MAHARASHTRA STATE BOARD OF VOCTIONAL EDUCATION EXAMINATION, MUMBAI 51

1	**Name of Course**	**C.C. in Boiler attendant**
2	**Course Code**	303433
3	**Max no. of Students**	25
4	**Duration**	2 year
5	**Course Type**	Full Time
6	**No. of Days per week**	6 days
7	**No. of hours per day**	7 Hrs
8	**Space require**	Theory Class Room – 200 sqft Three Practical Lab – 500 sqft each
9	**Entry qualification**	S.S.C. Pass
10	**Objective of syllabus**	1. Awareness of safety precaution 2. Knowledge of engineering skill, use of tools in assembly 3. Awareness of chemical plant 4. Awareness of maintenance of boiler & steam turbine in chemical plant 5. Awareness of basic fitting , turning & machinery
11	**Employment opportunities**	The trainee will either to be able to take up jobs with agencies which develop, maintain, repairs operation & maintenance of boiler & steam turbine. Work as or with working experience will be in a position to start his own independent business.
12	**Teachers Qualification**	1) For Vocational subject - B.E.Mech. 2) For Non Vocational Subject - Master Degree in Concern subject

13 **Teaching Scheme –**

Sr.	Subject	Subject Code	Clock Hours / Week		Total
			Theory	Practical	
1	**English (Communication Skill)**	90000001	2 Hrs	1 Hrs	3 Hrs
2	**Elective – I**		2 Hrs	1 Hrs	3 Hrs
3	**Elective – II**		2 Hrs	1 Hrs	3 Hrs
4	MECH. TECHN. MATERIAL SCIENCE	30340001	3 Hrs	8 Hrs	11 Hrs
5	**UNIT OPERATION & PROCESS**	30340034	3 Hrs	8 Hrs	11 Hrs
6	**BOILER THEORY**	30340044	3 Hrs	8 Hrs	11 Hrs
Total					**42 Hrs**

14	**Internship**	Two Month Summer Internship from 1st May to 30th June is Compulsory.

15 **Examination Scheme – Final Examination will be based on syllabus of both years.**

Paper	Subject	Subject Code	Theory			Practical			Total	
			Duration	Max	Min	Duration	Max	Min	Max	Min
1	English Communication skill)	90000001	3 Hrs	**70**	**25**	3 Hrs	**30**	**15**	**100**	**40**
2	Elective – I		3 Hrs	**70**	**25**	3 Hrs	**30**	**15**	**100**	**40**
3	Elective – II		3 Hrs	**70**	**25**	3 Hrs	**30**	**15**	**100**	**40**
4	MECH. TECHN. MATERIAL SCIENCE	30340001	3 Hrs	**100**	**35**	3 Hrs	**100**	**50**	**200**	**85**
5	**UNIT OPERATION & PROCESS**	30340034	3 Hrs	**100**	**35**	3 Hrs	**100**	**50**	**200**	**85**
6	**BOILER THEORY**	30340044	3 Hrs	**100**	**35**	3 Hrs	**100**	**50**	**200**	**85**
	Total								**900**	**375**

16 **Teachers** – Three Teachers per batch for vocational component. For English, Elective-I & II guest faculty on clock hour basis.

17 a) For Elective I – Student can choose any one subject

Code	Subject Name
90000011	**Applied Mathematics**
90000012	**Business Economics**
90000013	**Physical Biology (Botany & Zoology)**
90000014	**Entrepreneurship**

b) For Elective II – Student can choose any one subject

Code	Subject Name
90000021	**Applied Sciences (Physics & Chemistry)**
90000022	**Computer Application**
90000023	**Business Mathematics**

Subject Name : English (Communication Skill) - 1st Year
(Subject code : 90000001)

1) PROSE

	TOPIC	AUTHOR	
1	SPOKEN ENGLISH AND BROKEN ENGLISH	GEORGE BERNARD SHAW	
2	THE HOMECOMING	RABINDRANATH TAGORE	
3	WHAT WE MUST LEARN FROM THE WEST	N.R. NARAYAN MURTHY	
4	AFTER 20 YEARS	O .HENRY	
5	THE HAPPY PRINCE	OSCAR WILDE	

2) POETRY

1	IF	RUDYAR KIPLING	
2	BABY'S WORLD	RABINDRANATH TAGORE	
3	POISON TREE	WILLIAM BLAKE	
4	PSALM OF LIFE	H.W.LONGFELLOW	
5	HOPE	SIDDHARTH ANAND	

3) GRAMMER

		EXCERCISES
PARTS OF SPEECH NOUNS : KINDS OF NOUNS AND USAGES PRONOUNS PREPOSITIONS ADJECTIVES CONJUNCTION VERB ADVERB INTERJECTION	INTRODUCTION AND EXPLANATION	SENTENCE CORRECTIONS
ARTICLES / APOSTROPHES		
DIRECT /INDIRECT SPEECH		
HOMONYMS/HOMOPHONES		
FIGURES OF SPEECH		
LETTER WRITING – FORMAL AND INFORMAL		
COMPREHENSIONS		
EMAIL AND BUSINESS LETTERS (FORMAT TO BE TAUGHT WHICH IS USED IN WORKPLACE)		
COMPOSITIONS		

4) NON DETAIL

My experiments with truth – M.K.GANDHI
(an autobiography)

5) PRACTICAL

PRACTICALS – 30 MARKS
(BASED ON PERSONAL ENHANCEMENT)(THROUGH SKITS/CHARTS/FLASH CARDS/SKITS/PRACTICAL PROJECT)

OBJECTIVE : GROOMING THE STUDENT TOWARDS HIS CAREER.
AT THE END OF EACH TOPIC, THE STUDENT HAS TO HAVE BENEFITTED FROM IT.
KNOW THYSELF
GOAL SETTING HELP STUDENTS IDENTIFY THEIR OWN GOALS AND THUS LINK TO THEIR CAREERS AS PART OF CURRICULUM
TIME MANAGEMENT
TEAM WORK
INTERPERSONAL COMMUNICATION
GENERAL KNOWLEDGE/ QUIZ BASED ON THEIR SUBJECT
SPOKEN ENGLISH

English (Communication Skill) – 2nd year.

1) PROSE

	TOPIC	AUTHOR	
1	SPEECH AT CHICAGO	SWAMI VIVEKANANDA	
2	THE CASE FOR THE DEFENCE	GRAHAM GREENE	
3	WAITING FOR THE BUDDHA		
4	WATER – THE ELIXIR OF LIFE	C.V.RAMAN	
5	A HORSE AND TWO GOATS	R.K.NARAYAN	

2) POETRY

1	ROAD NOT TAKEN	ROBERT FROST	
2	Even this shall pass		
3	TO INDIA	SAROJINI NAIDU	
4	ALL THE WORLDS A STAGE	WILLIAM SHAKESPEARE	
5	A PRAYER FOR MY MOTHERS BIRTHDAY	HENRY VAN DYKE	

3) GRAMMER

		EXCERCISES
PARTS OF SPEECH NOUNS : KINDS OF NOUNS AND USAGES PRONOUNS PREPOSITIONS ADJECTIVES CONJUNCTION VERB ADVERB INTERJECTION	Different usages on the lines of competitive exams	SENTENCE CORRECTIONS
ARTICLES / APOSTROPHES		
DIRECT /INDIRECT SPEECH		
HOMONYMS/HOMOPHONES		
FIGURES OF SPEECH		
LETTER WRITING – FORMAL AND INFORMAL		
COMPREHENSIONS		
EMAIL AND BUSINESS LETTERS (FORMAT TO BE TAUGHT WHICH IS USED IN WORKPLACE)		
COMPOSITIONS		

4) NON DETAIL

MY EXPERIMENTS WITH TRUTH – M.K.GANDHI

5) PRACTICALS

CAREER CHART.(DEPENDING ON THE STREAM CHOSEN BY THE STUDENT)
ETIQUETTE FOR INTERVIEWS
BODY LANGUAGE
BUSINESS LETTERS
PRESENTATIONS

MARKING SCHEME :
PROSE : 20
POETRY : 15
GRAMMAR : 25
NON DETAIL : 10
PRACTICALS : 30

Elective 1 : Applied Mathematics - 1st Year
(Subject code : 90000011)

Theory	Practical
Detailed Syllabus: **1.0. Trigonometric ratios** 1.1. Angles & its measurements 1.2. Trigonometric ratios 1.3. Relation between degree and radian. 1.4. Fundamental identities. 1.5. Examples based on Fundamental Identities 1.6. Trigonometric ratios of compound angles 1.7. Factorization formulae 1.8. Inverse trigonometric functions 1.9. Properties of a Triangle	**Detailed Syllabus:** Solve problems on: 1) Conversion of radian to degree 2) Conversion of degree to radian
2.0. Plane co-ordinate geometry 2.1. Locus 2.2. Line	
3.0 Vectors and Linear Equalities 3.1. Definition of vector, position vector 3.2. Algebra of vectors(Equality, addition, subtraction and scalar multiplication) 3.3. Dot (Scalar) product with properties. 3.4. Vector (Cross) product with properties. 3.5. Solutions of Linear inequalities in one variable and two variables	
4.0. Determinants and Matrices 4.1. Definition and expansion of determinants of order 2 and 3. 4.2. Cramer's rule to solve simultaneous equations in 2 and 3 unknowns 4.3. Definition of a matrix of order m x n. 4.4. Types of matrices. 4.5. Algebra of matrices such as equality, addition, Subtraction, scalar multiplication and multiplication. 4.6. Transpose of a matrix. 4.7. Minor, cofactor of an element of a matrix, adjoint Of matrix and inverse of matrix by adjoint method. 4.8. Solution of simultaneous equations containing 2 and 3 unknowns by matrix inversion method.	Solve problems on Cramer's rule
5.0 Statistics and Probability 5.1. Measure of dispersion; mean deviation, variance and standard deviation of ungrouped/grouped data. 5.2. Analysis of frequency distributions with equal means but different variances. 5.3. Random experiments: outcomes, sample spaces (set representation). 5.4. Events: occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events 5.5. Probability of an event, probability of 'not', 'and' & 'or' events.	State and prove Baye's theorem

6.0. Set Relations & Functions 6.1. Types of functions 6.2. Domain, Co – domain, Range of a function 6.3. Composite and Inverse functions 6.4. Graphs of functions	Solve problems on Graphs
7.0. Logarithms 7.1. Introduction and Definition 7.2. Laws of logarithms 7.3. Numerical problems based on multiplication, division and power.	Solve problems on power law
8.0. Complex Numbers and Quadratic equations 8.1. Complex Numbers in the form of a+ib 8.2. Modulus, Complex conjugate, Argument of complex numbers 8.3. Algebra of complex numbers 8.4. Square root of complex numbers 8.5. Argand diagram 8.6. Nature of roots 8.7. Sum and product of roots 8.8. Formation of quadratic equation 8.9. Symmetric functions of roots 8.10. Cube roots of unity	
9.0. Sequences and Series 9.1. Definition of a sequence 9.2. Geometric Progression and Arithmetic Progression 9.3. Arithmetic mean, Geometric mean, harmonic mean 9.4. Special Series	1) **Proof of arithmetic progression and geometric progression** 2) **Proof of arithmetic mean and geometric mean**
10.0 Permutations and Combinations 10.1. Factorial notation 10.2. Fundamental principle of counting 10.3. Permutation 10.4. Combinations	
11.0 Mathematical Induction and binomial theorem 11.1. History, statement, Proof of Binomial theorem for positive integral indices, Pascal's triangle, general and middle term in binomial expansion 11.2. Principle of mathematical induction and it's application 11.3. Simple applications	**Proof of Binomial theorem**

Elective 1 : Applied Mathematics - 2 nd Year
(Subject code : 90000011)

Theory	Practical
Detailed Syllabus : **1.0. CALCULUS: Limits and Continuity** 1.1. Definition of a limit 1.2. Algebra of limits 1.3. Standard limits 1.4. Limit at infinity and infinite limits 1.5. Continuity of a function at a point 1.6. Algebra of continuous functions 1.7. Continuity in interval 1.8. Continuity of some standard functions	**Detailed Syllabus** 1) Theorem on a limit of a sequence 2) Theorem on continuity in interval
2.0. Differentiation 2.1. Derivative using first principle 2.2. Rules of Differentiation 2.3. Derivatives of standard functions 2.4. Derivatives of logarithmic and exponential functions 2.5. Derivative of composite functions 2.6. Derivative of Inverse functions 2.7. Derivative of implicit and parametric functions 2.8. Second order derivatives	Proof of derivative using the first principle with the help of an example
3.0. Applications of Derivatives 3.1. Geometrical applications 3.2. Derivative as a rate of change measure 3.3. Approximations 3.4. Maxima and Minima	
4.0. Integration 4.1. Definition of an integral of a function 4.2. Integrals of some standard functions 4.3. Rules of integration 4.4. Indefinite Integration 4.5. Definite Integration	Solve problems on definite integration
5.0 Application of Definite Integrals 5.1. Area under the curve 5.2. Volume of solid of revolution	
6.0. Differential equations 6.1. Definition 6.2. Formation of differential equations 6.3. Solution of first order and first degree differential equations 6.4. Applications of differential equations	Solve problems on first order and first degree differential equations
7.0 Numerical Methods 7.1. Definition of various operators and relation between the operators 7.2. Interpolation methods 7.3. Numerical integration	
8.0. Mathematical Logic 8.1. Statements and logical connectives 8.2. Statement Pattern and Logical equivalence 8.3. Application of logic	
9.0. Geometry 9.1. Pair of straight lines passing & not passing through origin 9.2. **Circle**: definition, Tangent and Normal **9.3. Conic:** Equation of Conics 9.4. **Three Dimensional Geometry:** Direction Cosines and ratios, Line, Plane	
10.0. Linear Programming Problems 10.1. Linear Programming Problems 10.2. Simplex Method	Solve problems on simplex method

11.0. Boolean Algebra 11.1. Boolean Algebra as an algebraic structure Algebra 11.2. Principle of Duality 11.3. Boolean function & switching circuits 11.4. Application of Boolean Algebra to switching circuits	State and explain the principle of duality

Elective - I - Business Economics – 1st year
(Subject Code – 90000012)

