M. P. BOARD OF TECHNICAL EDUCATION

(STATE CURRICULUM DEVELOPMENT CENTRE)

BHOPAL (M. P.)

(Pin–462023)

CURRICULUM

OF

THREE YEAR DIPLOMA PROGRAMME

IN

REFRIGERATION AND AIR CONDITIONING

M. P. BOARD OF TECHNICAL EDUCATION

(STATE CURRICULUM DEVELOPMENT CENTRE)

BHOPAL (M. P.)

(Pin–462023)

CURRICULUM

OF

THREE YEAR DIPLOMA PROGRAMME

IN

REFRIGERATION AND AIR CONDITIONING

PREFACE

Diploma Programme in Refrigeration and Air conditioning has been identified as a programme in new and emerging technologies as a result of the study on requirement of Technical man power in Madhya Pradesh (Volume III- Demand supply gaps 1986).

The State Directorate of Technical Education has therefore, rightly chosen this area for the introduction of middle level technician education at Government Polytechnic, Khandwa under World Bank Scheme. This course will serve to satisfy a long felt need of high density industrial Zone of West Madhya Pradesh.

The syllabus of the programme was developed in workshop organised at Government Polytechnic, Khandwa from 17-19 September, 1990.

The prepared syllabus was approved after a detailed discussion in the meetings of the Board of Studies on 11-2-91 and 8-4-91. The State Curriculum Development Centre coordinated the activity of developing the syllabus with the help of T.T.T.I., Bhopal and the members of the Board of Studies.

We are highly grateful to the Director of Technical Education, Bhopal for their valuable guidance, encouragement and active cooperation.

Words of obligation are due to Shri Gopal Sharma, Manager, Air Conditioning and Refrigeration, Bharat Heavy Electrical Ltd; Bhopal. It is due to his long term experience in the field of Refrigeration and Air Conditioning that a syllabus based on the needs of industry could be prepared.

(Contd..2)

Thanks to Professor Dr. N.K. Bhanthia T.T.T.I., Bhopal whose help and experience in the field of curriculum development proved a great asset.

Lastly we are also grateful to the Convenor Shri M.P.Dawande Principal, Government Polytechnic, Khandwa, who took an active part in giving a final shape to the syllabus.

Comments and healthy criticism from the faculty members are, however, welcome so that the syllabus can be reviewed periodically.

We hope to improve this in future.

Secretary,
M.P. Board of Technical Education,
Bhopal.

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING TO BE STARTED AT GOVERNMENT POLYTECHNIC, KHANDWA M.P. UNDER THE WORLD BANK PROJECT (CAPACITY EXPANSION)

State	:	Madhya Pradesh.
Title of Course	:	Diploma in Refrigeration and Air Conditioning.
Number of Course in the State	:	ONE
Duration and Year	:	Three Years.
Intake	:	30 (15, 10 + and 15, 10+2)
Name of Polytechnic offering Course.	:	Government Polytechnic Khandwa (M.P.)

OBJECTIVES:

The technicians after undergoing the course should be able to :-

(1) Possess sound knowledge of the construction and operation of Refrigeration and Air-conditioning plants.

(2) Understand physiological aspects of human comfort.

(3) Appreciate the design, fabrication, assembly and testing of Refrigeration and Air Conditioning plants including the materials and industrial processes involved.

(4) Install, commission, operate and maintain Refrigeration and Air conditioning plants.

(5) Independently undertake the job of repairing and servicing of Refrigeration and Air Conditioning plants, including their supervision.

(Contd...

(6) Know the working princip-les and uses of instruments and controls.

Teaching Method :	Workshop training	5.55%
	Laboratory Training	29.64%
	Class-room teaching	64.81%
	Total	100%

DURATION OF COURSE :

The duration of course shall be of 3 years. The eligibility to get admission shall be (10+Science Stream for Ist year and 12+Science or technical strean for 2nd year) 10+ and (10+2)+ Board examination or its equivalents.

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL

(STATE CURRICULUM DEVELOPMENT CENTRE)

FIRST/SECOND/ THIRD YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

INDEX

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SCHEME OF EXAMINATION FOR FIRST YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING/ COMPUTER SCIENCE.

S.No.	Subject.	Term work	Lab. work.	Progressive assessment. I	Progressive assessment. II.	Board paper.	Examination duration in hours.	Theory marks.	Board Pract.	Examination duration in hrs.	Marks	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Communication skill	30	-	10	10	1	3	100	-	-	-	
2.	Applied Physics- I.	25	25	10	10	1	3	100	-	-	-	
3.	Applied Physics- II.	25		10	10	1	3	100	1	3	50	
4.	Applied Chemistry- I.	25	25	10	10	1	3	100	1	3	50	
5.	Applied Chemistry- II.	25		10	10	1	3	100				
6.	Applied Mathematics-I.	30	-	10	10	1	3	100	-	-	-	
7.	Applied Mathematics-II	30	-	10	10	1	3	100	-	-	-	
8.	Applied Mechanics.	25	25	10	10	1	3	100	1	3	50	
	TOTAL	215	75	80	80	8	-	800	3	-	150	

(1) Total Theory Marks. 800

(2) Total of term work, Lab. work, Prog.Ass. & Practical Marks. 600

(3) Total Marks. 1400

NOTE:- The Curriculum, the Scheme of Studies and examination for I Year will be common to other Diploma courses in the State.

117

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FIRST YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING /COMPUTER SCIENCE.

SCHEME OF STUDIES. Total working weeks per year -28

S.No.	Subject.	Theory hours. per week	Theory hours For Year	Practical hours per week.	Practical hours per year	Total hours per year	Remarks.
1.	Communication Skill.	3	84	-	-	84	
2.	Applied Chemistry- I.	4	112	2	56	280	
3.	Applied Chemistry- II.	4	112				
4.	Applied Physics- I.	4	112				
5.	Applied Physics- II.	4	112	2	56	280	
6.	Applied Mathematics- I.	4	112	-	-	112	
7.	Applied Mathematics- II.	4	112	-	-	112	
8.	Applied Mechanics	3	84	2	56	140	
	TOTAL	30	840	6	168	1008	

Total hours per year - 1008 (Theory: 840 and Practical 168)

NOTE:- The Curriculum, the scheme of studies and examination for I year will be common to other Diploma Courses in the State.

8/1

FIRST YEAR

SUBJECT: COMMUNICATION SKILL.

RATIONALE

Place of English in our curriculum and its value is seldom called into question. However, teaching of English for students before stepping into the portab of polytechnics has been rather general and haphazard. The knowledged of English at last can be called basic. As a consequence, we perceive yarning hiatus between their needs and actual attainments. We must admit that the teaching of English at various levels, goes on in much the same manner as it used to be earlier. An attempt must be made to remove the imperfections of its foundations. There is a growing necessity for a more scientific and pragmatic approach, since teaching as a whole in diploma stage is carried on in English medium. English being medium of instruction of large number of books, magazines, research journals in English language are procured every year in polytechnics. Therefore it is rightly called library language all over the world.

The language requirements of technical courses are of a different nature. "Communication skill" as a subject is introduced to enable students to properly understand text books on science and technical subjects written in English. Hence, emphasis must be gradually shifted from General English to specialised scientific and technical literature. In the total operation of language syntax and levies form the most vital components. Due care has to be taken in their selection to achieve aims of the course.

AIMS OF THE COURSE :

The course aims at enabling the students -

a) to acquire among other words of general use, words from the register of physical sciences to the extent of about 600 words.

b) to develop ability to read and comprehend.

c) to understand and use grammatical structures which occur in the prescribed units.

d) to compose guided and free paragraphs.

To achieve these objectives the following books are prescribed :

1- A course in Technical English, Book-1
Revised Edition, 1984(Somaiya Publication Bombay.

2- Living English Structures, by W.Stannard Allen

3. Stories from Home and abroad (Ravindra Prakashan,Gwalior)
Selected and Edited by A.N.Kapoor.

FIRST YEAR

SUBJECT : COMMUNICATION SKILL.

SUMMARY OF CONTENTS

Sl.No.	TOPIC	NAME OF THE BOOKS	LECTURE HOURS
1.	Passages for comprehension	A course in Technical English Book-1 Somaiya Publications Bombay (Prescribed unit:1,2,4,5,7,8,9, 10,11,17)	22 Hours
2.	Grammar	Living English Structures (A Practice book for foreign students) by W.S. Allen (Prescribed Exercises: 1 to 5,7,8,26 to 29,76, to 79,81,83,85 to 88,93, 94,136,115,116,145,229, 230,232,243,244A,262 to 265.	23 Hours
3.	Short stories	Stories from Home & abroad(Ravindra Prakashan Patankar Bazar, Gwalior) Selected & Edited by Dr. A.N.Kapoor.	15 Hours.
4.	Unseen passages for comprehension		10 Hrs.
5.	Paragraph writing on topic of general interest.		14 Hrs.
			Total 84 Hours.

TOPIC 1. Passages for comprehension (A course in Technical English, Book-1)

1 (Unit-1) Miner goes to work :

The unit deals with the life of a miner using simple present tense for habitual action & also offers ideas about safety measures in mines/ differents types of works to be developed into paragraphs and single sentence answers to the questions, Concept words - put props, Phrasal verbs - hold up, go through, to look for, to be on the look out, Compound words- Sports fields, loading machine coal face.

2 Unit-2. Telex :

It deals with the general principle of telex, its superiority over letters and telephone calls and its various uses. It offers ideas to be developed into paragraphs and single sentence answers to questions, Linguistic points- use of prefix, Telex, inter transquants, Participle- incoming call, receiving order, Compound words- dial button; business people etc., comparative degree.

3 Unit No.4 Baird & Television :

It deals with the biography of Baild and describes the invention of television The unit offers ideas for writing short composition and short answer question (II)., Linguistic points (a) Participle- Talking pictures, moving parts etc (b) Use of phrases- in order tom to keep in time etc.

4: UNIT No. 5 BRICK LAYING :

It deals with the work of a mason i.e. laying of bricks using various tools and offers ample scope for writing short compositions on the ideas such as cavity, wall, and other forms of walls, bad weather conditions & loss of man hours in cold countries as compared & contrasted with tropical countries like India.

linguistic points (1) Concept words : Cavity wall, setting out, lay out, pointing, plate level. (II) Compound words: Load bearing walls, metal ties etc.

5. UNIT NO. 7 WEALTH FROM THE GROUND.

It deals with exploration, refining and transportation of oil, offers ideas to be developed into paragraphs and single sentence answers to questions.

Linguistic points. (a) Use of pharases such as : Look for, at sea, give out, turn into.

Modifiers : Impure and Unpurified.

Concept words : distillation, refining.

6. UNIT NO. 8 ROAD MAKING.

It deals with the making of a road, the spadework, needed, the planning etc. and offers ideas which can be developed into short paragraphs and short answers to questions.

Linguistic : It also offers the following lingusitic points (a) Concept words: Cut and fill, tender. (b) : Phrasal verbs: to decide, to devide on, to make through, to scrape off, to mark off. (c) Homonyms : higher, hire, petrol, patrol route, root, later latter; price, prize.

7. UNIT NO.9 SOLAR ENERGY :

(1) It deals with what is sidely known as alternative sources of energy to overcome the world wide crisis paragraphs on solar ... driver, solar cooker etc. It also offers ideas to be developed into short paragraphs; some of those can be answered in single sentences.

2. Linguistic points. a) Prepositional phrases. at the rate of, to come to rescue, in a few minutes, in a year's time, to result in, in the near future. b) Phrasal verbs

devoid of, consist of

c) Concept words Stinking, warping, bending, cracks etc.

8. UNIT 10 FLIGHT NO.631

It is a unit on a holiday flight of two English children and explains their thrill and joy. It offers & ideas to be developed into composition exercises and single sentence questions.

Linguistic material : a) Compound words. mediterranean - shore, giant hand, ... : anvil shape etc. b) distinguish between : quite - quiet; land - lend; cease - sieze; draught - draft c) Phrases. : to make one's way, to keep an eye on, come into view,

d) Phrasal verbs : read out, roll by pick up.

9: UNIT- 11 NON- DESTRUCTION TESTING.

It defines the concept of 'Non-destructive Testing' which is very useful in industry, (a) It offers ideas which can be developed into short composition exercises, (b) : linguistic material (1) Pharases: Instead of, in addition to, of course; depend on etc, (II) Distinguish between pairs of words, break-breake, measure-major, sale-sell, sale-sail, and cell affect-effect, (c) Compound words: Production failure machine components, material structure production process.

10: UNIT-17 DESIGNING A CAR

It deals with the idea of designing a car and offers ideas for composttion exercises, linguistic material compound words: (1): Compound words, scale model, road test, bench test, assembly line, fashion trend, mass-pro-duction transmission engineers; (2); Distinguish between pairs of words artist-artistic; proceed-precede; check-cheque, eliminate-illuminate etc; (3); Concept words, bucks, prototype, transmission; (4): Pharases : to work on, to concentrate on, to divide into etc.

TOPIC NO.2 : GRAMMER

1 : COUNTABLES AND UNCOUNTABLES.

For defferent topics following exercises from 'Living English Structucture' by W.S. Allen have been presecribed:-

Exercises: 1 to 5,7,8,26 to 29.

2 :THE PRESENT TENSE

Exercises: 76 to 79, 81

3: THE PRESENT PERFECT

Ex: 83, 85(Elementary& Advance)

4 THE PRESENT PERFECT CONT.

Ex.86 to 88

5 THE PAST TENSE

Ex:93 , 94

6 THE PAST PERFECT

Ex. 136

7 'SHALL - WILL' & 'GOING TO'

Ex:115,116

8 CONDITIONS & UNREAL PAST.

Ex: 145

9 REPORTED SPEECH.

Ex. 229,230,232

10 PASSIVE VOICE

Ex: 243,244A

11 PREPOSITIONS & ADVERBIAL PARTICLES

Ex: 262 to 265

TOPIC 3. SHORT STORY

("Stories from Home & abroad" by Dr. A.N. Kapoor)

3. SHORT STORY

A short story contains a germinal idea. There is unity of purpose, action and impression In it these may be a dramatic incident or situation; a telling scene; a clearly coordinated series of events; a phase of character, a bit of experience; an aspect of life; a moral problem - any of these, and illumerable other motives.

All these and others must be corefully understood and explained. While testing the comprehension of students asking of stock-in-trade Summary type question should be avoided. Short questions on humorous situntions, important incidents, series of events or moral-in any may be asked, Brief character-sketch may also be asked.

TOPICE 1: HOME COMING :-

A story of childs psychology Phatik sent to his maternal uncle to curve his mischief does not find his tay in Calcutta congenial to his naturne; is taken ill & flees back home very much disturbed.

These aspects can be developed into composition exercises.

TOPIC 2: THE LOST CHILD.

A story of a child's instinctive thrill and attraction towards landscape, flowers, butterflies and bees etc. has keen desire to possess toys, eat sweets, play swings and soundabouts, his lingering and logging behind; the fear of refusals by the parents; his request to the parents to go on the sound about and finally finding himself lost in the crowd and separated from his parents. The things which attracted him must did not interest him at all after his seperation from parents.

All these points can be developed into paragraph writing and short composition exercises.

TOPIC 3 : THE SELFISH GIANT.

A story of Giants selfishness and cruelty. He drives away children, puts up a was around his garden and lives within it alone. This results in the depa-rture of spring permanently and a spell of everlasting winter hail, storm etc. prevails.

When children steal into the garden spring returns. The giant realises his mistake and begings to love the title child. The little child who has wounds on his body takes the giant of heaven.

All these points offer material for writing paragraphs, compositions & similar story writing.

TOPIC 4 : THE REFUGEE :

A story about the extremely pitible condition of flood hit refugees wandering in strange places in search of food, work shelter etc. Their sufferings, hard work to sudden rise of the number of working class people resulting in sudden full of wages.

These points offer ideas for composition, character and paragraph writing.

-13-
-14-

1 2 3

TOPIC 5 : THE FORTUNE TELLER.

The story is about a fraudulent fortune teller -- a lady who tells sweet things to please her customers. Fortune telling is nothing but practice of deceit. Because of perpetration of fraud a case is registered against her.

The fortune letter is fired.

The story offers ideas about such fraudulent human behavious. The Story offers several such ideas for paragraph writing; character sketching and short compositions.

TOPIC 6 : THE LUNCHEON

The story deals with a humorous situation resulting from actual actions of an imposing lady which were incongrenous with her words.

While reading the story, the following salient features must be carefully looked into :

a. Character-sketch of the lady.
b. mental condition of the host.
c. the most amusing part of the story.

TOPIC 4. Unseen passage for comprehension

TOPIC 5. Paragraph writing on given ideas

TOPIC 1 : UNSEEN PASSAGE FOR COMPREHENSION :

A comprehension exercise consist of a passage upon which questions are set to test the students ability to understand the content of the given tent and to infer information and meanings from it.

A number of unseen passages, within the linguistic competence of X class passouts, may be selected by the teacher for the purpose of testing students comprehension.

TOPIC 2 : PARAGRAPH WRITING ON GIVEN IDEAS :

An idea, an argument, or a short passage has to be enlarged into a paragraph of about 150 words. For paragraph writing :-

a) a conclusion may be stated and the students asked to trace the steps by which this thought has been arrived at.

b) a metaphor, could be given, so that the students may explain its full meaning in plan language and give reasons to support it.

c) Students may be asked to study a picture and give an account of what the picture suggests.

d) Students may be asked to relate incidents from their experience.

FIRST YEAR

SUBJECT : COMMUNICATION SKILL

MARKING SCHEME

Distribution of marks for various components is as follows :-

1.	A course . in Technical English, Book-1	30
2.	Grammar	25
3.	Short stories	18
4.	Unseen passage for comprehension	12
5.	Paragraph writing on given ideas	15
	Total marks	100

FIRST YEAR

SUBJECT:- APPLIED PHYSICS.

RATIONAL

Physics form a foundation for all Technician courses. The study of engineering concepts like, motion, energy, charge, electric current, optics, vibrations and nuclear interactions etc. are incorporated. These concepts will help the students in understanding engineering subjects in higher classes where the emphasis will be on the application of these concepts. A good foundation in basic Sciences will also help students for self development in future, to cope up with the continuous flow of new innovation and discoveries in technology.

The topics in Applied Physics for the foundation course were identified on the following basis :

1) The attainment level in physics of students at entry level to polytechnics.

11) Reference to engineering subjects.

III) Continuity of sequence necessary for logical development of the subject.

FIRST YEAR
APPLIED PHYSICS PAPER - I.

APPLIED PHYSICS PAPER - I

	SCHEME OF STUDIES	LECTURE HOURS
1.	Physics and its importance in technician education.	1
2.	S.I. Units	4
3.	Energy and conservation laws	10
4.	Circular motion	5
5.	Rotary motion	5
6.	Simple Harmonic Motion	8
7.	Gravitational field and Satellites	10
8.	Molecular phenomena in Solids, Liquids and Gases.	7
9.	Physics of Solids - Elasticity	5
10.	Physics of Liquids - Surface tension & Viscosity	10
11.	Kinetic theory of gases, gas laws	7
12.	Heat and temperature	5
13.	Measurement of temperature	10
14.	Thermodynamics	5
15.	Vapours and hygrometary	5
16.	Heat transfer	9
17.	Ultrasonics	6
		112

FIRST YEAR

APPLIED PHYSICS PAPER - I.

TOPIC 1. PHYSICS AND ITS IMPORTANCE IN TECHNICIAN EDUCATION: Importance of teaching Applied Physics in technician education.

TOPIC 2. S.I. UNITS :

S.I. units, Base units their definitons, supplementary and derived units, symbols used for different units, Recommended prefixes. Dimensional equations. Use of dimensional equations to verify formulae (Simple cases involving physical quantities known to students). Limitations of dimensional equations.

TOPIC 3. ENERGY AND CONSERVATION LAW :

Different forms of energy Mechanical energy- Kinetic & potential energies of body. Gravitational PE & PE of configuration. Work energy Cycle, Law of conservation of energy. verification of the law of conservation of energy in case of freely falling body, Harvesting the solar energy. Practical applications, solar heaters, solar cookers etc., Momentum & impulse. Law of conservation of linear momentum. Elastic and inelastic collisions, Conservation of mass. Einstein's mass energy equation, University of conservation laws.

TOPIC 4 CIRCULAR MOTION :

Concept of Motion Classification of different types of motion. Characterstics of translatory and Rotary motion. Distinction between rotary and circular motion. Characteristics of circular motion. viz. angular displacement, angular velocity angular acceleration, frequency and periodic time and their relations, Centripetal and centrifugal forces. Applications, conditions for safe travel through a curved road, Banking of roads and bending of a cyclist.

TOPIC 5: ROTARY MOTION :

Rotation of rigid bodies, concept of moment of inertia, Its dependence on mass and concentration of mass & on axis of rotation. Statement of formulae of moment of interia for common solids (no derivation required). Torque angular K.E. and angular momentum. Projectile motion, range and height.

TOPIC 6. PERIODIC MOTION S.H.M. :

Concept of periodic motion, conditions necessary for the appearance & persuance of periodic motion. Classification of periodic motion based on the forces acting on the source (particle) conditions for the motion to be simple harmonic (defi.) characterstics of SHM. Phase and phase difference. Examples of SHM. Energy of a particle in SHM. problems.

TOPIC 7. GRAVITATIONAL FIELD AND SATELLITES :

Newtons law of gravitation. Gravitational force as one of the basic force in nature. Gravitational constant, Gravitational field. Intensity and potential of gravitational field. Force of gravity. Relation between 'g' and 'G', Factors affecting value of 'g', Principle of rockets. Natural and Man made satellites. launching artificial satellites. Orbital velocity and periodic time of revolution of satellites. Escape velocity communication satellites, Concept of weightlessness and overloading.

