

# Maharashtra State Board of Vocational Examination, Mumbai 400 051

1	Name of Course	Certificate Course in Mechanic Mechatronics									
2	Course code	301416									
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 – 240 sqft Practical Lab – 540 sqft									
9	Entry qualification	S.S.C. Pass									
10	Objective of syllabus	To undertsnd basic Electricity, Electronics. To understand use of electricity and electronics in mechanical engineering. To maintain and repair various mechanical tools and equipment based on electronics application									
11	Employment opportunities	work as Mechanic in Mechanical product manufacturing industry using electronics.									
12	Teachers Qualification	For Vocational Subject - B. E. Electronics or Equivalent and For Non Vocational Subject - Master Degree in concern Subject.									
13	Teaching Scheme –										
	Sr.	Subject	Subject Code	Clock Hours / Week		Total					
				Theory	Practical						
	1	English (Commu- nication Skill) 90000001	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	Basic Electricity and Measurement	30140018	3 Hrs	8 Hrs	11 Hrs					
	5	Basic Electronics	30140019	3 Hrs	8 Hrs	11 Hrs					
	6	Mechatronics Theory	30140020	3 Hrs	8 Hrs	11 Hrs					
	Total					42 Hrs					
14	Internship	Two Month Summer Internship from 1 <sup>st</sup> May to 30 <sup>th</sup> 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 (Commu- nication Skill) 90000001	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	Basic Electricity and Measurement	30140018	3 Hrs	100	35	3 Hrs	100	50	200	85
	5	Basic Electronics	30140019	3 Hrs	100	35	3 Hrs	100	50	200	85
	6	Mechatronics Theory	30140020	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			b) For Elective II – Student can choose any one subject Code Subject Name							
	90000011	Applied Mathematics		90000021	Applied Sciences (Physics & Chemistry)						
	90000012	Business Economics		90000022	Computer Application						
	90000013	Physical Biology (Botany & Zoology)		90000023	Business Mathematics						
	90000014	Entrepreneurship									
	90000015	Psychology									

**Subject Name : English (Communication Skill) - 1<sup>st</sup> 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) – 2<sup>nd</sup> 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 - 1<sup>st</sup> Year

(Subject code : 90000011)

Theory	Practical
<b>Detailed Syllabus:</b> <b>1.0. Trigonometric ratios</b> 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	<b>Detailed Syllabus:</b> Solve problems on: 1) Conversion of radian to degree 2) Conversion of degree to radian
<b>2.0. Plane co-ordinate geometry</b> 2.1. Locus 2.2. Line	
<b>3.0 Vectors and Linear Equalities</b> 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	
<b>4.0. Determinants and Matrices</b> 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 $m \times n$ . 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
<b>5.0 Statistics and Probability</b> 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

<b>6.0. Set Relations &amp; Functions</b> 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
<b>7.0. Logarithms</b> 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
<b>8.0. Complex Numbers and Quadratic equations</b> 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	
<b>9.0. Sequences and Series</b> 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) <b>Proof of arithmetic progression and geometric progression</b> 2) <b>Proof of arithmetic mean and geometric mean</b>
<b>10.0 Permutations and Combinations</b> 10.1. Factorial notation 10.2. Fundamental principle of counting 10.3. Permutation 10.4. Combinations	
<b>11.0 Mathematical Induction and binomial theorem</b> 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	<b>Proof of Binomial theorem</b>

## Elective 1 : Applied Mathematics - 2 nd Year

(Subject code : 90000011)

Theory	Practical
<b>Detailed Syllabus :</b> <b>1.0. CALCULUS: Limits and Continuity</b> 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	<b>Detailed Syllabus</b> 1) Theorem on a limit of a sequence 2) Theorem on continuity in interval