Theory	Practical
Detailed Syllabus : 1. **Introduction to Economics** – 1.1 Meaning & Scope - 1.2 Relevance of Economics to different disciplines - Economics & Management, Economics & Law-Economics and Humanities – 1.3 Micro Economics and Macro economics	1) Prepare a project on usefulness of micro – economics. 2) Prepare a project on usefulness of micro – economics. 3) Conduct a GD on the importance of Micro Economics and Macro Economics
2. **Macro Economics** – 2.1 Meaning, Definition and Features. 2.2 Aggregates-Nature of Aggregates , problems of Aggregation. 2.3 National Income, Meaning, Definition of National Income Different National Income Concepts 2.4. Estimation of National Income – Methods and Difficulties	1) Prepare a PPT presentation on macro-economics, National Income and how it is computed and the difficulties in measuring National Income. 2) Prepare a chart on the circular flow of National Income. 3) Make a comparative study of closed economy and open economy. 4) Conduct a case study of 5 individual families and find out the Disposable income to the individuals.
3. **Determinants of Aggregates** 3.1. Aggregate Demand and their components 3.2 Aggregate Supply and their components .	Prepare a chart on the components of aggregate demand. Conduct a GD on Keynes theory of employment and principles of effective demand. Take 2 or 3 case studies on entrepreneurship and discuss to what extent they provide employment to people.
4. **Money and Banking** 4.1 Meaning, definitions and functions of Money 4.2 Commercial Banks: Meaning and Functions. 4.3 Central Banks: Meaning and Functions.	Find out RBIs concept of money supply. A visit to various financial institutions. A visit to a rural bank, cooperative bank, commercial bank. A visit to the RBI Training college, NABARD OR IDBI Further For the first year the practical will consist developing familiarity with banking functions and will comprise Of what are different types of banking services, facilities, available to individuals/organizations? (to increase the financial literacy) how to open a bank account? different investments like – FD,MF facilities for financial inclusion

5 **Public Economics** 5.1 Government Budget and the Economy Government Budget – Meaning and its components 5.2 Types of Government Budget – Balanced, Surplus and Deficit.	Prepare a report on sourses of revenue in the budget of lacal Government. Comment. Conduct of GD on last year's government budget. Find out how a private budget/ finance differs from public budget/ finance Prepare hypothetical master budget for an imaginary company and discuss how you have allocated the funds for each department. Prepare a separate budget for production, personnel and administration, finance, marketing, advertising, etc.
6. **International Trade** 6.1 Comparative cost principal of International Trade. 6.2 Free trade Advantages, Disadvantages 6.3 Protectionist trade advantages, Disadvantages	1) Collect data on India's direction of trade 2) Collect data on India'strade Composition
Theory	Practical
Detailed Syllabus : 7.1. Concepts of Economic Growth and Economic Development 7.2 Indicators of Economic Development Monetary indicators 7.3 Human Development indicators	1) To make a project on discrepancies in India's economic growth and development. 2) Discuss the patterns of education among women in the post independence period. 3) Collect information on Human Development Index for different Indian states.
8.0. **Structural Changes in the Indian Economy since 1991.** 8.1 Economic reforms since 1991: Need and main features, Liberalization, privatization and Globalization. Their impact on Indian Agriculture, Industries and Service Sector. 8.2 Economic Planning – Meaning and Objectives 8.3 Achievements and Failures of 10th Five – Year Plan	1) Conduct a GD on the New Economic Policy, 19991 and its impact on the various sectors. 2) Visit to Agricultural Produce Market Committee to study the price Fixation of agricultural commodities. 3) Collection of market intelligence of agricultural commodities from newspaper and journals. 4) A visit to a cottage industry, small scale industry, large scale industry. 5) A visit to a MNC. Prepare an assignment on the WTO.
9.0. Current Challenges of Indian Economy 9.1 Problem of Population Explosion in India Causes, Effects and Remedial Measures to remove these problems 9.2 Problem of Poverty in India Causes, Effects and Remedial Measures to remove these problems 9.3 Problem of Unemployment in India Causes, Effects and Remedial Measures to remove these problems	Conduct a GD on population explosion and its impact. Prepare a comparative chart on employment in India dusting the five year plans. Conduct a GD to find out measures for poverty alleviation. Make ppt presentation on population explosion, poverty, unemployment.
10.0. Infrastructural Development in India 10.1 Transport and Communication, 10.2 Energy, 10.3 Health and Education	Prepare a project report on recent rends in communication. Prepare transport documents of trade namely goods forwarding note, lorry receipt, delivery challan, railway receipt, mates receipt, Bill of lading, airway bill, etc. Conduct case studies on different energy companies like Carin India, Power Corporation of India, Reliance Energy, Coal India ltd. Collect secondary data on health and education.

Elective - I - Business Economics – 2 nd year
(Subject Code – 90000012)

Theory	Practical
. **Introduction Micro Economics –** 1.1 Meaning, Definition ,Nature 1.2 Tools of Analysis, 1.3 Role of Assumptions	**1)** Conduct a GD on the usefulness of Micre economics2) Prepare a PPT on the role of assumptions in Economics
Consumer Behaviour and Demand Analysis 2.1 Concept of Utility, Total and Marginal Utility, Law of Diminishing Marginal Utility. Law of Equi – marginal Utility. 2.2 Concept of demand, Types of demand, Determinants of Market demand, Law of demand. 2.3 Price elasticity of demand – Concept and Importance	1) Make a ppt presentation on U. TU, MU, Law of diminishing marginal utility and law of equi – marginal utility. 2) Conduct a GD to substantiate the point that consumer behaviour mainly depends on economic theories. 3) Conduct a case discussion on elasticity of demand. **4)** A visit to a mall/ departmental store to study consumer behaviour.
Producer Behaviour and Supply Analysis. 3.1 Meaning of Supply 3.2 Market Supply 3.3 Determinants of Market Supply and Law of Supply.	1) Make a PPT differentiating total output, Stock and Supply concepts. 2) Make chart on law of supply with schedules and supply curve. 3) Prepare a project receipt on the Law of supply. 4) Conduct a case discussion on the elasticity of supply.
Forms of Market and Price Determination, 4.1 Perfect competition 4.2 Monopoly and Monopolistic Competition – Meaning and Features 4.3 Price Determination under Perfect Competition	1) Conduct a discussion on 'prevalence of one price is the best test of perfect competition' 2) A visit to various markets to study the competition. 3) Write a report on the features of buyers market and sellers market.
Factors of Production 5.1 Meaning and Features of Land as a factor of production, 5.2 Labour as a factor of production, 5.3 Capital as a factor of production, 5.4 Entrepreneur, Qualities and functions of entrepreneur.	1) A visit to SISI, DIC to study about entrepreneurship. practical will consist of: • Preparing a project report • How to start a business • Collecting information about Permission/ Licenses required from various government agencies/ authorities • Conducting proto type market surveys using the above statistical tools • Preparing questionnaires for different types of market surveys 2) Prepare a project report on how to start an industry with financial details. 3) Conduct an interview with successful entrepreneurs. 4) Prepare a questionnaire for entrepreneurs. 5) Find out the problems faced by informal sector labour and prepare a report.

Section II	
6.1 Meaning, Scope and Importance of Statistics in Economics	1) Analyze the charts and diagram various statistical reports. 2) Collect secondary data from journals, magazines and newspapers.
Collection and organization of data 7.1 Collection of data – primary and secondary 7.2 Methods of data collection – primary methods – Observation, Interview, Methods of secondary data – Census and sampling, Random sampling. 7.3 Organization of data – Census and sampling, Ramdom sampling.	1) Preparation of questionnaire for personal survey method, telephone interview and mail survey. 2) Select sample respondents and conduct socio – economic survey, marketing survey, etc. 3) Choose suitable sampling method to conduct the survey. **4)** Classification of collected data, tabulation of data and analysis and interpretation of data.
Graphical presentation of Data 8.1 Tables – Components and Types 8.2 Graphs – Curves, Bar diagrams, 8.3 Pie – diagrams.	1) Prepare a project report using statistical techniques, graphs, etc. 2) Prepare a bar diagram for the data collected. **3)** Prepare pie charts.
Measures of Central Tendency 9.1 Mean 9.2 Median 9.3 Mode	1) Solve practical problems of mean, median, etc.

Elective - I PHYSICAL BIOLOGY (Botany & Zoology) – 1st Year (Subject Code : 90000013)

Theory	Practical
Detailed Syllabus : **1.0. General Biology** 1.1. Definition and its concept 1.2. Living World: Nature and scope of Biology 1.3. Cell and Cell division: Structure of the cell, Cell division 1.4. Main features of life and its characteristics (Irritability, Homeostasis, Adaptations, Reproduction and Growth & death. 1.5. Origin and evaluation of life 1.6. Theories of evaluation of life, origin of life, special creation, spontaneous generation, Abiogenesis, Evidences of organic evolution paleontological anatomical & embryological 1.7. Study of Tissues	Study of cells and tissues
2.0. Introduction to Botany 2.1 Origin, development and scope of Botany 1.2 Classification and its need 1.3 Nomenclature 1.4.Taxonomic Hierarchy 1.5. Five Kingdom system of classification 1.6. Two Kingdom system of classification 1.7. Thallophyta, Bryophyta and Pteridophyta 1.8. Gymnosperms, Angiosperms	Study of angiosperms and gymnosperms
3.0. Vegetative Morphology of plants 3.1.Root: Root System – types, modifications of root (storage roots, velaman roots, photosynthetic roots, respiratory roots, parasitic roots, nodular roots) 3.2 Stem: Characteristics and Functions of the stem Modifications of the stems (Aerial – Tendrils, Thorns, Hooks, Phylloclade, Tuberous stems, Bulbils: Sub Aerial – Runners, Stolons, Suckers, Offsets: Underground – Rhizome, Corm, Stem Tuber, Bulb) 3.3 Leaf: Parts and Functions (Types and Modifications of leaf base, stipule, petiole are excluded) Venation Types of leaves (simple and compound) Phyllotaxy (alternate, opposite, Whorled) Modifications of leaves (tendrils, spines, scale leaves, Phyllode, reproductive leaves, trap leaves (details of Nepenthes only)	Study of the structure of a plant(root, stem, leaf)
4.0. Reproductive Morphology of plants 4.1. Inflorescence – Types (racemose, cymose, special) 4.2. Flower – Parts, Sex Distribution, Symmetry, Position of Gynoecium, detailed description of flower (perianth, calyx, corolla, aestivation, androecium – parts, fixation, dehiscence of anther, lengths of stamens, union of stamens), gynoecium – number of carpels, fusion of carpels (excluding variations under syncarpous), ovary – number of locules, placentation, types of styles, stigma.	

SECTION B - ZOOLOGY **5.0. General Biology of Living world** 5.1. Main features of life and its characteristics (Irritability, Homeostasis, Adaptations, Reproduction and Growth & death. 5.2. Origin and evaluation of life 5.3. Theories of evaluation of life, origin of life, special creation, spontaneous generation, Abiogenesis, Evidences of organic evolution paleontological anatomical & embryological 5.4. Study of Tissues	
6.0 Diversity of life 6.1 Study and Classification of animals	Classification of animals
7.0. Genetics **7.1. Chromosomal basis of inheritance**	
7.0 Study of Phylum: Chordata 7.1 General characters and out line classification of Chordata up to classes with typical examples. 7.2 Fishes: Distinctive features of cartilaginous and Bony fishes with typical examples. 7.3 Amphibia: Distinctive features of Urodela, Anura and Apoda with typical examples	Study of amphibians
8.0 Study of Reptiles, Aves and Mammals 8.1 Reptiles: Distinctive characters of Squamata, Rhynchocephalia, Crocodilia and Chelonia with typical examples. 8.2 Identification of Poisonous and Non- Poisonous Snakes, Poison apparatus, toxicity of Snake venom and treatment of snake bite including the first aid. 8.3 Aves: Distintive features of Carinatae and Ratitae with typical examples. 8.4 Mammals: Distinctive features of Prototheria , Metatheria and Eutheria.	1) Study of mammals 2) study of reptiles
9.0 Anatomy of Earthworm 9.1. General characteristics of earthworm 9.2. Digestive and reproductive system 9.3. Inter-relation of earthworm with mankind	Study of earthworm

Elective - I PHYSICAL BIOLOGY (Botany & Zoology) – 2nd Year (Subject Code : 90000013)

Theory	Practical
Detailed Syllabus : SECTION A - BOTANY **1.0. Reproduction in Angiosperms** 1.1 Introduction 1.2 Microsporogenesis and development of male gametophyte 1.3 Ovule – structure, types, megasporogenesis, development of embryo sac 1.4 Pollination – Types, Contrivances of cross and self pollination. Agents of Pollination (definition with one example only) 1.5 Fertilization: Post Fertilization changes including seed structure (dicot, Monocot) and types of germination (epigeal, hypogeal & vivipary – definitions with one example)	Detailed Syllabus Study of reproduction in angiosperms in details
1.6 Fruits: – Classification; false fruits, true fruits – simple (fleshy fruits – berry, pome, pepo, hesperidium, drupe: Dry fruits – dehiscent - legume, septicidal capsule, septifragal capsule, loculicidal capsule: Indehiscent – caryopsis, cypsela, nut: schizocarpic – lomentum, schizocarp), Aggregate and multiple fruits	
2.0. Plant Taxonomy 2.1 Introduction – alpha and omega taxonomy , aspects of taxonomy, flora, herbaria, botanical gardens (RBG – KEW , IBG – Kolkatta, NBG – Lucknow), binomial nomenclature, ICBN, Types of classification, Units of classification, brief account of Bentham and Hookers classification 2.2 Study of Malvaceae 2.3 Study of Fabaceae 2.4 Study of Solanaceae 2.5 Study of Liliaceae	
3.0. Internal Organization of plants 3.1 Tissues – Types (meristematic and permanent) and Functions 3.2 Internal Structure of Dicot Root (Primary) and Monocot root 3.3 Internal Structure of Dicot Stem (Primary) and Monocot stem 3.4 Internal Structure of leaf (Dicot and Monocot) 3.5 Secondary Growth in Dicot Stem	Study of monocot and dicot stem
4.0. Genetics 4.1 Introduction to genetics 4.2 Mendel's Principles – Monohybrid, Dihybrid cross, Concept of probability in relation to Mendel's laws 4.3 Linkage and crossing over (only concept and significance) 4.4 Mutations – gene and chromosomal (only definitions of terms: – spontaneous, induced, chromosomal structural and chromosomal numerical changes)	**Mendel's principle**
SECTION B - ZOOLOGY **5.0. Morphology of Humans** 5.1. Nutrition and respiration in man 5.2. Locomotion in man 5.3. Study of Human Skeleton	**Study of human skeleton(Bone theory)**
6.0 Physiology of Humans 6.1. Circulation 6.2. Osmoregulation and excretion 6.3. Nervous co – ordination 6.4. Hormonal co – ordination	**1) Study of hormones** **2) study of circulation and excretion(diagrammatic chart)**

7.0 Reproduction, growth and development 7.1. Details of Reproduction and human development	**Study of reproduction in humans**
8.0 Biology in Human welfare 8.1. Aquaculture: List of animals of aquacultural importance in Tabular form only 8.2. Poultry: Poultry farming methods, Layers and Broilers, Poultry diseases (Bacterial,Viral and Fungal - Three each) 8.3. Study of diseases: AIDS, Cancer, Typhoid 8.4. Immunity system 8.5. Biotechnology (Elementary aspects) 8.6. Applications of Biology: Vermiculture and Fishery	**Study of various diseases**