TOPIC 8. MOLECULAR PHENOMENA IN SOLIDS, LIQUIDS & GASES.:

Postulates of molecular kinetic theory of matter. Diffusion of solids, liquids and gases, Random motion of molecules. Molecular forces, nature of these forces, attraction & repulsion between molecules, Concept of internal energy. Change in internal energy of a body with quantity of heat and temperature.

TOPIC 9. PHYSICS OF SOLIDS - ELASTICITY :

Meanging of elasticity, idea of elastic & plastic behaviour of solids, deformation strain, stress its kinds and units., Hooke's law, elastic limit, elastic fatigue. Moduli of elasticities and their relationship. Young's modulus, its determination by searle's apparatus.

TOPIC 10. PHYSICS OF LIQUIDS-SURFACE TENSION, VISCOSITY AND BERNOULLIES EQUATION :

Surface tension. Behaviour of free surface of a liquid as a stretched membrane; surface energy; molecular explanation of surface tension. Capillary rise. Effect of temperature on surface tension of liquids. Spherical droplets. Capillarity phenomena in science and engineering., Steady, streamline and turbulent flow of liquids critical velocity. Viscus flow, viscous drag, Newton's law of viscous flow, coefficient of viscosity. Dependence of viscosity on temperature. Determination of viscosity of water by Poisuelle's method, Applications, Bernoullies theorem $P+\frac{1}{2} \rho v^2 + \rho gh.$ const. in steady stream line flow of liquids Stokes law. $F = 6 \pi \eta r v$ (no derivation)

TOPIC 11. PHYSICS OF GASES KINETIC THEORY OF GASES. GAS LAWS :

Kinetic theory of gases : Concept of perfect or ideal gas. Pressure exerted by a perfect gas. Kinetic interpretation of pressure and temperature. Concept of absolute zero. Deduction of gas laws viz. Boyle's law and Charle's law. General gase equation Universal and specific gas constant.

TOPIC 12. HEAT AND TEMPERATURE :

Distinction between Heat and temperature, Heat capacity and specific heat capacity of a body. Latent heat of ice and steam, Changing internal energy of a body by the process of heating or cooling. Heat of combustion, specific heat of combustion.

TOPIC 13. MEASUREMENT OF TEMPERATURE :

Basic principles of measurement of temperature depending on expansion of matter, change in resistance, production of thermo-e.m.f. & radiation of heat.etc., Principle of gas thermo-meter. Principle & constructional details of platinum resistance thermo-meter. Method of measuring temperature with it. Principle of a thermo-couple. Range of temperature measurement with thermo-couple., Principle of total radiation and optical pyrometers.

TOPIC 14. THERMODYNAMICS :

First law of thermodynamics. Second law of thermodynamics. Thermodynamic process-reversible and irreversible process., (Elementary discussion on second-law of thermodynamics is to be given).

TOPIC 15. VAPOURS AND HYGROMETARY :

Unsaturated and sturated vapours. Vapour pressure. Saturated vapour pressure. Relation between SVP & temperature concept of boiling., Humidity-absolute and relative humidity. Dew formation. Definition of dew point. Relation between vapour pressure at a given temperature and SVP at dew point, Measurement of relative humidity by Hairs hydrometer.

TOPIC 16. HEAT TRANSFER :

Modes of heat transfer-conduction convection & radiation., Distinction between different modes of heat transfer., Study and variable state of heat conduction. Temperature gradient and coefficient of thermal conductivity measurement of thermal conductivity, of good & bad conductors of heat. (Searl's method & Lee's method)., Radiation : distinction between good and bad radiators/absorbers/ reflectors of radiation., Concept of black body. Prevost theory of heat exchange stefan-Boltzman law. Newtons law of cooling and its limitations.

TOPIC 17. ULTRASONICS :

Audible sound waves - infrasonics Ultrasonics. Production of ultrasonics : Magnetostriction oscillator & Piezo-electric oscillator., Detection of ultrasonics : Piezo-electric & thermal detectors. Applications of ultrasonics : in drilling flaw detection, cold welding and cleaning etc.

1/30

FIRST YEAR.

APPLIED PHYSICS PAPER - II

1.	Nature of Light, dual-nature	2
2.	Refraction of Light	8
3.	Wave theory of light-Interference of light	7
4.	Defects of images	4
5.	Optical instruments	10
6.	Electromagnetic spectrum	5
7.	Dispersion of Light	8
8.	Electric field and intensity	3
9.	Electric potential and potential difference	3
10.	Capacitance and capacitors	6
11.	D-C circuits	10
12.	Heating effects of currents	3
13.	Cells, Batteries and their maintenance	5
14.	Magnetic field and Magnetometary	8
15.	Action of magnetic field on current carrying conductors.	7
16.	Quantum nature of light - Photoelectric effect	7
17.	Radioactivity, mass-energy equivalence, mass defects, biding energy, fission and fussion.	16
		112

FIRST YEAR

APPLIED PHYSICS PAPER - II

TOPIC 1. NATURE OF LIGHT - DUAL NATURE :

Light as energy. Dual-nature of light :- Corpuscular & Wave, Quantum nature of light.

TOPIC 2. WAVE THEORY OF LIGHT :

Wave theory of light : Huygen's principle, concept of wave front, approximation of waves as rays, Principle of superim position, interferance of light. Young's double slit experiment, conditions of interference.

TOPIC 3. REFRACTION OF LIGHT :

Refraction of light. Speed of light in different media, optical density. Refractive index, absolute refractive index, Refraction through different lenses, power of a lens. Lens makers formula Focal length of combination of lenses in contact and separated by a distance.

TOPIC 4. DEFECTS OF IMAGES : CHROMATIC & SPHERICAL ABBERATIONS :

Defects of images, chromatic and spherical abberations, elementary idea about removal of chromatic abberation and minimizing spherical abberation.

TOPIC 5. OPTICAL INSTRUMENTS: MICROSCOPE, TELESCOPES :

Use of convex lens as a simple microscope, compound microscope, expression for magnifying powers, Astronomical, terrestial and galillian telescopes and their magnifying powers. Concept of magnification as applied to telescope, Principle of sextent. Photographic camera, Eye, defects of vision and their removal.

TOPIC 6. ELECTROMAGNETIC SPECTRUM :

Electromagnetic spectrum. Range of visible, ultra-violet and infra-red spectrum.

TOPIC 7. DISPERSION OF LIGHT SPECTROMETER :

Dispersion of light. Defination of dispersive power. Pure and impure spectrum. Measurement of refractive index of a material (given in the form of prism) for different colour of light., Emission and absorption spectrum, line, band and continuous spectrum.

TOPIC 8. ELECTRIC FIELD AND INTENSITY :

Electron theory, Coulomb's laws of electrostatic force, Coulombs as unit of charge, concept of electric field, electric field intensity. permittivity and relative permittivity of medium. Electric flux and flux density.

TOPIC 9. ELECTRIC POTENTIAL & POTENTIAL DIFFERENCE :

Concept of electric potential potential difference; unit of potential. Potential at a point due to a point change. Potential due to a charged sphere.

TOPIC 10. CAPACITANCE CAPACITORS :

Concept of capacitance, its units. Principle of a capacitor Factors affecting the capacitance of a capacitor. Types of capacitors. Grouping of capacitors in series and parallel and mixed combinations. Effect of medium on capacitance, Dielectric materials and dielectric constants.

TOPIC 11. D-C CIRCUITS :

Ohm's law, conventional and electronic current, Resistance-dependance of resistance on length, thickness, temperature and nature of material, specific resistance, conductivity, conductance ohmic & non-ohmic resistance.

Conductors and Insulators, semiconductors, Grouping of resistances. theory of shunt., Unknown resistance, determination by half deflection and wheatstone bridge (meterbridge) method, Potentiometer, its principle, potential gradient. Use of potentiometer to :

(i) compare EMF of two cells.

(ii) determine p.d. across a resistance.

(iii) determine internal resistance of a cell.

TOPIC 12. HEATING EFFECTS OF CURRENT :

Relation between electric energy required to maintain a given current in a given circuit and -

a) P.D. acting in the circuit
b) resistance of the circuit
c) strength of current
d) time for which current is maintained.

Electric power and electric energy, Relation between heat produced and electric energy. Joule's laws of electricity.

TOPIC 13. CELLS, BATTARIES AND THEIR MAINTENANCE :

Comparative study of the chart specifying the primary and secondary cells, electrodes, electrolyte, depolariser, E.m.f.'s internal resistance of different types of cells. Maintenance of primary and secondary cells, when in use or when they are stored.

TOPIC 14. MAGNETIC FIELD :

Magnetic field due to a magnet, magnetic field due to a current carrying conductor, Magnetic induction, unit of magnetic induction, permeability and relative permeability, Magnetic induction due to a straight conductor carrying current, direction of magnetic field.

(Contd....

Magnetic induction at the centre of a circular coil carrying current, magnetic induction of a solenoid. Electromagnet, relation between strength of an electromagnet and intensity of electric current, Tangent law in magnetism. Principle & working of a Tangent galvenometer.

TOPIC 15. ACTION OF FIELD ON CURRENT CARRYING CONDUCTOR :

Force on a conductor carrying current and placed in magnetic field, Direction of the force. Magnitude and direction of force acting on a charge moving in a magnetic field. Condition when no force acts on the charge due to magnetic field Path traced by the moving charge in the magnetic field, Principle of working - of a moving coil galvenometer. Ammeter and Voltmeter. conversion of moving coil galvenometer into ammeter and voltmeter.

TOPIC 16. QUANTUM NATURE OF LIGHT-PHOTO-ELECTRIC EFFECT :

Plank's constant, Photon, Photoelectric effect, characterstics of photo-electric emission. Einstein's photo-electric equation Photocells, their different types and applications. Elementary idea of Laser Applications of Laser in science & technology.

(Contd..

TOPIC 17. RADIOACTIVITY MASS-ENERGY, MASS DEFECT & BIDING ENERGY. FISSION AND FUSSION :

Atomic number, mass number, nuclear isotopes Radioactivity, examples of radioactive substances. Alpha, Beta & Gamma disintegration properties of radioaction. Alpha particle as Helium nucleus, beta particle as negative charge, Gamma rays as electromagnetic radiation or photons of energy, Change in atomic number & mass number during radioactive emission, Mass defect, Biding energy. Law of decay experimental decay; half life period, Law of displacement. Artificial disintigration of nucleus, Nuclear transmutation during artificial disintigration, nuclear disitigration, energy fission, multiple chain reaction, Importance of nuclear energy in crisis, Nuclear fussion as another source of energy.

LABORATORY WORK IN PHYSICS.

A list of laboratory experiments in Physics is given below. The students are expected to perform at least ten experiments from the list depending upon the physical facilities available. The experiments performed by student should spread over a wide range of content.

The laboratory work in Physics should not only strengthen understanding of physical facts and phenomena but also help the students in developing the skills viz handling of equipment, recording observations and drawing useful inferences.etc

LIST OF EXPERIMENTS :

1. Precise measurement of length
   (A) Use of Linear and angular verniers.
   (B) Use of Screw vernier instruments.
2. To determine surface tension of liquid by capillary method.
3. To determine coefficient of viscosity of liquid by poiseuille's method.
4. To determine acceleration due to gravity by simple pendulum by plotting L-T graph.
5. To determine specific heat capacity of a metallic block.
6. To determine coefficient of thermal conductivity of a good conductor (Searle's method).
7. To study the polestrength developed in a specimen of soft iron with current passing through a coil wrapped round it and to measure the saturation current.
8. To compare the magnetic moments of two bar magnets by deflection method with the aid of deflection magnetometer.
9. Measurement of horizontal component 'H' of earths' magnetic induction.
10. Measurement of internal resistance of a cell by potentiometer.
11. Measurement of specific resistance of a unknown resistance by meterbridge method.
12. Conversion of galvanometer into an ammeter of given range.
13. To set a model of astronomical telescope and measure its magnifying power by visual observations & by actual calculations.
14. To investigate that different coloured rays are focussed at different points after suffering refraction through a lens & hence measure the disperative power of a lens.
15. To investigate the relation between current flowing through a resistance and the heat generated.
16. To measure the refractive index of prism material by -
    (i) i- δ curve method
    (ii) Spectrometer.

APPLIED PHYSICS.

PAPER-I

SPECIFICATION TABLE.

S.No.	Topic.	Marks allotted out of 100
1.	Unit 1 - 7	30
2.	Unit 8 - 10	25
3.	Unit 11 - 13	20
4.	Unit 14 - 16	20
5.	Unit 17	5
	Total marks	100

APPLIED PHYSICS.

PAPER -II.

SPECIFICATION TABLE.

S.No.	Topic.	Marks allotted (out of 100)
1.	Units 1 to 7	35
2.	Units 8 to 13	30
3.	Units 14 to 15	15
4.	Units 16 to 17	20
	Total Marks.	100

SUBJECT : APPLIED CHEMISTRY.

RATIONALE

The basic aim of teaching Applied Chemistry is to develop right type of attitudes in the students. It develops in the students the habit of scientific enquiry, ability to investigate the cause and effect relationships, ability to predict the results under given conditions of activities and given convincing reasons for his predictions. A student of chemistry is able to make generalisations.

The knowledge of Applied Chemistry is essential for a technician and engineers because chemistry is concerned with the changes in the structures and properties of matter and all engineering activities and processes are involved to bring out these changes.

The depth and breath of the contents were discussed and the topics were indentified with due consideration to the following -

1. The common requirement of Applied chemistry for all engineering courses.
2. The attainment level in chemistry of the student entering in the Polytechnic.

FIRST YEAR.

SUBJECT: APPLIED CHEMISTRY - PAPER - I.

TOPIC 1 : ATOMIC STRUCTURE AND NUCLEAR CHEMISTRY.:

Discovery of particles of atom and their placement in it, Relationship of structure of atom and Valency, Radioactivity.

TOPIC 2 : COLLIGATIVE PROPERTIES :

Osmosis, Osmotic pressure.

TOPIC 3 : PERIODIC CLASSIFICATION OF ELEMENTS.:

Development of periodic table.

TOPIC 4 : Catalysis and Chemical energetics :

Types, characteristics. Theory and applications of catalysis.

CHEMICAL ENERGETICS

Types of energy and Energy changes in chemical reactions.

TOPIC 5 : OXIDATION AND REDUCTION:

Concept of oxidation and reduction.

TOPIC 6 : ELECTROCHEMISTRY :

Electrolysis, Electroplating.

TOPIC 7 : THERMOCHEMISTRY :

Endo & Exothermic reaction.

TOPIC 8 : SURFACE CHEMISTRY :

Colloids, Emulsion, Gels.

TOPIC 9 : CHEMICAL PROCESS AND TECHNOLOGY :

Unit process & unit operations.

TOPIC 10: METALS AND ALLOYS

Metallurgical operation and metallurgy.

TOPIC 11 : WATER

Domestic and industrial water.

Summary of Contents

Paper - I

APPLIED CHEMISTRY

S.No.	Topic	T.H. Hrs.
1.	Atomic structure and Nuclear Chemistry	14
2.	Colligative properties	8
3.	Periodic classification and elements	6
4.	Catalysis and Chemical energetics	8
5.	Oxidation and Reducation	8
6.	Electrochemistry	8
7.	Thermo Chemistry	8
8.	Surface Chemistry	6
9.	Chemical process and technology	6
10.	Metals and Alloys	20
11.	Water	20
	Total	112

SUMMARY OF CONTENTS

FIRST YEAR.

PAPER - II

APPLIED CHEMISTRY

S.No.		Hrs.
1.	Ionisation, Corrosion and protection.	12
2.	Chemical equilibrium	8
3.	Fuels	20
4.	Refractories, Cement and Glass	8
5.	Carbon compounds	24
6.	High Polymers and Insulators	8
7.	Soap and Detergents	5
8.	Explosives	5
9.	Fertilizers and Pesticides	5
10.	Polyfunctional Organic compounds	12
11.	Pollution	5
	Total Hrs.	112

FIRST YEAR

SUBJECT: APPLIED CHEMISTRY PAPER- II.

TOPIC 1 : IONISATION CORROSION AND PROTECTION :

Theory of Ionisation pH value corrosion and protection.

TOPIC 2 : CHEMICAL EQUILIBRIUM :

Law of mass action Lechataliar's principles.

TOPIC 3 : FUELS :

Classification, analysis and Calorific-value.

TOPIC 4 : REFRACTORIES, CEMENT AND GLASS :

Refractories, Cement, Glass.

TOPIC 5 : CARBON COMPOUNDS :

Nomenclature, classification. Study of Carbon compounds

TOPIC 6 : HIGH POLYMERS AND INSULATORS :

Plastics and Rubber.

TOPIC 7 : SOAP AND DETERGENTS :

Principles of soap and detorgents.

TOPIC 8 : EXPLOSIVES :

TOPIC 9 : FERTILIZERS AND PESTICIDES :

TOPIC 10 : POLYFUNCTIONAL ORGANIC COMPOUNDS :

Lubricants, Paints, and Varnish.

TOPIC 11 : POLLUTION :

Air and Water pollution in environment.

FIRST YEAR

SUBJECT : APPLIED CHEMISTRY (PRACTICALS)

Experiments :	Hrs.
1. Indentification of two cations and two anions in a given sample.	16
2. To determine percentage of copper in a given sample of Brass iodometrically.	8
3. To determine the percentage of iron in a Iron salt redoxismetrically.	8
4. Volumetric estimation by electrolitic method.	4
5. Measurement of PH of different solutions/sample.	4
6. Quantative estimation of two metals in an alloy (Solder/brass)	4
7. Colorimetric estimation of metals in a given sample of an allow.	4
8. Proximate analysis (moisture contents and volatile matter) of a sample of coal.	4
9. To find out the value, soaponification value, Neutralisation value of the organic compounds like oils, fats and paints.	4
10. To prepare colloidel solution, emulsion and Gel and to study their general properties.	4
11. To prepare Bakelite plastic and Rayon.	4
12. To prepare Asprine.	4
13. To identify fibres in the textiles used in cloth	4
14. To set up a deniel cell and interprete the electrochemical theory of corrosion.	2
15. To find out the hardness of water (Temp/ permanent by Homers/EDTA methods.	6
16. To find out the flash point/fire point of dry/ non-drying oils.	4
Total	84 Hrs.

APPLIED CHEMISTRY
Paper - I
SPECIFICATION TABLE

S.No.	Topic	Marks alloted.
1.	Atomic Structure and Nuclear Chemistry	10
2.	Colligative properties	8
3.	Periodic classification of elements.	10
4.	Catalysis and chemical energetics.	8
5.	Oxidation- Reduction.	6
6.	Electrochemistry	6
7.	Thermochemistry	8
8.	Surface chemistry	6
8e	~~Cosmology~~	
9.	Chemical process and technology	6
10.	Metals and alloys	16
11.	Water	16
	Total Marks	100

FIRST YEAR

APPLIED CHEMISTRY

Paper - II

SPECIFICATION TABLE

S.No.	Topic	Marks alloted
1.	Ionisation corrosion and Protection.	12
2.	Chemical equilibrium	6
3.	Fuels	14
4.	Refractories, Cement and Glass	10
5.	Carbon compounds.	20
6.	High polymers and Isulators	6
7.	Soap and detergents	6
8.	Explosives	4
9.	Fertilizers and Pesticides	6
10.	Polyfunctional and Organic compounds	8
11.	Pollution.	8
	Total Marks	100

Scheme of Marks Practicals :

1.	Qualitative analysis	20
2.	Quantitative analysis	20
3.	Viva	10
	Total Marks	50

Note: Papers be set with marks division in the following manner -

Knowledge	Comprehension	Application
30	50	20

FIRST YEAR

SUBJECT : APPLIED MATHEMATICS

RATIONALE

Mathematics is the back-bone of all areas of Technology and hence occupies an important place in the curriculum of Polytechnic Educatich. The subject is equally important for the future self development of the Polytechnic students. In designing the curriculum for foundation course the admission level to polytechnics has been considered as 10th Board Examinatjon, and mathematical needs of technical subjects have been given heavy weightage. Integration of teaching of Mathematics with technical subjects is very basic and important. Therefore as for as possible problems of practical and applied nature should be included in the teaching of applied mathematics. Thereby developing the essential skill of converting a real situation parameters into a corresponding mathematical model.

FIRST YEAR

APPLIED MATHEMATICS

SUMMARY OF CONTENTS

S.No.	Topic	Theory hours
	PAPER I	
1.	Algebra	35
2.	Trigonometry	30
3.	Statistics.	32
4.	Matrices	15
	Total	112
	PAPER II	
1.	Co-ordinate Geometry	35
2.	Diff. Calculus	20
3.	Integral Calculus	27
4.	Vector Algebra	30
	Total	112

FIRST YEAR

SPECIFICATION TABLE

APPLIED MATHEMATICS - I.	Lect. hrs.	Marks Alloted Alloted (Approximately)
1. Algebra	35	33
2. Trigonometry	30	30
3. Statistics.	32	25
4. Matrices	15	12
Total	112	100 Marks

SPECIFICATION TABLE

APPLIED MATHEMATICS- II.	Lecture Hrs.	Marks allotted (Approximately)
1. Co-ordinate Geometry.	35	35
2. Diff. Calculus.	20	20
3. Integral Calculus.	27	20
4. Vector Algebra.	30	25
Total.	112	100

FIRST YEAR

FIRST YEAR C/M/E/ M. & A.C./ COMPUTER SCIENCE.
SUBJECT: APPLIED MATHEMATICS. PAPER I

TOPIC 1 :ALGEBRA.

C O N T E N T S

1 : SEQUENCE AND SERIES :

Difference between Sequence and Series, General term of a Series, To formulate a series.

2 : ARITHMETICAL PROGRESSION :

Definition Computation of n^{th} term, Sum of the n terms Arithmetic Mean.

3 : GEOMETRICAL PROGRESSION :

Definition n^{th} term, Sum of 'N' terms, Infinitic Geometric series and Geometric mean.

