.4 Double Angle Identities
 - 8.5 Half Angle Identities
 - 8.6 Conversion of sum or difference to products
 - 8.7 Problems
- 9. SOLUTION OF TRIANGLES 6 Hours**
- 9.1 The law of Sines
 - 9.2 The law of Cosines
 - 9.3 Measurement of Heights & Distances

9.4 Problems

10. MENSURATION OF SOLIDS

30 Hours

10.1 Review of regular plane figures and Simpson's Rule

10.2 Prisms

10.3 Cylinders

10.4 Pyramids

10.5 Cones

10.6 Frusta

10.7 Spheres

11. VECTORS

9 Hours

11.1 Scalars & Vectors

11.2 Addition & Subtraction

11.3 The unit Vectors i, j, k

11.4 Direction Cosines

11.5 Scaler or Dot Product

11.6 Deductions

11.7 Dot product in terms of orthogonal components

11.8 Vector or cross Product

11.9 Deductions

11.10 Analytic Expression for $a \times b$.

11.11 Problems

12. MATRICES AND DETERMINANTS

9 Hours

12.1 Definition of Matrix

12.2 Rows & Columns

12.3 Order of a Matrix

12.4 Algebra of Matrices

12.5 Determinants

12.6 Properties of Determinants

12.7 Solution of Linear Equations

12.8 Problems

REFERENCE BOOKS

1. Ghulam Yasin Minhas - Technical Mathematics Vol-I, IImi Kitab Khana, Lahore.
2. Prof. Riaz Ali Khan - Polytechnic Mathematic Series Vol I & II, Majeed Sons, Faisalabad
3. Prof. Sana Ullah Bhatti - A Text Book of Algebra and Trigonometry, Punjab Text Book Board, Lahore.

INSTRUCTIONAL OBJECTIVES

1.USE DIFFERENT METHODS FOR THE SOLUTION OF QUADRATIC EQUATIONS.

- 1.1 Define a standard quadratic equation.
- 1.2 Use methods of factorization and method of completing the square for solving the equations.
- 1.3 Derive quadratic formula.
- 1.4 Write expression for the discriminant.
- 1.5 Explain nature of the roots of a quadratic equation.
- 1.6 Calculate sum and product of the roots.
- 1.7 Form a quadratic equation from the given roots.
- 1.8 Solve problems involving quadratic equations.

2.UNDERSTAND APPLY CONCEPT OF ARITHMETIC PROGRESSION AND SERIES.

- 2.1 Define an Arithmetic sequence and a series.
- 2.2 Derive formula for the nth term of an A.P.
- 2.3 Explain Arithmetic Mean between two given numbers.
- 2.4 Insert n Arithmetic means between two numbers.
- 2.5 Derive formulas for summation of an Arithmetic series.
- 2.6 Solve problems on Arrthimetic Progression and Series..

3. UNDERSTAND GEOMETRIC PROGRESSION AND SERIES.

- 3.1 Define a geometric sequence and a series.
- 3.2 Derive formula for nth term of a G.P.
- 3.3 Explain geometric mean between two numbers.
- 3.4 Insert n geometric means between two numbers.
- 3.5 Derive a formula for the summation of geometric Series.
- 3.6 Deduce a formula for the summation of an infinite G.P.
- 3.7 Solve problems using these formulas.

4. EXPAND AND EXTRACT ROOTS OF A BINOMIAL.

- 4.1 State binomial theorem for positive integral index.
- 4.2 Explain binomial coefficients: $(n,0), (n,1), \dots, (n,r), \dots, (n,n)$
- 4.3 Derive expression for the general term.
- 4.4 Calculate the specified terms.
- 4.5 Expand a binomial of a given index.
- 4.6 Extract the specified roots.
- 4.7 Compute the approximate value to a given decimal place.
- 4.8 Solve problems involving binomials.

5.RESOLVE A SINGLE FRACTION INTO PARTIAL FRACTIONS USING DIFFERENT METHODS.

- 5.1 Define a partial fraction, a proper and an improper fraction.
- 5.2 Explain all the four types of partial fractions.
- 5.3 Set up equivalent partial fractions for each type.
- 5.4 Explain the methods for finding constants involved.
- 5.5 Resolve a single fraction into partial fractions.
- 5.6 Solve problems involving all the four types.

6. UNDERSTAND SYSTEMS OF MEASUREMENT OF ANGLES.

- 6.1 Define angles and the related terms.
- 6.2 Illustrate the generation of an angle.
- 6.3 Explain sexagesimal and circular systems for the measurement of angles.
- 6.4 Derive the relationship between radian and degree.
- 6.5 Convert radians to degrees and vice versa.
- 6.6 Derive a formula for the circular measure of a central angle.
- 6.7 Use this formula for solving problems.

7.APPLY BASIC CONCEPTS AND PRINCIPLES OF TRIGONOMETRIC FUNCTIONS.

- 7.1 Define the basic trigonometric functions/ratios of an angle as ratios of the sides of a right triangle.
- 7.2 Derive fundamental identities.
- 7.3 Find trigonometric ratios of particular angles.
- 7.4 Draw the graph of trigonometric functions.
- 7.5 Solve problems involving trigonometric functions.

8.USE TRIGONOMETRIC IDENTITIES IN SOLVING TECHNOLOGICAL PROBLEMS.

- 8.1 List fundamental identities.
- 8.2 Prove the fundamental law.
- 8.3 Deduce important results.
- 8.4 Derive sum and difference formulas.
- 8.5 Establish half angle, double angle & triple angle formulas.
- 8.6 Convert sum or difference into product & vice versa.
- 8.7 Solve problems.

9.USE CONCEPTS, PROPERTIES AND LAWS OF TRIGONOMETRIC FUNCTIONS FOR SOLVING TRIANGLES.

- 9.1 Define angle of elevation and angle of depression.
- 9.2 Prove the law of sines and the law of cosines.
- 9.3 Explain elements of a triangle.
- 9.4 Solve triangles and the problems involving heights and distances.

10.USE PRINCIPLES OF MENSURATION IN FINDING SURFACES, VOLUMES AND WEIGHTS OF SOLIDS.

- 10.1 Define mensuration of plane and solid figures.
- 10.2 List formulas for perimeters & areas of plane figure.
- 10.3 Define pyramid and cone.
- 10.4 Define frusta of pyramid and cone.
- 10.5 Define a sphere and a shell.
- 10.6 Calculate the total surface and volume of each type of solid.
- 10.7 Compute weight of solids.
- 10.8 Solve problems of these solids.

11.USE THE CONCEPT AND PRINCIPLES OF VECTORS IN SOLVING TECHNOLOGICAL PROBLEMS.

- 11.1 Define vector quantity.
- 11.2 Explain addition and subtraction of vector.
- 11.3 Illustrate unit vectors i, j, k .
- 11.4 Express a vector in the component form.
- 11.5 Explain magnitude, unit vector, direction cosines of a vector.
- 11.6 Derive analytic expression for dot product and cross product of two vector.
- 11.7 Deduce conditions of perpendicularity and parallelism of two vectors.
- 11.8 Solve problems

12.USE THE CONCEPT OF MATRICES & DETERMINANTS IN SOLVING TECHNOLOGICAL PROBLEMS.

- 12.1 Define a matrix and a determinant.
- 12.2 List types of matrices.
- 12.3 Define transpose, adjoint and inverse of a matrix.
- 12.4 State properties of determinants.
- 12.5 Explain basic concepts.
- 12.6 Explain algebra of matrices.
- 12.7 Solve linear equation by matrices.
- 12.8 Explain the solution of a determinant.
- 12.9 Use Crammers Rule for solving linear equations.

Phy-122 APPLIED PHYSICS

Total Contact Hours

Theory	32	T	P	C
Practicals	96	1	3	2

AIMS: The students will be able to understand the fundamental principles and concept of physics, use these to solve problems in practical situations/technological courses and understand concepts to learn advance physics/technical courses.