Subject Name : ENTREPRENEURSHIP – 1st Year
(Subject code : 90000014)

Theory	Practical
Detailed Syllabus : **1.0. Entrepreneurship** 1.1. Concept, Functions and need 1.2. Entrepreneurship: Characteristics and Competency 1.3. Relevance of Entrepreneurship to Socio-Economic Gain: generating National Wealth, creating Wage and Self -Employment, Micro, Small and Medium Enterprises, Optimizing Human and Natural Resource and Solving Problems in the path of prosperity, building enterprising Personality and Society. 1.4. Process of Entrepreneurship Development.	**Detailed Syllabus** I. Study visit by students to any enterprise of own choice. With the help of a schedule/questionnaire the students will record observation regarding – the background of entrepreneur, reasons for selecting the entrepreneurial career, starting the enterprise, the type of enterprise, the process of setting this enterprise, products/services, production process, investment made and marketing practices followed, profit or loss, growth and development, problems faced, institutions/organizations which offer support and entrepreneur's level and type of satisfaction.
2.0. Entrepreneurial Pursuits and Human Activities: 2.1. Nature, Purpose and pattern of Human Activities: Economic and Non-Economic, Need for innovation. 2.2. Rationale and Relationship of Entrepreneurial pursuits and Human Activities.	II. Preparation of a brief report based on the observations made during study-visit to an enterprise.
3.0. Acquiring Entrepreneurial Values and Motivation 3.1 Entrepreneurial Values, Attitude and Motivation-Meaning and concept. 3.2 Developing Entrepreneurial Motivation and Competency – concept and process of Achievement Motivation, Self-efficacy, Creativity, Risk Taking, Leadership, Communication and Influencing Ability and Planning Action. 3.3. Barriers to Entrepreneurship 3.4. Help and support to Entrepreneurs	
4.0. Introduction to Market Dynamics 4.1. Understanding a Market 4.2. Competitive Analysis of the Market 4.3. Patents, Trademarks and Copyright	
5.0. Project Selection 5.1. Product Identification 5.2. Project Formulation	

ENTREPRENEURSHIP – 2nd Year

Theory	Practical
Detailed Syllabus : **1.0. Entrepreneurial Opportunities and Enterprise Creation** 1.1. Sensing Entrepreneurial Opportunities 1.2. Environment Scanning 1.3. Market Assessment 1.4. Identification of Entrepreneurial Opportunities 1.5. Selection of an Enterprise 1.6. Steps in setting up of an Enterprise	**Detailed Syllabus**
2.0. Enterprise Planning and Resourcing 2.1. Business Planning – Preparation of a Project Report 2.2. Resource Assessment -Financial and Non – Financial. 2.3. Fixed and Working Capital Requirement, Funds, Flows, Profit Ratios, Break Even Analysis etc. 2.4. Mobilizing Resources – Sources and Means of Fund, Facilities and Technologies for starting an Enterprise.	
3.0. Enterprise Management 3.1. General management: Basic Management functions. 3.2. Organizing/Production of goods and services – quality, quantity and flow of inputs. 3.3. Managing Market: Meaning, Functions of Marketing, Marketing Mix: * Product * Price * Place * Promotion (advertising and sales promotion). 3.4. Managing Finance – Sources of Long Term and Short Term Finances, Determination of Cost, Income, Calculation of Profit/Loss. 3.5. Managing Growth and Sustenance -Affecting Change, Modernization, Expansion, Diversification and Substitution. 3.6. Entrepreneurial Discipline – Laws of Land, Ecology, Consumer's Concept, Adherence to Contract and Credits.	
4.0. Industrial Relations and Personnel Management 4.1. Meaning, Source of recruitment, Internal/External recruitment procedure 4.2. Incentives, appraisal and training, Industrial relations, Industrial disputes.	
5.0. Report Writing 5.1. Guidelines 5.2. Model project reports	

PRACTICAL (Second Year)

Introduction:

The Main objective of the course in Entrepreneurship is to generate in the students initiative, self reliance and enthusiasm so as to empower them to become entrepreneurs both in spirit and performance. A number of skills such as observation, evaluation, communication, resource mobilization and management, risk assessment, team building etc. is also to be developed in the students. Leadership qualities, sensitivity to business ethics and adherence to a positive value system are the core issues that the course highlights while presenting different concepts related to entrepreneurship.

Such a course should necessarily have a strong experiential component in the form of practical work. The objectives of the practical work are:

1 To introduce the students to the world of business by developing in them the core skills and competencies required for an entrepreneur.
2. To develop in the students qualities such as leadership, self-confidence, initiative, facing uncertainties, commitment, creativity, people and team building, integrity and reliability.
3. To enable the students to acquire the skills and knowledge needed for conducting surveys, collecting, recording and interpreting data and preparing simple estimates of demand for products and services.
4. To guide the students to prepare a Project Report.
5. To equip the students with knowledge and skills needed to plan and manage an enterprise through case studies conducted and recorded by the students in different fields such as resource assessment, market dynamics, finance management, cost determination, calculation of profit and loss etc.
6. To instill in the students important values and entrepreneurial discipline.

FORMAT

	Total marks: 30
1. Project Report/Survey Report	10 Marks
2. Viva-Voce on PW /SR	05 Marks
3. Case Study	10 Marks
4. Problem Solving	05 Marks
1. Project Report/Market Survey Report	**10 Marks**

a) Project Report:

Preparation of a Project Report for an enterprise involving products/services Students may be provided adequate guidance to choose a project based on their interests and availability of information and authentic inputs in the locality. The specimen proforma of project report given in the textbook may be used for preparing the report. However, mechanical preparation of the report by filling in the information in the proforma should be discouraged.

Further, as the students will be required to appear for a Viva-voce on the basis of their projects, sufficient care should be taken by the students to prepare the report after studying the various aspects involved thoroughly. In a nutshell, the project report should lead to viable enterprise.

b) Market Survey Report

Market research is the process and technique of finding out who your potential customers are and what they want. The survey may be on products and services already available in the market or students may also conduct surveys for new products and services. The report of the survey should be organised under the following broad headings :

1. Objectives.
2. Methods and tools (interviews ,questionnaires etc.) to be used to collect information.
3. Records of data and information.
4. Analysis of data and information.
5. Interpretation and conclusion.

For example, a survey may be conducted to find out the choice of households in toiletry soap, tooth paste etc. The data may be analysed to establish a pattern that may be useful to an entrepreneur.

Guidelines for assessment of Project Report / Survey Report

1. Presentation: Format, Clarity, Use of graphs, tables and other visuals, organisation, methodical recording of data and information and general neatness of execution. 5 marks
2. Originality and Creativity 3 marks
3. Authenticity of information and correctness of calculations and general feasibility of the project/ sustainability of conclusion drawn in the survey. 2 marks

2. Viva Voce on the Project /Market Survey Report 5 Marks

The questions should establish that the report is the original work of the student and that the student has a reasonably clear understanding of the work carried out by him/her. Entrepreneurial qualities such as leadership, self-belief, creativity, originality, initiative etc. may also be assessed by asking a variety of questions related to the report.

3. Case Study

10 marks

A case study is a focused research on an organisation, enterprise, practice, behaviour or person undertaken to highlight an aspect that the study attempts to examine. For instance, a case study may be conducted on the pollution control methods being employed by an industry. Or a successful industrialist may be chosen as a subject of a case study to analyze and understand the strategies that the industrialist adopted :to achieve success.

Ideally, a case study should be conducted on subjects with the objectives of bringing to the fore beliefs, practices, strategies, values etc. that have made them what they are. Such studies help us to understand the way in which great minds think and operate. We may also conduct case studies on failures; why a company collapsed, how a service lost its market etc. From both the types of case study, we learn lessons; how to do something or how not to do something. They also provide valuable insight into the processes involved in an enterprise.

A few topics are suggested for carrying out case studies :

i) Drawing a profile of a successful entrepreneur.
ii) Studying a public sector undertaking and highlighting its sucess/failure, by analyzing the factors responsible.
iii) Studying a small scale unit in the locality to bring out the procedures and processes adopted by the unit to become a feasible business venture.
iv) A study of competition in business by choosing two or more rivals in the market and analyzing their strengths and weaknesses.
v) Take the school itself for a case study and analyze any two aspects of the school plant for chalking out a plan of action: infrastructure, academics, co-curricular activities etc.
vi) A case study on a thriving fast food shop/restaurant in your locality. What makes it so popular?
vii) A case study on the ways in which a business unit has mobilised its financial resources.
viii) A case study on the enterprise management techniques adopted by a business house.
ix) A case study on the marketing strategies of a sucessful consumer durable company.
x) A case study on the financial management of a Public Limited Company.
xi) A case study on any Specialized Institution that supports and guides the establishment of a small scale unit.
xii) Studying the balance sheets of two big private companies to assess their trade and credit worthiness.
xiii) Studying the inventory management of a large manufacturing industry to ascertain the processes involved for optimizing cost.
xiv) Carrying out a case study on an established industrial house/company to find out the value system of the company and how it fulfils its social commitment/obligations.
xv) Carrying out a case study on an established industry to ascertain the processes followed to reduce/prevent pollution.
xvi) Study on enviourment friendly companies and their contribution to preservation.

Assessment of Case Studies

i) Presentation: Format, accuracy, clarity, authenticity and general neatness 7 marks
ii) Analysis and Conclusions 3 marks

4. Problem Solving 5 marks

In this session, the students will be requried to solve a problem in the form of a written test. The examiner may choose any problem related to the units in class XII Text Book and set it for the class. The problem may be in the following areas :

a. How to scan the environment to establish the feasibility of a project.
b. Given certain figures showing the consumption pattern of a product, drawing conclusions that have a bearing on similar products.
c. Carrying out market assessment for a given product/service to ascertain the feasibility factor.
d. Assessment of Working Capital.
e. Calculation of total cost of production.
f. Calculation of break-even point.
g. Determining location of a manufacturing unit.
h. Problems in inventory control (calculation of the Economic Order Quantity and carrying out ABC analysis).
i. Applying Pricing methods to determine the price of a product or service.
j. Applying promotion mix to plan a sales campaign for a product or service.
k. Working out a simple budget for a given task or job.

Assessment of Answers

The examiner may prepare five problems which are solved by him/her before they are presented to the students. The student may choose anyone of the problems and solve it, showing the different steps/different reasons involved in the solution. If the problem does not involve actual calculations, it may not have anyone correct answer. So weightage should be given not only to the final answer but to the entire process of problem solving that the student has followed. Originality and innovative spirit should be rewarded. The students should not be penalized for pelling errors, grammatical mistakes etc. as long as the answer is coherent. Where definite formulas are involved, accuracy should be given due weightage.

LIST OF SUGGESTED REFERENCE BOOKS

01. Entrepreneurship – Class XI – C. B. S. E., Delhi.
02. Entrepreneurship – Class XII- C. B. S. E., Delhi.
03. Udyamita (in Hindi) by Dr. M M.P. Akhouri and S.P Mishra, pub. by National Institute for Entrepreneurship and Small Business Development (NIESBUD), NSIC-PATC Campus, Okhla.
04. Trainer's Manual on Developing Entrepreneurial Motivation, By M.M.P. Aukhori, S.P. Mishra and R. Sengupta, Pub. by (NIESBUD), NSIC-PATC Campus, Okhla.
05. Behavioral Exercises and games – manual for trainers, learning systems, by M. V. Despande, P. Mehta and M. Nandami.
06. Product Selection by Prof. H.N. Pathak, Pub. By (NIESBUD), NSIC-PATC Campus, Okhla.
07. Entrepreneurial Development – Dr. S. Moharana and Dr. C.R.Dash, Pub. by RBSA Publishers, Jaipur.
08. Entreprenurial Development by S.S.Khanna, Published by S.Chand & Company Ltd., Ram Nagar, New Delhi.
09. Entrepreneurial Development by C.B. Gupta and N.P.Srinivasan, Publisher Sultan Chand & Sons, 1992.
10. Entrepreneurship Development – Principles, Policies and Programmes by P. Saravanavel, Publishers Ess Pee Kay Publishing House, Madras.
11. Entrepreneurship, Growth and Development, by Rashi Ali, Pub. by Chugh Publication and Strech Road, Civil Lines, Post Box No. 101, Allahabad-211991.
12. Entrepreneur and Entrepreneurship Development and Planning in India, by D.N.Mishra, pub. by Chugh Publication, Allahabad.
13. Aoudhogik Disha Nirdesh (in Hindi) Pub. by Centre for Entrepreneurship Development, M.P. (CEDMAP), 60, Jail Road, Jhangerbad, Bhopal-462008.
14. Entrepreneur, Industry and Self-employment Project, Part-l and 2(in Hindi), Pub. by Centre for Entrepreneurship Development, M.P. (CEDMAP), 60 Jail Road, Jhangerbad, Bhopal-462008.
15. Small Scale Industry & Self-Employment Projects, Part-l and 2 (in Hindi), Pub. by Centre for Entrepreneurship Development, M.P. (CEDMAP),60 Jail Road, Jhangerbad Bhopal.

Magazines

01. Udyamita Samachar Patra,(Monthly, Hind), Pub. by Centre for Entrepreneurship Development, M.P.(CEDMAP), 60 Jail Road, Jhangerbad, Bhopal-462008.
02. Science Tec. Entrepreneur (A Bi Monthly Publication), centre for Enterprenurship Development, M.P. (CEDMAP), 60 Jail Road, Jhangerbad , Bhopal -462008.
03. Laghu Udhyog Samachar.
04. Project Profile by DCSSI.
05. Project Profile by Pub. Centre for Enterpreeurship Development, M.P. (CEDMAP), 60 Jail . Road, Jhangerbad, Bhopal-462008.