<b>2.0. Differentiation</b> 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
<b>3.0. Applications of Derivatives</b> 3.1. Geometrical applications 3.2. Derivative as a rate of change measure 3.3. Approximations 3.4. Maxima and Minima	
<b>4.0. Integration</b> 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
<b>5.0 Application of Definite Integrals</b> 5.1. Area under the curve 5.2. Volume of solid of revolution	
<b>6.0. Differential equations</b> 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
<b>7.0 Numerical Methods</b> 7.1. Definition of various operators and relation between the operators 7.2. Interpolation methods 7.3. Numerical integration	
<b>8.0. Mathematical Logic</b> 8.1. Statements and logical connectives 8.2. Statement Pattern and Logical equivalence 8.3. Application of logic	
<b>9.0. Geometry</b> 9.1. Pair of straight lines passing & not passing through origin 9.2. <b>Circle:</b> definition, Tangent and Normal 9.3. <b>Conic:</b> Equation of Conics 9.4. <b>Three Dimensional Geometry:</b> Direction Cosines and ratios, Line, Plane	
<b>10.0. Linear Programming Problems</b> 10.1. Linear Programming Problems 10.2. Simplex Method	Solve problems on simplex method
<b>11.0. Boolean Algebra</b> 11.1. Boolean Algebra as an algebraic structure 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 – 1<sup>st</sup> year

(Subject Code – 90000012)

Theory	Practical
Detailed Syllabus : <b>1. Introduction to Economics –</b> 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
<b>2. Macro Economics –</b> 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.
<b>3. Determinants of Aggregates</b> 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.
<b>4. Money and Banking</b> 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

<b>5 Public Economics</b> 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 sources of revenue in the budget of local Government. Comment. Conduct a 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.
<b>6. International Trade</b> 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's trade Composition
<b>Theory</b>	<b>Practical</b>
<b>Detailed Syllabus :</b> 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.
<b>8.0. Structural Changes in the Indian Economy since 1991.</b> 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 during 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 trends 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.
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## Elective - I - Business Economics – 2 nd year

(Subject Code – 90000012)

Theory	Practical
<b>. Introduction Micro Economics –</b> 1.1 Meaning, Definition ,Nature 1.2 Tools of Analysis, 1.3 Role of Assumptions	1) Conduct a GD on the usefulness of Micro economics 2) Prepare a PPT on the role of assumptions in Economics
<b>Consumer Behaviour and Demand Analysis</b> 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.
<b>Producer Behaviour and Supply Analysis.</b> 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 report on the Law of supply. 4) Conduct a case discussion on the elasticity of supply.
<b>Forms of Market and Price Determination,</b> 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.

<b>Factors of Production</b>  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: <ul style="list-style-type: none"> <li>• Preparing a project report</li> <li>• How to start a business</li> <li>• Collecting information about Permission/ Licenses required from various government agencies/ authorities</li> <li>• Conducting proto type market surveys using the above statistical tools</li> <li>• Preparing questionnaires for different types of market surveys</li> </ul> 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.
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<b>Section II</b>	
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.
<b>Collection and organization of data</b> 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, Random 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.
<b>Graphical presentation of Data</b> 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.
<b>Measures of Central Tendency</b> 9.1 Mean 9.2 Median 9.3 Mode	1) Solve practical problems of mean, median, etc.

**Elective - I PHYSICAL BIOLOGY (Botany & Zoology) – 1<sup>st</sup> Year**  
**(Subject Code : 90000013)**

Theory	Practical
<b>Detailed Syllabus :</b> <b>1.0. General Biology</b> 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
<b>2.0. Introduction to Botany</b> 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
<b>3.0. Vegetative Morphology of plants</b> 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)
<b>4.0. Reproductive Morphology of plants</b> 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.	

<b>SECTION B - ZOOLOGY</b> <b>5.0. General Biology of Living world</b> 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	
<b>6.0 Diversity of life</b> 6.1 Study and Classification of animals	Classification of animals
<b>7.0. Genetics</b> <b>7.1. Chromosomal basis of inheritance</b>	
<b>7.0 Study of Phylum: Chordata</b> 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
<b>8.0 Study of Reptiles, Aves and Mammals</b> 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: Distinctive 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
<b>9.0 Anatomy of Earthworm</b> 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) – 2<sup>nd</sup> Year**  
**(Subject Code : 90000013)**

Theory	Practical
<b>Detailed Syllabus : SECTION A - BOTANY</b> <b>1.0. Reproduction in Angiosperms</b> 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	
<b>2.0. Plant Taxonomy</b> 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	
<b>3.0. Internal Organization of plants</b> 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
<b>4.0. Genetics</b> 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
<b>SECTION B - ZOOLOGY</b> <b>5.0. Morphology of Humans</b> 5.1. Nutrition and respiration in man 5.2. Locomotion in man 5.3. Study of Human Skeleton	Study of human skeleton(Bone theory)
<b>6.0 Physiology of Humans</b> 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)
<b>7.0 Reproduction, growth and development</b> 7.1. Details of Reproduction and human development	Study of reproduction in humans
<b>8.0 Biology in Human welfare</b> 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 – 1<sup>st</sup> Year