COURSE CONTENTS

1 MEASUREMENTS. 2 Hours.

- 1.1 Fundamental units and derived units
- 1.2 Systems of measurement and S.I. units
- 1.3 Concept of dimensions, dimensional formula
- 1.4 Conversion from one system to another
- 1.5 Significant figures

2 SCALARS AND VECTORS. 4 Hours.

- 2.1 Revision of head to tail rule
- 2.2 Laws of parallelogram, triangle and polygon of forces
- 2.3 Resolution of a vector
- 2.4 Addition of vectors by rectangular components
- 2.5 Multiplication of two vectors, dot product and cross product

3 MOTION 4 Hours.

- 3.1 Review of laws and equations of motion
- 3.2 Law of conservation of momentum
- 3.3 Angular motion
- 3.4 Relation between linear and angular motion
- 3.5 Centripetal acceleration and force
- 3.6 Equations of angular motion

4 TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA. 4 Hours.

- 4.1 Torque
- 4.2 Centre of gravity and centre of mass
- 4.3 Equilibrium and its conditions
- 4.4 Torque and angular acceleration
- 4.5 Rotational inertia

5 WAVE MOTION. 5 Hours

- 5.1 Review Hooke's law of elasticity

- 5.2 Motion under an elastic restoring force
- 5.3 Characteristics of simple harmonic motion
- 5.4 S.H.M. and circular motion
- 5.5 Simple pendulum
- 5.6 Wave form of S.H.M.
- 5.7 Resonance
- 5.8 Transverse vibration of a stretched string

6 SOUND.

5 Hrs

- 6.1 Longitudinal waves
- 6.2 Intensity, loudness, pitch and quality of sound
- 6.3 Units of Intensity of level and frequency response of ear
- 6.4 Interference of sound waves silence zones, beats
- 6.5 Acoustics
- 6.6 Doppler effect.

7 LIGHT.

5 Hours

- 7.1 Review laws of reflection and refraction
- 7.2 Image formation by mirrors and lenses
- 7.3 Optical instruments
- 7.4 Wave theory of light
- 7.5 Interference, diffraction, polarization of light waves
- 7.6 Applications of polarization in sunglasses, optical activity and stress analysis

8 OPTICAL FIBER.

2 Hours

- 8.1 Optical communication and problems
- 8.2 Review total internal reflection and critical angle
- 8.3 Structure of optical fiber
- 8.4 Fiber material and manufacture
- 8.5 Optical fiber - uses.

9 LASERS.

3 Hours

- 9.1 Corpuscular theory of light
- 9.2 Emission and absorption of light
- 9.3 Stimulated absorption and emission of light
- 9.4 Laser principle
- 9.5 Structure and working of lasers
- 9.6 Types of lasers with brief description.
- 9.7 Applications (basic concepts)
- 9.8 Material processing
- 9.9 Laser welding
- 9.10 Laser assisted machining
- 9.11 Micro machining

- 9.12Drilling, scribing and marking
- 9.13Printing
- 9.14Lasers in medicine

RECOMMENDED BOOKS

- 1Tahir Hussain, Fundamentals of Physics Vol-I and II
- 2Farid Khawaja, Fundamentals of Physics Vol-I and II
- 3Wells and Slusher, Schaum's Series Physics .
- 4Nelkon and Oyborn, Advanced Level Practical Physics
- 5Mehboob Ilahi Malik and Inam-ul-Haq, Practical Physics
- 6Wilson, Lasers - Principles and Applications
- 7M. Aslam Khan and M. Akram Sandhu, Experimental Physics Note Book

Phy-122APPLIED PHYSICS

INSTRUCTIONAL OBJECTIVES

1 USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS.

- 1.1 Write dimensional formulae for physical quantities
- 1.2 Derive units using dimensional equations
- 1.3 Convert a measurement from one system to another
- 1.4 Use concepts of measurement and Significant figures in problem solving.

2 USE CONCEPTS OF SCALARS AND VECTORS IN SOLVING PROBLEMS INVOLVING THESE CONCEPTS.

- 2.1 Explain laws of parallelogram, triangle and polygon of forces
- 2.2 Describe method of resolution of a vector into components
- 2.3 Describe method of addition of vectors by rectangular components
- 2.4 Differentiate between dot product and cross product of vectors
- 2.5 Use the concepts in solving problems involving addition resolution and multiplication of vectors.

3 USE THE LAW OF CONSERVATION OF MOMENTUM AND CONCEPTS OF ANGULAR MOTION TO PRACTICAL SITUATIONS.

- 3.1 Use law of conservation of momentum to practical/technological problems.
- 3.2 Explain relation between linear and angular motion
- 3.3 Use concepts and equations of angular motion to solve relevant technological problems.

4 USE CONCEPTS OF TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA TO PRACTICAL SITUATION/PROBLEMS.

- 4.1 Explain Torque
- 4.2 Distinguish between Centre of gravity and centre of mass
- 4.3 Explain rotational Equilibrium and its conditions
- 4.4 Explain Rotational Inertia giving examples
- 4.5 Use the above concepts in solving technological problems.

5 USE CONCEPTS OF WAVE MOTION IN SOLVING RELEVANT PROBLEMS.

- 5.1 Explain Hooke's Law of Elasticity
- 5.2 Derive formula for Motion under an elastic restoring force
- 5.3 Derive formulae for simple harmonic motion and simple pendulum
- 5.4 Explain wave form with reference to S.H.M. and circular motion
- 5.5 Explain Resonance
- 5.6 Explain Transverse vibration of a stretched string
- 5.7 Use the above concepts and formulae of S.H.M. to solve relevant problems.

6UNDERSTAND CONCEPTS OF SOUND.

- 6.1Describe longitudinal wave and its propagation
- 6.2Explain the concepts: Intensity, loudness, pitch and quality of sound
- 6.3Explain units of Intensity of level and frequency response of ear
- 6.4Explain phenomena of silence zones, beats
- 6.5Explain Acoustics of buildings
- 6.6Explain Doppler effect giving mathematical expressions.

7USE THE CONCEPTS OF GEOMETRICAL OPTICS TO MIRRORS and LENSES.

- 7.1Explain laws of reflection and refraction
- 7.2Use mirror formula to solve problems
- 7.3Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g. microscopes, telescopes, camera and sextant.

8UNDERSTAND WAVE THEORY OF LIGHT

- 8.1Explain wave theory of light
- 8.2Explain phenomena of interference, diffraction, polarization of light waves
- 8.3Describe uses of polarization given in the course contents.

9UNDERSTAND THE STRUCTURE, WORKING AND USES OF OPTICAL FIBER.

- 9.1Explain the structure of the Optical Fiber
- 9.2Explain its principle of working
- 9.3Describe use of optical fiber in industry and medicine.

LIST OF PRACTICALS.

- 1 Draw graphs representing the functions:
 - a) $y=mx$ for $m=0, 0.5, 1, 2$
 - b) $y=x^2$
 - c) $y=1/x$
- 2 Find the volume of a given solid cylinder using vernier callipers.
- 3 Find the area of cross-section of the given wire using micrometer screw gauge.
- 4 Prove that force is directly proportional to (a) mass, (b) acceleration, using fletchers' trolley.
- 5 Verify law of parallelogram of forces using Grave-sands apparatus.
- 6 Verify law of triangle of forces and Lami's theorem
- 7 Determine the weight of a given body using
 - a) Law of parallelogram of forces
 - b) Law of triangle of forces
 - c) Lami's theorem
- 8 Verify law of polygon of forces using Grave-sands apparatus.
- 9 Locate the position and magnitude of resultant of like parallel forces.
- 10 Determine the resultant of two unlike parallel forces.
- 11 Find the weight of a given body using principle of moments.
- 12 Locate the centre of gravity of regular and irregular shaped bodies.
- 13 Find Young's Modules of Elasticity of a metallic wire.
- 14 Verify Hooke's Law using helical spring.
- 15 Study of frequency of stretched string with length.
- 16 Study of variation of frequency of stretched string with tension.
- 17 Study resonance of air column in resonance tube and find velocity of sound.
- 18 Find the frequency of the given tuning fork using resonance tube.
- 19 Find velocity of sound in rod by Kundt's tube.
- 20 Verify rectilinear propagation of light and study shadow formation.
- 21 Study effect of rotation of plane mirror on reflection.
- 22 Compare the refractive indices of given glass slabs.
- 23 Find focal length of concave mirror by locating centre of curvature.
- 24 Find focal length of concave mirror by object and image method
- 25 Find focal length of concave mirror with converging lens.
- 26 Find refractive index of glass by apparent depth.
- 27 Find refractive index of glass by spectrometer.
- 28 Find focal length of converging lens by plane mirror.
- 29 Find focal length of converging lens by displacement method.
- 30 Find focal length of diverging lense using converging lens.
- 31 Find focal length of diverging lens using concave mirror.
- 32 Find angular magnification of an astronomical telescope.
- 33 Find angular magnification of a simple microscope (magnifying glass)

- 34 Find angular magnification of a compound microscope.
- 35 Study working and structure of camera.
- 36 Study working and structure of sextant.
- 37 Compare the different scales of temperature and verify the conversion formula.
- 38 Determine the specific heat of lead shots.
- 39 Find the coefficient of linear expansion of a metallic rod.
- 40 Find the heat of fusion of ice.
- 41 Find the heat of vaporization.
- 42 Determine relative humidity using hygrometer.