Elective – II - APPLIED SCIENCE (Physics & Chemistry) – 1st Year (Subject Code – 90000021)

Theory	Practical
Detailed Syllabus : **SECTION A : PHYSICS** **1.0. Measurement, Units, and Dimension** 1.1 Introduction: Need for measurement, Units and documents, accuracy, precision of measuring instruments. 1.2 Types of Errors: Constant error, systematic error, environment error (errors due to external causes). Error due to imperfection, random error, gross error, percentage error. 1.3 Combination of Error: Error due to addition, subtraction, multiplication, division, powers of observed quantities. 1.4 Units and Dimensions: Fundamental and derived physical quantities, systems of units in SI systems. Rules for writing units in SI, derived units in SI. Multiples and submultiples of SI units. 1.5 Dimensions: dimensional formulae and dimensional equations, dimensional constants and dimensionless quantities, principle of homogeneity of dimensions. 1.6 Application of dimensional method of analysis: Conversion of one system of units into another, to check the correctness of an equation, to derive the relationship between different physical quantities. 1.7 Order of magnitude and significant figures 1.8 Concept of accuracy and estimation of errors	**Detailed Syllabus** Perform a simple experiment on measurement and error
2.0. Scalars and Vectors 2.1. Introduction to scalars and vectors 2.2. Addition and subtraction of vectors 2.3. Product of vectors	
3.0. Motion & Force 3.1. Definition of Motion, Uniformly accelerated motion along straight line 3.2. Position time graph and velocity-time graph 3.3. Equation of a projectile path 3.4. Time of light, Horizontal range, Maximum height of a projectile 3.5. Definition and types of forces 3.6. Introduction to gravitation, electromagnetic and nuclear forces 3.7. Law of conservation of momentum 3.8. Elastic and inelastic collisions 3.9. Momentum of force, couple and properties of couple 3.10. Centre of mass and gravity 3.11. Conditions of equilibrium of a rigid body	**Experiment on gravitational force(example of a ball falling from a certain height)**
4.0. Friction 4.1. Origin and nature of frictional forces 4.2. Laws of static and kinetic fictions 4.3. Pressure due to fluid column 4.4. Pascal's law and its applications 4.5. Newton's formula 4.6. Stoke's law 4.7. Equation for terminal velocity 4.8. Bernaulli's principle and its applications	**Proof of Stoke's theorem and Bernaulli's principle**
5.0. Dynamics 3.1 Introduction, Newton's Law of Motion. 3.2 Application of Newton's laws – Objects suspended by strings, blocks placed in contact with each other on frictionless horizontal surface, apparent weight in a lift. 3.3 Impulse, Law of conservation of linear momentum, Conservation of linear momentum during collision. 3.4 Work, power, energy potential Energy (PE), Kinetic Energy (KE), definition & derivation for both, relation between KE & linear momentum.	**Derivation for Potential energy and kinetic energy**

3.5 Conservation and non conservative forces, Work energy theorem, law of conservation of energy in case of freely falling body and vertically projected body.	
6.0. Sound waves 6.1. Waves and oscillations 6.2. Progressive waves 6.3. Characteristics of transverse waves, longitudinal waves 6.4. Sound as longitudinal wave motion 6.5. Definition of period, frequency, wavelength giving their relations. 6.6. Newton's formula for velocity of sound, laplace's correction	
7.0. Thermal expansion 7.1. Expansion of solids, liquid 7.2. Linear expansion, area and volume expansion 7.3. Thermal conduction, temperature gradient and coefficient of thermal conductivity	**Experiment on expansion of solids in a thermal envirnment**
8.0. Refraction of light and lens 8.1. Refraction of light: Refraction of monochromatic light, Snell's law, Total internal reflection, Critical angle, Optical fiber, Dispersion of light, Prism formula, Rainbow, Scattering of light 8.2. Wave Theory of light: Huygen's principle, Construction of plane and spherical wave front, Wave front and wave normal, Reflection at a plane surface, Polarization, Plane polarized light 8.3. Interference and Diffraction: Interference of light, Condition's for producing steady interference, Young's experiment, analytical treatment, expression for path difference and fringe width, Measurement of wavelength by bi prism experiment, Diffraction due to single slit, Rayleigh's criteria, Difference between interference and diffraction 8.4. Critical angle, Optical fiber, dispersion of light, Prism formula, angular dispersion and dispersive power 8.5. Refraction at single curved surface 8.6. Lens maker's equation 8.7. Concept of conjugate foci 8.8. Magnifying power of simple microscope, compound microscope and telescope 8.9. Lens defects	**Experiment on Refraction of light using a prism**
9.0. Modern Physics <u>Part A – Electrons and Photons</u> 9.1. Discovery of electron 9.2. Charge and mass of electron 9.3. Photo electric current 9.4. Einstein's equation 9.5. Photoelectric cell and its applications <u>Part B – Atoms, Molecules and Nuclei</u> 9.6. Bohr's model 9.7. Hydrogen spectrum 9.8. Laser as a light source 9.9. Wavelength of an electron 9.10. Davisson and Germer experiment 9.11. Elementary idea of electron microscope	

SECTION B – CHEMISTRY **1.0. Basics of Chemistry** 1.1. Importance of Chemistry 1.2. Fundamental and derived units and their SI units 1.3. Gay-Lussac's law, Avogadro's law 1.4. Derivation of molecular weight, gram molecular volume 1.5. Stoichiometry Mole concept 1.6. Equivalent weight, Atomic weight, Molecular weight 1.7. Percentage composition and molecular formula 1.8. Numerical based on weight-volume relationship	**Solve Problems based on weight – volume relationship**
2.0. Atomic Structure 2.1 Characteristics of electron, proton and neutron. 2.2 Rutherford model of an atom. 2.3 Nature of electromagnetic radiation, 2.4 Planck's quantum theory. 2.5 Explanation of photo electric effect. 2.6 Features of atomic spectra. 2.7 Characteristics of hydrogen spectrum. 2.8 Bohr's theory of the structure of the atom. 2.9 Bohr's explanation of spectral lines. 2.10 Failure of Bohr's theory. 2.11 Wave-particle nature of electron. 2.12 de Broglie's hypothesis, Heisenberg's uncertainty principle. 2.13 Important features of the quantum mechanical model of an atom. 2.14 Quantum numbers, concept of orbitals, define an atomic orbital in terms of quantum numbers – shapes of s, p and d orbitals, state Aufbau principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity. 2.15 Electronic configurations of atoms. Explanation of stability of half filled and completely filled orbitals.	**Study of Planck's quantum theory and Bohr's theory**
3.0 Classification Of Element And Periodicity In Properties 3.1 The concept of grouping elements In accordance to their properties. 3.2 The periodic law. 3.3 The significance of atomic number and electronic configuration as the basis for periodic classification. 3.4 Classify elements into s, p, d, f blocks and discuss their main characteristics. 3.5 Periodic trends in physical and chemical properties of elements. 3.6 Periodic trends of elements with respect to atomic radii, ionic radii, inert gas radii, ionization energy, electron gain energy, electro negativity and valence. 3.7 Variation of atomic radii in inner transition elements.	**Study of Structure of periodic table**
4.0. Redox Reaction 4.1. Introduction to Oxidation & Reduction 4.2. Electron transfer concept 4.3. Oxidising & Reducing agents 4.4. Redox reactions in aqueous solutions 4.5. Oxidation number and rules for assigning oxidation number 4.6. Balancing of chemical equations	
5.0. Chemical Equilibrium 5.1. Introduction: Reversible and irreversible reactions 5.2. Rate of reaction and factors affecting it 5.3. Chemical Equilibrium	**Numerical problems based on K_p and K_c**

5.4. Laws of Mass action, Equilibrium constant, relationship between K_p and K_c	
6.0. Adsorption: 6.1. Concept of adsorption 6.2. Difference between absorption and adsorption 6.3. Physical and chemical adsorption 6.4. Factors affecting adsorption 6.5. Applications of adsorption	**Experiment on absorption(example of a sponge) to give the difference between absorption and adsorption**
7.0 Chemical Bonding and Molecular Structure 7.1 Kossel-Lewis approach to chemical bonding. 7.2 Factors favorable for the formation of ionic bond, energy changes in ionic bond formation. 7.3 Crystal lattice energy – calculation of lattice energy – Bom-Haber cycle. 7.4 Crystal structures of sodium chloride and Caesium chloride. 7.5 Properties of ionic compounds. 7.6 Covalent bond – VSEPR theory and predict the geometry of simple molecules. 7.7 The valance bond approach for the formation of covalent bonds. 7.8 Directional properties of covalent bond. 7.9 Properties of covalent bond. 7.10 Different types of hybridization involving s, p and d orbitals and draw shapes of simple covalent molecules. 7.11 Definition of coordinate covalent bond with examples. 7.12 Description of molecular orbital theory of homonuclear diatomic molecules. 7.13 Bonding, antibonding molecular orbitals, o, n bond orbitals, their symmetry. 7.14 Energy diagrams of molecular orbitals of H2, N2 and 02. 7.15 Concept of hydrogen bond – Types of hydrogen bonds, inter and intra molecular hydrogen bonds. 7.16 Effect of hydrogen bonds on some properties of substances with examples. 7.17 Different states of matter in terms of balance between intermolecular forces, thermal energy of particles.	
8.0. S-block, P-block, d-block & F-block elements 8.1. Introduction to S & P blocks 8.2. Position in periodic table, general electronic configuration 8.3. Comparison between alkali and alkaline earth metals 8.4. Sodium occurrence, uses of sodium 8.5. Methods of extraction 8.6. Physical and chemical properties 8.7. Difficulties in isolation of fluorine 8.8. Methods of preparation 8.9. Uses of fluorine	

Elective – II - APPLIED SCIENCE (Physics & Chemistry) – 2nd Year (Subject Code – 90000021)

Theory	Practical
Detailed Syllabus : **SECTION A - PHYSICS** **1.0. Electrostatics** 1.1 Gauss's theorem, proof and application 1.2 Mechanical force on unit area of a charged capacitor 1.3 Energy density of a medium 1.4 Concept of a condenser 1.5 Capacity of parallel plate condenser 1.6 Effect of dielectric on capacity 1.7 Energy of a charged condenser 1.8 Condensers in series and parallel	**Detailed Syllabus** **1) Proof of Gauss's theorem** **2) Solve numericals on series and parallel plate capacitors**
2.0. Current, Electricity and Magnetic effects of electric current <u>Part A – Current Electricity</u> 2.1. Ohm's Law 2.2. Ohmic and non-ohmic resistances , specific resistance, conductance, 2.3. Temperature dependence of resistivity 2.4. Thermistor 2.5. emf of a cell - internal resistance and back e.m.f's 2.6. Kirchoff's laws: statement and explanation, application to wheatstone's bridge for its balance conditions , metre bridge, principle of potentiometer 2.7. Comparison of e.m.f. of cell, determination of internal resistance of a primary cell, Series and parallel combination of cells. <u>Part B – Magnetic effects of electric current</u> 2.8. Biot Savart's law 2.9. Right hand Thumb rule 2.10. Magnetic induction at the center and at the point along the axis of circular coil carrying current 2.11. Flemming's left hand rule 2.12. Definition of Ampere 2.13. Ampere's law and its applications 2.14. Moving coil galvanometer 2.15. Ammeter 2.16. Voltmeter	**1) Solve numericals on Ohm's law** **2) Experiment on wheatstone's bridge**
3.0. Magnetism 3.1. Coulomb's inverse square law 3.2. Couple acting on a bar magnet placed in a uniform magnetic field 3.3. Magnetic moment of a magnet 3.4. Expression for Magnetic induction due to a bar magnet on axial and Equatorial lines 3.5. Superposition of magnetic fields 3.6. Tangent law 3.7. Deflection Magnetometer 3.8. Comparison of magnetic moments in Tan-A and Tan-B positions by Equal distance method and null method	

4.0. Electromagnetic waves 4.1. Electromagnetic waves and their characteristics 4.2. Transverse nature of electromagnetic waves 4.3. Electromagnetic spectrum 4.4. Propagation of electromagnetic waves in atmosphere	
5.0. Electromagnetic Induction 5.1. Laws of electromagnetic induction 5.2. Eddy currents 5.3. Self and mutual induction 5.4. Transformer 5.5. Coil rotating in uniform magnetic field 5.6. Alternating currents 5.7. Reactance and impedance 5.8. Power in a a.c. circuit with resistance, inductance and capacitance 5.9. Resonant circuit	**Solve numericals on power in a.c circuit, transformers and resonating circuits**
6.0. Semiconductors 6.1. Energy bands in solids 6.2. Intrinsic and extrinsic semiconductors 6.3. p – type and n – type semiconductors 6.4. P – N junction diode 6.5. LED 6.6. Rectifiers 6.7. Zener diode as a voltage regulator 6.8. Solar cell 6.9. Transistor as an amplifier 6.10. Oscillators 6.11. Logic gates	
7.0 Communication 7.1. Space communication 7.2. Ground, sky and space wave propagation 7.3. Satellite communication 7.4. Line communication 7.5. Two wire lines 7.6. Cables 7.7. Optical communication	**Study of various types of cables and wires**
SECTION B - CHEMISTRY **6.0. Electrochemistry** 6.1 Electrolytes and Non-electrolytes. 6.2 Faraday's laws of electrolysis. 6.3 Galvanic & Voltaic cells representation 6.4 Nernst equation (No derivation) , e.m.f. calculations.	**Experiment on faraday's law of electroststics**
7.0 Nuclear Chemistry 7.1 Composition of Nucleus - Isotopes, Isotones, Isobars, Nuclear stability - Factors effecting Nuclear stability, mass defect, binding energy, Average binding energy, N/P ratio, Magic Numbers). 7.2 Radio-active disintegration and its rate-Half-life and average life. 7.3 Natural and artificial radio-activity, disintegration series-Group displacement law-Types of Nuclear reactions (fission and fusion)-Differences between Nuclear and Chemical reactions- Radio-active isotopes and their applications Idoine 131 , Cobalt 60 , Sodium 24 , C 14 and P 30.	**Solve numericals on binding energy and half life rate**

8.0 Surface Chemistry 8.1 Adsorption and absorption. Physical and chemical adsorption-distinguishing properties-Adsorption of gases on Metals Adsorption from solutions (Elementary treatment). 8.2 Colloidal state:- True and colloidal solutions – Explanation of the terms - Dispersion medium, dispersed phase, Iyo-phillic and Iyo-phobic sols using the examples; smoke, cloud, blood, milk, starch solution and gold sol. 8.3 Emulsions:- Emulsifying agent and emulsification - its applications. Cleansing action of soap. 8.4 Catalysis - Explanation of the terms – Homogeneous and Heterogeneous catalysis – distinctions with suitable Examples-auto catalysis with one example	
9.0. Acids and Bases 9.1 Theories of Acids and Bases Lowry - Bronsted concept Lewis theory of acids and bases. 9.2 Ionic product of water, PH, Buffers - Numerical problems on these, Indicators - Choice of indicators, PH-range and uses. 9.3 Salt hydrolysis - Types of hydrolysis with examples.	**Solve numericals on pH value.**
10.0 Alkanes, Akkenes, Alkynes and Aromatic compounds 10.1. Introduction and importance of organic chemistry 10.2. General characteristics of organic compounds Classification of organic compounds	
11. Ethers **11.**1 Introduction:- Definition 11.2 Classification:- 11.3 Nomenclature and metamerism 11.4 Preparation, Reactions & Uses	**Study of Simple and mixed ethers with examples.**
12. Aidehydes and Ketones 12.1 Introduction 12.2 Carbonyl Compounds & classification 12.3 Nomenclature of aldehydes and ketones 12.4 Preparation & reaction of Aldehydes and ketones	
13.0 Acids & Esters 13.1. Introduction, Nomenclature, preparation, Reaction and uses of Acids & Easters	**Study of various types of acids**
14.0. Amines 14.1. Introduction, Classification and Nomenclature 14.2. Preparation of primary amines 14.3. Reaction of amines	
15.0. Biomolecules & Synthetic Fibres 15.1. Introduction 15.2. Carbohydrates and Proteins 15.3. Fats & Oils 15.4. Classification of Fibres 15.5. Preparation of fibres 15.6. Physical properties and uses of fibres	**Study of fibres**
16.0. Chemistry in application 16.1. Application of Chemicals in Medicine & healthcare 16.2. Application of chemicals in Food preservatives 16.3. Application of chemicals in Agricultural products	