4 : HARMONICAL PROGRESSION :

Definition, 'n' th term, Harmonic means

5 : ARITHMETICO-GEOMETRIC SERIES :

Explanation of Arithmetico-Geometric Series, its n^{th} term and sum of first 'n' terms.

6 : PERMUTATIONS :

Factorial Notation, Permutations of n dissimilar things taken at a time, Different cases of the above permutations.

7 : COMBINATION :

Combination of n dissimilar things taken at a time and its different cases.

8 : BINOMIAL THEOREM :

Binomial expansion of $(x + a)^n$, General term, Sum of the binomial Coefficients.

9 : EXPONENTIAL SERIES :

Meaning of e^x and sum of the series given in exponential form.

TOPIC 10 : LOGRITHMIC SERIES :

Expansion of Log (x + a) and sum the series given in Logrithmic form.

TOPIC 11 : PARTIAL FRACTION :

Principle of Partial fraction of different Algebric expressions.

TOPIC 12 : DETERMINANTS :

Concept and Principles of Determinants, Properties of determinants, Solution of Simultaneous equations by making use of determinants.

TOPIC 13 : MEAN AND R.M.S. VALUE :

Computation of mean and R.M.S. value.

TOPIC 2: TRIGONOMETRY

1 : TRIGONOMETRICAL RATIOS OF MULTIPLE AND SUB-MULTIPLE ANGLES :

-Half angles, Double angles, Triple angles.

2 : TRIGONOMETRICAL EQUATIONS :

-General solution of Trigonometrical equations.

3 : PROPERTIES OF TRIANGLES AND SOLUTION OF TRIANGLES

-Relations between sides and angles of a Triangle.

4 : DEMOIVER'S THEOREM :

-Concept of Demoiver's theorem and application.

FIRST YEAR C/M/E/ R.& A.C./ COMPUTER SCIENCE

TOPIC 3 : STATICS

1 : STATISTICAL METHODS :

Variates, data frequency, distribution, Tabulation and representations.

2 : MEASURES OF CENTRAL TENDENCY :

Mean, Median, Mode, Geometric mean, Harmonic mean.

3 : MEASURE OF DISPERSION :

Range, Quartile deviation, Mean deviation and standard deviation.

4 : PROBABILITY :

Events and Different Mathematical formulae.

TOPIC 4 : MATRICES

1 : MATRIX : Definition of Matrix

2 : SPECIAL MATRICES : Square matrix, Diagonal matrix, Row matrix, Column matrix, Scalar matrix, Unit matrix, Zero or null matrix, Upper and lower triangular matrices, Symmetric matrix, Skew symmetrix, Principal diagonal, Submatrices, Determinant of a square matrix, Minors of a matrix.

3 : OPERATIONS AND DIFFERENT LAWS : Scalar multiple of a matrix, Addition of matrix, Closer law, associative law, Identify inverse, Commutative law, Product of matrices, Reversal law for the transpose of a product, adjoint of a square matrix, Inverse of a matrix, Non Singular and singular matrices, Reversal law for the inverse of a product.

FIRST YEAR C./M./E./R.&A.C./ COMPUTER SCIENCE.
SUBJECT : APPLIED MATHEMATICS - II
TOPIC 1: CO-ORDINATE GEOMETRY.

1: COORDINATE SYSTEMS :

Cartesian, Coordinates, Polar Coordinates.

2: DISTANCE, DIVISION AND AREA :

Distance between two points, Division of line segment, Area of a triangle.

3: STANDARD FORMS OF THE EQUATION OF A STRAIGHT LINE :

Locus of a point, standard forms, General equation of a straight line and its reduction to the standard forms

line through two points.

STRAIGHT
4: INTERSECTION OF LINES :

Point of inter section of two st lines and (i) angle between them, (ii) bisector of the angle between them, (iii) length of perpendicular.

5: CHANGE OF AXES :

Transformation of coordinates when the origin is shifted or the axes are rotated.

TOPIC 6: PAIR OF ST. LINES REPRESENTED BY $AX^2 + 2hxy + by^2 = 0$

Homogenous quadratic equation $ax^2 + 2hxy + by^2 = 0$, Properties of the pair of st. lines represented by the above equation.

TOPIC 7: GENERAL EQUATION OF SECOND DEGREE REPRESENTING A PAIR OF ST. LINES.

Condition that the general equation of second degree represents a pair of st lines, Point of inter section and the angle between them.

8: CIRCLE :

(In cartesian Co-ordinates only), Definition, Standard forms, general equation, centre, radius, Tangent, Normal.

9 : CONIC SECTIONS :

General equation of second degree and its representation in particular cases.

10 : PARABOLA

Definition and its standard forms.

11 : ELLIPSE

Ellipse, its properties and standard equation, Tangent and normal.

12 : HYPERBOLA :

Hyperbola, its properties and standard form, asymptotes, rectangular hyperbola and conjugate hyperbola.

TOPIC : 2 : DIFFERENTIAL CALCULUS.

1 : FUNCTIONS

Independent and dependent variables, different types of function.

2 : LIMIT

Concept of limit and its evaluation.

3 : DIFFERENTIATION BY FIRST PRINCIPLE. :

Differentiation by first principle of Algebraic Trigonometrical, exponential, Longithmic and inverse function.

4. DIFFERENTIATION OF SUM, PRODUCT AND QUOTIENT OF TWO FUNCTIONS :

FIRST YEAR C./M./E./ R. & A.C./ COMPUTER SCIENCE.

TOPIC 3 : INTEGRAL CALCULUS

1 : INTEGRATION :

Definition of Integration, and Fundamental properties of integration.

2 : METHODS OF INTEGRATION :

Integration by substitution Integration by parts.

TOPIC 4 : VECTOR ALGEBRA

1 : INTRODUCTION OF VECTORS :

Concept of Vector and Scalar quantities.

2 : ADDITION OF VECTORS :

Principles of addition and substraction of vectors.

3 : COMPONENT OF VECTORS :

Component of Vectors, Standard unit vectors i, j, k.

4 : MULTIPLICATION OF VECTORS :

Scalar product and its applications, Vectors products and its application.

FIRST YEAR

SUBJECT : APPLIED MATHEMATICS.

REFERENCE BOOKS

1. Mathematics for Polytechnic Volume I and II prepared by TTTI.
2. Text book on differential calculus by Gorakh prasad.
3. Text book on Integral calculus - By Gorakh Prasad.
4. Plane Trigonometry part I and Part II - by S.L. Loney.
5. Co-ordinate Geometry - By S.L. Loney.
6. Mathematical statistics by - M. Ray and Sharma.

FIRST YEAR DIPLOMA IN C/M/E/ R. & A.C./COMPUTER SCIENCE.

R A T I O N A L E.

Applied Mechanics is one of the oldest branch of Physical Science and its knowledge is considered a necessity for a technician course in Engg. Mechanics in the foundation course of Diploma Examinations is intended to expose the students to the principles of mechanics with the help of illustrations selected from the field of engineering. The contents of the curriculum are classified under the conventional heads namely statics, Kinematics and Dynamics. The study of this subject in respect of topics left out could be integrated with their use in subjects, like 'Structure', 'Strength of Materials','Theory of Mechanics', 'Basic Machine Design etc.

The topics which have been selected for inclusion in the course of Engg. Mechanics have wide application in various courses and in industry and on the field. The curriculum is also aimed to develop in the students the ability to analyse system of forces and motions met with in the field of engineering.

FIRST YEAR DIPLOMA IN C/M/E/R.& A.C./COMPUTER SCIENCE

SUBJECT : APPLIED MECHANICS.

S.No.	Topics.	Theory Hrs.	Practical Hrs.
1.	Composition and Resolution of forces.	10	12
2.	Parallel forces & couples	6	4
3.	Moments & their applications.	6	4
4.	Equilibrium of forces.	8	8
5.	Centre of gravity.	6	4
6.	Friction	8	4
7.	Simple lifting machines.	10	16
8.	Motion of particles	8	
9.	Motion of rotation	4	
10.	Laws of motion.	4	
11.	Work, Power, Impluse and Energy.	8	4
12,	Transmission of Power	6	
	Total	84	56

FIRST YEAR C/M/E/ R. & A.C./ COMPUTER SCIENCE.

APPLIED MECHANICS.

TOPIC 1 : COMPOSITION AND RESOLUTION OF FORCES.

Definition of force, Effect of force, Characteristics of force, Principles of transmissibility of forces, Resultant force, Composition of forces, Methods of finding out the resultant of coplaner forces (analytical and graphical).

TOPIC 2: PARALLEL FORCES AND COUPLES.

Classification of parallel forces, Methods of finding out the resultant force of parallel forces (analytical and graphical), Position of the resultant force, definition of couple, Classification of couples, Characteristics of a couple, Moment of couple.

TOPIC 3: MOMENTS AND THEIR APPLICATIONS.:

Definition of moment of a force, Types of moments, Law of moments, Varignon's Principle of moment for concurrent forces & its applications, Levers and their types.

TOPIC 4: EQUILIBRIUM OF FORCES.

Syston of forces (definition), Various systems of forces (definition), Principle of Equilibrium, Lami's theorem, Methods of studying the Equilibrium of Coplaner forces, Lami's theorem, Condition of Equilibrium, Types of Equilibrium.

TOPIC 5: CENTRE OF GRAVITY :

Difference between centre of gravity and centroid, Centre of gravity of standard plane figure and solid bodies, Method of finding out centre of gravity of simple geometrical plane figures, Centre of gravity of composite body and cut section.

TOPIC 6: FRICTION :

Concept of friction, types of friction, Limiting friction, Coefficient of friction, Law of friction, Angle of friction and angle of Repose, Analysis of Equilibrium of bodies resting on inclined planes, Screw friction-Expression between Effort and Load for a screw Jack during winding and unwinding, Utility/Nuisance value of friction.

TOPIC 7: SIMPLE LIFTING MACHINES :

Basic concept of Machine, Definition of velocity ratio, mechanical advantages and efficiency of machine and their relation, Reversibility of a Machine and condition of self locking, Law of Machine, Maximum Mechanical Advantages and Maximum Efficiency of a Lifting Machine, Friction in a Machine, Calculation of M.A., V.R. and efficiency of the following machines.
(a) Wheel & Axle (Simple & differential), (b) Differential pulley block, (c) Single and double purchase crab, (d) Screw Jack and (e) Different systems of pulleyblocks.

TOPIC 8: MOTION OF PARTICLE :

Definition of speed, velocity Acceleration, Uniform Acceleration and variable acceleration, Motion under constant acceleration/retardation (Equation of motion), Motion under the force of gravity, Definition and determination of relative, angular acceleration and angular displacement, Definition of Trajectory, Velocity of projection, angle of projection, time of flight and range, Expression for motion of a projective and their applications.

TOPIC 9: MOTION OF ROTATION :

Definition of angular velocity, angular acceleration and angular displacement, Motion of rotation under constant angular acceleration.

TOPIC 10: LAWS OF MOTION :

Newtons' law of motion and their applications.

TOPIC 11: WORK, POWER, IMPULSE AND ENERGY :

Work (definition), Graphical representation of work, Calculate work done in pulling Bodies on rough incline planes, Power (definition), Types of Engine Powers, Define Efficiency of an Engine, Momentum (definition), Impulse (definition), Law of conservation of Momentum, Energy (definition), Types of Mechanical Energy, Law of conservation of energy.

TOPIC 12: TRANSMISSION OF POWER :

Concept of transmission of power, Types of beltz, velocity Ratio of a belt drive, Compound belting, slip of the belt, types of belt drive, length of the belt and power transmitted by belt, Ratio of tensions.

1/62

FIRST YEAR C/M/E./ REF. A.C./ COMPUTER SCIENCE.

SUBJECT: APPLIED MECHANICS

LIST OF EXPERIMENTS

S.No.	Exp. No.	Name of Experiment
1	2	3
1.	1	Verification of law of triangle of forces.
2.	2	Verification of law of parallelogram of forces.
3.	3	Verification of law of polygon of forces.
4.	4	Verification of Lami's theorem.
5.	5	Verification of Law of moments.
6.	6	To find out the centre of gravity of regular lamina.
7.	7	To find out the co-efficient of friction for surfaces of different material on horizontal plane.
8.	8	To find out the co-efficient of friction for surfaces of different material on inclined plane. Compare the value of angle of repose with co-efficient of friction.
9.	9	To study the forces in the members of Jib crane. Comparision of the results by vector diagrams and Lami's theorem.
10.	10	To find out the velocity ratio, Mechanical Advantage and efficiency of Differential wheel and axle and interperate the law of machine with the help of graph.
11.	11	To find out the velocity ratio; Mechanical Advantages and efficiency of single purchase crab and interperate the law of machine with the help of graph.
12.	12	To find out the velocity ratio; Mechanical Advantage and efficiency of Double Purchase crab and interperate the result graphically.
13.	13	To find out the velocity ratio; Mechanical Advantages and efficiency of screw jack. Demonstrate its working. Interperate the the result grapnically.
14.	14	To find out the velocity ratio; Mechanical Advantages and efficiency of Differential Pulley Block. Interperate the law of machine. Draw graphs.
15.	15	Measurement Brake Horse Power of an engine by Rope Brake Dynamometer. Drive Expression of measuring Horse power with Rope Brake Dynamometer.

—

1/63

FIRST YEAR

TABLE OF SPECIFICATION FOR 100 MARKS THEORY PAPER

FOUNDATION COURSE. SUBJECT :- APPLIED MECHANICS.

S.No.	TOPIC.	TOTAL MARKS.
1.	Composition and Resolution of forces	10
2.	Parallel forces and couples	6
3.	Moments and their applications	8
4.	Equilibrium of forces	8
5.	Centre of gravity	6
6.	Friction	8
7.	Simple lifting machines	14
8.	Motion of particles	8
9.	Motion of rotation	6
10.	Laws of motion	8
11.	Work, Power, Impluse and Energy	10
12.	Transmission of Power	8
	Total	100

APPLIED MECHANICS

REFERENCE BOOKS

(1) A Text Book of Applied Mechanics - R.S. Khurmi (SC Chand & Co.Ltd; New Delhi).

(2) Applied Mechanics - Ramamurtham (Dhanpat Rai and Sons New Delhi).

(3) Applied Mechanics - I.B. Prasad (Khanna Pub.New Delhi)

(4) Engineering Mechanics. - Timoshenko and Yong (Mc Graw Hills Book Co.)

SCHEME OF EXAMINATION

	S.No.	Subject.	Term work	Lab. work	Progressive Assessment. I	Progressive Assessment. II.	Board's Theory Exam. No. of paper	Board's Theory Exam. Duration in hours	Board's Theory Exam. Marks	Board Practical Exam. Duration in hours.	Board Practical Exam. Marks.	Remarks.
*	1.	Communication Skill.	20	-	10	10	1	3	100	-	-	
*	2.	Mathematics and Computer Applications.	20	-	10	10	1	3	100	-	-	
*	3.	Materials Technology.	20	20	10	10	1	3	100	3	50	
*	4.	Strength of Materials	20	20	10	10	1	3	100	3	50	
	5.	Thermodynamics.	20	20	10	10	1	3	100	3	50	
	6.	Heat Transfer.	20	-	10	10	1	3	100	3	50	
*	7.	Mechanical Drawing.	20	50	10	10	1	4	100	-	-	
*	8.	Fluid Mechanics and Machinery.	20	20	10	10	1	3	100	3	50	
*	9.	Manufacturing Process Engineering and Practice.	20	50	10	10	1	3	100	3	100	
*	10.	Electrical Engineering and Electronics.	20	20	10	10	1	3	100	3	50	
		TOTAL	200	200	100	100			1000		400	

NOTE:- * The subjects are common with Second Year Diploma in Mechanical Engineering (10+2 New Scheme.)

Total Theory Marks. - 1000

Total Sessional & Practical Marks (600+400) - 1000

Ratio of Theory, Sessional and Practical Marks - 1:1

Grand Total - 2000

M.P.BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SCHEME OF STUDIES.

S.No.	Subject	Theory and Tutorial Hrs. per week	Total Theory and Tutorial Hrs.per year	Practical hours per week	Total Practical lab. hours per year.	Total Contact hours/year	Remarks
* 1.	Communication Skill	1+1	56	-	-	56	
* 2.	Mathematics and Computer Application.	2+1	84	-	-	84	
* 3.	Materials Technology.	2+0	56	1	28	84	
* 4.	Strength of Materials.	1+1	56	1	28	84	
5.	Thermodynamics.	1+1	56	1	28	84	
6.	Heat Transfer.	1+1	56	1	28	84	
* 7.	Mechanical Drawing.	1+0	28	5	140	168	
* 8.	Fluid Mechanics and Machinery.	1+1	56	1	28	84	
* 9.	Manufacturing Process Engineering & Practice.	2+0	56	3	84	140	
* 10.	Electrical Engineering and Electronics.	2+1	84	2	56	140	
	TOTAL	14+7	588	15	420	1008	

NOTE:- * These subjects are common with Second Year Diploma in Mechanical Engineering (10+2 New Course)

1166

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

C U R R I C U L U M.

2.1	Communication Skill	Common with Second Year Civil, Mechanical, Electrical Engineering.
2.2	Mathematics and Computer Application.	Common with Second Year Civil, Mechanical, Electrical Engineering.
2.3	Materials Technology.	Common with Second Year Mechanical Engineering.
2.4	Strength of Materials	Common with Second Year Mechanical Engineering.
2.5	Thermodynamics.	-
2.6	Heat Transfer.	-
2.7	Mechanical Drawing.	Common with Second Year Mechanical Engineering.
2.8	Fluid Mechanics and Machinery.	Common with Second Year Mechanical Engineering.
2.9	Manufacturing Process Engineering and Practice.	Common with Second Year Mechanical Engineering.
2.10	Electrical Engineering and Electronics.	Common with Second Year Mechanical Engineering.

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA COURSE IN C/M/E/ET/AUTOMOBILE ENGINEERING/ COMPUTER SCIENCE / REFRIGERATION & AIR CONDITIONING.

COMMUNICATON SKILL

R A T I O N A L E.

Importance of acquiring proficiency in communication skill for professional courses is indisputable. Inspite of raising entry level in Polytechnics, no significant change is expected to be brought about in the entry behaviour of students seeking admission to diploma courses with the prescribed syllabus at 10 + 2 stage in English. Since medium of instruction for diploma courses is English and the new entrants will not have the added benefit of learning such subjects as Physics and Chemistry in the first year, they will be deprived of certain amount of exposure to English. This used to pave the way for students and remove to certain extent their problem of new medium in learning engineering subjects. Under the circumstances, a course in Communication Skills has to be devised which will ensure accessibility of students to Engineering subjects. Therefore, they must be adequately equipped to enhance their listening, speaking, reading and writing skills. This task, though seemingly uphill, has to be achieved in 6 hours of effective teaching.

AIMS OF THE COURSE :-

The course aims at enabling the Students :-

(a) To understand vocabulary items which among others must include words from the register of Physical and Social Sciences,

(Contd..)

(b) To understand and use grammatical items,

(c) To develop reading comprehensions,

(d) To understand idea in the units which shall include besides topics from Physical Sciences, topics reflecting awareness of social changes, economic and industrial growth,

(e) To write both guided and free compositions based on the prescribed text.

(f) To attain skills in various forms of technical writing such as feasibility report, trouble report in the form of memorandum, description of processes and objects, and writing instructions,

(g) To develop skills of composing various types of business letters.

In order to achieve the aforesaid objectives of the course relevant portions from (i) A Course in Technical English, Book I, (ii) Passages in General Studies, (iii) A Course in Technical English, Book II may be taken. The first two books may be used as text books, while the third should be used as a reference book by the subject teacher.

--

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA COURSE IN C/M/E/ET/AUTOMOBILE ENGINEERING/ COMPUTER SCIENCE/REFRIGERATION & AIR CONDITIONING

COMMUNICATION SKILLS.

SCHEME OF STUDY.

S.No.	Topics.	Lecture Hours.
(1)	Applied Grammer -	18
(2)	Passages for comprehension. -	20
(3)	Technical Writing. -	10
(4)	Business letter -	08
	TOTAL -	56 Hours.

SECOND YEAR

SUBJECT : COMMUNICATION SKILL

PRESCRIBED TOPICS IN DETAILS.

S.No.	Topics.	Lecture Hours.
1.	Applied Grammar :	(18)
	(a) Determiners	
	(b) Tenses.	
	(c) Sequence of tenses.	
	(d) Introduction to verbs -	
	i) Negative, interrogative forms and uses.	
	ii) List of Auxillary verbs used in short answer	
	In the construction so / neither/nor + Aux. + subject.	Exercise 35- ' A Course in Technical English Book- I.
	Use of 'shall' and 'will'	Exercise 40 and 41 - ' A Course in Technical English' Book - I
	'Can' used to express ability	Excercise 37 - ' A Course in Technical English' Book - I
	' Would' used to state hypothetical situations	Exercise 42 - ' A Course in Technical English' Book - I.
	(e) The passive voice :	
	i) Use.	
	ii) A table of active tenses and their passive equivalents.	
	(f) Subject - Verb Agreement.	
	(g) Prepositions	

(Contd....)

2-	(A) Passages from Physical Sciences :	(9)
	(i) Taming the Aton.	$1\frac{1}{2}$
	(ii) Redar and its uses	2
	(iii) The Indian Satellite Communication Programme	2
	(iv) A Volcano.	$1\frac{1}{2}$
	(v) Lasers	2
	(b) Passages from Social Studies :	(11)
	(i) Salient Features of the Indian Constitution.	2
	(ii) Structure of Government.	2
	(iii) Functioning of an Economic system.	2
	(iv) Production and Productivity	3
	(v) Professional Writing :	2
3.	Technical Writing:	(10)

(i) Its importance

(ii) Features of Technical Style.