Ch-112 APPLIED CHEMISTRY

T	P	C
1	3	2

Total Contact Hours

Theory	32
Practical	64

Pre-requisite: The student must have studied the subject of elective chemistry at Secondary school level.

AIMS After studying this course a student will be able to:

1. Understand the significance and role of chemistry in the development of modern technology.
2. Become acquainted with the basic principles of chemistry as applied in the study of relevant Technology.
3. Know the scientific methods for production, properties and use of materials of industrial & technological significance.
4. Gains skill for the efficient conduct of practicals in a Chemistry lab.

COURSE CONTENTS

- | | |
|--|----------------|
| 1. INTRODUCTION AND FUNDAMENTAL CONCEPTS. | 2 Hours |
| 1.1 Orientation with reference to this technology. | |
| 1.2 Terms used & units of measurements in the study of chemistry. | |
| 1.3 Chemical Reactions & their types. | |
| 2. ATOMIC STRUCTURE. | 2 Hours |
| 2.1 Sub-atomic particles. | |
| 2.2 Architecture of atoms of elements, Atomic No. & Atomic Weight. | |
| 2.3 The periodic classification of elements periodic law | |
| 2.4 General characteristics of a period and group. | |
| 3. CHEMICAL BOND. | 2 Hours |
| 3.1 Nature of chemical Bond. | |
| 3.2 Electrovalent bond with examples. | |
| 3.3 Covalent Bond(Polar and Non-polar, sigma & Pi Bonds with examples. | |
| 3.4 Co-ordinate Bond with examples. | |
| 4. WATER. | 2 Hours |
| 4.1 Chemical nature and properties. | |
| 4.2 Impurities. | |
| 4.3 Hardness of water (types, causes & removal) | |
| 4.4 Scales of measuring hardness (Degrees Clark French, PPM, Mg- per liter). | |

4.5	Boiler feed water, scales and treatment.	
4.6	Sea-water desalination, sewage treatment.	
5.	ACIDS, BASES AND SALTS.	2 Hours
5.1	Definitions with examples.	
5.2	Properties, their strength, basicity & Acidity.	
5.3	Salts and their classification with examples.	
5.4	pH-value and scale.	
6.	OXIDATION & REDUCTION.	2 Hours
6.1	The process, definition & examples.	
6.2	Oxidizing and Reducing agents.	
6.3	Oxides and their classifications.	
7.	NUCLEAR CHEMISTRY.	2 Hours
7.1	Introduction.	
7.2	Radioactivity (alpha, beta and gamma rays).	
7.3	Half life process.	
7.4	Nuclear reaction & transformation of elements.	
8.	CEMENT.	2 Hours
8.1	Introduction	
8.2	Composition and manufacture,.	
8.3	Chemistry of setting and hardening.	
8.4	Special purpose cements.	
9.	GLASS.	2 Hours
9.1	Composition and raw material.	
9.2	Manufacture	
9.3	Varieties and uses.	
10.	PLASTICS AND POLYMERS.	2 Hours
10.1	Introduction and importance.	
10.2	Classification.	
10.3	Manufacture.	
10.4	Properties and uses.	
11.	PAINTS, VARNISHES AND DISTEMPER.	2 Hours
11.1	Introduction	
11.2	Constituents.	
11.3	Preparation and uses.	
12.	CORROSION.	2 Hours

- 12.1 Introduction with causes.
12.2 Types of corrosion.
12.3 Rusting of iron.
12.4 Protective measures against-corrosion.
- 13. REFRACTORY MATERIALS AND ABRASIVE. 2 Hours**
13.1 Introduction to Refractories.
13.2 Classification of Refractories.
13.3 Properties and Uses.
13.4 Introduction to Abrasives.
13.5 Artificial and Natural Abrasives and their uses.
- 14. ALLOYS. 2 Hours**
14.1 Introduction with need
14.2 Preparation and Properties.
14.3 Some Important alloys and their composition.
14.4 Uses.
- 15. FUELS AND COMBUSTION. 2 Hours**
15.1 Introduction of fuels.
15.2 Classification of fuels.
15.3 Combustion.
15.4 Numerical Problems of Combustion.
- 16. LUBRICANTS. 1 Hour**
16.1 Introduction.
16.2 Classification.
16.3 Properties of lubricants.
16.4 Selection of lubricants.
- 17. POLLUTION. 1 Hour**
17.1 The problem and its dangers.
17.2 Causes of pollution.
17.3 Remedies to combat the hazards of pollution.

BOOKS RECOMMENDED

1. Text Book of Intermediate Chemistry (I & II)
2. Ilmi Applied Science by Sh. Atta Muhammad.
3. Polytechnic Chemistry by J.N. Reedy Tata Mc Graw Hill (New Delhi).
4. Chemistry for Engineers by P.C. Jain (New Delhi, India).

INSTRUCTIONAL OBJECTIVES

1.UNDERSTAND THE SCOPE, SIGNIFICANCE AND FUNDAMENTAL ROLE OF THE SUBJECT.

- 1.1 Define chemistry and its important terms.
- 1.2 State the units of measurements in the study of chemistry.
- 1.3 Write chemical formula of common compounds.
- 1.4 Describe types of chemical reactions with examples.

2.UNDERSTAND THE STRUCTURE OF ATOMS AND ARRANGEMENT OF SUB ATOMIC PARTICLES IN THE ARCHITECTURE OF ATOMS.

- 2.1 Define atom.
- 2.2 State the periodic law of elements.
- 2.3 Describe the fundamental sub atomic particles.
- 2.4 Distinguish between atomic no. and mass no.; isotopes and isobars.
- 2.5 Explain the arrangements of electrons in different shells and sub energy levels.
- 2.6 Explain the grouping and placing of elements in the periodic table.

3. UNDERSTAND THE NATURE OF CHEMICAL BOUND.

- 3.1 Define chemical bond.
- 3.2 Describe the nature of chemical bond.
- 3.3 Differentiate between electrovalent and covalent bonding.
- 3.4 Explain the formation of polar and non polar, sigma and pi-bond with examples.
- 3.5 Describe the nature of coordinate bond with examples.

4. UNDERSTAND THE CHEMICAL NATURE OF WATER.

- 4.1 Describe the chemical nature of water with its formula.
- 4.2 Describe the general impurities present in water.
- 4.3 Explain the causes and methods to removing hardness of water.
- 4.4 Express hardness in different units like mg/liter., p.p.m, degrees Clark and degrees French.
- 4.5 Describe the formation and nature of scales in boiler feed water.
- 4.6 Explain the method for the treatment of scales.
- 4.7 Explain the sewage treatment and desalination of sea water.

5. UNDERSTAND THE NATURE OF ACIDS, BASES AND SALTS.

- 5.1 Define acids, bases and salts with examples.
- 5.2 State general properties of acids and bases.
- 5.3 Differentiate between acidity and basicity and use the related terms.
- 5.4 Define salts, state their classification with examples.
- 5.5 Explain p-H value of solution and pH scale.

6. UNDERSTAND THE PROCESS OF OXIDATION AND REDUCTION.

- 6.1 Define oxidation.
- 6.2 Explain the oxidation process with examples.
- 6.3 Define reduction.
- 6.4 Explain reduction process with examples.
- 6.5 Define oxidizing and reducing agents and give at least six examples of each.
- 6.6 Define oxides.
- 6.7 Classify the oxides and give examples.

7. UNDERSTAND THE FUNDAMENTALS OF NUCLEAR CHEMISTRY.

- 7.1 Define nuclear chemistry and radio activity.
- 7.2 Differentiate between alpha , Beta and Gamma particles.
- 7.3 Explain half life process.
- 7.4 Explain at least six nuclear reactions resulting in the transformation of some elements.
- 7.5 State important uses of isotopes.

8. UNDERSTAND THE MANUFACTURE, SETTING AND HARDENING OF CEMENT.

- 8.1 Define portland cement and give its composition.
- 8.2 Describe the method of manufacture.
- 8.3 Describe the chemistry of setting and hardening of cement.
- 8.4 Distinguish between ordinary and special purpose cement.