Elective –II - Computer Applications– 1st year
(Subject Code – 90000022)

Theory	Practical
Detailed Syllabus : **1.0. Introduction** 1.1. Basic Computer and its structural theory 1.2. Input devices 1.3. Output devices 1.4. Storage devices 1.5. Computer types and their applications 1.6. Computer Software/Hardware	**Detailed Syllabus** **1.0. Computer basics** 1.1. Identification of Keyboard, Printer, Monitor Scanner, Webcam, Microphone, Speaker 1.2. Sample collection of various type of storage devices, specifications and charts
2.0. Operating systems 2.1. Various types of Operating systems 2.2. Comparison between the different types of OS 2.3. Network Operating systems and their features 2.4. Microsoft Disk Operating System, its nature and history. 2.5. Unix, features, merits and demerits in using Unix as OS. 2.6. Microsoft Windows, development & growth of MS Windows, features, merits and demerits of MS Windows. 2.7. MS Windows NT, features, merits & demerits 2.8. System requirements for various Operating Systems 2.9. Windows default icons and their applications	**2.0. Practice** 2.1. Practice of MS DOS commands 2.2. Installation of MS Windows 2.3. Practice on Add/Remove programs 2.4. Practice on My computer, Display properties, My documents, My Network places
3.0. Microsoft Word 3.1. Introduction to MS Office 3.2. MS Word applications 3.3 Creation of Document and file operations 3.4. Formatting features of document 3.5. Modification/ editing documents 3.6. Inserting images, files, tables, symbols and various attributes 3.7. Creating and formatting of tables 3.8. Mail merge 3.9. Page layout and design features 3.10. Spell & grammar check in documents 3.10. Print preview & printing of documents 3.11. Converting documents to PDF files.	**3.0. Documentation** 3.1. Create and save a document 3.2. Format the text with different font size, font styles 3.3. Setting up different page sizes, orientation. 3.4. Making various type of documents like Bio Data, letters, project reports 3.5. Printing of documents
4.0. Microsoft Excel 4.1. Introduction to Excel and its applications 4.2. Features of MS Excel 4.3. Outline of Worksheet & Workbook 4.4. Data types 4.5. Study of various menus of MS Excel 4.6. Creation of worksheet, editing worksheets, save, copy & deleting worksheets. 4.7. Functions of MS Excel 4.8. Formulas of MS Excel. 4.9. Types of charts, creation of data Charts, editing and insertion of charts. 4.10. Sort facility 4.11. Interconnecting Charts 4.12. Page setup, printing worksheets, charts… etc. 4.13. Converting Worksheets to PDF files.	**4.0. Practice of Worksheets** 4.1. Create and save worksheets 4.2. Editing the worksheets 4.3. Formatting worksheets 4.4. Insert charts 4.5. Making worksheets using formulas & functions 4.6. Making worksheets & printing with different formatting effects 4.7. Making worksheets with images, numbers and print them

Theory	Practical
5.0. MS Power point 5.1. General Introduction 5.2. Features & Applications of MS Power point 5.3. Creating Presentations 5.4. Study of different layouts and making presentations using different layouts 5.5. Using different animation effects. 5.6. Add Audio/Voice and visual effects to slides. 5.5. Filtration 5.6. Converting presentations to PDF files. 5.7. Inserting images, symbols to slides	**5.0. Power Point practice** 5.1. Create Slides of different types 5.2. Running presentations 5.3. Add slide transition effects and run slide show 5.4. Make presentations with audio/visual effects. 5.5. Printing PPT files 5.6. Making PDF format of PPT files
6.0. Networking & Internet Utilities 6.1. General Introduction of Computer Networking 6.2. Requirements/ Applications of Computer Networking 6.3. Layouts of Different Networks 6.4. Study of various Networking components 6.5. Limitations and merits of different topologies 6.6. Study of Server/client concept 6.7. Internet & its applications 6.8. Email and Chatting 6.9. E-trading concepts 6.10. Downloading files (Text and media files)	**6.0. Networking practice** 6.1. Identifying different network components 6.2. Collecting samples, charts, images of different networking components. 6.3. Installation of Network Interface card 6.4. Getting connected to Internet and accessing the internet 6.5. Creating personalized Email account 6.6. Chatting (Text and Voice chat) 6.7. Searching/surfing for the information in different sites. 6.8. Downloading
7.0. Project work 7.1. Understand the concept of making projects and preparing the project reports. 7.2. Preparation of a project using the software skills learned during the course.	**7.0. Project Work** 7.1. Making a working model/project using MS Excel/Power Point 7.2. Project Report

Elective –II - Computer Applications– 2nd year
(Subject Code – 90000022)

Theory	Practical
Detailed Syllabus : **1.0. Introduction MS Access** 1.1. Objects of learning MS Access 1.2. Applications of MS Access 1.3. Database and Database Management System 1.4. Elements of Database Management System 1.5. Types of Data Bases & the merits & demerits	**1.0. Study of overview of MS Access** 1.1. Accessing MS Access and its menus to get familiar with it
2.0. Controlling Data Entry 2.1. Restrict Data Entry using field properties 2.2. Establish a pattern for entering field values 2.3. Create a list of values for a field	**2.0. Creating Data Tables, Designing Fields and setting field properties**
3.0. Joining Tables and creating Queries 3.1. Create Query joins 3.2. Join unrelated tables 3.3. Relate data within a table 3.4. Set Select Query properties 3.5. Create Parameter Queries 3.6. Create Action Queries	**3.0. Creating Queries**
4.0. Forms & Reports 4.1. Design a Form Layout 4.2. Enhance the appearance of a Form 4.3. Restrict Data entry in forms 4.4. Adding a command button to a Form 4.5. Create a Subform 4.6. Organize report information 4.7. Format the report 4.8. Set Report Control properties 4.9. Control Report pagination 4.10. Summarize Report information 4.11. Add a sub report to an existing report 4.12. Create a mailing label report	**4.0. Practicing Forms and Reports** 4.1. Creating different forms using different layouts 4.2. Data entry in to the forms 4.3. Creating different Reports using different layouts 4.4. Data formatting in to reports
5.0. Sharing data across applications 5.1. Import data in to Access 5.2. Export data from Access 5.3. Analyze Access data in Excel 5.4. Export Access data to a Text file 5.5. Merge Access data with a Word document	**5.0. Practice:** 5.1. Import Excel sheets in to Access 5.2. Import Tables in to Access 5.3. Export Access tables in to Excel format 5.4 Export Access data to a Text file 5.5. Merging data
6.0. Study of Application packages 6.1. Introduction to application oriented software packages 6.2. Study of Railway reservation Package 6.3. Study of different modules and menus available in online Railway Reservation Package 6.4. Study of Banking packages 6.5. Study of Library Management packages 6.6. Study of Inventory control packages 6.7. Study of School Management Packages	**6.0. Practice** 6.1. Collection of different trial packages 6.2. Visiting Organizations to collect different formats and procedures used in the system 6.3. Creating forms and Reports for the different packages using appropriate data bases
7.0. Project work 7.1. Understand the concept of making projects and preparing the project reports. 7.2. Visiting different organizations to have an idea of different packages 7.3. Preparation of a project using the software skills learned during the course.	**7.0. Project Work** 7.1. Making a working model/project using MS Access 7.2. Project Report

Elective – II - Business Mathematics – 1st year
(Subject Code – 90000023)

Theory	Practical
Detailed Syllabus: **1.0. Logarithms** 1.1. Introduction to logarithms 1.2. Laws of logarithm, characteristics and mantissa	**Practice:** 1. At least 5 to 10 exercises per chapter 2. One home/class assignment per chapter
2.0. Sets, Relations and functions 2.1. Study of Relation, Function 2.2. Types of functions 2.3. Domain, Co – domain, Range of a function 2.4. Composite and Inverse functions 2.5. Graphs of functions	
3.0. Complex Numbers 3.1. Definition of complex numbers 3.2. Line	
4.0 Quadratic Equations 4.1 Nature of roots of Quadratic Equation 4.2 Sum and Product of roots of quadratic equations 4.3 Formation of Quadratic Equations 4.4 Symmetric functions of roots 4.5 Cubs roots unity	
5.0. Determinants 5.1 Determinant of order three 5.2 Applications of Determinants	
6.0. Trigonometric ratios 1.1. Angles & its measurements 1.2. Trigonometric ratios 1.3. Relation between degree and radian. 1.4. Fundamental identities. 1.5. Examples based on Fundamental Identities 1.6. Trigonometric ratios of sum and difference of two angles 1.7. Factorization formulae 1.8. Inverse trigonometric functions 1.9. Properties of a Triangle	
7.0. Plane Co-ordinate Geometry 7.1. Locus 7.2. Line	
8.0 Partition values and measure of dispersion 8.1 Partition values 8.2 Measures of Dispersion	
9.0. Moments Skewness Kurtosis 9.1 Moments 9.2. Skewness 9.3 Kurtosis	
10.0. Bivariate frequency distribution and correlation 10.1.Bivariate frequency distribution 10.2 Bivariate Correlation 10.3 Rank correlation	
11.0. Permutations and Combinations 11.1 Factorial notation 11.2 Principle of counting 11.3 Permutations 11.4 Combinations	

12.0. Probability 12.1 Types of Event 12.2 Addition Theorem 12.3 Conditional Probability	
13.0. Random Variable and Probability Distribution 13.1 Definition and Types of Random variable 13.2 Probability Distribution of random variable 13.4. Risk and uncertainty	
14.0. Commercial Arithmetic 14.1 Commission Brokerage 14.2 Discount 14.3 Insurance	

Elective – II - Business Mathematics – 2nd year
(Subject Code – 90000023)

Theory	Practical
1.Mathematical Logic 1.1 Statements and logical connectives 1.2 Statement pattern and logical equivalence 1.3 Venn Diagram	
2. Matrices 2.1 Definition and Types matrices 2.2 Algebra Matrices 2.3 Inverse of a Matrix 2.4 Solution of Equations	
3. Limit and Continuity 3.1 Definition 3.2 Algebra of limits 3.3 Application of Standard limits 3.4 Continuity of a function at a point	
4. Differentiation 4.1 definition of Derivative 4.2 Derivative from first principles 4.3 Rules of Differentiation 4.4 Derivative of composite functions 4.5Derivative of Inverse functions 4.6 Logarithmic Differentiate 4.7 Derivates of Implicit functions 4.8 Derivatives of Parametric functions. 4.9 Second order derivatives	
5. Application of Derivatives 5.1 Increasing and Decreasing functions 5.2 maxima and Minima 5.3 Approximation and Error	
6. Integration 6.1 Definition of an integral 6.2 Integral of standard functions 6.3 Rules of Integration 6.4 Methods of Integrations Integration by parts 6.5 Definite Integrals	
7. Differential Equations 7.1 Definition 7.2 Formation of Differential Equations 7.3 Solution of first order and first degree differential equations 7.4 Applications of Differential equations	
1.Theory of Attributes 1.1 Introduction Notation and class frequencies 1.2 Consistency of data 1.3 independence of Attributes 1.4 Association of Attributes	
8. Regression Analysis 8.1 Introduction 8.2. Data and information 8.3. Tabulation of data 8.4. Graphs and diagrams, scatter diagrams, histograms, bar charts…etc 8.5 Equation of lines of regression 8.6 Regression coefficient and its properties	
9. Numerical Methods 9.1 Finite differences 9.2 Interpolation with equal intervals 9.3 Interpolation with unequal intervals 9.4 Numerical integration	
10. Discrete Probability Distribution 10.1 Binomial Theorem 10.2 Binomial Distribution 10.3 Poisson Distribution	

11. Management Mathematics 11.1 linear programming problem 11.2 Assignment problem 11.3 Sequencing	
12. Demography 12.1 Introduction, definition, Uses of vital statistics 12.2 Measurements of Mortality 12.3 Life tables	
13. Index Number 13.1 Introduction 13.2 Definition and Notations of index numbers 13.3 Types of index number 13.4 Construction of index number 13.5 cost of living index number 13.6 Uses of cost of living index number	
14.0. Spread sheets 14.1. Introduction to spread sheets 14.2. Features and functions of spread sheet softwares 14.3. Use and limitations of spread sheet softwares in business 14.4. Apply spread sheet software to the manual work of chartered management accountant.	**Practice:** 1. Using spread sheet package 2. Entering data in to Spread sheet 3. Making graphs the selected data using Spread sheet packages 4. Using functions and formulas 5. Making accounts using Spread sheet packages

Subject Name - Mechanical Technology and Material Science

Subject Code - 30340001

Theory – 1st year	Practical – 1st year
1] **Fundamental of material** □ Introduction of metals and non metals □ Structure of metal □ Formation of grain □ Imperfection in crystals □ Deformation in metal and change in properties □ Fracture □ Equilibrium diagram □ Iron, carbon equilibrium diagram □ Time temperature transformation diagrams	1. Take the tensile test of M.S. specimen & Draw stress strain diagram, yield pts.
2 **Ferrous metals and alloys** □ Pig iron and cast iron □ Effect of chemical elements on iron □ Classification of steel and its application □ Alloy steel and special alloy steel 3 **Non Ferrous metals and alloys** Introduction to non ferrous alloys □ Aluminum and its alloys □ Copper and its alloys □ Lead and its alloys □ Nickel and its alloys □ Alloys for high temperature service □ Metal for nuclear energy 4 **Crystal Structures** □ Fundamental concept □ Unit Cells □ Metallic crystal structures □ FCC Structure □ BCC Structure □ HCP Structure □ Weld ability 5 **Properties of Metal** □ **Mechanical properties of Metal** Elasticity, ductility, malleability, brittleness, Toughness, Stress strain behavior, Elastic limit, hooks Law, UTS, poisons ratio, factor of safety, hardness and hardness tests shear strength, resistance. □ **Electrical properties of Metal** Electrical conductivity, resistivity, electrical Characteristic of commercial alloys	2. Study the mechanical properties like Elasticity, ductility, malleability, Brittleness, toughness of Different materials – M.S., C.S. Bronze, Copper, Aluminum Study the Hardness test □ Brinnel Hardness test □ Rockwell hardness test