(Subject code : 90000014)

Theory	Practical
<b>Detailed Syllabus :</b> <b>1.0. Entrepreneurship</b> 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.	<b>Detailed Syllabus</b> 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.
<b>2.0. Entrepreneurial Pursuits and Human Activities:</b> 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.
<b>3.0. Acquiring Entrepreneurial Values and Motivation</b> 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	
<b>4.0. Introduction to Market Dynamics</b> 4.1. Understanding a Market 4.2. Competitive Analysis of the Market 4.3. Patents, Trademarks and Copyright	
<b>5.0. Project Selection</b> 5.1. Product Identification 5.2. Project Formulation	



## ENTREPRENEURSHIP – 2<sup>nd</sup> Year

Theory	Practical
<b>Detailed Syllabus :</b> <b>1.0. Entrepreneurial Opportunities and Enterprise Creation</b> 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	<b>Detailed Syllabus</b>
<b>2.0. Enterprise Planning and Resourcing</b> 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.	
<b>3.0. Enterprise Management</b> 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.	
<b>4.0. Industrial Relations and Personnel Management</b> 4.1. Meaning, Source of recruitment, Internal/External recruitment procedure 4.2. Incentives, appraisal and training, Industrial relations, Industrial disputes.	
<b>5.0. Report Writing</b> 5.1. Guidelines 5.2. Model project reports	

## Subject Name : Psychology – 1<sup>st</sup> Year

(Subject code : 90000015)

Theory	Practical
<b>Detailed Syllabus :</b> <b>1.0. Psychology Introduction :</b> 1.1. Definition of Psychology 1.2. Methods of Psychology 1.3. Subfields of Psychology 1.4. Schools of Psychology (a) Old (b) New	<b>Detailed Syllabus</b> I. Study until by student to any organization for differently able person with special needs or a centre for the treatment of the mentally ill. With the help of a questionnaire the student will record observation regarding the type of treatment given, different therapies available at the organization/centre, prognosis of the patients improvement in quality of life, support for previous care given to the patient/clients.
<b>2.0 Memory</b> 2.1 A Theory of General Memory Function 2.2 Information Processing Theories 2.3 The Levels of Processing Theories 2.4 The Organization of Long Term Memory 2.5 Retrieval From Long term memory. 2.6 Forgetting	II. Preparation of a brief report based on the observations made during case study-visit to an organization.
<b>3.0 Learning</b> 3.1 Definition 3.2 Classical Conditioning 3.3 Instrumental Conditioning 3.4 Escape Learning 3.5 Avoidance Learning 3.6 Signature of Instrumental Conditioning 3.7 Cognitive Learning	
<b>4.0 Motivation</b> 4.1 Definition 4.2 Motives as References, Explanations and Predictions. 4.3 Theories of Motivation 4.4 A Normal of Biological Motivation 4.5 Biological Motivation 4.6 Social Motives 4.7 Self-Actualization Motivation 4.8 Frustration and Conflict of motives	
<b>5.0 Personality</b> 5.1 Definition 5.2 Theories of Personality	
<b>6.0 Motivation</b> 6.1 Definition 6.2 Etiology 6.3 Diagnosis 6.4 Clinical Features 6.5 Treatment	
<b>7.0 Perception and Attention</b> 7.1 Definition of Perception 7.2 Sensory Processes 7.3 Illusions 7.4 Attention	

<b>8.0 Emotions</b> 8.1 Definition 8.2 Expression and Perception of Emotions 8.3 Physiology of Emotions 8.4 Stress	
<b>9.0 Intelligence</b> 9.1 Definition 9.2 Intelligence Quotient (IQ) 9.3 Intelligence Testing	