9. UNDERSTAND THE PROCESS OF MANUFACTURE OF GLASS.

- 9.1 Define glass.
- 9.2 Describe its composition and raw materials.
- 9.3 Describe the manufacture of glass.
- 9.4 Explain its varieties and uses.

10. UNDERSTAND THE NATURE AND IMPORTANCE OF PLASTICS AND POLYMERS.

- 10.1 Define plastics and polymers.
- 10.2 Explain the mechanism of polymerization.
- 10.3 Describe the preparation and uses of some plastics/polymers.

11. KNOW THE CHEMISTRY OF PAINTS, VARNISHES AND DISTEMPERS.

- 11.1 Define paints, varnishes and distemper.
- 11.2 State composition of each.
- 11.3 State methods of preparation of each and their uses.

12. UNDERSTAND THE PROCESS OF CORROSION WITH ITS CAUSES AND TYPES.

- 12.1 Define corrosion.
- 12.2 Describe different types of corrosion.

- 12.3 State the causes of corrosion.
- 12.4 Explain the process of rusting of iron.
- 12.5 Describe methods to prevent/control corrosion.

13. UNDERSTAND THE NATURE OF REFRACTORY MATERIALS AND ABRASIVE.

- 13.1 Define refractory materials.
- 13.2 Classify refractory materials.
- 13.3 Describe properties and uses of refractories.
- 13.4 Define Abrasive.
- 13.5 Classify natural and artificial abrasives.
- 13.6 Describe uses of abrasives.

14. UNDERSTAND THE NATURE AND IMPORTANCE OF ALLOYS.

- 14.1 Define alloy.
- 14.2 Describe different methods for the preparation of alloys.
- 14.3 Describe important properties of alloys.
- 14.4 Enlist some important alloys with their composition, properties and uses.

15. UNDERSTAND THE NATURE OF FUELS AND THEIR COMBUSTION.

- 15.1 Define fuels.
- 15.2 Classify fuels and make distinction of solid, liquid & gaseous fuels.
- 15.3 Describe important fuels.
- 15.4 Explain combustion.
- 15.5 Calculate air quantities in combustion. gases.

16. UNDERSTAND THE NATURE OF LUBRICANTS.

- 16.1 Define a lubricant.
- 16.2 Explain the uses of lubricants.
- 16.3 Classify lubricants and cite examples.
- 16.4 State important properties of oils, greases and solid lubricants.
- 16.4 State the criteria for the selection of lubricant for particular purpose/job.

17. UNDERSTAND THE NATURE OF POLLUTION.

- 17.1 Define Pollution (air, water, food).
- 17.2 Describe the causes of environmental pollution.
- 17.3 Enlist some common pollutants.
- 17.4 Explain methods to prevent pollution.

MT-111 TECHNICAL DRAWING

Total contact hours:

Practical	96 Hours	T	P	C
		0	3	1

Prerequisites: Fundamental knowledge of drawing.

- AIM**
1. Apply the different related knowledge, skills and attitudes in technical sketching, working drawing.
 2. To teach the students how to graphically represents the refrigeration and air conditioning system.
 3. To draw visualization, sense of form and proportions of various forms of drawing.
 4. To teach the students how to make layout, of ducting, piping etc.

LIST OF PRACTICALS

- 1. USES AND APPLICATION OF TECHNICAL DRAWING. 3 Hours**
 - 1.1 Technical drawing
 - 1.2 uses of technical drawing.
 - 1.3 Common drawing terms.
 - 1.4 application of drawing forms
 - 1.5 Practice of conventions
- 2. DRAWING SCALES. 3 Hours**
 - 2.1 Importance and meaning of drawing scales.
 - 2.2 Metric scale
 - 2.3 Inch scale.
 - 2.4 Applications of drawing scales.
- 3. SKETCHING TOOLS AND MATERIALS. 6 Hours**
 - 3.1 Types of drawing papers.
 - 3.2 Care and maintenance of sketching tools, materials (sheet format, title block, waterres and boarder line.)
- 4. LINE SKETCHING. 6 Hours**
 - 4.1 Introduction to sketching techniques.
 - 4.2 Sketching of horizontal lines.
 - 4.3 Sketching of vertical lines.
 - 4.4 Sketching arcs and circles.
 - 4.5 Sketching ellipses and conic sections.
 - 4.6 Proportions in sketching.

- | | | |
|------------|--|----------------|
| 5. | LETTERING. | 6 Hours |
| | 5.1 Importance of good lettering. | |
| | 5.2 Letter strokes. | |
| | 5.3 Letter guidelines. | |
| | 5.4 Composition of lettering. | |
| 6. | ALPHABET OF LINES. | 3 Hours |
| | 6.1 Importance of alphabet of lines. | |
| | 6.2 Common alphabet of lines. | |
| | 6.3 Application of the alphabet of lines. | |
| 7. | INTRODUCTION TO PICTORIAL DRAWING. | 6 Hours |
| | 7.1 Uses of pictorials. | |
| | 7.2 Three types of pictorial. | |
| | 7.3 Isometric sketches of rectangular block. | |
| | 7.4 Isometric arcs and circles. | |
| | 7.5 Oblique sketch of rectangular block | |
| | 7.6 Proportion in pictorial sketching. | |
| 8. | INTRODUCTION TO MULTI-VIEW SKETCHING. | 9 Hours |
| | 8.1 Concept multi-view drawing. | |
| | 8.2 Explain principal views. | |
| | 8.3 Principal plane of projections. | |
| | 8.4 Projectors/projection lines. | |
| | 8.5 Multi-view sketching. | |
| 9. | BASIC DIMENSIONAL. | 6 Hours |
| | 9.1 Definition of dimensions. | |
| | 9.2 Two types of dimensions | |
| | 9.3 Systems of measurement. | |
| | 9.4 Dimensional multi-views. | |
| | 9.5 Dimensional pictorials. | |
| | 9.6 Dimensioning holes, areas, and circles. | |
| | 9.7 Dimensional angles. | |
| | 9.8 Notes and specifications. | |
| | 9.9 Rules in dimensioning. | |
| 10. | GEOMETRICAL CONSTRUCTION. | 9 Hours |
| | 10.1 Importance of geometry. | |
| | 10.2 Definition of terms. | |
| | 10.3 Basic geometrical construction. | |
| | 10.4 Tangents. | |

- 10.5 Applied geometrical construction.
- 11. WORKING DRAWINGS. 12 Hours**
- 11.1 Uses of working drawing.
 11.2 Preliminary design sketching.
 11.3 Detail drawing
 11.4 Assembly drawing.
 11.5 Process and operations.
 11.6 Lay-out drawing.
 11.7 Application of working drawing.
- 12. PICTORIAL DRAWINGS. 6 Hours**
- 12.1 Concept of sections.
 12.2 Material symbol in sections.
 12.3 Types of sections.,
 (a) Full sections (b) Half section
 (c) Removed section (d) Broken section.
 (e) Phautum section (f) off-set-section.
- 13. PICTORIAL DRAWINGS. 12 Hours**
- 13.1 Importance of isometric drawing.
 13.2 Types of isometric drawings.
 13.3 Isometric drawing of normal surface.
 13.4 Oblique drawing of rectangular- block.
 13.5 Isometric drawing of circle.
- 14. AUXILIARY DRAWING 9 Hours**
- 14.1 Uses and applications of AUXILIARY drawing.
 14.2 Primary AUXILIARY view, frontal projections.
 14.3 Primary AUXILIARY views horizontal projection.
 14.4 Primary AUXILIARY view profile projection.
 14.5 True length of a line in the AUXILIARY.
 14.6 Secondary auxiliary views.
 14.7 Application of auxiliary views.

RECOMMENDED BOOKS

- 1.Engineering Drawing. by French & Vierck.