(iii) Style : Literary and Technical

(iv) Mechanics of Technical Writing- abbreviations, numerals, punctuations and spelling rules.

(v) Various forms of T.R. - Feasibility Report, Progress - Report, Trouble Report, in the form of memorandum.

(vi) Description of objects and processes.

(Contd...)

4. Business Letters : (08)

(i) Brief introduction

(ii) Mechanics

(iii) Style.

(iv) Types of business letters.

NOTE : For the purpose of attaining the objectives of the course, relevant portions from these three books (A Course in Technical English - Book I, A Course in Technical English - Book II, Passages in General Studies) may be used.

—

1/74

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA COURSE IN C/M/E/ET/AUTOMOBILE ENGINEERING COMPUTER SCIENCE/REFRIGERATION & AIR CONDITIONING.

SYNOPSIS OF

COURSE OF STUDIES & SCHEME OF EXAMINATION

SECOND YEAR (10+2) Branches: C/M/E/ET/Auto Comp.Science/ Refri. & A.C.

SUBJECT : COMMUNICATION SKILLS.

BOOKS PRESCRIBED

1. A Course in Technical English, Book-I, Somaiya Pub. Bombay.

(Unit to be taught : 12,13,14,15,16 - Passages
1,3,4,5,6,7,8,11,12 - Applied Grammer)

2. Passages in General Studies, Vikas Publication, Bhopal

(Unit to be taught : 3,4,5,7,10)

3. TECHNICAL WRITING :

(I) Its importance,

(II) Style :- Literary and Technical
- Features of Technical Style.

(III) Mechanics of Technical Writing :- Abbreviations, numerals punctuations, and spelling rules.

(IV) Types of Technical :- Feasibility Report, Progress Report, Trouble Report in the form of memorandum.

(V) Description of objects and processes.

4. BUSINESS LETTERS:

(I) Brief introduction,

(II) Mechanics and style.

(III) Types of business letters :- (a) Application for job
(b) Letter of Enquiry
(c) Orders
(d) Complaint.

NOTE:- For item Nos. 3 and 4, ' A Course in Technical English Book II, Somaiya Publications, Bombay,' May be used as a reference book by the subject teacher.

SECOND YEAR DIPLOMA COURSE IN C/M/E/ELECTRONICS/ REFRIGERATION AND AIR CONDITIONING.

SUBJECT : MATHEMATICS AND COMPUTER APPLICATION.

DIFFERENTIAL CALCULUS :

1. Limits and continuity, Derivability.
2. Differentiation of sum, product and questions of functions, Differentiation of function of a function.
3. Differentiation of Trigonometrical, Inverse trigonometrical and Hyperbolic functions, Differentiation of implicit function and parametric equations, Logarithmetic differentiation.
4. Partial Differentiation.
5. Successive Differentiations.
6. Leibnit's Theorem.
7. Errors and approximation.
8. Geometrical meaning of differential coefficients and its application in finding the equation of Tangent, Normal, Sub-tangent and sub-normal.
9. Radius of curvature (cartesian formula)
10. Maxima & Minima (Single variable).

INTERNAL CALCULUS :

1. Integration of

$$\frac{1}{ax^2 + bx + c}, \quad \frac{px + q}{ax^2 + bx + c}, \quad \frac{1}{\sqrt{x^2 + b^2 + c}}, \quad \frac{px + q}{\sqrt{ax^2 + bx + c}}$$

2. Reduction formula for integration of $\sin^n x \cos^n x$.
3. Definite integrals (Definition and properties)
4. Evaluation of

$$\int_0^{\pi/2} \sin^n x \cos^n x \, dx$$ integrals of Gamma functions.

5. Application of integral calculus in Engineering
   (a) Definite integral as limit of a sum.
   (b) Area of plane curves.

Contd..9

(c) Length of Arcs of plane curves.

(d) Work done.

(e) Volume of solids of Revolution.

(f) Mean and Root Mean Square values.

(g) Moment of Inertia.

(h) Centre of gravity.

(i) Simpson's rule.

DIFFERENTIAL EQUATIONS. ..20

1. Introduction.

2. First order and first degree differential equations.

(a) Variable separables.

(b) Homogeneous Equations.

(c) Exact differential equations.

(d) Linear differential equation.

3. Second order linear differential equations with constant coefficient (Method of solution).

(a) F (D) y = 0

(b) f (D) y = F (x) F(x)

COMPUTER APPLICATION : ..24

1. Different Number Systems; Decimal; Binary, Octal, Hexadecimal and their conversion & associate arithmatic. ..5

2. Boolean Algebra, Demorgan's Theorems ..5

3. Different Codes; BCD, ASC II etc. ..2

4. Hard ware : Printer (D.P), Hard Disk, Floppy, VDU --2

5. Soft ware : Flow Chart, Basic Language programming and use of statements : PRINT, LET, IF, NEXT, THEN, INPUT, DATA READ. ..5

6. Fortran's Language Programming and use of similar. Fortran's statements. ..5

MATERIALS TECHNOLOGY

R A T O N A L E

Materials Technology is advancing very fast with the explosion of Technology. This subject will : provide basic insight in the students regarding modern Engineering materials and their technology used by the industrial concern. The objective is to include topics like equilibrium diagrams, heat treatment, corrosion with characteristics functions, uses and their engineering applications.

.....

MATERIALS TECHNOLOGY

SCHEME OF STUDY

Unit No.	Title	Lect. hrs.	Tut/Lab. hrs.	Total hrs.
1	Engineering requirement of materials.	2	-	2
2.	Technical Properties and Testing of materials.	4	10	14
3.	Structure of metal.	5	3	8
4.	Plastic Deformation, recovery, recrystallisation and grain growth.	3	-	3
5.	Equilibrium diagram.	6	-	6
6.	Heat Treatment of steels.	7	12	19
7.	Ferrous metals, Alloys and Alloy steels.	7	3	10
8.	Non metallic materials.	6	-	6
9.	Non ferrous metals & alloys.	5	-	5
10.	Plastics.	4	-	4
11.	Metal Preservation.	2	-	2
12.	Selection of materials	2	-	2
	Total	56	28	84

.....

MATERIALS TECHNOLOGY

TOPIC - 1. Engineering requirements of Materials.

Introduction to engineering materials, properties and behavioural characteristics. Basis for selection of materials. Development of new materials and their impact on the design of new products.

TOPIC - 2. Technical Properties and Testing of Materials.

Mechanical properties, strength, Tensile, compressive, fatique, Impact, Elasticity, Plasticity, Ductility, Toughness Brittleness, Malleability, Hardness.

Destructive tests for tension, compression, Impact and hardness.

Non destructive methods : Magnetic, Crack detection, Ultra sonic and radiographic tests, Area of application of each method.

Tension test procedure, calculations and interpretation of test results for selection of materials, Impact test procedure. Brinell and Rockwell hardness tests- Applications, working principle of hardness testers.

TOPIC - 3. Atomic structure and its effect on Properties.

Solidification phenomena, formation of crystals, grains and grain boundaries.

Space lattices types, BCC, FCC and HCP. Dendrites and dendritic growth, effect of dendrites on properties of the metal, methods of preventing dendritic growth. col-umnar, crystals, formation effect on properties, methods of preventing formation of columnar crystals.

Bonds - Ionic, Covalent and metallic allotropy.

Metallography - Macro and Micro examination of metals, scope and limitations. The metallurgical microscope - construction, working principle - care, and uses.

Contd....

Need for preparing specimens-materials and equipment required for common engineering metals and alloys procedure.

TOPIC- 4. Plastic Deformation, recovery, Recrystallisation and Grain growth .

Elastic and Plastic deformations, advantages of the metallic property of plastic deformation in shaping of metals ;effect on properties - strain hardening. Recrystallisation ;cold working and hot working definition. Recovery recrystallisation, and grain growth , effect: .. on properties.

TOPIC -5. EQUILIBRIUM DIAGRAMS.

Cooling curves - solid solutions - types - formation characteristics, factors effecting formation of solid solutions.

Equilibrium or phase diagrams - plotting of equilibrium diagrams and its interpretation. Phase rule and Lever rule and its application. Pure iron - properties, cooling curve, Iron corbon diagram. Definition of terms applicable to iron corbon diagram. Interpretation of Iron - carbon diagram.

TOPIC -6. HEAT TREATMENT OF STEEL .

Heat treatment objectives, types - Annealing and normalising , types of annealing process. Normalising procedure, applications, selection of annealing/ normalising method.

HARDENING Objectives, requirement in a steel for being hardened. Selection of hardening temperature, quenching medium, effect of quenching media on hardness, preparation of jobs for hardening,defects due to improper

Contd....

quenching.

T.T.T. curves construction and interpretation, hardening defects identification.

Tempering aims, effects on structure, procedure, tempering medium, applications, selection of proper tempering temp, and medium, temper colours. Hardenability Jominy test, interpretation of test results.

Surface hardening - scope and limitations, advantage, types, Flame hardening, Induction hardening, procedure and applications.

Case hardening methods, carburising, Nitriding cyniding and carbonitriding.

TOPIC -7. FERROUS METALS AND ALLOYS.

Advantages and limitations of C.I. Mechanical properties, machinability, weldability, Corrosion resistance, effect of high temperature. Effect of impurities on properties of gray C.I. and white C.I.

Production of malleable cast iron. Type of Malleable C.I., properties and applications. Production of nodular C.I., micro-structure of nodular C.I., Advantages of nodular C.I. and its applications.

Alloy cast iron : effect of alloying elements like Ni, Mo, Vanadium, applications of alloy C.I.

Plain carbon steel - & classification as per carbon content, effect of impurities, limitation of plain carbon steels, free cutting steels and its application.

Alloy steels - definition, reasons for alloying, alloying elements and their effect on properties.

Contd...

Alloy steel classification.

Tool steels-typical compositions, requirements of tool steels, high speed steel, high carbon steels.

TOPIC-8. NON FERROUS METAL AND ALLOYS:

Copper and its main alloys - Brasses and bronzes characteristic of copper, brasses and bronzes. compositions and uses of different types of brasses and bronzes.

Engineering properties of Aluminium and its applications in Engineering Field. Aluminium alloys ; Cast, wrought alloys and their applications. Engineering properties of zinc and nickel, and their application.

Bearing alloys white metal, lead-base, Tin-base, Zn-base, Al-base, Bronze, and Gun metal.

TOPIC-9. NON - METALLIC MATERIALS :

Ceramics, types, characteristics, applications

Refractories - desirable properties, classification - special features of acid, basic and neutral refractories. Causes of failures refractories, factors to be considered while selecting refractories.

Rubber - Origin, engineering qualities, applications, commercially available forms, valcanisation.

Synthetic rubber - types, uses. Abrassives - definition , types, qualities (hardness, toughness and fracture qualities) applications, commercial forms.

Adhesives - types, desirable qualities, principle of adhesion, setting of adhesives, preparing surfaces application, commercial name of adhesive.

Contd...

(Insulators - for heat and electricity, Desirable qualities, effect of moisture and temperature, types of insulation materials and their applications. Function of lubricants, desirable properties, types of lubricants, commercial names of lubricants and their specific applications and characteristics.

TOPIC-10. PLASTICS.

Characteristics of plastics, classification of plastics. Thermo plastics - types, properties, applications, Thermo setting plastics - types, properties, applications, plastic components such as binder, filler, plasticizer colour, lubricants, catalysis and their functions. Plastic processing methods.

TOPIC-11. METAL PRESERVATION.

Corrosion - theories - factor accelerating corrosion. Methods for minimising corrosion attack. chemicals which prevent corrosion, methods of applying protective coatings.

TOPIC-12. SELECTION OF MATERIALS.

Requirements for selecting a material for an engineering use -

(a) Service.

(b) Fabrication.

Various service requirement and Fabrication requirement. Necessity of alternative materials.

.....

LIST OF EXPERIMENTS.

1. Study and use of metallurgical microscope.
2. Preparation of micro-specimen.
3. To study microstructural characteristics of grey cast iron, white cast iron and malleable cast iron.
4. Microstructure of carbon steel.
5. Effect of normalising, annealing on the hardness and microstructure of high carbon steel.
6. Hardening of steel - effect of carbon and temperature.
7. Tempering of steel - effect of temperature on properties.
8. Effect of quenching media on hardness of steel.
9. Carborising and case hardening of steels.
10. Jominy hardenability test and its industrial use.
11. Microstructure of some important industrial brasses and bronzes.

.....

LIST OF REFERENCES.

(Experiments in materials technology by Prof. Higgerson and Polytechnic Teachers)

1. A text book of material science and metallurgy by O.P Khanna.
2. Material science and processes by S.K. Hajra Choudhary.
3. Material science by G.S.S. Narang.
4. Material sceince by B.L. Gupta.

.....

SUBJECT : STRENGTH OF MATERIALS

RATIONALE

The technician of any discipline in general and of mechanical discipline in particular is expected to have the sound fundamental knowledge of the subject - " Strength of Materials" to fulfill his job functions efficiently. The knowledge of this subject is particularly essential for the technician working in Design, Main tenance, Shopfloor, Inspection and Quality - Control and Production departments.

This subject includes the study of behaviour of material and stresses produced in the engineering parts and structures due to various kinds of loading system and the resistance offered by the parts and structures to such loading system according to the structural properties of materials.

The syllabus given here covers the above aspects of materialsused for common engineering structures and corponents like bold rim of a wheel, shells, joints, frames, columns and struts, springs, shafts, beams, cylinders and machine components.

.....

SUBJECT : STRENGTH OF MATERIALS

S Y N O P S I S

S.No.	TOPIC	TIME IN HOURS		
		THEORY	LAB/Tut.	TOTAL
1.	Simple stresses and strains	10	6	16
2.	Testing of Machanical properties of materials	3	6	9
3.	Shear Force Bending moment	8	2	10
4.	Bending stresses in beams	4	2	6
5.	Shearing stresses in Beams	4	1	5
6.	Deflection of Beams	4	2	6
7.	Torsion of Shaft.	4	2	6
8.	Springs	3	1	4
9.	Columns and Struts	4	1	5
10.	Combined Bending and Direct stress.	4	2	6
11.	Stresses in Frames	4	2	6
12.	Principal planes and principal stresses.	4	1	5
	T O T A L	56	28	84

STRENGTH OF MATERIALS

TOPIC - 1 : Simple stresses and strains :-

Introduction, Types of loads and deformations, Types of stresses and strains Hookes law, stress-strain diagram different Modul of materials (E.N.K) - stresses in bars of varying sections, composite sections and compound sections, Thermal stresses and strains, Thermal stresses in composite sections poissons ratio: volumetric strain, Relation between the bulk modulus and the young's modulus and between the modulus of elasticity and modulus of rigidity.

Strain Energy, Resilience, Proof resilience, modulus of resilience. Types of loading, maximum instantaneous stresses in different kinds of loading.

TOPIC - 2 : Testing of Mechanical Properties of Materials -

Necessity of testing of materials, classification of test, Important/destructive tests, Tensile Test, compressive Test, Impact Test, fatique test, endurance limit. Hardness test, relation ship of hardness number with tensile strength of materials.

Bending Test :- Shear Test

TOPIC - 3 : Shear Force and Bending Moment : -

Types of beams, Types of loading, shear force and bending moment, sign conventions. S.F. and B.M. diagrams for cantilever beam with various kinds and combination of loading, S.F. and B.M. diagrams for a simply supported beam with various kinds of loading and combination loading, over hanging beams, point of contraflexure. Numerical problems.

TOPIC - 4 : Bending stresses in Beams :-

Theory of simple-bending, Assumptions made in simple bending eqn., Derivation of bending eqn., stresses

in beams, equation of bending, centroid of sections, Moment of Inertia of symmetrical & Unsymmetrical section, section modulus; bending stresses in symmetrical and un symmetrical sections, beams of uniform. Strength, simple Numerical problems.

TOPIC -5 : Shear stresses in beams :-

Introduction :-
Shear-stress equation, assumptions, distribution of shear stresses over various sections such as rectangular, circular,

I-section, T-section and 'L' section.

Numerical problems of elementary nature.

TOPIC -6 : Deflection of Beam :

Introduction ,-
Strength and stiffness of the beam. Curvature of the bend beam, Importance of deflection and practical applications, Derivation of the equation for the deflection of beam and slope, Relation between slope, deflection and radius of curvature, calculation of slope and deflection for simply - supported and cantilever beam, With point load & UDL for simple cases only.

TOPIC-7 : Torsion of shafts :

Torsion (defination) ,Torsional stresses and strains in a circular-shaft, Assumptions in torsion eqn. Derivation of Torsion equation, strength of solid shaft, polar moment of inertia. Torsional rigidity of shaft, calculation of shaft dia on the basis of (1) strength (2) stiffness for given power to be transmitted, Maximum Torque. Problem involving comparision of solid and hollow shaft.

TOPIC-8 : Springs:

Definition, Types of springs,
uses of springs, carriage springs,

or leaf. spring-semi helical and spiral springs elliptical type and quarter elliptical type., construction and uses, calculation of dimensions regarding no of plates, thickness of plate, max stress deflection & stiffness. Defination of Helical springs, and stiffness, close coiled helical spring, construction, use, & calculation of no. of turns & dia of wire and coils, max stress deflection and stiffness.

TOPIC-9 : Columns & struts :

Defination of strut and coloumn, short & long columns. Cripplin; or critical load, Different end conditions, determination of slenderness ratio, equivalentlength, assumptions, Numerical problems using Euler's formula, limitations of Euler's formula, Rankine's formula, radius of gyration, Rankines constant. for different end conditions and materials, limitation of Rankines Formula, Numerical problems of simple nature, comparison of Euler and Rankines Formula.

TOPIC-10 : Combined Bending and Direct stresses :

Axial loading and transverse bending of beam, Effect and nature, eccentric load and eccentricity stress calculation, Stress distribution and method of superposition, limit of eccentricity, middle third & middle fourth rule, Numerical problems.

TOPIC-11 : Stress in frames :

Definition of frame, classification of frames, no. of joints and number of members in a perfect frame, strut and tie-members, assumption made in finding out stresses in the members, method of joints, method of sections and graphical method, Bows notations, solution of problems by all three methods.

TOPIC-12 : Principal planes and principal stresses :

Stresses on an inclined section/subjec-ted to direct stress, stresses on an inclined section subjected to sheer-stress, definition of principal stresses & principal planes, location of principal planes. Calculation of normal and shear stress on a plane inclined to any angle to the direction of load, when (1) only tensile load. (2) Tensile & compressive load. (3) Tensile, comp. and shear load Principal stresses, Max shear stress, Magnitude and direction of normal stress on planes carrying the max. shear stress, Calculation of above by graphical method, Mohr's circle method for all the three loading conditons.

STRENGTH OF MATERIALS

LIST OF PRACTICALS

1. Study of Universal Testing Machine.
2. Study of Brinell Hardness Testing Machine.
3. Study of Izod Impact Testing Machine.
4. Tensile test of M.S. rod for (Prepared as per I.S.) on Universal Testing Machine.
5. Compression Test of wood / C.I. (As per I.S.) on Universal Testing Machine.
6. Hardness Test of Steel specimen by Brinell Rockwell and Vickers Hardness Testing Machine.
7. Izod Test on Impact Testing Machine.
8. Charpy Test on Impact Testing Machine.
9. Fatique Test on Fatique Machine.

.....

REFERENCE BOOKS

S.No.	Name of Book	Name of Author
1.	Strength of Materials	B.C. Punmia Vol.I
2.	------ do -----	R.S. Khurmi.
3.	------ do -----	Sadhu Singh
4.	------ do -----	K.D. Saxena
5.	------ do -----	S. Ramamurthem
6.	------ do -----	I.B. Prasad
7.	------ do -----	Rydor
8.	Laboratory Experiments in strength of materials	B.D. Sharma

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT: THERMODYNAMICS

R A T I O N A L E.

Basic principles of thermodynamics form an essential element of any mechanical engineering course these days. It is thought that if the basic principles are mastered in this core area, student will be able to solve many problems related to this area because the principles involved have fairly universal applications. Keeping this in mind the present course lays more emphasis on understanding and applying of fundamentals to practical problems in the area of thermodynamics. The study of these fundamentals will also be of direct relevance for comprehending Final year diploma course in Refrigeration and Air Conditioning.

The topics selected will also meet the requirements of the subjects kept at later stage. An introduction to air compressor will make the students more aware of the field applications.

M.P BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT: THERMODYNAMICS.

SCHEME OF STUDIES.

Topic No.	Name.	Theory hrs.	Tut./ Lab. Hrs.	Total Hours.
1.	Basic concept of thermodynamics	8	2	10
2.	First law of thermodynamics.	8	4	12
3.	Second law of thermodynamics.	8	4	12
4.	Ideal gases and processes.	8	4	12
5.	Two phase system.	4	4	8
6.	Thermodynamic cycles.	6	2	8
7.	Gas mixture and psychrometrics.	6	2	8
8.	Refrigeration systems.	4	4	8
9.	Air compressor.	4	2	6
	TOTAL	56	28	84

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT : THERMODYNAMICS.

1. BASIC CONCEPT OF THERMODYNAMICS :

Introduction, Macroscopic and microscopic aspects, Dimensions and units (S. I. units) system and surroundings- Closed system, open system and Isolated systems, Homogenous and Heterogheous system, working substance, pure substance, thermodynamics equilibrium, property, state and process, process and cyclic process, Density, specific volume and specific weight, Temperature, pressure. Energy and Forms of energy, stored energy. Heat, work, Reversible and Irrevessible process. Thermal capacity, specific Heat and Molecular heat.

2. FIRST LAW OF THERMODYNAMICS :

Law of conservation of mass, Law of conservation of energy, Relation between mass and energy, First law of thermodynamics. Application of First law to Non-flow or closed system - Reversible constant volume process, Reversible constant pressure process, Reversible constant temperature process, Reversible adiabatic process, Irreversibility. Application of First law to steady flow systems. Applications of steady flow energy Equation to work developing system (I.C. Engines, Turbines etc.), work absorbing systems. (pumps, compressors, refrigerators), Non work developing and absorbing esystems (Nozzles, heat exchangers etc.) Simple numerical problems in S.I. units.