## Abnormal Psychology - 2<sup>nd</sup> Year

Theory	Practical
<b>Detailed Syllabus :</b> <b>1.0. Abnormal Psychology</b> 1.1. Definition of Psychological Disorder 1.2. Classification of Psychological Disorder	<b>Detailed Syllabus</b> <p>The Main objective of the course in Psychology is to help the students establish a better rapport with their clients. A basic understanding and knowledge of this subject will enable the students to deal with each client as an individual, while also being aware of his/her unique needs. Also, due to the established mind-body connection, some patients requiring Physiotherapy have a Psychological cause as the basis of their physiological symptoms. Severe physiological symptoms requiring therapy can lead to psychological conditions in the patient. Relevant knowledge of psychology can help sensitize the physiotherapist to the needs of the client and treat the patient in a more holistic manner.</p> <p>Such a course would need to have an experimental component in the form of practical work. The objectives of the practical work are :-</p> <ol style="list-style-type: none"> <li>1. To give the students firsthand experience in field work with hospitals / centers catering to the psycho-physiological needs of patients.</li> <li>2. To develop in the students the skill and sensitivity to deal with each patient as an individual with his or her own unique need.</li> <li>3. To guide the students to prepare a project report.</li> <li>4. To equip the students to make a note of patients psychological conditions in the case history of the patient.</li> <li>5. To instill in the students the right values and a greater understanding of their patients.</li> </ol>

<b>2.0 Schizophrenia</b> 2.1 Definition 2.2 Symptoms 2.3 Subtypes 2.4 Treatment 2.5 Prognosis	
<b>3.0 Paranoia</b> 3.1 Definition 3.2 Symptoms 3.3 Subtypes 3.4 Treatment	
<b>4.0 Manic Depressive Psychosis</b> 3.1 Definition 3.2 Symptoms 3.3 Subtypes	
<b>5.0 Melancholia</b> 5.1 Symptoms 5.2 Treatment	
<b>6.0 Anxiety</b> 6.1 Symptoms of anxiety 6.2 Difference between normal fears and anxiety disorder 6.3 Peripheral manifestations of pathological anxiety. 6.4 Classification of anxiety disorder. 6.5 Treatment	
<b>7.0 Phobia</b> 7.1 Definition 7.2 Symptoms 7.3 Types of phobia 7.4 Treatment	
<b>8.0 Obsessive Compulsive neurosis (OCN)</b> 8.1 Definition of Obsession 8.2 Definition of Compulsion 8.3 Symptoms 8.4 Treatment	
<b>9.0 Hysterical Conversion Disorder</b> 9.1 Definition 9.2 Clinical features (Symptoms) 9.3 Treatment	
<b>10.0 Neurasthenia</b> 10.1 Definition 10.2 Symptoms 10.3 Treatment	
<b>11.0 Personality Disorders</b> 11.1 Definition 11.2 Symptoms 11.3 Classification / Types of Personality Disorders 11.4 Anti-social Personality Disorder (i) Etiology (ii) Treatment	
<b>12.0 Psychotherapy</b> 12.1 Definition 12.2 Types of Psychotherapy	

<b>13.0 Organic Psychosis</b> 13.1 Definition 13.2 Symptoms 13.3 Types of Organic Psychosis (i) Causes (ii) Clinical Features (iii) Treatment (iv) Course and Prognosis	
<b>14.0 Alcohol Related Mental Disorders</b> 14.1 Definition 14.2 Etiology 14.3 Classification 14.4 Treatment and Rehabilitation.	
<b>15.0 Epilepsy</b> 15.1 Definition 15.2 Varieties / Types of epilepsy 15.3 Cause of epilepsy 15.4 Aggravating factors 15.5 Post-ictal disorders 15.6 Epilepsy Vs. Pseudo-seizures 15.7 Status Epilepticus & treatment 15.8 Treatment of Epilepsy	
<b>16.0 Mental Retardation (MR)</b> 16.1 Definition 16.2 Classification 16.3 Etiology 16.4 Diagnosis 16.5 Clinical Features 16.6 Treatment	
<b>17.0 Frustration and conflict</b> 17.1 Definition of Frustration 17.2 Sources of Frustration 17.3 Types of conflict	
<b>18.0 Mental Mechanisms</b> 18.1 Classification	

## **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 success/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 successful 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 environment 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 required 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. Entrepreneurial 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. Saravanel, 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-I 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-I 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 Udhdyog Samachar.
04. Project Profile by DCSSI.
05. Project Profile by Pub. Centre for Enterpreurship Development, M.P. (CEDMAP), 60 Jail . Road, Jhangerbad, Bhopal-462008.