Theory – 1st year	Practical – 1st year
Thermal properties of metal Heat capacity, thermal expansion, thermal Conductivity, thermal stress 6 **Magnetic Properties of metal** Basic concepts, diamagnetism and Para magnetism, ferromagnetism, influence of temperature on magnetic behavior, domain and hystersis, soft and hard magnetic material. 7 **Heat Treatment of material** Normalizing Hardening Quenching and tempering Annealing Stress Relieving Case carburizing and case hardening. Toughening Weld ability of Metal definition and concept Effect of alloying elements on weld ability Purpose and types of weld ability tests	3. Study the Electrical Properties of some conductors (conductivity, Resistively) Aluminum, Copper, Brass, Tungsten
8 **Cracking phenomena in steel** Cold crack due to hydrogen Hydrogen cracking Measurement and control of hydrogen in the deposited weld metal Cracking mechanism in the weld metal and HAZ Weld decay Lamellar tearing Hot cracking Reheat cracking	4. Study the effect on materials with heat treatment Normalizing, Hardening, Quenching & Tempering Anne ling, Stress Reliving, Case Hardening, Toughing For Different Material's M.S., C.S.,Nickel,Capper

Theory – 2nd year	Practical – 2nd year
1 Bench work and fitting Introduction- Vices – Hammers- Chisels- Chipping- Files- Filling- Scrapper-Scraping- Grinding and Polishing- Hacksaw sawing- Marking tools – Surface plate- Scriber – Punch- V block- Angle plate- Try square – Marking out – Drill- Drilling- Reamer- Reaming- Taps- Tap drill size-Tapping – Dies and stock- Dieing. **2 Sheet Metal Work** Introduction – Metal used in sheet metal work- Sheet metal hand tools- Sheet metal operation-Sheet metal joint- Hems and Sems – Sheet metal allowance- Sheet Metal working machine-Laying out a pattern **3 Plumbing, Threading, Fasteners & joints** Plumbing- Specifications of pipes- Material used for pipes-Pipe fitting & Joints-Taps & valves – Plumber tools – Threaded fasteners- screw threads and their uses- Indian standard threads-Cap screw and machine screw-Set screw- Methods of producing screw threads- Bolts- Studs- Forms of nuts- Riveting joints. **4 Smithy and Forging** Maintenance and application of smith health- Anvil- Swage block-Tongs-Hammer-Flatters- Measuring tools e.g.-Try square- Steel rules- Calipers-Operations e.g. up setting- drawing down- bending setting- forge welding. **5 Welding Technology** Welding Welding introduction to different welding processes, like gas Welding, ARC welding TIG, MIG, submerged arc welding, spot Welding, electrodes etc. Brazing methods & application, Knowledge of welding skills. **6 Metal Turning (Lathe)** 6.1 Function of lathe, Types of lathe, the size of lathe, Descriptions & function of lathe parts, 6.2 Lathe accessories and attachments. 6.3 Operation on Lathe 6.4 Cutting Tools, Classification , Influence of tool angles. 6.5 Types of tools, cutting speed, Feed, Depth of cut, 6.6 Machining time. Cutting tool signature.	**Fitting** 1. Filing Flat surfaces: Checking flatness and square ness using a try square – Types of filing – Cleaning files. 2. Chipping: Hints on chipping 3. Hack sawing: Selection of blades for different metal sections - Fix hack sawing the material for the job blades maintaining. Correct tension and direction – Hack sawing. Filing 'V groove and complex profile by file & check with profile gauge. 4. Filing radius –check with radius gauge 5. Check profile with profile gauges. 6. Drill plate, Drilling, counter sinking, counter boring. Operations on job 7. Drilling and Tapping: Internal threading of holes by using hand taps – determine the tap drill size, drilling, counter-sinking and tapping – precautions with tapping a blind hole. 8. External thread cutting using die.

Theory – 2nd year	Practical – 2nd year
7 DRILLING Introduction Types of drilling machine, Portable drilling machine, Sensitive drilling machine. Upright drilling machine, Radial Drilling Machine; Gang drilling machine, Multiple spindle drilling machine Automatic drilling machine, Deep hole drilling machine; The size of a drilling machine, Upright drilling machine parts. Radial drilling machine parts, Work holding devices, Tool holding devices, Drilling machine operation, Drilling machine tools. Twist drill nomenclature. Drill size Designation of drill material Reamer, reamer nomenclatures. Counter bore, Countersinks and spot face, Taps. Tap nomenclatures. Cutting speed Feed, Depth of cut, Machining time in drilling	**Basic Workshop Practice** 1. Step turning and Radius forming: Free hand form turning – by using form tool. 2. Drilling and Boring-Use of inside caliper and outside Micrometer for bore measurement. 3. Drilling and reaming: by hand-Method of checking the bore With a plug gauge. 4. Drilling and step Boring: Boring blind hole with a boring tool.
8 SHAPER Introduction. Types of shapers. Principal parts. Shaper size; Shaper mechanism; Work holding devices. Shaper operations. Shaper tools; Cutting speed, feed and depth of cut; Machining time. **9 SLOTTING** Introduction. Types of slotting machine; Slotter size; Slotting machine parts; Work holding devices; Slotter operation; Slotter tools; Cutting speed, feed and depth of cut.	5. Drilling, Boring and Recessing: Internal recessing to a size broader than the width tool – Form a recess. 6. Shaping blind & open keyways on shaping machine 7. Shaping irregular surfaces.(Concave / Convex)
Powder Metallurgy Introduction- Process Description-Manufacture of metal powder- Blending of powders- competing profiteering- Sintering-Secondary operation –ISO Static pressing – Product of powder metallurgy-Advantages of process – Disadvantages and limitation-Design considerations Introduction to CNC	8. Slotting internal grooves on slotting machine 9. Welding Practical-fusion run with/without filler rod on MS Sheet – squire butt joint on MS sheet LAP,T& Edge joint on M.S. Sheet

List of Books

1 M. N. Uppal A Text - book of ngineering Chemistry
2 V. P. Mehta A Text - book of polytechnic Chemistry
3 Banswal, Mahajan and Mehta A Text - book of,Applied Chemistry
4 Hazra Choudhary Elements,of workshop technology
5 S.K.Hajra Choudhary Elements of workshop technology Vol-I First 1964 Media promoters & Publisher pvt. Ltd.
6 Mahajan Mechanical Technology Third 1989 Vrinda publication

Sr. No.	Name of the equipment/ machinery	NOS.
1	TRAINEES TOOL KIT	5
2	Try Square 10 cm Blade	5
3	Calipers outside 15 cm spring	5
4	Caliper inside 15 cm spring	5
5	Dividers 15 cm Spring	5
6	Calipers 15 cm Hermaphrodite	5
7	Scriber 15 cm	5
8	Punch center 10 cm	5
9	Screw driver 15 cm	5
10	Chisel cold 20 cm	5
11	Trammel 30 cm	5
12	Hammer ball peen 0.5 kg with handle	5
13	Hammer Mallet	5
14	Hammer Plastic	5
15	Hammer ball peen 0.5 kg with handle	5
16	File flat 25 cm second cut	5
17	File flat 25 cm second cut	5
18	Hacksaw frame adjustable 20-30 cm	5
19	Dot slot punch	5
20	Steel rule 15 cm English and metric	5
21	Steel rule 30 cm English and metric	5
22	Try square 20 cm Blade	5
23	Steel tool box	5
24	Scriber	5
25	Lock and keys	5
26	Combination plier	5
27	Jenny calipers	5
28	Aluminum tray 15 cm X 10 cm	5
29	Fellow polish cloth standard size	5

	SHOP OUTFIT & MEASURING INSTRUMENTS	
30	Straight edge 45 cm X 45 cm	1
31	Marking table 90X90 cm	1
32	Surface plate 45 cm X 45 cm	1
33	Vee Block pair 7 cm and 15 cm with clamps	1
34	Angle plate 10 X 20cm	1
35	Number Punch 3 mm set	2
36	letter Punch 3 mm set	2
37	Round punch 3 mm X 4 mm set of 2	2
38	File flat 20 cm bastard	2
39	Oil Stone 15 X 5 cm X 2.5 cm	
40	Spanner adjustable 10 cm	1
41	Chisel cold 20 cm cross cut	2
42	Chisel 10 cm flat	2
43	Drill twist 1.5 mm to 15mm (various sizes) by 0.5	2
44	Files assorted sizes and type including safe edge	10
45	Micrometer inside 50-150 mm with screen	2
46	Bench Vice 12 cm jaw	5
47	Work Bench 240 X 120 60 mm with screen	3
48	Drill point angle gauge	1
49	Vernier Calipers 20 cm	2
50	Vernier height gauge 30 cm	1
51	Huntington and diamond dresser	1
52	Taps and dies complete set (metric)	2 set
53	Hacksaw frame	5
54	Fire buckets with stand	1
55	Thread pitch gauge metric, BSX, BSF, MC, MF & SAE	1 each
56	D.E. spanner ser of 12 metric 6 mm to 32 mm	1 set
57	Ring spanner set at 12 metric 6 mm to 32	1 set
58	Stud extractor set of 3	1 set
59	Universal puller for removing pulleys, bearings	1 set
60	Unserviceable engine/gear box rear axle	1
61	Stud remover with socket handle	1
62	Combination pliers 15 cm	5
63	Depth guage (inch and metric	1
64	Screw pinch gauge (inch and metric)	1 set
65	Feeler gauge 20 blades (inch and metric)	1
66	Aluminum tray 45 X 30 mm	5
67	Oil can 0.5 liter capacity	1
68	Surface gauge	1
69	Cylinder bore gauge (mercer)	1
70	Telescopic gauge	1
71	Steel measuring tape 10 meter in a case	2
72	Sets of Morse socket MT 0-1,1-2,and 2-3	1 set
73	Blow lamp	1
74	Torque wrenches 5-35 Nm,12-68 Nm&50-225 Nm.	1 each
75	Outside micrometer English 0-1,1-2,2-3,3-4,4-5,And 5-6 inches	1 each

76	Micrometer outside 1 to 25 mm,25mmto 50mm ,50 to75 mm,75 to100mm,100 to 125mm,125 to 150mm.	1
77	Surface gauge with dial test indicator plunger type i.e. 0.01 mm	1
78	Printed wall chart framed for display showing measuring instruments.	10
79	Inside micrometer English 2” to 6” with extension road	1
80	Vernier bevel protractor (metric and inch)	1
81	Vernier calipers (inch and metric) 6”x12”	1
82	Vernier micrometers(inch and metric)	1
83	Vernier height gauge 150 mm height (inch and metric)	1
84	Dial micrometer (inch and metric)	1
85	Small bore gauge (standard)	1
86	Dial test indicator to read (inch an metric)0.02mm	1
	GENERAL INSTALLATOIN /MACHINERIES	
87	Radial Drilling Machine 25mm capacity	1
88	Power Hacksaw	1
89	Rotary Cut off Machine	1
90	Shaping machine	1
91	Hydraulic Press 2 ton capacity	1
92	Surface plate (small)	1
93	Surface plate (big)	1
94	Standard Arc Welding machine	1
95	Horizontal milling machine	1
96	Bench Drilling machine 6-12mm cap Motorized with chuck and key	1
97	Grinding machine (general purpose)D.E. pedestal with 300mm dia wheels rough and smooth	1
98	Hydraulic Trainer with Power pack	1
99	Pneumatic Trainer	1
	Workshop furniture	
100	Suitable Work Tables with vices As required	1
101	Stools 25 Nos	25
102	Tool Cabinet 2 nos	2
103	Trainees locker 2 nos	2
104	Fire fighting equipment , first aid box etc As required	1
105	Book shelf (glass panel) 1 nos	1
106	Storage Rack As required	2
107	Storage shelf As required	2

SUBJECT NAME : UNIT OPERATION & UNIT PROCESS
SUBJECT CODE : 30340034

THEORY	PRACTICAL
Flow of fluids	Pipes – Method of joining them, Expansion joints, Valves, Safety devices, Diaphragm control valve, Steam trap, Reynolds numbers, Bernoulli's, equation
Heat transfer	Modes of heat transfer thermal conductivity,
Evaporation	Horizontal, vertical tube, forced circulation and falling film evaporators
Distillation	Introduction boiling point diagram equilibriums curve
Extraction and leaching	Extraction and leaching application of liquid - liquid extraction, Theory, definition, choice of solvent, distribution coefficient
Absorption and Adsorption stripping	Introduction, equilibrium mass transfer coefficient, factors affecting rate of absorption, absorption towers
Crystallization	Introduction, classification of crystallizes
Drying	Introduction, vapor pressure, curve for water, relative humidity and other definitions tray drier
Filtration	Introduction, factors affecting filtration, classification of filters
Size reduction and screening	Introduction and classification of equipments, crushing and grinding
Humidification and cooling towers Refrigeration and air conditioning	Introduction, defamations, Humidity, and types of cooling towers Introduction, definitions, terms involved various equipments used in refrigeration and air cooling
Mixing	Mixing liquids with liquid, mixing solids with solids, mixing solids with liquid and equipment used
Introduction Laboratory preparation 1) Oil and Soap	Introduction to unit process. Manufacturing of soap and glycerin with flow sheets, its uses , chemical reaction
2) Nitro Benzene 3) Aspirin	Manufacturing process of Nitric Acid by Oswald process with flow sheets , chemical reactions , process description and uses
4) Cl_2 Gas	Manufacturing of Sulfuric Acid by contact process, raw material Manufacturing of Caustic Soda and chlorine Process classification, raw material, chemical reactions, flow sheets and uses.