(Contd....)

3, SECOND LAW OF THERMODYNAMICS :

Limitations of First law of thermodynamics, Heat engine and Heat pump, statements of second law of thermodynamics- Kelvin- planck statement, Clausius statement - diagramatic representation of the statements. Reversible and irreversible processes, carnot cycle, Reversibility and Efficiency, Thermodynamic Temperature scale, Clausius Inequality, Entropy, corollaries of second law of thermodynamics. Simple numerical problems in S.I. units.

4. IDEAL GASES AND PROCESSES :

Introduction, Boyle's law, Charle's law, characteristic equation for gases, Avagadro's Hypothesis and universal gas constant, Joule's law, specific heats of gases and their relation with gas constant, Non-flow, reversible adiabatic or Isentropic process. Non-flow processes using Ideal gas- Isochoric, Isobaric, Isothermal, Hyperbolic, Isentropic, polytropic processes. Change in entropy during polytropic process. Free expansion process, Throttling process. Steady flow processes using Ideal gas. Simple numerical problems in S.I. units.

5. TWO PHASE SYSTEM :(including properties of water and refrigerants.

Introduction of pure substance, phases, phase transformation at constant pressure, phase transformation; P-V-T Data, pressure - Temperature curve, generation of steam, conditions of steam, Thermodynamic properties of steam, steam tables, P-V-T. surface, steam property charts -T-s diagram,

(contd...)

Enthalpy - Entropy (h-s) diagram, pressure - Enthalpy (p-h) diagram, processes of vapar - P-V and T-S representation, work done during the process, heat transferred during the process, change in internal energy in case of constant pressure, constant volume, Adiabatic (Reversible and irreversible), Isothermal, polytropic, Throttling processes, Measurement of quality of steam, simple problems using S.I. unit.

6. THERMODYNAMIC CYCLES :

Air standard cycles, Efficiency of Air standard cycle, carnot cycle, otto cycle, Diesel cycle, Dual combustion cycle, Brayton or Joule cycle, use of efficiency expressions only, (No derviation of expressions,) Rankine cycle, vapour compression cycle and its analysis.

7. GAS MIXTURES AND PSYCHROMETRICS :

General considerations and mixtures of ideal gases, Dalton model, Amagat model, A simplified model of a mixture involving gases and a vapour, The first law applied to gas-Vapour mixtures, Adiabatic saturation process, wet bulb and dry-bulb temperature, The psychrometric chart, psychrometric properties.

8. REFRIGERATION SYSTEMS :

Absorption refrigeration system, steam jet refrigeration system.

9. AIR COMPRESSOR :

Introduction, classification, working of reciprocating air compressor, Air compressor Terminology, Equation for work porkg of air compressed with and without clearance, Volumetric efficiency, Multistage compression, H.P. and different efficiencies of a compressor, Root blower, Vane type blower, centrifugal compressors, static and total heads, velocity diagrams, Rotary V^s Reciprocating compressor, Axial V^s centrifugal compressors.

THERMODYNAMICS.

LIST OF EXPERIMENTS.

1. Demonstration of any thermodynamic devices (Boiler, steam Turbine, I.C. Engines, Vapour Refrigeration system, Air Compressor, etc.) for the purpose of First law Analysis of the systems by :-
   - (i) Identifying system boundary.
   - (ii) Identifying input and output energy quantities.
   - (iii) Measuring properties at input and output points.
2. Experiments to measure the following in different situations:-
   - (i) Pressure (above and below atmosphere)
   - (ii) temperature (temp. of flowing fluid, surface temperature, high temperatures etc.)
   - (iii) flow measurement of fluids, (fuel, cooling water, steam, air etc.)
   - (iv) speed.
   - (v) Power (brakes and dynamometers, indicators)
3. A first law open system air flow analysis, experiment with appropriate instrumentation.
4. Study of models, charts and actual units of the following:-
   - (i) common type of boilers.
   - (ii) steam Turbine.
   - (iii) surface condenser.
   - (iv) cooling tower.
   - (v) Vapour compression system of refrigeration.
5. Running and maintenance of Refrigerator.
6. Determination of dryness fraction of steam by combined separating and throttling calarimetor.
7. Study of - (1) Domestic Refrigerator.
   (2) Window type air conditioner.
8. Study of single stage air compressor.
9. Performance testing of a centrifugal/ Rotary air Compressor.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT: THERMODYNAMICS

LIST OF SUGGESTED REFERENCE BOOKS.

(1) Fundamental of classical Thermodynamics

3rd Edition S.I. VERSION

by - Gordan J. Van Wylen, Richard E. Sonntag
John Wiley & Sons.

(2) A course in thermodynamics & Heat Engines.

by- Kotha neeraman, Deulaundwar, Khajo-ria, Arora,
Dhanpat Rai & Sons.

(3) Thermal Engineering.

P.L. Ballaney,

Khanna Publishers.

(4) Thermodynamics by C.P. Gupta and Prashad.

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT : HEAT - TRANSFER.

R A T I O N A L E.

The laws which govern heat transmissions are important to the engineers in the design, construction, testing and operation of heat exchange apparatus. The mechanical engineer deals with the problem of heat transfer in the field of I.C. Engines, Steam generation, Refrigeration, heating and ventilation. To estimate the cost, feasibility and size of equipment necessary to transfer a specified amount of heat in a given time; a detailed heat transfer analysis is necessary.

Looking to the problems stated above, the subject heat transfer is kept in second year Diploma in Refrigeration and Air Conditioning. This will enable the students to understand, the physical picture of heat transfer, how heat transfer problems occur in Refrigeration and Air Conditioning and problems which can not be solved merely by thermodynamic reasoning alone but require analysis based on the science of heat transfer.

More emphasis have been placed on use of empirical equations rather than mathematical treatment. The syllabus has been prepared slightly in detail so that depth of coverage becomes clear.

Since the Government of India has already adopted the S.I. system of units to be in line with the other countries of the world, the S.I. units only have to be used in this subject.

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : HEAT TRANSFER.

SCHEME OF STUDIES.

S.No.	Topic.	Theory Hours.	Tut./Lab. Hours.	Total Hours.
1.	Introduction.	2	-	02
2.	Steady State Conduction (one dimensional)	6	6	12
3.	Steady state Conduction (Two dimensional)	5	4	09
4.	Unsteady State heat conduction.	3	-	03
5.	Thermal insulation.	2	-	02
6.	Convection.	6	4	10
7.	Free convection.	6	4	10
8.	Boiling.	4	2	06
9.	Condensation.	4	2	06
10.	Radiation.	6	2	08
11.	Solar radiation.	6	-	06
12.	Heat Exchanger.	6	4	10
	TOTAL	56	28	84

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

HEAT TRANSFER.

1. Introduction - Modes of Heat Transfer.
2. Steady state conduction - one dimensional) plane walls, radial systems-cylinders Heat source systems, plane wall with heat sources, cylinder with heat sources, conduction-convention systems, Extended services, thermal contact resistance.
3. Steady state conduction - two dimensions (simple numerical solution and use of shape factors.
4. Unsteady - state heat conduction (Use of various charts)
5. Thermal Insulation.
6. Convection (Laminar, transition and trubulent flow dimensionless numbers, concept of boundary layer.
   Evaluation of convective heat transfer transfer coefficient heat transfer coefficient for different geometries by use of emprical equations. Factors affecting the value of heat transfer coefficient, mechanical energy losses.)
7. Free convection (dimensionless, numbers, determination of heat transfer, coefficients for different geometries. Free convection boundary layer.)
8. Boiling (regimes of boiling, emprical equations for uncleate boiling and critical heat flux).
9. Condensation (film-wise condensation, growth of film on a vertical plate, velocity and temperature, profiles heat transfer coefficient for film condensation on a vertical plate, outside surfaces of tubes and tube banks, inside surface of tubes, dehumidification, drop-wise condensation.

(Contd..

10. Radiation - (nature of thermal radiation, absorptivity, reflectivity and transmissivity, concept of black body, grey body, stefan-Boltzmann Law, Kirchoffs Law, Emissivity, radiation, shape factor, determination of radiation shape factor for different geometries. Heat exchanges by radiation between different surfaces

11. Solar radiation (Solar constant, solar radiation incident upon the earth surface, spectral distribution of solar radiation, Movement of earth, latitude, longitude, geometrical relationship between earth and sun, solar angles, geometrical relationship between earth, sun and surface on earth, tilt angle time calculations, solar radiation calculations).

12. Heat Exchanger (Overall heat transfer coefficient, mean temperature differences, use of correction factors, effectiveness NTU method, different types of heat exchangers. Empirical design factors for different types of heat exchangers. Selection of heat exchangers, fouling of heat exchangers, use of extended surfaces, Augmentation factors, materials of construction).

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT : HEAT TRANSFER.

LIST OF EXPERIMENTS

1. Determination of thermal conductivity of insulating powder.
2. Comparision of thermal conductivities at various temperatures.
3. Determination of temperature distribution along the length of given bar.
4. Determination of thermal conductivity of given bar at various temperatures.
5. To determine average surface heat transfer coefficient for a pipe losing heat by forced convection.
6. To plot surface temperature distribution along the length of pipe.
7. To determine average heat transfer coefficient.
8. Determination of Thermal conductivity of Insulating material in the form of slab.
9. Comparision of Thermal conductivities of various insulating materials.
10. To study the temperature distribution along the length of fin in both natural and forced convection.
11. To study phenomenon of cross flow heat exchanger between condensing steam and cold water.
12. Determination of overall heat transfer coefficient for a tube-in-tube type heat exchanger.

(Contd...

13. To calculate - (i) Rate of heat transfer.
(ii) L.M.T.D.
(iii) Theoretical overall heat transfer coefficient.

14. To compare the performance of parallel flow & counter flow heat exchanger.

15. Determination of emissivity of non black surface.

16. Determination of Stefan - Boltzmann constant.

17. To find out heat transfer coefficient of dropwise and filmwise condensation at various flow rates of water.

18. Visualisation of condensation process in dropwise as well as film-wise condensation.

19. To determine heat flow rate through lagged pipe and compare it with the heater input for known values of thermal conductivity of lagging material.

20. To determine thermal conductivity of lagging material by assuming input to be heat flow rate through lagged pipe.

NOTE:- The teachers are advised to perform few experiments depending upon the availability of equipment in the institution.

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

SECOND YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT :- HEAT TRANSFER

LIST OF SUGGESTED TEXT/ REFERENCE BOOKS.

(1) Heat Transfer by J.P. Holman (S.I. metric Edition)
Mc graw Hill (Metric Editions, Mechanical Engineering Series)

(2) Engineering Heat transfer
By C.P. Gupta and Rajendra Prakash
Nem chand & Bros, Roorkee.

(3) A Text Book on Heat Transfer
By Dr. S.P. Sukhatme.
Orient Langman Ltd; New Delhi.

(4) Problems in Heat Transfer
By E. Krasnoshekekov, A. Sukomel
Mir Publisher, MOSCOW.

(5) Heat and Mass Transfer
by Chapman.

SUBJECT : MECHANICAL DRAWING.

R A T I O N A L E

Drawing as a communication medium, has a significant role in the professional practice of technicians./ Development of competencies related to drawing is, therefore, one of the important aims of any technician curriculum. This course of mechanical drawing for diploma courses is aimed at developing a foundation of such basic knowledge and skill, Wherever I.S. 696 is to be referred it is understood that latest revision shall be followed.

SUBJECT : MECHANICAL DRAWING.

CONTENTS

S.No.	TOPIC.	Theory Hours.	Pract. Hours.	Total. Hrs.
1.	Introduction to drawing and drawing instruments.	1	-	01
2.	Planning and layout of draiving.	1	-	01
3.	Standard co nvention and symbols in Engg. Drawing practice.	02	-	02
4.	Line and letter printing	01	8(1 plate)	09
5.	Scales.	02	9(1 plate)	11
6.	Engineering Curves.	03	18(2 plates)	21
7.	Dimensioning techniques.	02	-	02
8.	Orthographic projection of points, lines and planes.	04	24(3 plates)	28
9.	Projection of solids.	02	18(2 plates)	20
10.	Section of solids.	02	9 (1 plate)	11
11.	Intersection of surfaces	02	9(1 plate)	11
12.	Development of surfaces.	02	9(1 plate)	11
13.	Projection of simple machine parts and components.	02	27(3 plates)	29
14.	Isometric Projections.	02	9 (1 plate)	11
	Total	28 Hrs.	140 Hrs. (16 plates)	168 Hours.

MECHANICAL DRAWING.

TOPIC :1 : INTRODUCTION TO DRAWING INSTRUMENTS.

Introduction to drawing equipments, instruments and their uses.

TOPIC 2 : PLANNING AND LAYOYT OF DRAWING

Planning of drawing sheet as per I.S. 696 - 1972, Indian standard practices of laying out and folding of drawing.

TOPIC 3 : STANDARD CONVENTIONS AND SYMBOLS USED IN ENGINEERING DRAWING PRACTICE.

Identification and representation of various symbols used in Mechanical Engineering Drawing, Identification and representation of various symbols used in Electrical Engineering Drawing, Identification and representation of various symbols of building elements, materials and sanitary fittings.

TOPIC 4 : LINES AND LETTER PRINTING.

Different types of lines used in engineering practices, practice problems for representation of each type of line, standard practice for writing single stroke vertical and inclined capital and lower cases letters, standard practice of writing numerals.

TOPIC 5 : SCALES.

Importance of scale in Engineering Drawing, Types of scales- Plain, diagonal and vernier scale, practical problems for constructing various types of scale.

TOPIC 6 : ENGINEERING CURVES

Terms associated with engineering curves, types of engineering curves, Method of construction of engg. curves, Practice problems of drawing various engineering curves.

TOPIC 7 : DIMENSIONING TECHNIQUES

Principles, system and arrangement of dimensioning, practice problems of correct method of dimensioning.

TOPIC 8 : ORTHOGRAPHIC PROJECTION OF POINTS LINES AND PLANES.

Definition of various terms associated with orthographic projection, planes of projections, quadrants, first and third angle method of projection, practice problems on projection of points projection of line in different positions with respect to H.P., V.P. and X-Y line, Projection of planes in different position with respect to reference plangs.

TOPIC 9 : PROJECTION OF SOLIDS

Types of solids, terminology, positio n of solid with respect to reference planes, procedure of drawing projections of solid in different position with respect to reference planes, Practice Problems to draw projections of solid in different positions.

TOPIC 10 : SECTION OF SOLIDS

General concept of sectioning, planes, auxiliary planes and true s shape of section, practice problems for drawing projections and section of solids.

TOPIC 11 : INTERSECTION OF SURFACES

Definition of intersection of surfaces and its applications, distinction between line method and cutting plane method, pr actice problems for drawing lines of intersection of different intersecting solids.

TOPIC 12 : DEVELOPMENT OF SURFACES

Concept and importance of development in Engineering applications stating few important applications; parallel line and radial line method, practice problems.

TOPIC 13 : PROJECTIONS OF SIMPLE MACHINE PARTS AND COMPONENTS.

Procedure for drawing projections and sectional views of simple machine components, practice problems of sketching and drawing the projections and sections of simple machine components, Assembly drawing of simple machine parts.

TOPIC 14 : ISOMETRIC PROJECTIONS

Limitations of orthographic projections, definitions of the terms Axonometric, Oblique, Isometric and dimetric projections, procedure for preparing isometric, oblique drawing of geometrical solids and simple machine parts, practice problems

MECHANICAL DRAWING.

BOOKS RECOMMENDED.

(1) I. S. 696, 1972 (Latest revision)

(2) Engineering Drawing

By N.D . Bhatt.

(3) Engineering Drawing & Machine Drawing.

By Dhawan Kumar.

(4) Engineering Drawing

By M.B. Gupta.

(5) Geometrical Drawing

By P.S. Gill (Publisher - Kotson & Sons).

(6) Machine Drawing

By P.S. Gill (Publishor - Kotson & Sons.)

FLUID MECHANIC AND MACHINERY.

R A T I O N A L E.

This course is intended to introduce basic principles of fluid mechanics to the students. It is further extended to cover some important applications of fluid mechanics by the inclusion of fluid machinery especially water turbines and water pumps. The principles of fluid mechanics find wide applications in many different situations directly as well as indirectly and their mastery will help the technicians in solving many varied problems in the industry.

Fluid storage, transportation and measurement are some of the applications which abound, whatever be the nature of industry. Use of pneumatic and hydraulic controls is fast increasing. Also the use of fluid machinery, turbines, motors and pumps for controls, general purpose and in power stations is getting an accelerated fill up. Thus there is a great relevance for this subject for mechanical technicians.

It should be noted that the mechanical technicians have to deal with a large variety of fluids like water, air, steam, ammonia and even plastics. The major emphasis in this subject is on the study of incompressible fluid like water, However it is hoped that the applicability or otherwise of the principles dealt with in this subject will be considered for other fluids so as to provide wider perspective to this subject.

FIRST YEAR DIPLOMA IN MECHANICAL ENGINEERING.

(Two Year Diploma * 2 Scheme)

SUBJECT :- FLUID MECHANICS AND MACHINERY

C O N T E N T S

Topic No.	TOPIC.	Lecturer Hrs.	Pract./Lab. Hrs.
	S E C T I O N 'A'		
1.	Fundamentals of fluid flow.	04	-
2.	Pressure and its measurement	06	04
3.	Basic equations of fluid flow.	06	.06
4.	Flow through orifices and mouth pieces.	06	.04
5.	Flow through pipes.	06	.02
	SECTION "B"		
6.	Impact of jets.	05	02
7.	Water turbines.	10	.06
8.	Water pumps.	06	.04
9.	Model analysis.	.03	--
10.	Hydel Power stations.	.04	--
	Total	56	28

FLUID MECHANICS AND MACHINERY

SECTION 'A'

1, FUNDAMENTALS OF FLUID FLOW :-

Definition of Fluid : (a) Ideal (b) Practical compressible and incompressible fluid, fluid properties density, specific weight, specific gravity, viscosity (dynamic and kinematic) Types of flow-laminar and turbulent, steady and unsteady uniform and nonuniform discharge, Continuity equation. Simple numerical problems on equation of continuity with practical and specific applications.

2. PRESSURE AND ITS MEASUREMENT :-

Concept of pressure, intensity of pressure, pressure head, difference between gauge pressure, vacuum and absolute pressure. Manometers, piezometer, U-tube manometer, inclined manometer, differential manometer, pressure gauges.

3. BASIC EQUATIONS OF FLUID FLOW :-

Various forms of energies present in fluid flow, elevation energy, kinetic energy, pressure or flow energy. Total energy of fluid particle in motion.

Bernoulli's theorem, general steady flow energy equation and derivation of Bernoulli's equation, assumptions made, practical applications of Bernoulli's equation-venturimeter, flow nozzle, orifice plate, pitot tube, simple problems on venturimeter, pitot tube and orifice plate.

4. FLOW THROUGH ORIFICES AND MOUTH PIECES :

Vena-contracta, coefficient of contraction, velocity and discharge, head losses due to sudden enlargement, contraction and obstruction in a pipe. Mouth pieces-types, purpose simple problems on 'loss of head'

5. FLOW THROUGH PIPES :

Laminar and turbulent flow, Head loss, pipe friction factors, Darcy's formula, chezy's equation, simple pipe line problems. based on Darcy's formula.

Water hammer, simple explanation.

SECTION 'B'

6. IMPACT OF JETS :

Impact of jet on flat plate (stationary and moving), Impact of jet on curved plate (Stationary and moving), work done by pelton turbine runner. Simple Problems.

7. WATER TURBINES :

Classification - Impulse and reaction, comparison, description and working of pelton, Francis and Kaplan turbines, selection of turbines.

8. WATER PUMPS (Centrifugal and reciprocating) Principle, construction, working, classification layout, comparison of centrifugal & reciprocating pumps, starting, specific speed, selection of pumps.

9. MODEL ANALYSIS :

Geometric, Kinetic and dynamic similarity.

10. HYDEL POWER STATION :

Schematic diagram, function of various elements, advantages over other power stations.

LIST OF EXPERIMENTS IN FLUID MECHANICS AND MACHINERY

The laboratory work must be performed on the following points.

(i) Objectives.

(ii) Apparatus.

(iii) Procedure.

(iv) Sketch of experimental set-up.

(v) Data sheet.

(vi) Data processing.

(vii) Precautions.

(1) To measure the pressure of water in pipe by :-

(a) Piezometer.

(b) Different types of manometers.

(2) To apply Benaulli's equation to flow of water in a given flow situation.

(3) To determine C_c, C_v, C_d for orifices and mouth pieces

(4) To determine losses due to sudden enlargement and sudden contraction and elbows.

(5) To study and use the following for flow measurement.

(a) Venturimeter.

(b) Flow nozzle.

(c) Orifice plate.

(d) Pitot tube.

(6) To study different types of water turbines and determine performance characteristics.

(7) Study of a centrifugal pump.

(8) Study of reciprocating pump.

R E F E R E N C E.

(1) A text book of Hydraulics, Fluid mechanics & Hydraulic Machines by Khurmi
(S. Chand & Co. Ltd;)

(2) Fluid mechanics by M. Danchar.

(3) Hydraulic & Hydraulic Machines by Dr. Jagdish Lal.

(4) Hydraulic & Hydraulic Machines by Priyani.

(5) Fluid mechanics with Engg. applications.
by R.L. Draughtery and A.C. Jugersoll
(M.C.Graw Hill)

(6) Fundamentals of Hydraulic Machinery by S. Ananthaswamy.

(7) Journal of Experiments in hydraulic laboratory
by Y.V.N. Rao & Hasan (New heights).