## Elective – II - APPLIED SCIENCE (Physics & Chemistry) – 1<sup>st</sup> Year

(Subject Code – 90000021)

Theory	Practical
<b>Detailed Syllabus :</b> <b>SECTION A : PHYSICS</b> <b>1.0. Measurement, Units, and Dimension</b> 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	<b>Detailed Syllabus</b> Perform a simple experiment on measurement and error
<b>2.0. Scalars and Vectors</b> 2.1. Introduction to scalars and vectors 2.2. Addition and subtraction of vectors 2.3. Product of vectors	
<b>3.0. Motion &amp; Force</b> 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	<b>Experiment on gravitational force(example of a ball falling from a certain height)</b>

<b>4.0. Friction</b> 4.1. Origin and nature of frictional forces 4.2. Laws of static and kinetic frictions 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	<b>Proof of Stoke's theorem and Bernaulli's principle</b>
<b>5.0. Dynamics</b> 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. 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.	<b>Derivation for Potential energy and kinetic energy</b>
<b>6.0. Sound waves</b> 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	
<b>7.0. Thermal expansion</b> 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	<b>Experiment on expansion of solids in a thermal envirnment</b>
<b>8.0. Refraction of light and lens</b> 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	<b>Experiment on Refraction of light using a prism</b>

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	
<b>9.0. Modern Physics</b> <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	

<b>SECTION B – CHEMISTRY</b> <b>1.0. Basics of Chemistry</b> 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	<b>Solve Problems based on weight – volume relationship</b>
<b>2.0. Atomic Structure</b> 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.	<b>Study of Planck's quantum theory and Bohr's theory</b>

<b>3.0 Classification Of Element And Periodicity In Properties</b> 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.	<b>Study of Structure of periodic table</b>
<b>4.0. Redox Reaction</b> 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	
<b>5.0. Chemical Equilibrium</b> 5.1. Introduction: Reversible and irreversible reactions 5.2. Rate of reaction and factors affecting it 5.3. Chemical Equilibrium 5.4. Laws of Mass action, Equilibrium constant, relationship between $K_p$ and $K_c$	<b>Numerical problems based on <math>K_p</math> and <math>K_c</math></b>
<b>6.0. Adsorption:</b> 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	<b>Experiment on absorption(example of a sponge) to give the difference between absorption and adsorption</b>
<b>7.0 Chemical Bonding and Molecular Structure</b> 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 H <sub>2</sub> , N <sub>2</sub> and O <sub>2</sub> .	

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.	
<b>8.0. S-block, P-block, d-block &amp; F-block elements</b> 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) – 2<sup>nd</sup> Year

(Subject Code – 90000021)

Theory	Practical
<b>Detailed Syllabus :</b> <b>SECTION A - PHYSICS</b> <b>1.0. Electrostatics</b> 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	<b>Detailed Syllabus</b> 1) Proof of Gauss's theorem 2) Solve numericals on series and parallel plate capacitors
<b>2.0. Current, Electricity and Magnetic effects of electric current</b> <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.	1) Solve numericals on Ohm's law 2) Experiment on wheatstone's bridge