5.	MAGNETISM AND ELECTRO MAGNETISM.	3 Hours
5.1	Theory of magnetism	
5.2	Properties of magnets, units of flux, flux density	
5.3	Electromagnetism, units of magnetizing force and field strength	
5.4	Magnetic field strength, Ampere-turns	
5.5	Solenoid, uses in RACT	
5.6	Polarity of electromagnetism, Right Hand Rules	
5.7	Electromagnetic induction, Faradays Laws, Lenz's Law	
5.8	Permeability, Reluctance, their units	
5.9	Motor action between two mag. fields	
5.10	Fleming's Left Hand Rule.	
6.	CAPACITORS AND INDUCTORS	4 Hours
6.1	Capacitance, its units and types	
6.2	Combination of capacitors in series and parallel	
6.3	Use of capacitors in RACT	
6.4	Inductance and its unit	
6.5	Back emf	
6.6	Inductive reactance and units	
7.	D.C. GENERATOR.	5 Hours
7.1	Electrical generator, basic principles	
7.2	Construction, field, armature, yoke, commutator, brushes etc.	
7.3	Emf equation	
7.4	Types of DC Generators and their uses.	
8.	ELECTRIC MOTORS.	10 Hours
8.1	Principle of induction motors	
8.2	3-phase S.C. induction motor	
8.3	1-phase capacitor motor	
8.4	Split phase induction motor	
8.5	Repulsion start induction motor.	
8.6	Shaded pole motor.	
9.	ALTERNATOR.	10 Hours
9.1	Principle of alternator.	
9.2	Construction of alternator.	
9.3	E.M.F. equation of alternator	
9.4	Excitation of alternators	
10.	TRANSFORMERS.	2 Hours

- 10.1 Principle of operation, construction
- 10.2 Primary and secondary windings and voltages
- 10.3 Step up and step down transformer.
- 10.4 Current ratios in each case

11. TYPES AND USE OF WIRING 3 Hours

- 11.1 Cleat wiring.
- 11.2 Batten wiring.
- 11.3 Conduit wiring.
- 11.4 Earthing.

12. TYPES OF WIRE AND CABLES 3 Hours

- 12.1 V.I.R. cables.
- 12.2 P.V.C. cables.
- 12.3 Multi-core cables
- 12.4 Flexible cables.
- 12.5 Lead sheathed cables.
- 12.6 Paper insulated cables.
- 12.7 Varnish cambric cables.
- 12.8 Mineral insulated cables.
- 12.9 Uses of cables.

13. ELECTRICAL ACCESSORIES. 6 Hours

- 13.1 Starters.
- 13.2 Magnetic contactors.
- 13.3 Stabilizer.
- 13.4 Circuit breakers.
- 13.5 Time delay relay.
- 13.6 Timers.

REFERENCE BOOKS

- 1. Althous - Modern refrigerating and Air conditioning
- 2. B. L. Theraja - Electrical Technology

ET-113 APPLIED ELECTRICITY

INSTRUCTIONAL OBJECTIVES

1.UNDERSTAND THE ELECTRICITY FUNDAMENTALS.

- 1.1 Define electron theory of electricity.
- 1.2 Define resistance, current and voltage.
- 1.3 Enlist types of electricity.
- 1.4 Enlist the methods of generation of electricity
- 1.5 Define electrostatic electricity.
- 1.6 State the difference between direct and alternative current.

2.UNDERSTAND THE OHMS LAW AND COMBINATION OF RESISTANCES.

- 2.1 Define ohm's law
- 2.2 Describe series and parallel circuits.
- 2.3 Explain series and parallel circuits (Combined).
- 2.4 Apply ohm's law in series and parallel circuits for simple problem solving.
- 2.5 Determine voltage drop in series, parallel and series.
parallel circuits.
- 2.6 Define power losses.
- 2.7 Explain alternating current.
- 2.8 State the values of A.C.
- 2.9 State the relations between different values of AC
- 2.10 Define Frequency, time period & cycle.

3.UNDERSTAND THE FUNDAMENTALS OF ELECTRIC CIRCUITS AND ELECTRICAL MATERIALS

- 3.1 State between different electrical circuits (Series & parallel).
- 3.2 Draw symbols used in elect circuits.
- 3.3 State the use of volt meter, ampere meter and ohm meter.
- 3.4 State the use of wattmeter.
- 3.5 Make the connections of basic instruments, (Ammeter, Voltmeter & Watt meter).
- 3.6 State the use of tong tester and multimeter.
- 3.7 Define conductor, semi conductor and insulator.

4. UNDERSTAND THE APPLICATION OF KIRCHHOFF'S LAW.

- 4.1 Define Kirchhoff's current law.
- 4.2 Define Kirchhoff's voltage law.
- 4.3 Apply Kirchhoff's laws in solving simple problems.

5. UNDERSTAND MAGNETISM AND ELECTROMAGNETISM.

- 5.1 State theory of magnetism.
- 5.2 State the properties of magnets and units of flux, flux density.

- 5.3 Define electromagnetism and units of field strength and magnetizing force.
- 5.4 Define magnetic field strength and amp-turn.
- 5.5 Explain electromagnetic induction and Faraday's Laws.
- 5.6 Explain the working principle of a solenoid and its uses in RACT.
- 5.7 Define permeability & its unit.
- 5.8 Define reluctance and its unit.
- 5.9 Explain motor action between two mag. fields and Fleming's Left Hand Rule.

6. UNDERSTAND THE APPLICATION OF CAPACITORS AND INDUCTORS IN RACT.

- 6.1 Define capacitance and its unit
- 6.2 State formulae for combining capacitors in series and parallel
- 6.3 Explain the types and uses of capacitors in RACT
- 6.4 Define inductance and its unit
- 6.5 Define back emf
- 6.6 Explain the inductive reactance and unit.

7. UNDERSTAND FUNDAMENTALS OF ELECTRICAL GENERATORS.

- 7.1 Explain the working principle of DC Generator
- 7.2 State the construction of a DC Generator
- 7.3 State emf equation
- 7.4 State the types of DC Generators and their uses.
- 7.5 State the use of commutator

8. UNDERSTAND WORKING OF AC ELECTRICAL MOTORS.

- 8.1 Enlist the electric motors commonly used in air-conditioning field.
- 8.2 Explain the working principle of AC induction motors.
- 8.3 Explain split phase Induction motor, its ratings and uses.
- 8.4 Explain repulsion start induction motor, its ratings and uses.
- 8.5 Explain capacitor start induction motor, its ratings and uses.
- 8.6 Explain the working of 3-phase induction motor.
- 8.7 Draw circuit diagrams for all AC motors used in RACT.

9. UNDERSTAND THE FUNCTION AND CONSTRUCTION OF AN ALTERNATOR.

- 9.1 State the principle of an alternator.
- 9.2 Explain the construction of an alternator.
- 9.3 Derive the E.M.F equation of an alternator.
- 9.4 Explain the efficiency of an alternator.
- 9.5 State how alternators are excited.

10. UNDERSTAND THE TRANSFORMER AND ITS APPLICATION.

- 10.1 State the principle of transformers.
- 10.2 Enlist the types of transformer.

- 10.3 Explain primary and secondary windings and the relation between their voltages.
- 10.4 State step up and step down transformer.
- 10.5 Explain the current ratios in both types of transformers.

11. UNDERSTAND THE TYPES AND USES OF WIRING SYSTEMS.

- 11.1 Enlist the types of wiring.
- 11.2 State cleat wiring method and uses.
- 11.3 State Batten wiring method and uses.
- 11.4 State conduit wiring (surface & concealed) method and uses.
- 11.5 State the need of earthing.
- 11.6 State the methods of earthing.

12. UNDERSTAND THE TYPES OF WIRES AND CABLES.

- 12.1 Distinguish between wire and cables.
- 12.2 Explain current and voltage ratings of wires and cables.
- 12.3 Enlist the types of cables.
- 12.4 State properties and uses of V.I.R cable.
- 12.5 State properties and uses of P.V.C cable.
- 12.6 State the construction and uses of multicore cables.
- 12.7 State the sizes and ratings of flexible cable.
- 12.8 State the ratings and uses of lead sheathed and paper insulated cables.
- 12.9 Distinguish between varnish cambric cables and mineral insulated cables.
- 12.10 State the current ratings of 1/.044, 3/.029, 3/.036, 7/.029, 7/.036 and 7/.044 cables.

13. UNDERSTAND THE ELECTRICAL ACCESSORIES WHICH ARE COMMONLY USED IN AIRCONDITIONING INDUSTRY.

- 13.1 State the purpose of starter and its use with electrical motor above 5 H.P.
- 13.2 Explain the construction of magnetic contactor and its use in single and three phase circuit.
- 13.4 Explain the function and working principle of circuit breaker.
- 13.5 Explain the use and function of time relay.
- 13.6 Explain the use and function of DOL and Star-delta starters.
- 13.7 Draw circuit diagrams of motors with electric accessories connected with them.

ET-113APPLIED ELECTRICITY.