UNIT OPERATION:-

UNITS	PRACTICAL	THEORY
Flow of Fluids	To determine Reynolds no. at different velocities. Determine frictional losses in a straight pipe, pipe fitting, valvs Study of head vs. capacity curve for pumps	Mechanism of Fluid Flow ,nature of fluid, Reynolds number ,Bernoulli's Theorem, losses due to friction, contraction, enlargement and fitting, various meters for fluid flow, control of flow and its use. Transportation of fluids. Classification, Principle and function of pumps, blower fan compressors and conveyor elevators ,pneumatic transportation – Pressure and vacuum, Different types of valves and pipe fittings
Heat transfer	Calculate overall heat transfer coe. For a shell & tube heat exchanger.	Mechanism of Heat Transfer in solid, liquid and gases and their application in industries Different types of transfer equipment-Heat exchangers, coolers, condenser and chillers Different types of boiler , steam traps, Reboilers, heaters, vaporizers, Funnels Kilns Fouling of heat transfer surfaces-maintenance of heat exchange equipment,
Evaporation	To find rate of evaporation for vertical tube evaporator.	.Capacity, steam economy of evaporators Surface and contact condensers, barometric condensers, Vacuum Producing devices-Steam jet ejectors, Vacuum pumps,Multi effect evaporation and methods of feeding Vapor recompression
Distillation	Separation of liquid mixture by distillation using packed tower	Introduction, Vapor-liquid equilibrium. Boiling point diagram, Raoult's law , Henry's Law, Relative volatility, constant boiling mixture, equilibrium diagram, distillation methods, Flash differential, rectification, Isotropic, Extractive, vacuum. Steam distillation Binary and multi compound distillation (Batch & Continuous). Determination of number of plates by Macabetale, Ponchan-Savarit method, minimum total –optimum reflux ratio. location of fed place-line, types of distillation column, plate efficiency-overall Murphree. point /local. factor affecting efficiency

Extraction and leaching	Study of spray extraction column	Introduction definition terms feed solvent extract solute raffinate selection of solvent to its properties application of extractions equipment used for extractions classification of equipment-single stage extraction – Agnited mixer, flow mixer settler multistage extraction Multistage mixer settler equipment spray towers packed towers perforated plate towers leaching introduction, field of application , leaching equipment , percolation tanks, counter current multiple contact , shanks system agitated vessels, turbine type agitator , Dorr agitator , oil extraction from oil seeds.Leaching- leaching equipment, percolation tanks.Counter current multiple contact , shanks system agitated vessels, turbine type agitator. Dorr agitator , oil extraction seeds.
Absorption and stripping introduction	Calculation of flooding velocity by using packed tower	Equipments used for absorption – columns, tower packing, flooding velocity, method of stripping .
Crystallization	Study of super saturation	Introduction method of super saturation and different types of crystallizes and their specific applications in industries.
Drying	Findig rate of drying by using tray dryer.	Theory , equilibrium moisture content , factors controlling constant drying rate , constant rate period falling rate period factor affecting rate of drying , types of dryers and their uses .
Filtration	Operation of plate & frame filter press	Theory, different type of filters such as plate frame filter press , rotary drum filter and centrifuges
Size reduction	Size reduction using ball mill,hammer mill. To carry out sieve analysis with sieve shaker.	Size reduction and screening , separation ,Classification of crushing and grinding machineries , sedimentation – gravity session, cyclone separators Types, use of size reduction equipment i.e black jaw crusher ,hammer mill, ballmill.
Humidification and cooling towers	Determination of wet bulb & dry bulb temperater.	Theory of Humidification and different terms related to Humidification .Theory and different types of cooling towers
Mixing	Operation of mixer settler	Introduction , classification of mixing equipments and it's applications , mixers for mixing solid- solid, solid-liquid, solid-gas

Refrigeration	Study of refrigeration units	Vapor absorption and vapor recompression system, different types of refrigents and their properties and specific use in industries
Transportation of material	Study of Conveyor, elevators	Conveyor, elevators Pneumatic transportation – pressure and vacuum

SECOUND YEAR

UNIT PROCESSES:-

- Introduction of chemical industries in India.
  - Inorganic chemical industries
  - Sulphur and Sulphuric acid
  - Fuel and industrial gasses
  - Fertilizer industries
  - Nitrogen industries
  - Phosphorous industries
  - Cement and lime etc.
- Natural product industries
  - Oils, soaps and detergents , glycerin
  - Paints and varnishes
  - Carbohydrate and fermentation industries
  - Food industry
  - pulp and paper products
  - Petroleum etc
- Synthetic organic chemical industries
  - Petrochemicals
  - Aromatics
  - Pesticides
- Pharmaceutical Industry
- Polymerization industries
- Metallurgical Industries
  - Iron and steel
  - Aluminum
  - Copper
  - Lead and zinc
- Biotechnology
  - Fermentation
  - Formulation

- Micro biology
- Dyes and pigments
- Pesticides

- <u>Drugs (Medicine)</u>

- EFFLUENT TREATMENT (WATER MANAGEMENT SYSTEM) & AIR POLLUTION:-

1. Sources of water and water quality
2. Water pollutants-Organic inorganic, Sediments, thermal, Radioactive, biological
3. Sources of water pollution
4. Treatment of water – purification, Sedimentation, Coagulation, Filtration, Sterilization (Physical and Chemical methods of Sterilization
5. Water Softening (Removal of hardness) - Boiling, Distillation, Clark's Method, Caustic soda process, Ion exchange
5. Effluent, Types and sources of effluents
6. Effluent analysis (PH, COD, BOD, TSS, Clarity)
7. Treatment of effluent
8. Types of equipments use for treatment

9. Permissible standards
10. Air pollution
11. Types of pollutants
12. Sources of pollutants
13. Effect of air pollution
14. Analysis of air pollutant
15. Equipment use for measurement and control of air pollution
16. Permissible standards

MAINTENANCE TECHNIQUE:-

UNIT	PRACTICAL	THEORY
Maintenance of pipe line and valves	Cutting and threading of pipes. Bending and fitting of pipe as per drawing. Fitting of different types of pipe joints use of quick released coupling.	Pipe and pipe joints. Pipe bending fixture. Standard pipe threads. Tap and dies Standard pipefitting.
	Maintenance of globe valve , Gate valve, Stop cock, Non return valve, ball valve , needle valve, Plunger valve, Piston valve, Pneumatic valve, Electrical glass line button valve, butterfly valve Testing and fitting of different type of valves on pipe line .	Construction and future of different types of valves. Metallurgy – Corrosion along with respect to corrosion . selection of metal for chemical application . lining material . Metal testing method destructive and non destructive .
Maintenance of Pumps	Maintenance and assembly of different type of pump such as centrifugal pump , gear pump , plunger pump , vacuum pump , hydraulic pump, screw pump, and multistage pump application of voice , RPM ,	Type of pumps their construction details and use .
	Fitting of bearing such as ball bearing , roller bearing, bush bearing etc. Their care . lubrication and maintenance . removing bearing with bearing puller .	bearing their type material and use information about bearing removing and fitting kit. Lubricant and lubrication type of lubricant and method of lubrication . Properties of lubricant
Maintenance of machinery	Maintenance compressor , blowers, crushers, mixers and pulverizes .	Construction use of compressor, blower, crusher, mixer, and pulverizes.

ADVANCED UNIT OPERATION:-

VALVS– Pneumatically operated valve, electrically operated valve, rotary air lock valve , piston valve , solenoid valve ,plunger valve .

PUMPS – Vacuum pump with mechanical seal, vaccum Pump with normal gland packing, metering Pump, srew pump for viscous flow

HEAT EXCHANGERS – Multipass heat exchanger, Plate heat exchanger, spiral heat exchanger. cooling tower.

BOILER – Oil fire boiler, rice hurk boiler, gas fire boiler.

EXPLOSIVE METER FOR SAFETY – Gas detector ,smoke detector, fire alarm system,sprinkerls system for safety

For Unit Operation Laboratory

Sr. No.	*Name of the equipment*	Qty
01	*Reynolds's Experiment equipment*	01 Set
02	*Shell and tube heat exchanger glass type*	01 No.
03	*Boiler (Electrically Heated)*	01 No.
04	*Vertical Tube Evaporator*	01 No.
05	*Packed tower of glass for flooding velocity experiment*	01 No.
06	*Top driven centrifuge*	01 No.
07	*Rotary vacuum filter*	01 No.
08	*Tray drier*	01 No.
09	*Hammer mill*	01 No.
11	*Ball mill*	01 No.
12	*Blake jaw crusher*	01 No.
13	*Mixer settler type extractor*	01 No.
14	*Spray extraction tower*	01 No.
15	*Multistage compressor fitted with inter cooler*	01 No.
16	*Sieve shaker and sieves*	01 No.
17	Annular (for flow of fluids)	01 No
18	Vacuum pump with mechanical	01 No
19	Seals	1
21	Pneumatically operated valve	1
22	Electrically operated valve	1
23	Multipass heat exchanger	
24	Thermal mass flow meter	11
25	.Magnetic flow (Rotameter)	1
26	.Screw pumps for viscous flow	
27	.Metering pump	1
28	.Rotary air lock valve	1
29	.Plate heat exchanger	1
30	.Spiral heat exchanger	11
31	.Glass Tube heat exchanger	1
32	Oil fire boilers	1
33	.Rice hurk fire boiler	1
34	Gas fired boiler	1
35	.Rising film and fallowing film Evaporators	1
36	Bruck fild viscometer	1
37	.Crystlisers – Flickers	
38	.Absorption- striping	1
39	dryer , Pedal dryer ,	1
40	Droplet formation , Uses of nozzle , and water Distribution concept in cooling towers	1
41	Filtration – Lift filter , Sparker filter, Star filter , Notch filter , filtration media , Micron size	1

42	Explosive meters for safety i) Gas detector ii) Smoke detector iii) Fire alarm system iv) Sprinklers system for safety	 1 1 1 1
43	*Humidification /Dehumidification and air handling unit*	1
44	Piston valve	2
45	Solenoid valve	2
46	Plunger valve	2
47	Pneumatic control valve	2
48	Safety valve	2
49	Rotary air lock valve	2
50	Cooling tower (common for instrumentation lab)	2
51	Pressure vessel with all accessories (training type)	2

TOOL KIT FOR (1 TRAINEE)

S.N.	Name of Tool	Q.R
1	Caliper outside spring 6”/15”cm	1
2	Caliper inside spring 6”/15cm	1
3	Divider spring 6”/15cm	1
4	Center punch 4”/10cm	1
5	Prick punch 6”/15cm	1
6	Chisel cold flat 1”/2.5cm	1
7	Chisel cross cut 3”/8” X 1/8”	1
8	Chisel diamond point 3”/8”/10mm	1
9	Chisel half round 3/8”/10mm	1
10	Hammer ball pain 1lb handle	1
11	Hammer ball pain ½ lb handle	1
12	Hack saw frame adjustable with pistol gripe for 8”-12” blade by 20cm-30cm	1
13	Steel rule 12” English & metric /30cm	1
14	Screw diver set	1
15	Square engg. 6” blade /15cm	1
16	Scriber	1
17	Safety goggles	1
18	Soldering gun with stand	1
19	De soldering pump	1
20	Connector	1
21	Safety shoes	1
22	Neon tester	1
23	Magnetic point screw driver	1
24	Combination pliers	1
25	Long nose pliers	1
26	Insulator fine cutter	1

SUBJECT NAME : BOILER THEORY
SUBJECT CODE : 30340044

FIRST YEAR

1. Reading & recording of process variable like pressure, temperature, flow etc.
2. Cleaning work area and equipments removing dust, washing etc. precaution in case of moving machinery
3. Lubrication: - Pumping out lubricating oil from drums, Reading oil to bearing of equipments, pump etc. Use of grease gun operation oil filters both centrifugal and stationary.
4. Operation of various types of valves , by pass valves , gate valve, beedle valve , steam valve etc, setting of feed water and steam regulators as well as serve control valves
5. Pumps – Operation of different types pumps including reciprocating , centrifugal and gear , pumps , starting including priming where applicable normal stopping g emergency stopping (in case of power failure) central of flow etc.
6. Operation of fan and blowers like forced drafts fans, induce draft fans etc. Including starting, stopping capacity adjustment etc.
7. Operation of steam driven equipments like feed water pumps, fans , etc including starting , stopping & capacity adjustment
8. A) Operation of fuel (i.e. coal/ oil / gas) feeding mechanism including adjustment of flow of coal , Create drive and draft regulation for proper combustion .use of mechanical stoker
   b) Study burners for oil and gas and also filters
9. Operation of ash disposal plant. Function and maintenance of pumps, hydro actors, hydroajectors, clinker grinder and submerged type ash plants
10. Normal level control in boilers- Operation & reading of gauge glass etc. level control during the emergency operation and use of blow down valves
11. Reading and control of stem pressure and steam flow.
12. Operation of super heater and re – heater control of superheat and reheat temperature
13. Operation of steam pressure reducing station for auxiliary steam supply for oil heater, detractor passing and process steam, if any
14. Operation of water softener equipment including feed water softener, Clarificulators precipitators, filters, chemical dosing etc. Pre and post chlorination system. Reactivation of ion exchanges etc.
15. Working and management of steam boiler and economizer
16. Operation of pulverizes, exhausters, P.A. fans , coal scale, coal feeders , coal classifiers etc. Regulation of primary air , secondary air and flame shape , use of pilot oil terches both as flame stabilizer and at start , use of load carrying oil burners , if any and regulation of air for proper combination of oil . Adjustment of coal fitness.
17. Correct use of various types of cocks, mounting and accessories used on boilers
18. Firing and raising, steam and blow down in Boilers – Precautions to be taken – procedure to be observed before starting, firing & when raising steam

19. Operation of boiler feed pump – starting & stopping, including emergency operation. Purpose of balance chamber, leak off & recirculation line. Checking & correctness of pressure gauges.
20. Internal conditioning of boiler water by checking the TDS & alkenity by blow down to prevent, sealing, priming, carry over & caustic gauging
21. Conditioning of steel & condensate cycle, importance of silica in high pressure boilers & how it is controlled
22. Periodical cleaning in the boiler with deminraled & cons ate for prevention of scale or other deposit on heating surfaces
23. Periodical inspection of boilers. Preparation of boiler for testing , hydraulic test & stem test
24. Precaution to be taken before entering or alloying person to enter a boiler which is connected to another boiler on the steam
25. Correct method of firing & combustion control for prevention of smoke
26. Testing the correctness of gauge glass & cocks by blowing through them
27. Priming of boiler – the danger of water logging steam pipes & precaution to be observed in running
28. Replacement of gauge glass
29. Procedure to be followed in the event of shortage of water , bulging or facture of furnace of flat plates or bursting of tubes or of any accident to a boiler or steam pipe
30. Adjustment of safety valves for correct blowing pressure
31. Precaution to be taken when starting ansconomiser to work after period of rest.
32. Detection of false water level and knowledge of alarm device.
33. Procedure to be adopted in putting as economizer into commission and also in putting it out of commission when boiler is on steam.
34. Checking and renewal of gland packing of pump and valve.
35. Correct method of stocking boiler including cleaning and banking fires in a workman like manner to prevent avoidable smoke.
36. Checking and adjustment of cocks and valve.
37. Working knowledge and fitting of feed pump and injector.
38. Working of feed water heaters and daierstors.
39. Boiler safety precaution.
40. Observation of easing a safety valve. Use of blow down cock or valve.
41. Cleaning oil torches.
42. Adjustment of high stream and low water safety valve. Renewal of fusible plage.
43. Use of spark igniters and oil sump for oil torches.
44. Cleaning of economizer by using appropriate appliances.
45. Interlock tripping of boiler auxiliaries and basic knowledge of purgainers lock
46. Operation and working of multicar dust collectors & electrostatic precipitators
47. Emergency operation of boiler in the event of –
    a) Loss of fire
    b) Failure of one FD fan
    c) Failure of one ID fan
    d) Failure of one Air pre – heater
    e) Boiler tube

f) Failure of economizer tube furnace tube & super heater tube

g) Failure of boiler feed pump and sudden leas of read

j) Blooking of coal passage

k) Failure of lagging

l) Jamming of the grate. Failure of gauge glass

48) Soot blowing and boiler furnace cleaning during operation. Use and care of different types of soot blowers.