<p><b>Part B – Magnetic effects of electric current</b></p> <p>2.8. Biot Savart's law</p> <p>2.9. Right hand Thumb rule</p> <p>2.10. Magnetic induction at the center and at the point along the axis of circular coil carrying current</p> <p>2.11. Flemming's left hand rule</p> <p>2.12. Definition of Ampere</p> <p>2.13. Ampere's law and its applications</p> <p>2.14. Moving coil galvanometer</p> <p>2.15. Ammeter</p> <p>2.16. Voltmeter</p>	
<p><b>3.0. Magnetism</b></p> <p>3.1. Coulomb's inverse square law</p> <p>3.2. Couple acting on a bar magnet placed in a uniform magnetic field</p> <p>3.3. Magnetic moment of a magnet</p> <p>3.4. Expression for Magnetic induction due to a bar magnet on axial and Equatorial lines</p> <p>3.5. Superposition of magnetic fields</p> <p>3.6. Tangent law</p> <p>3.7. Deflection Magnetometer</p> <p>3.8. Comparison of magnetic moments in Tan-A and Tan-B positions by Equal distance method and null method</p>	
<p><b>4.0. Electromagnetic waves</b></p> <p>4.1. Electromagnetic waves and their characteristics</p> <p>4.2. Transverse nature of electromagnetic waves</p> <p>4.3. Electromagnetic spectrum</p> <p>4.4. Propagation of electromagnetic waves in atmosphere</p>	
<p><b>5.0. Electromagnetic Induction</b></p> <p>5.1. Laws of electromagnetic induction</p> <p>5.2. Eddy currents</p> <p>5.3. Self and mutual induction</p> <p>5.4. Transformer</p> <p>5.5. Coil rotating in uniform magnetic field</p> <p>5.6. Alternating currents</p> <p>5.7. Reactance and impedance</p> <p>5.8. Power in a a.c. circuit with resistance, inductance and capacitance</p> <p>5.9. Resonant circuit</p>	<p><b>Solve numericals on power in a.c circuit, transformers and resonating circuits</b></p>
<p><b>6.0. Semiconductors</b></p> <p>6.1. Energy bands in solids</p> <p>6.2. Intrinsic and extrinsic semiconductors</p> <p>6.3. p – type and n – type semiconductors</p> <p>6.4. P – N junction diode</p> <p>6.5. LED</p> <p>6.6. Rectifiers</p> <p>6.7. Zener diode as a voltage regulator</p> <p>6.8. Solar cell</p> <p>6.9. Transistor as an amplifier</p> <p>6.10. Oscillators</p> <p>6.11. Logic gates</p>	



<b>7.0 Communication</b> 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	<b>Study of various types of cables and wires</b>
<b>SECTION B - CHEMISTRY</b> <b>6.0. Electrochemistry</b> 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.	<b>Experiment on faraday's law of electrostatics</b>
<b>7.0 Nuclear Chemistry</b> 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 Iodine 131 , Cobalt 60 , Sodium 24 , C 14 and P 30.	<b>Solve numericals on binding energy and half life rate</b>
<b>8.0 Surface Chemistry</b> 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, lyo-philic and lyo-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	
<b>9.0. Acids and Bases</b> 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.	<b>Solve numericals on pH value.</b>

<b>10.0 Alkanes, Alkenes, Alkynes and Aromatic compounds</b> 10.1. Introduction and importance of organic chemistry 10.2. General characteristics of organic compounds Classification of organic compounds	
<b>11. Ethers</b> 11.1 Introduction:- Definition 11.2 Classification:- 11.3 Nomenclature and metamerism 11.4 Preparation, Reactions & Uses	<b>Study of Simple and mixed ethers with examples.</b>
<b>12. Aldehydes and Ketones</b> 12.1 Introduction 12.2 Carbonyl Compounds & classification 12.3 Nomenclature of aldehydes and ketones 12.4 Preparation & reaction of Aldehydes and ketones	
<b>13.0 Acids &amp; Esters</b> 13.1. Introduction, Nomenclature, preparation, Reaction and uses of Acids & Esters	<b>Study of various types of acids</b>
<b>14.0. Amines</b> 14.1. Introduction, Classification and Nomenclature 14.2. Preparation of primary amines 14.3. Reaction of amines	
<b>15.0. Biomolecules &amp; Synthetic Fibres</b> 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	<b>Study of fibres</b>
<b>16.0. Chemistry in application</b> 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– 1<sup>st</sup> year**  
**(Subject Code – 90000022)**

<b>Theory</b>	<b>Practical</b>
<b>Detailed Syllabus :</b> <b>1.0. Introduction</b> 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	<b>Detailed Syllabus</b> <b>1.0. Computer basics</b> 1.1. Identification of Keyboard, Printer, Monitor Scanner, Webcam, Microphone, Speaker 1.2. Sample collection of various type of storage devices, specifications and charts
<b>2.0. Operating systems</b> 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	<b>2.0. Practice</b> 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
<b>3.0. Microsoft Word</b> 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.	<b>3.0. Documentation</b> 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
<b>4.0. Microsoft Excel</b> 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.	<b>4.0. Practice of Worksheets</b> 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