LIST OF PRACTICALS

96 Hours

1. Making an artificial magnet by:
 - (a) Passing electric current
 - (b) Energizing of solenoid.
2. Plotting lines of forces of bar magnet keeping North and South poles of the magnet towards geographical South-North poles and East-West direction respectively.
3. To make a simple twist joint of P.V.C cable No.1/0.004
4. To make a married joint of P.V.C cable No 7/0.36 or 7/0.29
5. To make pigtail joint of P.V.C Cable No 1/0.044.
6. To make a "tee" joint of P.V.C. Cable No 7/0.36 or 7.029
7. To wire up two lamps, separately controlled from one place (cleat or batten wiring system).
8. To control one lamp with one switch in conduit or batten wiring system.
9. To wire up one light point, one ceiling fan point and one two pin socket separately controlled in cleat or batten wiring system.
10. To control one lamp from three places using intermediate switch in batten wiring system.
11. To control one bell from one place only.
12. To make an assembly of a 40 watt fluorescent tube with choke, starter, and connectors.
13. Verification of Ohm's law.
14. Measurement of resistance of a given wire with the help of voltmeter, ammeter (Method $V=IR$), Ohmmeter and wheat stone bridge.
15. To measure the voltage drop in a series circuit.
16. Study of split phase motor, capacitor motor and shaded pole motor and their connections.
17. Study of three phase star-delta circuit and its connection, with induction motor.
18. Study of single and three phase energy meter.
19. Draw an electric circuit diagram of a refrigerator with motor, capacitor, relay and overload.
20. Draw automatic motor control circuit diagram of single phase induction motor with speed-regulator switch.
21. Study of voltage stabilizer and its function.
22. Application and function of circuit breaker with electric motors
23. Study of slip-ring motor and its control working (Manual and Automatic)
24. Study the parts of a capacitor type motors and their connections.
25. Servicing an electric motors, fan motors, split phase induction motor and capacitor start capacitor run motor.
27. Related problem solving of above topics.
28. Practice of use of tong tester
29. Connections of wattmeter
30. Making a solenoid
31. Study of electrolytic capacitors and their use in capacitor-start induction motors
32. Verification of Kirchhoff's Laws
33. Verify current and voltage ratios in transformers

34. Connect a compressor with capacitor, relay and overload and observe their working.

Comp-122COMPUTER APPLICATIONS

Total contact hours					
Theory	32 Hours	T	P	C	
Practicals	96 Hours		1	3	2
Pre-requisite	None				

AIMS This subject will enable the student to be familiar with the operation of a Micro-computer. He will also learn DOS, BASIC language and word processing to elementary level.

COURSE CONTENTS

- 1. ELECTRONIC DATA PROCESSING (EDP) 6 Hours**
 - 1.1 Basics of computers
 - 1.2 Classification of computers
 - 1.3 Block diagram of a computer system
 - 1.4 Binary number system
 - 1.5 BIT, BYTE, RAM, ROM, EROM, EPROM
 - 1.6 Input and output devices
 - 1.7 Secondary storage media details
 - 1.8 Processors and types
 - 1.9 Using computer for system software
 - 1.10 Using computers for application software.
 - 1.11 Common types of software and their application.

- 2. DISK OPERATING SYSTEM (DOS) 6 Hours**
 - 2.1 Internal commands
 - 2.2 External commands
 - 2.3 Batch files
 - 2.4 Advance features.

- 3. BASIC LANGUAGE 10 Hours**
 - 3.1 Introduction to high level languages
 - 3.2 Introduction to BASIC
 - 3.3 REM Statement
 - 3.4 Assignment statement
 - 3.5 Input statement
 - 3.6 Read-Data statement
 - 3.7 IF-THEN statement
 - 3.8 IF-THEN Else statement
 - 3.9 FOR-NEXT statement
 - 3.10 DIM statement
 - 3.11 L PRINT statement

- 3.12 STOP statement
- 3.13 END statement
- 3.14 Logic of a BASIC Programme
- 3.15 Running a BASIC Programme
- 3.16 Saving and Retrieving a Programme
- 3.17 Advance features

4. WORD PROCESSING

7 Hours

- 4.1 Starting word processor session
- 4.2 Opening a document
- 4.3 Saving a document
- 4.4 Ending word processor session (Temporarily)
- 4.5 Retrieving a document
- 4.6 Spell check
- 4.7 Margins and tab setting
- 4.8 Aligning Paragraph
- 4.9 Printing a document
- 4.10 Advance features

5.COMPUTER GRAPHIC IN BASIC

3 hours

- 5.1Graphic fundamentals
 - 5.2Points and lines
- 5.3Dots in space
- 5.4A lightening blot
- 5.5Shapes
- 5.6Expanding circles and rectangles

RECOMMENDED BOOKS

1. Ron S. Gottfrid, Programming with BASIC,
 2. Any Word Processor Latest Release (e.g., Word, Word-Perfect etc).
 3. ABC'S of DOS (latest release).
- 4.Judd Robbins, Mastering DOS 6.0 and 6.2

Comp-122COMPUTER APPLICATIONS

INSTRUCTIONAL OBJECTIVES

- 1. UNDERSTAND ELECTRONIC DATA PROCESSING (EDP).**
 - 1.1 Describe basics of computers.
 - 1.2 Enlist different classification of computers.
 - 1.3 Explain block diagram of a computer system.
 - 1.4 Describe binary number system.
 - 1.5 State the terms used in computers such as BIT, BYTE, RAM, ROM, EROM, EPROM.
 - 1.6 Identify input and output devices.
 - 1.7 Describe secondary storage media.
 - 1.8 Explain processor.
 - 1.9 Name different types of processors.
 - 1.10 Explain the use of computer for system software.
 - 1.11 Explain the use of computer for application software.
 - 1.12 Enlist common types of software and their application.
 - 1.13 Explain various application of above softwares mentioned in 1.12
- 2. UNDERSTAND DISK OPERATING SYSTEM (DOS).**
 - 2.1 Explain the use of various internal command of DOS.
 - 2.2 Explain the use of various external command of DOS.
 - 2.3 Describe batch files.
 - 2.4 Identify advanced features
- 3. UNDERSTAND BASIC LANGUAGE.**
 - 3.1 Explain high level languages.
 - 3.2 Explain Basic language.
 - 3.3 Describe Rem statement
 - 3.4 Describe assignment statement
 - 3.5 Explain Input statement
 - 3.6 Explain Read-Data statement
 - 3.7 Explain If-Then Statement
 - 3.8 Explain If-then-Else Statement
 - 3.9 Explain For-Next Statement
 - 3.10 Explain DIM Statement
 - 3.11 Explain LPRINT statement
 - 3.12 Explain stop statement
 - 3.13 Explain end Statement
 - 3.14 Describe Logic of Basic program
 - 3.15 Describe running a Basic Program
 - 3.16 Describe saving & retrieving Basic Program
 - 3.17 Describe some Advance features of Basic program

4. UNDERSTAND WORD PROCESSING SESSION

- 4.1. Describe word-processing
- 4.2 Name command to be entered on Dos-prompt to load word-processor
- 4.3 Identify initial screen
- 4.4 Describe the command to open a document
- 4.5 Describe the procedure for naming the document
- 4.6 Explain importance of giving extension to a document
- 4.7 Describe saving and retrieving a document
- 4.8 Explain importance of saving the work at regular intervals
- 4.9 State temporarily Ending word-processing session & document retrieval
- 4.10 State procedure to re-enter word processor
- 4.11 State procedure to re-open the document and editing
- 4.12 Describe spell-check facility
- 4.13 Describe Margins & Tab Setting
- 4.14 Describe to align paragraph
- 4.15 Describe Re-editing techniques
- 4.16 Describe procedure to set-up printer
- 4.17 Describe command for printouts
- 4.18 Explain multiple-copy printout procedure
- 4.19 Explain some advance features
- 4.20 Describe procedure of condensed printing
- 4.21 Describe procedure for change of fonts

5.UNDERSTAND PROGRAMMING INSTRUCTIONS FOR COMPUTER GRAPHIC IN BASIC LANGUAGE

- 5.1Identify graphic fundamentals in basic language
- 5.2Explain to draw points and lines
- 5.3Explain to draw dot in space
- 5.4Explain to draw lighting blot
- 5.5Explain to draw shapes
- 5.6Explain to draw expanding circles and rectangles