49) Importance of draft temperature reading at special loads. Interpretation of , deviation from slandered reading for identical loads .

50) Economical working of boilers

51) Entry and up keeping of log sheet, trouble log etc.

52) Observation of use, operation & maintenance of modern package type and automatic boilers

SECOND YEAR

1. Safeties at work – accident do not happen they are caused. Fire precautions causes and types of fire, precautions against outbreak of fire .fire extinguisher type's end uses. Boiler safety rules knowledge of boiler, rules & safety precautions & using electrical appliances.
2. Revision of the work of previous year.
3. Industrial fuels solid, liquid and gaseous solid fuels coal & deterioration of coal in storage. Principal constituents &classification of coals .coal size grading &moisture conditioning volatile matter , matter moisture & ash content ,calorific value fusion of ash & clinkering liquid &gaseous fuel slow speed diesel ,bunker (heavy &light furnace oil) blast equivalent of fuels ,grading of fuels &effect of impurities on combustion.
4. Fuel handling plant :-arrangement for receiving ,storage &conveying of coal to bounders , arrangement for receiving ,storage transporting fuel oil, need of heaters when using high density fuel oils.
5. Pulverize(coal mill) different types of pulverizes used in modern boiler , difference in design provision for removal of tramp iron &pyrites methods used for removal of moisture from coal undergoing pulverization ,function &theory of operation of classifiers importance of fine ness of pulverized fuel & methods of controlling it factors effecting fineness range of outlet temperature for direct fired installation bin system of firing hazard with pulverized fuel &precaution ,measure necessary to minimize these hazards .coal feeders their types &use . Grind ability of coals &its importance to pulverize operation precautions to be observed in case emergence shut down &in case of fire in pulverizes.
6. Elementary principle of combustion & methods of firing different fuels in boilers. Chemical reaction & factors affecting combustion such as temperature surface area etc the product of combustion specific heat of gases. Air supply and affects of excess and in sufficient primary & secondary air on combustion. Ash fusion – analysis of the gases
7. Steam – Its heating & power properties; Principles of stem and application in modern Boiler. Steam preventing, escape of heat. Lagging stem, steam distribution, charging of steam quality, condsate handling, traps etc. Wet steam saturated steam , super heated steam and their properties , Boiling point , temperature and pressure relations sensible heat , latest heat super heat reheat and total heat super heat , reheat and total heat . Use of steam table and entropy chart.
8. Heat transmission - Methods of heat transfer – conduction- transmission of heat trough boiler plate & composite as well as pipe coverings, convection – natural and forced , convectioning in liquids , heat transfer from condensing vapour – boiler circulation and radiation.
9. Steam generator – (Boiler) – Internal pressure versus stress, elementary knowledge of boiler drum construction and development and drum internals. Boiler metallurgy, types of boiler . fire tube boiler ,locomotive boiler , Cornish boiler , lancagire boiler ,water tube boiler , vertical tubular boiler, economic boiler , waste heat boiler , electric boiler . Advantages of water tube boiler over fire tube boiler and bent tube boilers over straight tube boiler. Difference between box type header and sectional header. Types of water walls used for furnace and their purpose. Use and types of baffles. Feed water circulations effects of high temperature on boiler steel.
10. Boiler Auxiliary plant -
    Boiler mountings and fitting , Description and use of water safety valves , Blow down valves , check valves, combustion stop and check valves , gauge glasses (mounted and remove type) draught pressure gauge , fusible plug , reheated , chain grate and spreader stocker etc. Different types of drum water level gauges and flame indicators. Use and advantages of televised viewers for drum water level and furnace flame.

DRAUGHTS

i) Methods for obtaining draughts and their management neutral forced regulated draught; pressurized and balanced draught furnace. Advantages and disadvantages of each – General arrangements of ID fans and F.D. fans Control by gas circulation spread regulation of ID fans

ii) Burner and firing –

Types of pulverized fuel burners and their control function of each component of the burner – purpose of primary and secondary air supply method of transporting ovlvarised fuel from coal mills to burners. Arrangement of burners for tangential firing, horizontal front firing, and single down shot and double down shot firing etc causes and remedies of fires in coal burners and burner pipes. Safety precautions to be adopted in case of fires causes, effects and preventions of furnace explosive. Importance of furnace purging and how it is achieved, types of oil burners in use. Injection of oil steam, mechanical automation of oil, study of typical oil burners and purpose of each component. Types of oil ignition touch their function and use. Description and use of spark igniters and oil gas firing system.

11. Stoking and boiler operation –

Methods of hand and mechanical firing water level glow down. Cleaning fires banking to fires. Cleaning heating surface care of refractoriness' – carbon losses clinkers. Formation – difference between the use pulverized fuel in the ocilers and firing on grates. Emergency operation explosion hazard feed pump failure FD fan failure, grate or stocker failures and fuel oil pump failure.

12. Super heaters , Reheater and De – super heater :-

Different types of super heaters and their function – Location of super heater vin high temperature and high pressure boiler. Requirement of super heat temperature of steam. Effects of temperature on superheated tube. Purpose and general application of de – super heaters. Advantage & disadvantages of two general types of de- superheated. Importance of drain and vents in super heaters.

13. Economizer:- types of economizer &their function in high temp. &high pressure boilers procedure to be followed if economizer gets steam bound .purpose of reciprocating, lines in economizer.
14. Soot Blowers.:-purpose & types of soot blowers .fixed &retarding types &their use precautionary measures taken while soot blowing .methods of soot blowing &cleaning boiler furnace during operation .
15. Air Pre-heater:-recuperative & regenative types of air pre heater &their advantage &disadvantage, location of air pre heater & f.o.fans temp. Limit to which air can be pre heater.
16. Feed water heaters.- bleeding of turbine & use of bled steam for heater feed water. Description &use of closed type of feed water & deacrator feed water heater.
17. Feed water regulator:-method of regulation feed water to boiler description &use of bailes types of feed water regulation valve &purpose of by pase valvation the system.
18. Boiler feed water pumps :- different types of feed water pumps .construction details of a multistage pump .use of circulation line & balance chamber .purpose balance draw &of pump waiming line & speed control

19. Water treatment-
    Object of feed water treatment, water analysis water of high pressure boilers. Impurities in water and their harmful effects. Effects of other suspended matter such as oil, alkalinity, hardness etc, in feed water. Total dissolved solid – methods of purification - use of decameters – priming and foaming, scale formation and corrosion, chemical cleaning of boilers, softening and demineraliser plant
20. a) Use of Co2 indicator and reconder, smoke density indicators and reconder, stem flow meter , hot water meter 10 pt , thermometer
    b) Boiler protection system
21. Boiler inspection
    Knowledge of Indian boiler act & rules. Isolating boiler for cleaning and inspection. Offering boiler for hydraulic test and open inspection
22. Ash handling system: Typical methods of handling bottom ash and fly ash in boilers using pulverized fuel. Description and use of cyclone type of mechanical dust collectors and multicores.Description,function and use of hydrovactors,hydroijectors,clinkers and grinders, method of ash disposal in these plants, vacuum system for disposal of fly ash and bottom ash. Principle and function of an electro static precipitator. Constructional detail of a typical precipitator. Description and function of sub merged type of ash plant.
23. Lubrication: Elementary knowledge of principle of lubrication. Lubricants – oil and greases as used in boilers and accessories, importance of lubrication for machinery, methods of lubrications.
24. Knowledge of different methods of fixing tubes by expanding with ferrules, changing of gland packing, grinding and adjusting cocks and valves etc
25. Knowledge of modern packages types boilers and automatic boilers, their advantages over other boilers, Different types, efficiency of boilers, (overall and thermal)
26. Modern development in trade – New techniques etc.

26 (a) Boiler Testing – Losses due to incomplete combustion, escape of solid combustion, matter with ash, soot, etc. Loss due to escape of combustible gases .Chimney loss, heat carried away by moisture from by hydrogen, loss due to radiation and other losses

27. Quality and finish of work – Importance of quality and finish of job at all stages
28. Introduction to work amplification – job study, job analysis including the planning of sequences of operation, critical approach and method of working, Estimation of time & material
29. Revision & test
    ISI specification to be understood and followed
    i) Colour code for identification of pipe lines used in thermal power station – 9404 - 1979
    ii) Parameters of stationary steam boilers recommended 8596-1977
    iii) Parameters of stationary stem boilers , terminology for 8595 – 1977

Sr No	Name of tools & equipments	Quantity Total
1	Rule steel 15 cm with metric gradutations also	10
2	Square try 10 cm blade	10
3	Caliper outside 15 cm spring	10
4	Caliper inside 15 cm spring	10
5	Caliper 15 cm Aermophrodits	10
6	Devider 15 cm spring	10
7	Scriber 15 cm	10
8	punch Centre 10 cm	10
9	Screw Driver 15 cm	10
10	Chiesel Cold 19 cm	10
11	Hammer Ball Peen 0.45 Kg with handle	10
12	Hammer Ball Peen 0.22 Kg with handle	10
13	File flat 25 cm second cut	10
14	File flat 25 cm smooth cut	10
15	File half round second cut 15 cm	10
16	Hacksaw frame adjustable 20-30 cm	10
17	Safety goglee (Pistol grip - tabular)	10
18	Dot a lot punch	10

Sr No	Name of tools & equipments	Qty
19	Rule steel 30 cm with TO Read metric also	4
20	Rule Steel 60 cm	4
21	Straight edge 45 cm steel	2
22	Plate surface 45 cm x 45 cm	2
23	Marking Table 91 x91 x 122 cm	1
24	Universal scribing block 22 cm	2
25	Block Vee pair 7 cm & 15 cm with clamp	2
26	Angle plate 10 x 20 cm	2
27	Level sprit 15 cm metal	1
28	Punch latter 5 cm set	1
29	Punch figure set 3 cm	1
30	Punch Bellow 6 mm to90 mm set of 5	2
31	Punch round 3 mm x 4mm set of 3	2
32	Portable hand drill (Electric) 0 to 6 mm	2
33	Drill brace hand 0 to 12 mm	2
34	Drill twist s/s 1.5 mm to 12 mm by 0.4 mm	1
35	Drill twist s/s 3 mm to 15 mm by 1/2 mm	1
36	Tap & Dies complete set in box B.A.	1
37	Tap & Dies complete set in box B.S.F.	1
38	Tap & Dies complete set in box with worth.	1
39	Tap & Dies complete set in box American	1
40	Tap & Dies complete set in box Matric	1
41	File Knife edge 15 cm smooth	4
42	File warding edge 15 cm smooth	4
43	File cant saw 15 cm smooth	4

44	File pnather edge 15 cm smooth	4
45	File triangular 15 cm smooth	2
46	File round 20cm cord cut	8
47	File square edge 15 cm second cut	4
48	File square edge 25 cm second cut	4
49	Filler gauge	1 set
50	File triangular 20 cm second cut	8
51	File flat 30 cm second cut	8
52	File flat 20 cm bastered	8
53	File flat 30 cm bastered	8
54	File swiss type needle set of 12	2
55	File half round 25 cm second cut	8
56	File half round 25 cm Bastered	8
57	File round 30 cm Bastered	4
58	File hand 15 cm second cut	8
59	Iron soldring 350 gm	2
60	Lamp blow 0.55 littero	2
61	Spanner adjustable 15 cm	2
62	Spanner whito worth 0.6mm to 25mm set of	4
63	Interchangable Ratenet socket set with a 12 mm Driver socket range 4 mm to 14 mm set of 7	1 set
64	APPOLO Box spanner set in mm 3x4, 6x7, with a tommy bar	1 set
65	Glass magnifying 7 cm	2
66	Clamp tool maker 5 cm & 7.5 cm set of 2	8
67	Clamp "C" 5 cm	2
68	Clamp "C" 10 cm	2
69	Reamer adjustable max 9 mm, 12mm, 19mm set of 3	1
70	Reamer taper 4 mm to 9 mm set of 4	1
71	Reamer parallel 6 mm to 12mm set of 5	1
72	Scraper flat 15 cm	8
73	Scraper 3 corner 15cm	8
74	Scraper half round 15 cm	8
75	Chisel cold 9 mm cross cut, 9mm diamond	8
76	Chisel cold 19 flat	8
77	Chisel cold 9 mm round nose	8
78	Extractor stud Ezy – out	2
79	Micrometer 0-2.5 cm out side	8
80	Micrometer 0-25 cm out side	4
81	Micrometer 25-50 cm out side	3
82	Micrometer 50-75 cm out side	2
83	Micrometer inside 5 cm to 20 cm with extension rods 50-75 cm out side	1
84	Vernier caliper 20 cm	1
85	Vernier level protractor 20 cm	1
86	screw pitch gauge	10
87	Drill twist T/S 6 mm to 25 mm x1.5mm	1
88	Drill chock 12 mm	1
89	Pipe wrench 40 cm	1
90	Pipe wrench 30 cm	1

91	Pipe vice No. 4	2
92	Adjustable pipe die 0-205 cm cap.	1
93	Wheel dresser (one for 4 units)	1
94	Machine vice 10 cm	1
95	Sleev drill morse 0-0, 0-1, 1-2, 2-3	1 set
96	Vice bench 12 cm jaw	10
97	Vice leg 10 cm jaw	2
98	Bench working 240	4
99	Almirah 180 x 90 x 30 cm	2
100	lockers with 8 drawers (Standard) size	2
101	Matal rack 182 x 182 x .5 cm	1
102	Fire extinguisher (for 4 units)	2
103	Fire Buckets	2
104	Hand hammer 1 kg. with handle	2
105	Mallet	2

1	Anvil 50 kg on stand	1
2	Drilling machine piller sensitive 0-20 mm cap with swivel table motorise with clock and key	1
3	Drilling machine bench sensitive 0-12 mm cap motorise with clock and key	2
4	Forge portable hand blower 38 cm to 45 cm	1
5	Grinding machine (General purpose)D. E. pedastal with 17 mm dia wheels rough & smooth with twist drill grinding attachment.	1

Note :- The Practical should be conducted in industries having boiler's capacity more than 50 sq.mt. heating surface area.

REFERENCES

Safety Codes Act and Regulations under the Act
Boiler Operation and Maintenance Manuals
Manufacturer s operation manuals

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