<b>Theory</b>	<b>Practical</b>
<b>5.0. MS Power point</b> 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	<b>5.0. Power Point practice</b> 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
<b>6.0. Networking &amp; Internet Utilities</b> 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)	<b>6.0. Networking practice</b> 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
<b>7.0. Project work</b> 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.	<b>7.0. Project Work</b> 7.1. Making a working model/project using MS Excel/Power Point 7.2. Project Report

## **Elective –II - Computer Applications– 2<sup>nd</sup> year**

**(Subject Code – 90000022)**

<b>Theory</b>	<b>Practical</b>
<b>Detailed Syllabus :</b> <b>1.0. Introduction MS Access</b> 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	<b>1.0. Study of overview of MS Access</b>  1.1. Accessing MS Access and its menus to get familiar with it
<b>2.0. Controlling Data Entry</b> 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	<b>2.0. Creating Data Tables, Designing Fields and setting field properties</b>
<b>3.0. Joining Tables and creating Queries</b> 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	<b>3.0. Creating Queries</b>

<b>4.0. Forms &amp; Reports</b> 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	<b>4.0. Practicing Forms and Reports</b> 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
<b>5.0. Sharing data across applications</b> 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	<b>5.0. Practice:</b> 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
<b>6.0. Study of Application packages</b> 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	<b>6.0. Practice</b> 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
<b>7.0. Project work</b> 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.	<b>7.0. Project Work</b> 7.1. Making a working model/project using MS Access 7.2. Project Report

## Elective – II - Business Mathematics – 1<sup>st</sup> year

(Subject Code – 90000023)

Theory	Practical
<b>Detailed Syllabus:</b> <b>1.0. Logarithms</b> 1.1. Introduction to logarithms 1.2. Laws of logarithm, characteristics and mantissa	<b>Practice:</b> 1. At least 5 to 10 exercises per chapter 2. One home/class assignment per chapter
<b>2.0. Sets, Relations and functions</b> 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	
<b>3.0. Complex Numbers</b> 3.1. Definition of complex numbers 3.2. Line	
<b>4.0 Quadratic Equations</b> 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 Cubic roots unity	
<b>5.0. Determinants</b> 5.1 Determinant of order three 5.2 Applications of Determinants	
<b>6.0. Trigonometric ratios</b> 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	
<b>7.0. Plane Co-ordinate Geometry</b> 7.1. Locus 7.2. Line	
<b>8.0 Partition values and measure of dispersion</b> 8.1 Partition values 8.2 Measures of Dispersion	
<b>9.0. Moments Skewness Kurtosis</b> 9.1 Moments 9.2. Skewness 9.3 Kurtosis	
<b>10.0. Bivariate frequency distribution and correlation</b> 10.1. Bivariate frequency distribution 10.2 Bivariate Correlation 10.3 Rank correlation	
<b>11.0. Permutations and Combinations</b> 11.1 Factorial notation 11.2 Principle of counting 11.3 Permutations 11.4 Combinations	

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

## Elective – II - Business Mathematics – 2<sup>nd</sup> year

(Subject Code – 90000023)

Theory	Practical
<b>1.Mathematical Logic</b> 1.1 Statements and logical connectives 1.2 Statement pattern and logical equivalence 1.3 Venn Diagram	
<b>2. Matrices</b> 2.1 Definition and Types matrices 2.2 Algebra Matrices 2.3 Inverse of a Matrix 2.4 Solution of Equations	
<b>3. Limit and Continuity</b> 3.1 Definition 3.2 Algebra of limits 3.3 Application of Standard limits 3.4 Continuity of a function at a point	
<b>4. Differentiation</b> 4.1 definition of Derivative 4.2 Derivative from first principles 4.3 Rules of Differentiation 4.4 Derivative of composite functions 4.5 Derivative of Inverse functions 4.6 Logarithmic Differentiate 4.7 Derivates of Implicit functions 4.8 Derivatives of Parametric functions. 4.9 Second order derivatives	
<b>5. Application of Derivatives</b> 5.1 Increasing and Decreasing functions 5.2 maxima and Minima 5.3 Approximation and Error	
<b>6. Integration</b> 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	
<b>7. Differential Equations</b> 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	