Comp-122COMPUTER APPLICATIONS

LIST OF PRACTICALS

96 hours

DOS

- 1 Identify key board, mouse, CPU, disk drives, disks, monitor & printer
- 2 Practice for booting up of a computer system with DOS system disk and power off system at DOS prompt
- 3 Practice for CLS, VER, VOL, DATE & TIME commands
- 4 Practice for COPY, REN commands
- 5 Practice for DEL, TYPE, PATH, PROMPT, COPY CON, MD, CD, RD commands
- 6 Practice of the practicals at S. No. 3, 4, 5
- 7 Practice for FORMAT command with /s, /4, /u switches
- 8 Practice for DISKCOPY, DISKCOMP commands
- 9 Practice for SCANDISK, XCOPY, DELTREE, TREE, LABEL commands
- 10 Practice for PRINT, UNDELETE commands
- 11 Practice for the practicals at S. No. 8, 9, 10, 11
- 12 Practice for creating a batch file

BASIC

- 1 Practice for loading & unloading BASIC software and identify role of function keys in Basic
- 2 Identify role of various keys in continuation with ALT key in BASIC programming
- 3 Practice for CLS, LOAD, SAVE, FILE, RENUM command by loading any existing BASIC Program
- 4 Practice for editing any existing BASIC Program
- 5 Prepare BASIC Program to display sum of two numbers using INPUTS
- 6 Prepare BASIC Program to display sum of two numbers using READ-DATA
- 7 Prepare BASIC Program to multiply two numbers
- 8 Prepare BASIC Program to calculate Area of Rectangle, when length and width are given
- 9 Prepare BASIC Program to calculate area of a circle when radius/diameter is given
- 10 Prepare very simple BASIC Programs using IF-THEN-ELSE and FOR-NEXT statement
- 11 Identify DIM statement
- 12 Practice for LPRINT statement for various Programs hard-copy output

WORD PROCESSING

- 1 Practice for loading & unloading a word processor
- 2 Practice for creating document & saving it
- 3 Practice for spell-check facility of the word-processor
- 4 Practice for editing an existing document
- 5 Practice for various word-processing Menu Options
- 6 Practice for printing a document
- 7 Practice for margin and TAB setting and document alignment
- 8 Practice for some advance features

RACT 113 PRINCIPLES OF REFRIGERATION

Total contact hours

Theory	64 hours	T	P	C	
Practical	96 hours		2	3	3

- Prerequisites:**
1. Fundamental knowledge of Basic Sciences.
 2. Fundamental knowledge of Math.

Aims. The student will be able to:-

1. Understand basic principles of refrigeration.
2. State the principles of vapor compression used in refrigeration and equipment.
3. Understand loads etc. Refrigeration cycle, its major components, their construction operation maintenance and calculate

COURSE CONTENTS

I. FUNDAMENTALS OF REFRIGERATION.

4 Hours

- 1.1 Definition of Refrigeration and Air-conditioning
- 1.2 Scope of Refrigeration, Types of Refrigeration.
- 1.3 Conversion of F.P.S System to SI (metric system).
- 1.4 Energy, solar Energy, Heat, Specific heat-unit of heat.
- 1.5 Intensity of heat.
- 1.6 Quantity of heat, laws of thermodynamics.
- 1.7 Methods of heat transfer.
- 1.8 Methods measuring temperature.

2. SATURATED AND SUPER-HEATED VAPOURS. 6 Hours

- 2.1 Pressure, Pascal's law, Liquid pressure, saturated liquid, Boiling point of liquid, Sublimation.
- 2.2 Saturation temperature, vaporization and evaporation, condensation.
- 2.3 Effect of pressure on saturation temperature and critical temperature.
- 2.4 Saturated vapour table of different gases.
- 2.5 Simple vapour compression cycle.
- 2.6 Suction and discharge temperature and pressure of different refrigerants.
- 2.7 Condensing and Evaporating temperature pressure.

3. IDEAL GAS LAWS: 4 Hours

- 3.1 Effect of heat on volume, expansion of solid and liquid.
- 3.2 Pressure volume relationship at constant temperature
- 3.3 Pressure temperature relationship at constant volume

3.4	General gas law, problem solving.	
3.5	Specific heats of gases.	
4.	REFRIGERANTS.	6
Hours		
4.1	Requirement of a good refrigerant.	
4.2	Common refrigerants.	
4.3	Classification of refrigerants and uses.	
4.4	Study of group I, II, III, refrigerants of each high and low side pressure.	
4.5	Refrigerant cylinders, colour code for refrigerant cylinders.	
4.6	Use of pressure temperature curves and tables.	
4.7	Selection of refrigerants, replacement of one refrigerant with other.	
4.8.	Introduction of HCFC's Refrigerants.	
5.	COMPRESSORS.	14
Hours		
5.1	Purpose of compressor.	
5.2	Types of compressor.	
5.3	Reciprocating compressor.	
5.4	Rotary compressor.	
5.5	Centrifugal compressor	
5.6	Screw type compressor.	
5.7	Working principles of various compressors.	
6.	COMPRESSOR EFFICIENCY.	4 Hours
6.1	Volumetric efficiency.	
6.2	Mean effective pressure.	
6.3	HP of compressor.	
6.4	Performance of reciprocating compressor.	
7.	DOMESTIC COMMERCIAL CONDENSERS.	6 Hours
7.1	Purpose of condenser.	
7.2	Types of condenser.	
7.3	Condenser load.	
7.4	Quantity and temperature size of condensing medium.	
7.5	Description of cooling tower and load calculations.	
8.	RERIGERANT CONTROL.	10 Hours
8.1	Purpose of refrigerant control.	
8.2	Types of expansion valve.	
8.3	Automatic expansion valve construction/working principles.	
8.4	Thermostatic expansion valve construction/working principles.	

- 8.5 Capillary tube refrigerant control.
- 8.6 Low side, high side pressure float value.
- 8.7 Hand Expansion valve.
- 8.8 Fault finding in refrigerant control.

9. EVAPORATORS.

6 Hours

- 9.1 Purpose of evaporators.
- 9.2 Types of evaporators.
- 9.3 Flooded and dry expansion evaporators.
- 9.4 Non frosting and frosting tube evaporators.
- 9.5 Logarithmic mean temperature difference.
- 9.6 Natural convection evaporators.

10. MOTORS' CONTROL.

4 Hours

- 10.1 Purpose of motor control.
- 10.2 Low pressure motor control.
- 10.3 High pressure motor control.
- 10.4 Range and differential adjustment.

REFERENCE BOOKS.

- 1. Modern Refrigeration and air conditioning by Althous.
- 2. Principles of Refrigeration by R.J. Dossat.
- 3. ASHRAE Handbook - Fundamental & Equipment Volume

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the students will be:

1.UNDERSTAND THE FUNDAMENTALS OF REFRIGERATION AND AIR-CONDITIONING.

- 1.1 Define refrigeration and air conditioning.
- 1.2 Differentiate between refrigeration and air conditioning.
- 1.3 Explain the scope of refrigeration.
- 1.4 Explain the types of refrigeration.
- 1.5 Explain F.P.S. system.
- 1.6 Mertic system .
- 1.7 SI system.
- 1.8 Make conversion of each unit in to other.
- 1.9 State energy, heat, specific heat unit of heat.
- 1.10 State definition of energy.
- 1.11 Differentiate between K.E and Potential energy.
- 1.12 Calculate intensity of heat and its measuring instruments.
- 1.13 Explain quantity of heat.
- 1.14 Explain laws thermodynamics.
- 1.15 State the method of heat transfer.
- 1.16 Explain the method of heat transfer.
- 1.17 Explain the method of measuring temperature.

2. UNDERSTAND THE SATURATED AND SUPERHEATED VAPOURS.

- 2.1 Define pressure, pressure of liquid, heat, boiling point of liquid.
- 2.2. Define saturated liquid and sublimation.
- 2.3 Define saturation temperature, vaporization, evaporation and condensation.
- 2.4 Explain the effect of pressure on saturated temperature and critical temperature.
- 2.5 Use saturated vapour tables of different gases.
- 2.6 Explain simple vapour compression cycle.
- 2.7 Define suction and discharge temperature of a refrigeration cycle.
- 2.8 Define effect on cycle efficiency due to change in condensing and evaporating temperature.
- 2.8.0. Define condensing and evaporating pressure.