(8) Fluid mechanics by Dr. M.L. Mathur (Std. Publication).

SUBJECT : MANUFACTURING PROCESS ENGINEERING AND PRACTICE.

R A T I O N A L E.

Manufacturing process are advancing very fast with the explosion of technology. This subject will provide basic insight in the students regarding modern of mass manufacturing processes. In order to maintain proper level of interest for understanding the subject in the First year, elementary introduction is given, especially in metal machining. The abilities developed by studying this subject will be directly helpful to all the technicians, in whatever field they are employed.

INTRODUCTION :-

To cover the broad base for technicians employed in the categories of production, maintenance, inspection, design-drafting, and industrial engineering, the subject gives the opportunity for exhaustive study of metal casting, mechanical working of metals joining and metal machining processes.

The course is aimed with the objective of eleminating less important and in-corporating important course material. The course materials selected and arranged in objectives and contents in such a manner, so as to contribute to mechanical engineering diploma student's specific technical knowledge in stimulating of creative thinking and solving of facing problems.

APPROACH :

Taking into consideration the above objectives much emphasis has been given to understand the selection of machines, materials, tools and applications thereof. An attempt has also been made to develop the manipulative skill together with funlamentals of processes and sufficient practical work in the different shops in the workshop has been suggested to be imparted to the students.

—

MANUFACTURING PROCESS

ENGINEERING & PRACTICE

C O N T E N T S.

S.No.	TOPIC.	THEORY HRS.	PRACTICAL HRS.	TOTAL.
1.	Metal Casting	15	24	39
2.	Mechanical Working.	18	24	42
3.	Metal Joining.	14	24	38
4.	Metal Machining.	09	12	21
	TOTAL	56	84	140

FIRST YEAR DIPLOMA IN MECHANICAL ENGINEERING.

SUBJECT : MANUFACTURING PROCESS I ENGG. AND PRACTICE.

TOPIC 1 : METAL CASTINGS.

(a) Patterns Making :- Introduction to metal casting- Advantages and limitations of casting as a production process.

Types of patterns and materials desirable properties.

Types and area of applications, special features of solid, split match- plate and sweep pattern pattern Allowances - shrinkage Phenomena- Shrinkage Allowance and shrinkage rule. Effect of shrinkage on castings. Machining and draft allowances.

Use of fillets, Technique of preparation of patterns.

Colour code for patterns.

Use of cores in moulding. Determination of shape and size of Cores-Preparations of cores and core-boxes.

(b) Moulding :- Sand properties, Moisture content and its effects. Sand compositions for different applications-Sand conditioning-Moulding materials and machines moulder tools and functions.

Different parts of mould-preparation of sand-moulds- open, two mould box, three mould box, process and application. Characteristics and defects of moulds.

Casting metals :- Casting metals- Typical application of cast iron, brass, steel, Alluminium, gun-metal .

Furnaces :- Pit furnaces, cupola and crucible furnaces, their salient features, advantages and limitations. Preparing furnace for melting, safety aspects.

Casting prdcess :- Dangers of pouring the metals directly on moulds. Use of runners, risers, gate etc. Factors affecting shape and size cleaning and testing of castings-flows. Need for special casting, methods like, centrifugal, and die casting. Area of applications casting defects- causes and analysis salvaging of faculty castings quality control techniques at different stages in the foundry.

TOPIC 2: MECHANICAL WORKING.

(a) Hot working :-

Importance and principle of mechanical working- structural changes in the process. Advantages and disadvantages of hot working equipments required and different hot working methods.

(b) Cold working :-

Basic principles, grain structure, strength hardness, cold processes. Forging, press work, cold rolling, drawing, spinning. Residual stresses and the remedies.

Comparison of hot and cold working, advantages and disadvantages of cold working.

Preheating principles equilibrium diagram, its use for determining preheating temperature.

(c) Metal Rolling :

Principles of metal rolling, basic components. Simple rolling process equipment. Types of deformations, ingot rolling materials, Principle of thread rolling, Manufacture of seam less tubes. Flow diagram of a modern rolling mill.

Types of rolling mills, salient features, method, selection.

Metal Drawing :-

Basic Concept of plasticity, ductility, malleability.

Different drawing practice.

Wire work drawing equipment, die details.

Metal Spinning :- Process of metal spinning principles.

Extrusion :- Extrusion- Direct and indirect methods.
Advantages and limitations.

Forging :- Die forging, defects, calculations
Advantages and limitations.

Forging :- Press forging, up set forging, die-material.

Press Work :- Double action, press, Die punch, types of die, specification of press, safety.

2

TOPIC 3 : METAL JOINING.

(i) Arc welding :-

Principle of Arc welding -

a. A C and D C

b. Metal Arc, Carbon Arc, Atomic Hydrogen.

c. Shielded and unshielded Arc.

Applications of Arc welding Difference between A.C. and D.C. Arc welding machines, Bare and coated electrodes, materials of electrodes, cast iron, steel, nonferrous and alloys,

Sequence of operations involved in Arc welding,

Precautions.

Fundamental types of joints, edge, butt, Corner, lap and tee and welding of the joints (above), plug joint, pipe and flat joint.

(ii) Resistance welding processes from basic principles for given job, selection of process of resistance welding, equipments and tools. Differentiate between squeeze time weld time and hold time.

(iii) Gas welding :-

Basic principle of gas welding, gas combinations and necessity.

Different flames and their temprtures and proper adjustments, equipments and tool and their functions.

Low and high pressure gas welding torch, Differentiate between these on the basis of construction and application.

Fluxes types and selection. Filler metals necessity classification and selection.

(iv) Gas Cutting :

Gas cutting, lance cutting, carbon and metal Arc cutting. Description and application. Cutting torch and comparison with welding torch Gas cutting operation, condition affecting the quality of cut-safety precautions.

(v) Weldability :-

Weldability characteristics of weldable material. Influence of welding conditions. Weldability test-component, Simultation, critical. Description and application. Comparison of weldability of different metals welding defects and causes.

Testing of welds-Visual-destructive-selection of suitable method of testing as per quality.

TOPIC 4: METAL MACHINING.

Introduction, scope and limitations of machining, machining methods, Principle elements of metal cutting, Lathe functioning, constructional details of lathe bed, head stock, tail stock, saddle, cross slide, compound slide, lead screw, feed, shaft and tumbler gear.

(a) Turning - Drilling :

Work holding methods for lathes, Drilling machine, types of drill machines, construction of drilling machine, drill chuck, drill shank and type of drills.

(b) Machining :

Shaping, slotting and planning machinings constructions, functions of main parts. Work holding devices-Quick return machanism for shaper, planer and slotter.

WORKSHOP PRACTICAL.

SUBJECT : MANUFACTURING PROCESS ENGINEERING AND PRACTICE.

S.No.	Practical details.	Shop	Time allotted	Remark
1	2	3	4	5
1.	Carpentry practice on Sawing, planning, chiselling and simple Joinery work.	Carpentry/ Pattern shop.	6 Hrs.	
2.	Making a split/solid pattern from wood.	Pattern shop.	3 Hrs.	
3.	Making a core - box.	-do-	3 Hrs.	
4.	Tempering of sand, practice of green and dry sand making.	Moulding shop/ & Foundry.	3 Hrs.	
5.	Practice of core making and baking.	-do-	3 Hrs.	
6.	Practice of open mould in a two box, using split pattern and solid pattern. Locating the core.	-do-	3 Hrs.	
7.	Demonstration of casting of metal in pit furnace.	-do-	3 Hrs.	
8.	Simple forging practice (Making a square bar out of a given round bar, Making of a chisel) and bolt.	Blacksmithy Shop	9 Hrs.	

1	2	3	4	5

9. Practice of upsetting of a round on power hammer.	Blacksmithy shop	3 Hrs.
10. Practice of sheet cutting with the help of straight and bent snips. Making small rectangular prism and cylinder.	Tinsmithy shop	6 Hrs.
11. Practice of making of washer of any size on a flypress.	-do-	3 Hrs.
12. Practice of piercing, notching and circle cutting with the help of a Metal master machine.	-do-	3 Hrs.
13. Practice of sawing, filling and fitting of small rectangular pieces preparation of edges for welding.	Fitting	9 Hrs.
14. Linear measurement of jobs with the help of calliper, micrometer and simple measuring tools.	-do-	3 Hrs.
15. Demonstration and practice of bead laying (welding) on a flat piece.	Welding.	2 Hrs.

1	2	3	4	5
16.	Practice of welding of corner edge and Tee joint.	Welding.	3 Hrs.	
17.	Welding 'V' butt joint.	-do-	3 Hrs.	
18.	Practice of joining wires and rods of different size on spot welding machine.	-do-	2 Hrs.	
19.	Practice of making gas flames with nozzles and making simple joints.	-do-	2 Hrs.	
20.	Demonstration and practice of plain turning & step turning on any given piece of bar.	M/c. Shop.	3 Hrs.	
21.	Practice of Knurling grooving and boring on a lathe turning between centre and using chuck.	-do-	3 Hrs.	
22.	Simple drilling practice on flat pieces.	-do-	3 Hrs.	
23.	Shaping of a rectangular job.	-do-	3 Hrs.	

REFERENCES

S.No.	Title.	Author/Publisher
1.	Foundry Practice.	Asian Publication.
2.	Welding Technology Vol. I.	Hazra Choudhary.
3.	Mechanical Technology.	Charnok.
4.	Forging and Forming.	Russi - noff.
5.	Manufacturing processes	Young.
6.	Manufacturing Science and Technology Vol. I & II.	Hazra Choudhary. Suresh Dalela.
7.	Workshop Technology Vol. I. & II.	Hazra Choudhary.
8.	Workshop Technology Vol. I & II.	Raghuvanshi.

SECOND YEAR DIPLOMA IN MECHANICAL ENGINEERING
ELECTRICAL ENGINEERING AND ELECTRONICS/
[illegible]
REFRIGERATION AND AIR CONDITIONING

** C O N T E N T S **

SECOND YEAR DIPLOMA IN MECHANICAL ENGINEERING
ELECTRICAL ENGINEERING AND ELECTRONICS/
REFRIGERATION AND A.C.

=O=

1. D.C.Machines:- Constructional features of D.C. Machines-field system,main poles, inter poles, commutator, armature, types of armature windings, number of parallel circuits, EMF equation. D.C.Motor :- Back emf, speed equations, torque equation, Series shunt and compound field connections, characteristics of d.c. motor; their applications for various types of load, starting and speed control of d.c. motors.

2. Alternating current Circuits:- Sinusoidal waveform, average & effective values, form factor; phase and phase difference, vector representation, circuits containing, R,L. and C and their combinations,

Three phase a.c. star and delta connections, current and voltage relationstip between phase and line quantities, power in three phase circuit, Neutral current, 3 phase 3 wire and 3 phase 4 wire systems.

3. Transformers :- Principle, constructional features of core type and shell type single and three phase transformers. Transformation ratio and e-m.f. equation. Transformer on load, ideal transformer, no load current, Transformer on load(Vector diagram), transformer resistance and reactance in terms of primary and secondary. Open circuit and short circuit tests, Losses, efficiency and regulation of transformer, all day efficiency. Cooling of transformers.

4. Synchronous Machines:- Principle, relation between F.N. &F construction-cylindrical rotor and salient pole rotor, slip rings, 3 phase windings on stator; emf equation of the generator, losses. Synchronous motor principle, speed equation synchronous motor under variable load and variable excitation. Application for power factor improvement and applications as drive.

contd.... .2

5. Induction Motor:- Principal, construction, wound rotor and squirrel cage rotor, Slip & slip frequency, rotor copper loss, rotor [illegible] rotor resistance and reactance at standstill and running conditions. Torque equation, slip-torque and speed-torque characteristics.

Starting of induction motor-types of starters, D.O.L., star/delta and auto transformer starter. Applications of induction motor.

6. Single phase motors:- Principle, production of starting and running torque, split phase motor-capacitor start and capacitor run motors, shaded pole motors.

7. Electrical Measurments:- Principles of M.C.,M.T. instruments and induction type of meters, necessity of controlling and damping torques and methods of production them. Voltmeters & ammeters, use of instrument transformers for extension of range.

8. Wattmeters and energymeters:- Single phase type, measurement of power in three phase circuit by two wattmeter method, two element and three element wattmeters and energymeters & their connection diagrams.

9. Electronics:- Semiconductor devices-P.N. Junction,diodes. Transistors, P+N-P & N-P-N, [illegible], SCR,(only identification, of terminals and the characteristics of the devices). Simple circuits-H.W.and F.W. rectifier, wave-forms filters, use in battery charging circuits.

Amplifier- amplifier action of transistor, classification of amplifiers.

SCR as a controlled rectifier device.

----0----

SECOND YEAR DIPLOMA IN MECHANICAL ENGINEERING

= 0 =

List of recommended practicals for Electrical Engineering and Electronics.

1. Study of D.C. Machine .
2. Speed control of D.C. motors.
3. Study of D.C. Motor starters.
4. Performance of R.L.C; series & parallel circuits.
5. Star and Delta Connection-Verification of phase and linevoltages and current.
6. Determination of transformation ratio.
7. Determination of efficiency of single phase transformer by o.c. & s.c. tests.
8. Study and operation of 3 phase squirrel cage and slipring induction motor.
9. Study and operation of starters for induction motor.
10. Study and operation of single phase induction motor.
11. Study and mode of connection of different types of measuring instruments.
12. Measurment of power and energy in single phase circuit.
13. Measurement of power in a three phase circuit by two wattmeter method.
14. Study of Various electronic devices such as diodes, transistors, FET,SCR etc.
15. Study of rectifiers and observation of wave form on CRO.
16. Study of a battery charging circuit.

List of Reference Books

1. Electrical Engineering and Electronics
By. B.L.Theraja

2. Electrical Measurements
By. J.B .Gupta
Dhanpat Rai & Sons Pub.

3. Elementry Electrical Engineering
By. H.Partab
Dhanpat Rai & Sons Pub.

4. Electrical Engineering
By. S.L. Uppal
Khanna Pub.

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FINAL(THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SCHEME OF EXAMINATION

S.No.	Subject.	Term work	Lab. work	Progressive Assessment I	Progressive Assessment II	Board's Theory Exam. No. of paper	Board's Theory Exam. Duration in hrs.	Board's Theory Exam. Marks	Board's Practical Exam. Duration in hours	Board's Practical Exam. Marks	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
1.	Refrigeration-I	20	20	10	10	1	3	100	3	50	
2.	Refrigeration-II	20	20	10	10	1	3	100	3	50	
3.	Air Conditioning-I	20	20	10	10	1	3	100	3	50	
4.	Air Conditioning-II	20	-	10	10	1	3	100	-	-	
5.	Refrigeration and Air Conditioning System Control and Instrumentation.	20	20	10	10	1	3	100	3	50	
6.	Engineering Drawing.	-	50	10	10	1	3	100	3	50	
7.	Entrepreneurship and Management.	20	-	10	10	1	3	100	-	-	
8.	Installation, Operation Maintenance of Refrigeration and Air conditioning Plants.	20	20	10	10	1	3	100	3	50	
9.	Project.	-	50	-	-	-	-	-	3	100	
	TOTAL	140	200	80	80	8	-	800	-	400	

Total Theory Marks. 800

Total Sessional & Pract. and Progressive marks. 900

Ratio of Theory, Sessional and Practical marks. 1:1.125

Total Marks. 1700

1/135

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SCHEME OF STUDIES.

S.No.	Subject.	Theory and Tutorial hours per week.	Total Theory and tutorial hours per year	Practical hours per week	Total Practical Lab. hours per year	Total contact hours/year	Remarks
1	2	3	4	5	6	7	8
1.	Refrigeration - I.	2+1	84	2	56	140	
2.	Refrigeration - II.	2+1	84	2	56	140	
3.	Air Conditioning -I.	2+1	84	2	56	140	
4.	Air Conditioning -II.	2+1	84	-	-	84	
5.	Refrigeration and Air Conditioning system control and Instrumentation.	3+0	56	-	-	56	
6.	Engineering Drawing.	1+0	28	5	140	168	
7.	Entrepreneurship and Management.	2+0	56	-	-	56	
8.	Installation, Operation and Maintenance of Refrigeration and Air Conditioning Plants.	2+0	56	3	84	140	
9.	Project.	-	-	3	84	84	
	TOTAL	15+4	532	17	476	1008	

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

RATIONALE.

Refrigeration is becoming popular day-by-day and luxuries of Yesterday are becoming necessities of today. The importance of Refrigeration is increasing in the human life. Refrigeration has become heart of food industry. Preservation of food, fruits, vegetables, meat and fishes etc. are common examples of Refrigeration. a technician has to face in general. Hence it is felt that basic knowledge of Refrigeration must be gained by a technician of this discipline.

This subject deals with the basic principles of Refrigeration. It starts with basic refrigeration cycles and its analysis. It makes convergent to the student with various components of a Refrigeration system and their detailed study, which will be useful in the operation of a refrigeration unit.

M.P. BOARD OF TECHNICAL EDUCATION

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : REFRIGERATION - I.

SCHEME OF STUDIES.

Topic No.	Name of Topic.	Theory Hours	Tut./Lab. Hours	Total Hours
1.	Air conditioning Cycle	10	2	12
2.	Vapour Compression Refrigeration Cycle.	10	6	16
3.	Evaporators	4	2	6
4.	Compressors	6	4	10
5.	Expansion Devices.	4	2	6
6.	Condensers and Cooling Towers	8	4	12
7.	Defrosting Methods.	3	2	5
8.	Non-Mechanical Refrigeration	3	2	5
9.	Refrigeration	8	4	12
		56	28	84

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.1 SUBJECT : REFRIGERATION - I.

TOPICS

3.1.1 AIR REFRIGERATION CYCLE :

Concept of Refrigeration, Standard Rating of Refrigeration. Comparision of Engine, Refrigerator and Heat Pump with the help of Source and Sink Temperature, Performance, Purpose, Carnot Cycle- Reversed Carnot Cycle-Coefficient of Performance-Air Refrigeration Cycle-Bell Coleman Refrigerator. Actual Analysis of Bell Coleman Cycle. Advantages and Disadvantages of Air Refrigeration system. Necessity of Cooling the Aeroplanes- Air Craft Cycles-Simple Cooling and Simple evaporating Type, Bootstrap and Boot Strap Evaporator. Regenerative-Reduced Ambient Type Cooling System. Comparision of Different Air Cooling Systems used for Air Craft Actual Air Conditioning System of Aeroplane with Controls.

(No. of Hours 12)

3.1.2 VAPOUR COMPRESSION REFRIGERATION CYCLE :

Simple vapour Compression Refrigeration Cycle, simple saturated Cycle Processes-Compression-Condensation-Expansion and Evaporation. T-S, H-S, P-H, Diagrams. Vapour Compression Refrigeration Cycle. Analysis of Vapour Compression System. Theoretical H.P. -C.O.P.-LOAD-Etc. Effect of suction Temperature and Condensing [illegible] Temperature on Cycle Performance, effect of Subcooling and Degree of Super Heat on performance.

Effect of Changes in the condensor and Evaporator Pressures on the performance of Cycle, use of suction Heat Exchanger, Deviation from simple Cycle, Numerical Problems with the help of Charts and Tables

(Contd...

3.1.3 EVAPORATORS :

Purpose of Evaporators Types of Evaporators-Direct Expansion and Flooded Evaporators. Natural Convection and Forced Convection Evaporators, Liquid Chilling Evaporators. Capacity of Evaporators. Overall Heat Transfer Coefficient. Secondary Evaporator.

(No. of Hours 06)

3.1.4 COMPRESSORS :

Purpose of Compressor, Types of Compressors, Reciprocating-Rotary and Centrifugal Compressors. Hermatically Sealed Compressor. Reciprocating Compressor-Volumetric Efficiency of Reciprocating Compressor. Factors Influencing Total Volumetric Efficiency-Variation in Compressor Capacity with Suction and Condensing Temperature. Compressor Horse Power. Multi stage Compression. Water Jacketing of the Compressor cylinders. Wet Compression-Effect of Compressor Clearance on H.P. Compressor Speed-Mechanical Efficiency and other Efficiences. Effect of Suction, Super Heat on Compressor Performance. Advantages and Disadvantages of Centrifugal Compressor over Reciprocating Compressor Selection of Compressor.

(No. of Hours 10)

3.1.5 EXPANSION DEVICES :

Purpose, Types of Expansion Devices, Capillary Tube, Automatic Expansion Valve, Thermostatic Expansion Valve, Low side Float Valve, High Side Float Valve, Solenoid Controlled Valve, Expansion Valve Rating and Selection.

(No. of Hours 06)

3.1.6 CONDENSERS AND COOLING TOWERS :

Purpose, Different Types of Air cooled and water cooled condensers. Advantages and Disadvantages of air cooled cond-

(Contd.....

ensers over water cooled condeners. Economic Water Rate. Water Velocity and Operation of the Condenser. Evaporative Condenser. Effect of non condensible gases on performance of Condenser. Methods of Cooling Water For Condenser spray ponds-Cooling Towers - Natural and Forced draft cooling Towers. Simple numerical problems on Condensers and cooling Towers.

(No. of Hours 12)

3.1.7 DE-FROSTING METHODS :

Humidity and its Relation to Evaporators-Importance of Defrosting Evaporators-Frosting-Non Frosting and Defrosting Evaporators - Temperature Defrost Methods, Time Shut Down and supplementary Heat Defrost Methods.

(No. of Hours 05)

3.1.8 Non Mechanical Refrigeration Absorption Refrigeration, Steam jet Refrigeration-Therm Electric Refrigeration, Vortex Tube Refrigeration.