3. UNDERSTAND THE IDEAL GAS LAWS.

- 3.1 State the effect of heat on volume, expansion of solids and liquids.
- 3.2 Explain pressure volume relationship at constant temperature.
- 3.3 Explain pressure temperature relationship at constant volume
- 3.4 Derive the general gas equation.
- 3.5 Define the specific heats of gases at constant volume and pressure

4. UNDERSTAND THE ROLE OF REFRIGERANTS

- 4.1. Define refrigerants
- 4.2. Classify refrigerants according to application and safety.
- 4.3. Describe the properties of refrigerants.
- 4.4. State safety measure in handling refrigerants.
- 4.5. Explain the effect of overcharge and undercharge of refrigerant in the system
- 4.6. Explain HCFC's Refrigerants.

5. UNDERSTAND THE WORKING PRINCIPLES AND USE OF COMPRESSORS IN AIR CONDITIONING FIELD.

- 5.1. State the purpose of compressor.
- 5.2. List the types of compressor.
- 5.3. Explain the construction and working principle of reciprocating compressor.
- 5.4. Explain the construction and working principle of rotary compressor.
- 5.5. Explain the construction and working principle of screw type compressor.
- 5.6. Explain the construction and working principle of centrifugal compressor.

6. UNDERSTAND COMPRESSOR'S EFFICIENCY.

- 6.1. Achieve the necessary skill in finding volumetric efficiency
- 6.2. Define mean effective pressure
- 6.3. Explain HP of compressor
- 6.4. Explain the effect of variables on the efficiency of the compressors.

7. UNDERSTAND THE DOMESTIC AND COMMERCIAL CONDENSERS.

- 7.1. Describe the purpose of condenser
- 7.2. Name the types of condensers.
- 7.3. Calculate condenser load.
- 7.4. Explain the working principles of cooling tower.
- 7.5. Label different parts of cooling tower.
- 7.6. Estimate the load of cooling towers.

8. UNDERSTAND THE CONCEPT AND WORKING PRINCIPLES OF REFRIGERANT CONTROL.

- 8.1 State the purpose of refrigerant control valve.
- 8.2 Name the types of refrigerant control valves.
- 8.3 Explain the working principle, and construction of the thermostatic expansion valves.
- 8.4 Explain the working principles and construction of automatic expansion valve.
- 8.6 Explain the working principles of capillary tube .
- 8.7 Explain the working principles of float valves.

9. UNDERSTAND THE BASIC PRINCIPLES AND APPLICATION OF EVAPORATORS.

- 9.1 Explain the purpose of evaporator.
- 9.2 Describe the types of evaporators.
- 9.3 Distinguish between flooded and dry expansion evaporators.
- 9.4 Name the types of evaporator regarding their construction, shape and temperature.
- 9.5 Distinguish between frosting and non frosting types of evaporators.
- 9.6 Describe logarithmic mean temperature difference.

10. KNOW MOTORS' CONTROL.

- 10.1 State the purpose of motor control.
- 10.2 Define low pressure motor control.
- 10.3 Define high pressure motor control.
- 10.4 Define range and differential adjustment.

RACT 113 PRINCIPLE OF REFRIGERATION

LIST OF PRACTICALS

96 HOURS

1. Introduction of common refrigeration hand tools.
2. Introduction of refrigeration instruments and their uses.
3. Copper tubing and fittings.
4. Tube cutting bending, flaring and swaging.
5. Tube soldering, brazing and annealing.
6. Study of pressure gauges.
7. Gauge manifold and charging lines.
8. Reciprocating compressor construction.
9. Dismantling of open type reciprocating compressor.
10. Cleaning and servicing of reciprocating compressor.
11. Reciprocating compressor parts and reassembling.
12. Gasket making practice.
13. Hermetic sealed reciprocating compressor construction, dismantling and cleaning.
14. Reassembling of hermetic sealed reciprocating and rotary compressors.
15. Cleaning and flushing of refrigeration components.
16. Practical on trainer to understand refrigeration cycle.
17. Study of electrical components of domestic refrigeration appliances.
18. Study and use of voltmeter/AVO meter and ampere meter.
19. Determine the terminals (common, start, run) of a sealed compressor.
20. Testing of compressor motor, fan motor for open, ground or short.
21. Testing of Thermostatic Expansion Valve.
22. Application of finishers and painting the refrigeration appliances.
23. Servicing of refrigerators shelves and cabinets and core.
24. Instructions and care for use of refrigerators.

RACT 123 REFRIGERATION WORK SHOP PRACTICE - I

Total contact hours	288 Hours	T	P	C	
			0	9	3
a.	Basic Electronics applied to HVAC & R.		0	3	1
b.	Metal shop.		0	3	1
c.	Machine/welding shop.		0	3	1

AIM:After going through the workshop practice the student will be able to understand the use of electronic devices in the HVAC&R field, sheet/metal shop & machine/welding shop.

A. BASIC ELECTRONICS APPLIED TO HVAC&R

LIST OF PRACTICAL (TOTAL 96-HOURS)

1. Introduction of terminology used in electronics.
2. Demonstrate the use of diode as a rectifier.
3. Demonstrate the use of transistor as an amplifier in CE configuration.
4. Study the working of silicon controlled rectifier (SCR) to control DC motor speed. (DC Power).
5. Study the working of Diac & Triac to control AC power.
6. Study the working of control transformers.
7. Study the working of Uni Junction Transistor (UJT) in time delay circuit.
8. Demonstrate the use of a thermocouple for temperature control.
9. Demonstrate the use of thermistor for temp. control.
10. Demonstrate the use of opto-coupler in:-
 - a. Illumination control (Photo cell)
 - b. counter
 - c. pin-hole detection
 - d. Flame failure control
11. Study the working of DC time delay relay.
12. Study the working of sequence timer.
13. Study the working of AC resistance s.Sensitive relay.
14. Study the working of heat sensitive relay.
15. Study the working of electro-pneumatic controller.
16. Study the working of electro-mechanical controller.

BOOKS:

- 1- Electronics in Industry by George M Chute.
- 2- Industrial Electronics and control by Killoeffler.
- 3- Electronics for Industry by W.I. Bendz.
- 4- Industrial Electronics Control by W.D. Cocurel.
- 5- ASHRAE Hand Book- Application & Equipment Volume.

B. METAL SHOP (TOTAL 96 HOURS)

1. Study of measuring and laying out tools, and simple exercises.
2. Study and the use of measuring instruments.
3. Use of micrometer and exercise on micrometer.

4. Use of vernier caliper.
5. Making one project involving rivetting.
6. Exercise on soldering.
7. Demonstration on common plumbing tools and their uses.
8. Demonstration of pipes, pipe fittings, valves.
9. Sketching G.I. pipe, Taps, Cocks, Valves.
10. Demonstration pipe joints, pipe cutters, pipe vice.
11. Practice in cutting and threading of G.I. pipes.
12. Practice in fitting of G.I. fittings.
13. Laying out of a Square Duct.
14. Laying out of a Rectangular Duct.
15. Laying out of a Circular Duct.
16. Forming of a Square Duct Sample.
17. Laying out and making of grooved lock joint.
18. Hammer grooved lock joint.
19. Single and double seam joint practice.
20. Riveted Lap Seam.
21. Corner Double Seam Lock.
22. Pocket Solder Lock Seam.
23. Pittsburgh Corner Lock Seam.
24. "1" Standing Seam.
25. 90 Degree Elbow with square back and throat.
26. Making an Ice Tray.
27. Making a rectangular Duct.
28. Making a square duct.
29. Making a Two way Duct.

C. MACHINE SHOP/WELDING SHOP (TOTAL 96 HOURS)

1. Study of a Bench Lathe Machine
2. Laying out and making of a steel piece for simple turning.
3. Centering and facing.
4. Simple turning on a 1/2" diameter steel piece
5. Step Turning
6. Practice of different threads
7. Practice of knurling, taper turning and drilling on lathe
8. Practice Tapers, Taper Turning on bench Lathe
9. Oxy Acetylene gas welding equipment and Accessories
10. Flame making and types
11. Preparation of Flange joint (1/16" mild steel sheet)
12. Preparation of Butt joint (1/16" mild steel sheet)
13. Preparation of Corner Joint, Lap joint
14. Brazing of Butt joint on a mild steel sheet of 1/16" thick and copper tube using Brass as a filler metal.
15. Brazing of Butt joint on a mild steel sheet of 1/16" thick using copper as a filler metal
16. Copper tube welding with copper rods. copper tube brazing with brass rod with blow lamps.
17. Introduction of Electric Arc welding spot welding and equipment
18. Arc welding of circular tubes and pipes
19. Arc welding of hermetic sealed compressor.
20. Spot welding of mild steel.
21. Preparation of shelving.