(No. of Hours 05)

3.1.9 REFRIGERANTS :

Introduction cum classification, Desirable properities of Refrigerants. (Thermodynamic Physical and Safe working Properties) Air, Ammonia, Carbon Dioxide, Methyl Chloride-Halogenated Hydracarbons-R_{11}-R_{12}-R_{13}-R_{22}-R_{113}-R_{114} Application of Freon Group. Azeotrops, Cryogenic Refrigerant - Secondary Refrigerants. NaCl and $CaCl_2$ Brines. Anti Freeze Solutions, Selection of Refrigerants.

(No. of Hours 12)

(Contd.....

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.1 REFRIGERATION LABORATORY - 1

LIST OF EXPERIMENTS

S.No.	Name of the Practical
1.	Cutting copper Tubing Flaring copper tubing Bending copper tubing.
2.	Soldering copper tubing Making soldered joint using swaged tubing.
3.	Study (dismantling and assembling) of 1. Two-way service valve 2. One-way service valve 3. Liquid line valve
4.	Calibration of pressure gauges Calibration of Compound gauges Installing gauges Removing gauges
5.	Pressure and temperatures on operating units. (Observation after unit has operated for a period of time).
6.	Purging air from system.
7.	Locating refrigerant leaks using the Halide leak detector.
8.	Charging a system through low side.
9.	Determining the operating head pressure of a system. I. Determining the refrigerant. II. Checking refrigerant pressure with gauge pressure. III. Determining the operating head pressure with data.
10.	Testing the efficiency and capacity of a Compressor.
11.	Evacuation of a system charged with refrigerant.
12.	Removing refrigerant from the systems. I. Using compressor. II. Using Pump out unit. III. Using refrigerant cylinder. VI. Using special access fitting.

(Contd....

13. Thermostatic automatic valves.

I. Adjusting the automatic systems.
II. Servicing and trouble shooting.

14. The capillary tube -

I. Adjusting the capillary tube system.
II. Servicing and trouble shooting.

15. Hermetic and semihermetic compressors.

I. Construction features.
II. Testing a hermetic compressor motor assembly.

(Total Practical Hrs. 56)

=O=C=

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT :- REFRIGERATION - II

R A T I O N A L E

Looking to the vast use of Refrigeration, basic knowledge of Refrigeration must be supplemented by practical applications in the field. Refrigeration has vast field of application- right from daily life to preservation of food and industrial uses. Refrigeration application in medical science has helped in increasing human life. These vast uses have led to study the applications of Refrigeration squarely.

This subject deals with the field of application of Refrigeration in food industry, ice making units, chilling centres etc, It also incorporates the study of emerging topic like Cryogenic. Besides human comfort, it deals with commercial uses of refrigeration.

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : - REFRIGERATION - II

SCHEME OF STUDIES

Topic No.	Name of Topic	Theory Hours	Tut./Lab Hours	Total Hours
1.	Vapour Compression Refrigeration System	18	6	24
2.	Absorption Refrigeration System	6	4	10
3.	Cryogenics	6	4	10
4.	Food Spoilage/Preservation	14	6	20
5.	Ice- making	6	4	10
6.	Storage Conditions	6	4	10
		56	28	84

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.2 SUBJECT : - REFRIGERATION - II

TOPICS

3.2.1 Vapor Compression Refrigeration systems with multiple evaporators and components. Introduction. Function of Compressor, Condenser, Expansion Valve, Flush Chamber, Evaporator Pressure, Balancing Valve, Inter Cooler dual compressor and their Symbolic Representation.

Multistage Compression-Flash Gas Removal, Flash Inter-Cooling-Choice of intermediate pressure, complete multi-stage compression system-multi Evaporator system (Single Compressor individual expansion Valves)- Single compressor-Multiple Expansion valves)-Individual Compressor with Compound Compression-Cascade system. Optimum cooling Temperature between cascade circuit. Simple Numerical problem.

(No. of Hours 24)

3.2.2 Absorption Refrigeration system-Introduction-Simple Absorption system. Practical Ammonia Absorption System. Domestic Electrolux Refrigerator, Lithium Bromide System.

(No. of Hours 10)

3.2.3 Cryogenics. Joule Thomson Effect, Properties of materials at Cryogenic Temperature, Liquification of air, Linde's System, Claude System. Liquification of Hydrogen and Helium. Cryogenic Equipments-Compressors, Expanders, pumps, Heat Exchangers, Regenerators and Valves-Cryogenic insulation, Liquid Storage and Applications. Elementary-Idea of Magenetic Cooling system.

(No. of Hours 10)

(Contd...

3.2.4 Food Spoilage, Preservation - Food Preservation Deterioration and spoilage-Enzymes-Micro-Organisms. Bacteria-Yeasts and Molds-Control of Spoilage Agents. Preservation by Refrigeration, Refrigerated Storage, RH and air velocity in chill rooms. Combined-Chilling and Storage, Freezing and Frozen Storage-Freezing Methods. Quick Freezing and Sharp Freezing. Packaging materials-Frozen Storages. Description and construction of cold storage, walk-in-coolers Display cases, Refrigerated vending machines. Bar Refrigerators.

(No. of Hours 20)

3.2.5 Ice Making :

Description and working of an ice plant cooling load calculation. Preservation of Fruits and vegetables, Chilling plants for Dairy Products, Fish and Meat Chilling and Storage.

(No. of Hours 10)

3.2.6 Storage conditions and properties and perishable products like-Apples, Bananas, Grapes, Oranges, Lemons, Onions, Potatoes, Tomatoes, Fish, Meat, Poultry-Eggs, Beer, by referring the Tables and applications of Regrigaration in Regrigerated Railway Cars, Trunks, Trailers.

(No. of Hours 10)

=O=O=

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.2 REFRIGERATION-II LABORATORY

SUGGESTED LIST OF EXPERIMENTS

1. Identification of refrigeration systems and components. Introduction of common tools for refrigerating machines.

2. Identification of pipe fittings and joints. To make gas tight joints and pipe connections.

3. Dismatling and assembling of reciprocating type of open semi-hermatic and hermatic compressors and study of their parts.

4. Repair and replacement of parts of compressors.

5. Lapping of compressor valve and valve seat.

6. Cutting of gasket and refitting of shaft seal on shaft checking compressor for leaks under vaccum pressure.

7. Checking, Scraping and adjustment of compressor bearings.

8. Diagnosis of faults and repairing of compressors.

9. Method of returning oil from evaprator to compressor Removal of oil from the syston.

10. Checking and repairing of different types of evparators.

11. Testing evaporator coils for leak, choke and Repairing and descaling of fins.

(Total lab. hours 56)

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT :- AIR CONDITIONING - V

RATIONAIE

Refrigeration and Air Conditioning are considered as the Keynotes of human comfortable life. Human desire is to live in comfort conditions. Also, specific conditions are essential for cotton textile mills, and the related industrial and commercial fields. Therefore thenost urgent needs are to control the climatic variables like humidity and temperature.

Air Conditioning deals with these areas of climatic variables. It is the purpose of this subject to provide basic knowledge of Air Conditioning which involves the creation of comfort conditions for human body, This requires the study of Thermodynamics of human body and load calculation methods for air conditioning of rooms/buildings, hospitals etc.

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : AIR CONDITIONING - I

SCHEME OF STUDIES

Topic No.	Name of Topic	Theory Hours	Tut./Lab Hours	Total Hours
1.	Psychrometrics	12	6	18
2.	Requirements of Comfort Air Conditioning.	6	2	8
3.	Building Survey and Design Conditions.	4	4	8
4.	Solar Radiation	6	2	8
5.	Load Calculation	10	6	16
6.	Duct Design and Air Distribution.	8	4	12
7.	Air Conditioning System	6	2	8
8.	Central Air Conditioning System	4	2	6
		56	28	84

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.3 SUBJECT : - AIR CONDITIONING - I

TOPICS

3.3.1 PSYCHROMETRIC - Introduction, Meaning of Air Conditioning-Psychrometry and Pyschrometric Properties. Psychrometric Relations. Psychrometric chart. Psychrometric Process. Sensible Heating and Cooling-Bypass factor. Cooling and Humidification. Heating and Humidification, Dehumidification and cooling. Dehumidification and heating. Evaporative cooling. Mixing of air stream Sensible Heat Ratio. Room Sensible Heat Factor. Apparatus Dewpoint Temperature cooling Tower-Numerical Problem.

(No. of hours 18)

3.3.2 Requirements of Confort Air Conditioning. Thermodynamics of Human Body. Effective Temperature-Comfort and Comfort chart summer and winter comfort. Recommended Inside Design conditions. Ventilation and Ventilation Standards.

(No. of hours 8)

3.3.3 Building Survey and Design Conditions : Building Survey-Location of equipments and services. Air Conditioning Load Estimate-Out-Door Loads Internal Loads. Out door Design Conditions-Summer and winter. Storage of Heat in Building Structures. Constant Space Temperature and Equipment Operating Periods.

(No. of hours 8)

3.3.4 SOLAR RADIATION : Distribution of Solar Radiation. Direct Solar Radiation on a surface. Heat Gain through glass. Effect of Shading Device. Over all Heat.

(Contd.....

Transmission Coefficient-Periodic Heat Transfer Through Walls and Roofs. Imperical Method to evaluate Heat Transfer through walls and Roofs. Infiltration, Infiltration Factor and calculation of load.

(No. of hours 8)

3.3.5 LOAD CALCULATION : Cooling Load, Preliminary Consideration, Internal Heat Gains-Wall, Ceiling and Floor. Product Load, Respiration Heat Load Occupancy Load, Miscelleneous Load. System Heat Gains. Safety Factor. Break up of Ventilation Load and effective sensible Heat factor, cooling load Estimate. Heating Load Estimate. Psychrometric Calculation for cooling, High latent cooling and all out door air Applications nomerical problems.

(No. of hours 16)

3.3.6 DUST DESIGN AND AIR DISTRIBUTION :

Room Air Distribution, Types of supply air outlets.

Selection and Location of outlets.

Distribution Patterns of outlets

Locating Return Air

Opening, Total, Static and Velocity Pressures.

Flor Through Ducts. Friction loss in Ducts-Rectangular equivalents Circular ducts.

Dynamic Losses in Ducts. Pressure Losses in Elabows.

Loss Due to enlargement and Static Regain loss due to Construction. Air Flow Through a simple duct system. Air Duct Design-Equal Friction Method-Velocity Reduction Methodstatic Regain Method. Simple Problems. Duct Systems. Air Distribution System. Simple Problems.

(Contd..

3.3.7 AIR CONDITIONING SYSTEM : Scope, System Selection, Economics, Environment control requirement, unitary Air Conditioning System-Room Air Conditioner Window and Portable units. Packaged Air Conditioning Application-Construction and working principles and controls.

(No. of hours 8)

3.3.8 Central Air Conditioning System. Air System System features-Constant Volume Variable Temperature System. Variable Capacity Control. Face and by pass Damper Control and Air Reheat Control Multizone unit system. Dual Duct System.

(No. of hours 6)

=0=0=

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : - AIR CONDITIONING - II

SCHEME OF STUDIES

S.No.	Name of Topic	Theory Hours	Tut./Lab. Hours	Total Hours
1.	Air Water System	22	-	22
2.	Humidifiers, Air Washer Dehumidifier and Evaporative Cooling	22	-	22
3.	Solar Energy Utilisation	10	-	10
4.	Fans	10	-	10
5.	Air Cleaning	10	-	10
6.	Air Conditioning System	10	-	10
		84	-	84

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.4 SUBJECT :- AIR CONDITIONING -II

TOPICS

3.4.1 AIR WATER SYSTEM : Air water system, induction unit system-system features. System description-system design considerations. All water system, single piping system and Multipiping system. System-Features and system description. Ventilation System. Necessity for Ventilation. Design Considerations. Natural Ventilation.

General Rules-Mechanical Ventilation.

(No. of hours 22)

3.4.2 Humidifiers, Air Washer, Dehumidifier and Evaporative Cooling-Humidifiers-Common Considerations for Humidification - Method-Evaporating the water by Air Washer. Air Washer-Adiabatic Air Washer-Various Process in the Air Washer-Construction-Chilled Water Supply-Performance.

Dehumidifiers-Spray Type Dehumidifier, Absorbers-Liquid Absorbent Dehumidifier, Evaporative Cooling-Types-Efficiency-Application and Limitation-Modified cooling system.

(No. of hours 22)

3.4.3 Solar Energy Utilization. Flat plate Solar Collectors. Liquid Heaters-Air Heaters and Concentrating Coolectors and their applications.

Heating and Cooling by Solar Energy.

(No. of hours 10)

(Contd....

3.4.4 FANS - Types of fans. Application.Centritugal Fans-Forward and Backward Curved Blade Fans. Radial Blade Fans. Axial Flow Fans. Fan Arrangement, Laws of Fan Performance, Fan Selection, Accessories and Controls.

(No. of hours 10)

3.4.5 AIR CLEANING : Air Impurities -Contact with water washing. Dry Filtering. Various Coated Air Cleaners. Cell Type-Renewable Pad. Mechanically Replaced and Automatically Reconditioned-Electro Static Precipitators, Dust Separator, Centrifugal and Cyclone Dust Separator. Microvee filters-stages of Air filtration,size of dust partices.

(No. of hours 10)

3.4.6 AIR CONDITIONING SYSTEM : In Cars, Buses and Railway Coaches.

(No. of hours 10)

=0=

FINAL(THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.3 & 3.4 :- AIR CONDITIONING I & II LABORATORY

SUGGESTED LIST OF EXPERIMENTS

1. Dismantling and assembling differentmakes of window model air-conditioners and study of their parts.

2. Dismantling and assembling different rakes of water coolers and bottle coolers and study of their parts.

3. To determine the evaporator load for a window model air conditioner.

4. To determine the operating characteristics of A.C. systen employing air cooled condensing units.

5. To determine the condenser loand of a window model air conditioner.

6. To determine the capacity of a water cooled A.C. system.

7. To determine the capacity of a cooling tower.

8. To determine the operating Characterstics of a water chilling unit and its capacity.

9. To determine the following parameters with the help of Psychrometer &psychrometric charts.

   (i) RSHF - Room Sensible Heat Factor.

   (ii) GSHF - Ground Sensible Heat Factor.

   (iii) ESHF - Effective Sansible Heat Factor.

   (iv) ADP - Apparatus dew point in an air conditioned room at various room conditions.

10. Performance of air duct systems. study of duct components like grills, registers, ceiling diffusers, air directions, control vanes etc.

(Total . 3 hours 56)

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT :- REFRIGERATION AND AIR CONDITIONING SYSTEM CONTROL AND INSTRUMENTATION

R A T I O N A L E

Modern systems are controlled by electronic devices. Systems run continuously and the operation of equipments should be accurate enough. To make them precise, various control devices are employed. These devices help in maintaining the system operational. Also, maintenance of these devices must be a part of study for the learners.

Refrigeration and Air Conditioning systems also need various control devices/instruments for maintaining the system operative. Hence a study of the basic principles of these control devices is essential to be included in the curricula. The contents of this course shall provide a knowledge of these control instruments.

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

: REFRIGERATION AND AIR CONDITIONING

SUBJECT : SYSTEM, CONTROL AND INSTRUMENTATION

SCHEME OF STUDIES

S.No.	Name of Topic	Theory Hours	Tut./Lab Hours	Total Hours
1.	Temperature Measurement	8	-	8
2.	Pressure Measurement	8	-	8
3.	Flow meters and PH Measurement.	8	-	8
4.	Psychrometers & Humidity Measurement	4	-	4
5.	Measurement of Air Purity	4	-	4
6.	Sound and Vibration Control	8	-	8
7.	Refrigeration system Balancing and Controls.	5	-	5
8.	Electrical Switches	3	-	3
9	Lubricating Oil for Compressor	4	-	4
10.	Different types of Relays	4	-	4
		56	-	56

FINAL (THIRD) YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

3.5 SUBJECT:- REFRIGERATION AND AIR CONDITIONING SYSTEM, CONTROL AND INSTRUMENTATION.

TOPICS:

3.5.1 TEMPERATURE MEASUREMENT:

Liquid Filled thermometers-Gas thermometers-Vapour Pressure thermometers- Bimetal thermometers-Transducers-Electrical resistance thermometers-Thermocouples-Temperature indicating and recording instruments for use with thermocouples-Radiation and optical pyrometer-General temperature measuring practice-Cryogenic temperature measurement-Room thermostats Two position thermostats-Mercury Switch thermostats-Snap action thermostats-Electronics thermostats, Pneumatic thermostats.

(No. of hours 08)

3.5.2 PRESSURE MEASUREMENT:

Manometer-Bell type pressure gauges-Bellows in pressure gauge-Bourdon tube pressure gauge-Differential pressure gauge-Diaphragm type differential pressure devices-Electrical Transducers-Thermo-couple gauge, Mechanical and Electrical transducers-Resistance change strain gauge, variable capacitance gauge-Manometer transducers-Electropneumatic transducers-Magnetic circuit transducrs. Vaccum gauges and compound Pressure Gauge.

(No. of hours 08)

3.5.3 FLOW METERS AND PH MEASUREMENT:

Magnetic flow meter-Heat input flow meter-impact meters-Variable area meters, orifice meters-pitot tube, volometer-Electrical transducers. Turbine type flow meters-Strain

(Contd....)

gauge flow meter Anemometer-hot sphere anemometer, cup anemometer Anemotherm air meter Meaning of PH Measurement Principle of Ph meter-pH measurement and control.

(No.of hours 8)

3.5.4 PSYCHROMETERS & HUMIDITY MEASUREMENT:

Mass transfer and the evaporation of water into moist air-Theory of psychrometer-Practical use of psychrometer-correlation of psychrometer-Wet bulb temperature with Dry bulb temperature Humidity standard and relative humidity measurement, specific Hygrometer Dew point determination.Thermal confort meter-Determination of moisture content of fabric and materials-Humidistats. Electric humidity controls-Proportional humidity controls-Pneumatic humidity controllers.

(No. of hours 4)

3.5.5 MEASUREMENT OF AIR PURITY :

Air contaminants-Air composition Classification of Air contaminants-Nature of air borne contaminants-Suspended particle-Industrial air contaminants. Air pollution Ratio active air contaminants fall out atmospheric pollution. Airborne micro organisms-Odour Sense of smell-Sensory measurement-Odour sources-Odour removal-Purification of air and its measurements and standards-Methods of air cleaning, performance test methods-Location and space limitations-Selection, installation and maintenance.

(No.of hours 4)

(Contd...)

3.5.6 SOUND AND VIBRATION CONTROL.

Sound power and Sound power level-sound intensity and characteristics-loudness or loudness level-Noise, Noise level meter-sound sources Determination of sound Reducing the transmission of sound power. Reducing the transmission of sound Human response to sound-Vibration isolation sound and vibration measurement-Sound control for outdoor Refrigeration and Air conditioning equipment sound control for indoor Refrigeration and Air conditioning equipment Fansound-Design of accustical treatment for duct systems-Air flow noise in duct-selection of room terminals-Mechanical equipment noise insolation-vibration isolation and control-equipment vibration-vibration isolators materials-type-selection of isolation of vibration and noise in pipes isolation of duct vibration.

(No. of hours 08)

3.5.7 REFRIGERATION SYSTEM BALANCING AND CONTROLS:

Evaporator pressure regulator-suction pressure regulator-Temperature regulating valve-Solenoid valves-Check valves-Pressure relief valves. System balance-equibirium-evaporator capacity control-condenser capacity control-system capacity Vs. Load cycling controls- temperature control-Differential and range adjustment Space control pressure controls-Low pressure control-High pressure control-compressor capacity control

(No. of hours 5)

3.5.8 Electrical Switches-Relays-Solarls-Electric or pneumatic motor Time clocks-Modulating damper motors. Control motors-Two position damper motors-Bimetal damper actuator-control valves-Solenoid, diaphragm and motorised valves-Three ways valves-Mixing valves.

(No. of hours 3)

3.5.9 Lubricating Oil for compressor compressor lubricating oil properties. Desirable properties of lubricating oil for Refrigeration System-Method of lubrication Lubrication of compressor.

(No. of hours 4)

3.5.10 <u>DIFFERENT TYPES OF RELAYS</u>:

Hot wire current coil and potential-Thermal overload protection for Hermetic motors, oil separators-Discharge Mufflers, Accumulators, Filters, Driers, Strainers, Sight Glass.

(No. of hours 04)

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

SUBJECT : ENGINEERING DRAWING

R A T I O N A L E.

Engineering Drawing is the language of Engineers. A student should be able to read and interprete the drawings. It is the purpose of the course to develop the ability to visualize machine components ,co-nocpt of form & propoption are developed through practice combined with thoroughness.

An attempt has been made to make the student familiar with symbols and various drafting practices as per I.S.I. codes. Large number of drawing plates should be prepared in the class rooms so that clear perception is developed.

M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : ENGINEERING DRAWING

SCHEME OF STUDIES

S.No.	Name of Topic.	Theory Hours.	Tut./Lab. Hours.	Total Hours.
(1)	Projection and Multiview Representation.	4	26	30
(2)	Sectional Views.	4	20	24
(3)	Dimensioning, Tolerancing, Machining Welding, Electrical and Civil Engg. symbols.	4	8	12
(4)	Drawing symbols of Refrigeration and Air Conditio ning.	3	9	12
(5)	Proportionate Sectional Drawings of Refrigeration and Air Conditioning components.	5	25	30
(6)	Pipe Drafting and Tube Fittings.	1	8	9
(7)	Duct work symbols and Drawings.	4	5	9
(8)	Schematic diagrams of Refrigeration and Air Conditioning systems.	2	25	27
(9)	Wiring diagrams for typical Refrigeration and Air Conditioning systems.	1	14	15
		28	140	168

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.6 SUBJECT : ENGINEERING DRAWING

TOPICS

3.6.1 PROJECTION & MULTIVIEW REPRESENTATION

First & Third angle Orthographic projection, superfluous view, conversion of pictorial views into orthographic view.

(No. of hours 30)

3.6.2 SECTIONAL VIEWS

Full, Half, partial, revolved & removed sections, offset section, sectioning convertions, section lines Hatching prodedure for different materials, sectional views of compressor, piston, connecting rod, bearings, Couplings.

(No. of hours 24)

3.6.3 DIMENSIONING, TELERANCING MACHINNING, WELDING, ELECTRICAL & CIVIL ENGINEERING SYMBOLS.

Size & location dimensions, specific dimensioning of cylinder, holes, arcs, narrow space angles, countersunk, counter bore, spot facing, screw thread etc. Tolerance of forms & positions, Machining and surface finish symbols. Welding joint and electrical engg. symbols. Windows, Ventilators etc.

(No. of hours 12)

3.6.4 DRAWING, SYMBOLS OF REF. & AIR CONDITIONING

Air eleminator, Expansion joint, Heat exchanger, Thermostat, float, valves, Dampers, valves, capillary tube, compressor, condenser, cooling Tower, evaporators, float valves, expansion valve, Hand expension valve, thermostatic expension valve etc. from I.S.I.

(No. of hours 12)

3.6.5 PROPORTIONATE SECTIONAL DRAWING OF REFRIGERATION AND AIR CONDITIONING COMPONENTS.

Sectional propoionate sketches of corponents like refrigerant compressor reciprocating and rotory type, pressure reducing valve, stop valve, radidation trap, theromostatic expansion valve, low & high pressure float valves, Heat exhangers, Gaugemanifold evaporators, condoners.

(30 hours)

3.6.6 PIPE DRAFTING AND TUBE FITTINGS

Conventions and symbols.

(No. of hours 9)

3.6.7 DUCT WORK SYMBOLS & DRAWINGS :

Forms of seams & joints in sheet metal duct construction duct layout for residential & comercial systems.

(No. of hours 9)

3.6.8 SCHEMATIC DIARGRAMS OF REFRIGERATION & AIR CONDITIONING SYSTEMS

Layout of building simple flow diagrams for vapour compression & absorption refrigeration systen, Electrolux systen, Multievaporator with Multi expansion valve and dual compressor. Conscant volume variable Temperature A.C. Systen using symbols.

(No. of hours 27)

3.6.9 WIRING DIAGRAMS FOR TYPICAL REFRIGERATION & AIR CONDITIONING SYSTEMS.

Wiring diagrams for thermostic switch, household refrigerator, window airconditioners, central air conditioning unit, ice-plants. Cold-storage, current starting relay ,solid state starting relays, voltage starting solenoid valve.

(No. of hours 15)

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : 3.6 ENGINEERING DRAWING

S.No.	TOPICS	NO. of PLATES
3.6.1	Projections and Multiview representation	2
3.6.2	Sectional views	2
3.6.3	Dimensioning, Tolerencing, Machining and Welding, Electrical and Civil Symbols.	2
3.6.4	Drawing Symbols of Refrigeration and Air Conditioning.	2
3.6.5	Sectional drawing of Refrigeration and Air Conditioning Componants.	3
3.6.6	Pipe drafting and tube fittings.	1
3.6.7	Duck- work Symbols and drawings	1
3.6.8	Schematic Diagrams of Refrigeration and Air Conditioning Systems.	2
3.6.9	Wiring diagrams for typical Refrigeration and Air-Conditioning Systems.	1
	Total	16

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : ENTERPRENEURSHIP AND MANAGEMENT

R A T I O N A L E

Enterprenorship is the key to industrial evolution. Now-a-days people are anxious to establish their own enterprises. For this people must be aware of the basic principles of managing a business. Various functions of management must be learnt and practiced by enterprenours.

The contents of this subject presents an over-all-view of the operations of organisation and fundamental principles of Management. It covers vide range of management functions and various management levels, e.g. marketing Sales & financing etc. This course is remarkable for its sweep and depth and gives an exhaustive position of various topics.

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : ENTERFRENUERSHIP AND MANAGEMENT

SCHEME OF STUDIES

S.No.	Name of Topic	Theory hours	Tut./Lab. hours	Total hours
1.	Launching Industries	7	-	7
2.	Business Communication	7	-	7
3.	Personnel Management	12	-	12
4.	Financial Management	12	-	12
5.	Marketing Management-I	10	-	10
6.	Marketing Management-II	8	-	8
		56	-	56

3.7 ENTREPRENEURSHIP AND MANAGEMENT

3.7.1: LAUNCHING INDUSTRIES :

Entrepreneurship - Concept of small, medium and large industry - Market analysis - Product selection - Financial planning - Organising and setting up the industry - Project report for proprietor concern, partnership concern and private limited concern- Role of Government Financial and other institution in starting industries.

7 Hrs.

3.7.2: Business communication - Need and functions- Kinds of business letters- Essentials of an effective business letter - illustration, Aids to brevity and clarity - Bar charts, pie diagrams- Graphs- points and lines. Operation research and its application to business, PERT AND CPM Legal aspects in business - Managerial Economics- Management information system- Managerial decisions- Analysis.

7 Hrs.

3.7.3: PERSONNEL MANAGEMENT

Personnel Management concept and functions-Man Power Planning, Recuitment- Selection- Selection process or technique- Interviewing- Types of interview and Procedures-Training-Needs and Methods of Training-Training procedure,systems of training for difference levels of staff in industry-Performance appraisal-Job evaluation-safety-Need for safety-Safety committee and profarmes-Instructions and training-Accidents-Economic aspects causes and types of accidents-Accident prevention-Health-Employee benefits-Case study.

12 Hrs.

3.7.4 : FINANCIAL MANAGEMENT.

Scope of accounting - Capital budgeting- Provision of finance-Sources of finance, permanent capital, medium and short term capital- Purpose of accounting- Profit and loss account- Balance sheet, Break-even analysis- working capital management, Cash flow analysis, Fund flow analysis Financial ratio analysis, Case studies.

12 Hrs.

3.7.5 : MARKETING MANAGEMENT- I

Marketing concepts for different firms, Functions, Marketing planning, organising and control, Marketing mix-product, Brand, Package, Service, Product life cycle, Pricing products, Distrubution channels, wholesaling- Retailing, Promotion of product, Advertising, Sales promotion, Publicity, Trade exhibitions.

10 Hrs.

3.7.6 MARKETING MANAGEMENT-II

Sales Management, Functions, Personal selling, selling theories, Sales objective, policies and strategies- Sales force selection, Training Supervision and evaluation, Sales quota, Sales territory, Salesman compensation, Sales management relationships, Case studies.

8 Hrs.

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

SUBJECT : INSTALLATION OPERATION AND MAINTENANCE OF REFRIGERATION AND AIR CONDITIONING PLANTS

SCHEME OF STUDIES

S.No.	Name of Topic	Theory Hours	Tut./Lab. Hours	Total Hours
1.	Layout and Installation of small equipments	5	9	14
2.	Layout and Installation of Central Systems	5	9	14
3.	Water Conditioning Systems and Descaling	12	15	27
4.	Central Plant Service Operations	12	16	28
5.	Services of small Equipments and Trouble Shooting	5	10	15
6.	Cooling of Hermetic Compressors	5	7	12
7.	Servicing of Central Systems and Trouble Shooting	12	18	30
		56	84	140

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

3.8 SUBJECT : INSTALLATION OPERATION AND MAINTENANCE OF REFRIGERATION AND AIR CONDITIONING PLANTS.

3.8.1 LAYOUT AND INSTALLATION OF SMALL EQUIPMENTS :

Selection of location- Layout of equipments and piping- Installing of small hermetric systems- Installation of window airconditioners : Window Trnasen and through the wall installation- Sealed compressor installation instruments.

5 Hrs.

3.8.2 LAYOUT AND INSTALLATION OF CENTRAL SYSTEMS :

Selection of location- Layout of equipments and piping- Layout of ducting and water piping-Electrical installation.

5 Hrs.

3.8.3 WATER CONDITIONING SYSTEMS AND DESCALING :

Benefits of water conditioning- Water source appraisal- of water systems- Types of causes of scale and deposits- prediction of scale forming tendencies- Scale deposit prevention- Water conditioning method for scale control- Types of corrosion control- Causes of corrosion- Corrosion monitoring-External water circuit corrosion- slime and algae control- Descaling procedures.

12 Hrs.

3.8.4 CENTRAL PLANT SERVICE OPERATIONS :

Starting the compressor- Pressure testing the plant for leaks-Evacuation and dehydration-Vacuum standing test- Adding oil to the compressor-Commissioning and evaluation of system performance-Test operations on commissioning performance of Plant-Compressor Pump down-Removing

(Contd....

Refrigerant from the system-Purging non-Condensable Gases-Preparing for a prolonge shut down. Starting the system after a prolonged shut down.

3.8.5 SERVICING OF SMALL EQUIPMENTS AND TROUBLE SHOOTING

Hermetic compressors- Manufacturing characteristics-inspection-Running test of hermetic compressor servicing burnt-out hermetic compressors-Interchaning refrigerant in hermetic systems.

5 Hrs.

3.8.6 Cooling of hermetic co[illegible]ors-Compressor over heating Moisture factor-Over charing-Hermetic motor burnt out-Trouble shooting and rectification Procedure for servicing appliances with burnt out hermetic compressors-Procedure for servicing appliances excluding those with burnt out compressor- A look at service safety.

5 Hrs.

3.8.7 SERVICING OF CENTRAL SYSTEMS AND TROUBLE SHOOTING:-

Maintenance Instructions :-

Preventive maintenance : Compressor, Condenser, Evaporator electrical circuits and controls.

Cooling water problems, V-belt drive Coupling drive Soldering, Electric Switch gear, Brazing.

Single phasing of electric motors.

Moter insulation resistance.

Motor contr ls.

Controls trouble shooting chart.

System Trouble Shooting,

Diagnosing the trouble,

Trouble shooting chart.

12 Hrs.

FINAL(THIRD) YEAR DIPLOMA IN REFRIGERATION & AIRCONDITIONING

3.6 Installation operation Maintenance of Refrigeration and Air-conditioning plants-Laboratary

List of experiments

S.No.

1. Stripping, clearing, assembling and readjusting of expansion valves of different makes for correct functioning. Use of liquidmoisture indicator.
2. Complete overhauling of different make domestic refrigerators.
3. Complete dismantling repairing, assembling of sealed units of different makes of refrigerators for mechanical and electrical faults.
4. Stripping and assembling motors and switch gears of different make. Adjusting and testing motor controls for correct functioning.
5. Removing defects of different types of starting relays and overload protection.
6. Servicing of air-conditioners of different makes, diagnosis of all troubles and repairing, cleaning of air filters.
7. Checking mechanical and electrical faults for rectification of different makes of air conditioners.
8. Study of starting relays, starting and running capacitor and thermal over load switch, Thermostat etc.
9. Study of complex wiring and installation plans of different makes of air-conditioners in practice.
10. Study and preparation of preventive maintenance, and maintenance schedule for different types of air-conditioners.

(Total Pract. Hrs. 45 84)

FINAL YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

3.9 SUBJECT : PROJECT

The necessity of Project work has been emphasised on the group work. A student has to undertake one minor project from topic 'A' and one major project from topic 'B' out of two projects undertaken by the students atleast one should involve him in working in the shop floor and/or laboratories. Minor project from topic 'A' is to be undertaken individually and major project from topic 'B' could be undertaken in groups which however should not consist of more than 4 students. However, the teacher will be free to make modification depending on the constraints under which he may have to operate.

TOPIC 'A' : To prepare a write up or feasible report containing more than 1500 words, using appropriate diagrams and illustrations and in simple language on refrigeration and air conditioning topics, such as -

SUGGESTED TOPICS:

(1) Feasibility of non-conventional sources of energy for a particul-ar application in refrigeration and air conditioning.

(2) Prepare a corporative study report on various refrigeration systems.

(3) Prepare a technical report about the Psychrometric processes.

(4) Prepare a survey of the refrigeration and air conditioning equipment available Make a comparative study and suggest a suitable choice.

(Contd..

(5) Prepare a survey for the application of the refrigeration and air conditioning in respect of

(A) Manufacture and Heat treatment of metals.

(B) Medical applications.

(C) Civil Engineering applications.

(D) Air conditioning of special building.

(E) Super conduction for Electric Power Transmissions

(F) Air-Conditioning in Textile industry.

(G) Photographic industry.

(H) Food preservation.

TOPIC 'B' MAJOR PROJECT :

(Note :- One project to be completed by a group of not more than 4 students.)

Design and make type Project/Investigation Project/ Feasibility studies.

SUGGESTED TOPIC :

(1) Ice plant for 1 tonne capacity per day.
(2) Ice Cream Manufacture.
(3) Refrigeration for Dreweries.
(4) Air-Conditioning of -
  (A) Houses and office.
  (b) Hotels and Restaurants.
  (c) Departmental stores.
  (d) Theatre and Auditoriums.
  (e) Hospitals.

Contd.....

(5) Cold storage and commercial cabinets.

(6) Water-Coolers.

(7) Desert Coolers.

(8) Household refrigerations.

(9) Window air-conditioners.

(10) Solar heating and cooling.

(11) Heat pumps.

(12) Computer-Section of your institute.

(13) Library of your institute.

(Three (3) hours/ week)

I.S.I. CODE SPECIFICATIONS :

(1) Air conditioning. 659-1964

(2) Bottle cooler. 2167-1962

(3) Cold Storage, insulation and safe operation code of practice for 661-1964.

(4) Commercial refrigerations. 1474-1959

(5) Domestic refrigerators.(absorption type) 3621-1966

(6) Domestic refrigerators (Mechanically operated) 1476-1971

(7) Evaporative air coolers (Desert coolers) 3315-1965

(8) Glassary of terms used in refrigeration and air conditioning. 3615-1967

(9) Ice cans. 1069-1961

(10) Ice cubes trays for domestic refrigerators. 5030-1969.

(11) Ice tank. 2374-1963.

(12) Mechanical refrigeration safety code. for 660-1963.

(13) Metal air ducts. 665-1963.

(14) Recommendation on units and symbols for refrigeration 4831-1968.

(15) Room air - conditioners. 1391-1960

(16) Self contained drinking water cooler. 1475-1971.

(17) Testing refrigerant compressors, code of practice and measurement procedures. for 5111-1969.

--

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

TEXTS AND REFERENCE BOOKS.

S.No.	Title.	Author
1	2	3
1.	Principles of Refrigeration	Roy J. Dossat
2.	Refrigeration and Air conditioning	Richard C.Jordan & Gayle.D.Priester.
3.	Air Conditioning and Refrigeration	Durgess.H. Jennings Samuel.R.Lewis.
4.	Modern Refrigeration Practice.	Guy R.King.
5.	Refrigeration-A Practical manual for machines.	G.H. Reed.F.Inst.R.
6.	Refrigeration Principles and Practice.	Norman Shape.
7.	Refrigeration Servicing	Paul F. Goliber.
8.	Audels Commercial Refrigeration	Edwin.P. Anderson.
9.	Air Conditioning Installation and Maintenance.	Earnest Triconi.
10.	Home Refrigeration and Air Conditioning.	Edwin.P. Anderson.
11.	Refrigeration Air Conditioning and Cold Storage.	Raymond C. Gunther.
12.	Principles of Refrigeration	R. Watren Marsh & C. Thomas Clive
13.	Commercial and Industrial Refrigeration	C. Wesley Nelson
14.	Air Conditioning and Refrigeration	Stocker

(Contd...)

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

TEXTS AND REFERENCE BOOKS

S.No.	Title.	Author
1	2	3
15.	Air Conditioning and Refrigeration	Severns and Fellows
16.	Air Conditioning and Refrigeration	Paul Laung.
17.	A Course in Refrigeration and Air Conditioning.	Subash C. Arora
18.	Hand Book of Air conditioning system Design.	Carrier Air Conditioning Company.
19.	Ashare Guide and Data Book 1961, 1963, 1966.	-
20.	Asre Air Conditioning-Refrigeration DATA BOOK Refrigeration application.	-
21.	Thermodynamics	Van Wylen.
22.	Thermodynamics	J.P. Holman.
23.	Basic Thermodynamics.	Skrotzki.
24.	Heat Transfer	S.P. Sukhatme.
25.	Heat and Mass Transfer	Chapman.
26.	Heat and Mass Transfer	J.P. Holman.
27.	Heat Transfer	C.P. Gupta & Rajendra Prakash.
28.	Thermal Environmental Engineering.	James L. Theelkeld.
29.	Momentum, Heat & Mass Transfer.	C.O. Bennet & J.E. Myers.

(Contd....)

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

TEXTS AND REFRIGERATION BOOKS.

S.No.	Title.	Author
1	2	3
30.	Engineering Thermodynamics.	F. Husang.
31.	Principles of Refrigeration	R.J. Dossat.
32.	Refrigeration & Air Conditioning II Edition.	W.F. Stocker & J.W. Jones.
33.	Refrigeration & Air Conditioning.	C.P. Arora.
34.	Industrial Instrumentation & Fundamentals.	Austin E. Fribance.
35.	Electronic Instrumentation & Measurementals.	William David Cooper.
36.	Industrial Instrumentation	Eckman.
37.	Principles of Electronics Instrumentation	Disfenderfer
38.	Mechanical Measurement.	Beckwith & Buck.
39.	Automatic Controls of Heating Air-conditioning.	John E. Haines.
40.	Electric Controls for Refrigeration & Air Conditioning.	Langle.
41.	Ashrae Hand Book "System, F Fundamentals"	
42.	Thermal Environmental Engineering.	James. L. Threlkeld.
43.	Modern Air Conditioning Practice.	Norman C. Harris.
44.	Modern Refrigeration Air-Conditioning.	Althouse.
45.	Refrigeration an Air Conditioning.	C.P. Arora.

(Contd....)

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING.

TEXTS AND REFERENCE BOOKS.

S.No.	Title.	Author.
1	2	3
46.	Ashrae Hand Books-Refrigeration Systems & Applications- 1986 S I Edition.	—
47.	Ashrae Hand Books-Refrigeration (Systems & Applications) 1986 S I Edition.	—
48.	Design & Construction Practice of Cold Storage.	Gunther.
49.	Ammonia Absorption Refrigeration in Industrial Processes.	Marcel Bogart
50.	Thermal Environmental Engg.	James L. Threlkeld.
51.	Theory & Design of Cryogenic System.	A. Arkharov, I, Marferira & Y.E. Mikulin.
52.	Cryogenic Systems.	R.F. Haselden.
53.	Hand Book of Airconditioning System Design.	Carrier.
54.	Automatic Control of Heating and Airconditioning.	John E. Haines
55.	Compressor Manual.	Kirloskar Brother's Ltd;
56.	Basic Refrigeration and Air-Conditioning	P.N. Ananthanarayanan.
57.	Reciprocating & Rotary Compressors.	Prof. Vladimir Chlumsky.

(Contd....)

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

TEXTS AND REFERENCE BOOKS.

S.No.	Title.	Author.
1	2	3
58.	Pumps, Fans Compressors.	V.M. Cherkasaky.
59.	Kirloskar and Shriram for Manual for Hermetically sealed Compressors.	--
60.	Airco nditioning System Design.	Farrier.
61.	Environmental Control- Air-conditioning & Refrigeration Theory & Practice.	Michael K. Weaver, James M. Kirkpatric
62.	Refrigeration & Air Conditioning Refrigeration Institute.	--
63.	Solar Engg. Technology.	Ted. J. Jansen.
64.	Modern Airconditioning Practice.	Norman C. Harris.
65.	Ashrae Hand Books- System & Application 1986	--
66.	Refrigeration & Airconditioning.	Manohar Prasad.
67.	Process Heat Transfer.	Kenn.
68.	Heat Exchangers.	Oxisik.
69.	Compact Heat Exchangers.	Kays & London.
70.	Heat Exchangers.	Holland.
71.	Reciprocating and Rotary Compressors.	Prof. Vladmir Chlumsky.

(Contd...)

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

TEXTS AND REFERENCE BOOKS.

S.No.	Title.	Author
1	2	3
72.	Pumps, Fans Compressors	V.M. Cherkassky.
73.	Computer Programming FORTRAN IV	Rajaraman.
74.	Numerical Methods & Engg.	Salvadori & Baron.
75.	Computer oriented Numerical Methods.	Rajaraman.
76.	Basic Refrigeration & Airconditioning.	P.N. Ananthanarayan
77.	Kirloskar & Shriram Hermatic Compressor Manuals.	---
78.	Operation and Maintenance Manual for Central Air Conditioning & Refrigeration System.	Blue-ster Ltd;
79.	Voltas Manuals of Installation & Servicing of Central Plant System.	---
80.	Modern Airconditioning Practice.	Norman C. Harries.
81.	Erection, Operation and Service Manual for Refrigeration Compressors.	Accal.
82.	Small Business Management Planning & Operations.	William D.Helies Jr. & Reymond T.Bubbard.
83.	Personal Management.	Edwin B. Flippo.

(Contd....)

THREE YEAR DIPLOMA IN REFRIGERATION AND AIR CONDITIONING

TEXTS AND REFERENCE BOOK.

S.No.	Title.	Author.
1	2	3
84.	Fundamentals of Financial Management.	James C. Van Horne.
85.	Principles of Marketing.	Filip Kotler
86.	Business Communication.	R. Lesikar.
87.	Environmental Control - Airconditioning and Refrigeration Theory & Practice.	Michael K. Weaver James M. Kirkpatric.
88.	Audel's Airconditioning & Home Refrigeration & Airconditioning.	Edwin P. Anderson.
89.	Refrigeration & Airconditioning Airconditioning & Refrigeration Institute.	---
90.	Heat Pumps-Design and Appl.	D.A. Reay
91.	Refrigeration & Airconditioning.	W.F. Stoecker & J.N. Jones
92.	Modern Refrigeration Practice.	Guy R. King.
93.	Standard Refrigeration and Airconditioning Ques & Ans.	Steve Elonka.