<b>1.Theory of Attributes</b> 1.1 Introduction Notation and class frequencies 1.2 Consistency of data 1.3 independence of Attributes 1.4 Association of Attributes	
<b>8. Regression Analysis</b> 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	
<b>9. Numerical Methods</b> 9.1 Finite differences 9.2 Interpolation with equal intervals 9.3 Interpolation with unequal intervals 9.4 Numerical integration	
<b>10. Discrete Probability Distribution</b> 10.1 Binomial Theorem 10.2 Binomial Distribution 10.3 Poisson Distribution	
<b>11. Management Mathematics</b> 11.1 linear programming problem 11.2 Assignment problem 11.3 Sequencing	
<b>12. Demography</b> 12.1 Introduction, definition, Uses of vital statistics 12.2 Measurements of Mortality 12.3 Life tables	
<b>13. Index Number</b> 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	
<b>14.0. Spread sheets</b> 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.	<b>Practice:</b> 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 Code: 30140018**

**Subject Name : Basic Electricity and Measurement**

1. Conducting material
  - 1.1 Conducting material-Properties, Classification,
  - 1.2 Characteristics of good/Bad Conductors, Semi/Super Conductors and their Applications.
  - 1.3 Bare Conductors, O.H. Conductors, ACSR, Copper Aluminum G. I., , winding wires Bus Bars ,
  - 1.4 Wires & Cables, L.T.& H.T. Cables Conductors.
  - 1.5 Requirements of Resistive Material.
  - 1.6 Properties of Resistive material.
  - 1.7 Types of Resistive Material.
2. Insulating material
  - 2.1 Properties of Insulating material, Classifications,
  - 2.2 Types w. r. t. Thermal sensitivity Insulating material & its Die electric strength Solid, Liquid & Gas)
  - 2.3 Insulation material Required for--Winding wires, Cables/ wires (HT & LT), O.H. Insulators (Advance) HT & LT, Switch gear
  - 2.4 Die electric medium its properties. .
3. Semi Conductor material
  - 4.1 Characteristics of semi conductors material.  
Semi conductor alloys, oxides, sulphides & Halides etc.
  - 4.2 Commonly used semi conductor material and their Application.
4. Magnetic material
  - 5.1 Requirements of magnetic material Permanent Magnetic material,
  - 5.2 Magnetic material used for cores (CRGO, Ferrites) Application.
5. Special Application of materials
  - 6.1 Contact material- slip ring, force free spring, carbon brushes, Brush Holder, commutator, Switch gear, Contacts
  - 6.2 Thermocouple materials,
  - 6.3 Bimetal materials,
  - 6.4 Soldering materials, Fuse materials
6. Cell and Batteries
  - 7.1 Requirements of Cell and Batteries materials
  - 7.2 Primary Cells description, Classification
  - 7.3 Secondary Cells , Classification Lead Acid Battery, Construction, Nicel Battery Maintenance free Battery
  - 7.4 Maintenance, installation, applications, write off procedures..

7. Electrostatics
  - 1.1 Voltage & Die-Electric Strength (concepts only)
  - 1.2 Principle of Capacitor. Capacitance, Series / Parallel Combination Charging & Discharging of Capacitor.
8. Electric Current & Circuits
  - 2.1 Concepts & Types of circuit., Ohm's Law, Factors Controlling the 'R' of material. Effect of Temp., Law of Resistance, Resistivity etc.
  - 2.2 Polarity of 'IR' Drops. Internal Resistance, Potentiometer- Construction & Applications. Shunts-Applications.
9. Network Circuits
  - 3.1 Kirchhoff's Laws (KCL, KVL), Simple problems, Wheatstone's Network, Meter Bridge & Applications.
  - 3.2 Simple numerical Problems
10. Electro- Chemistry
  - 4.1 Chemical effects of Electric current, Faraday's Laws of Electrolysis- E.C.E., Applications of Electrochemistry,
11. Thermo- Electricity
  - 5.1. Heating effect of elect. Current, Joule's Law Thermocouple, See-back effect, & Application.
  - 5.2 Simple Calculations on Joule's Law Electric Power, Energy, Calculations on Power & Energy (Elect. Bills).
12. Electro-magnetism.
  - 6.1 Permeability, Laws of Magnetic Forces, Definitions Of Mag. Field strength, Flux density, Intensity of Magnetism,, MMF, Ampere-Turns, Reluctance. Etc. Comparison between Mag. Field & Elect. Field.
  - 6.2 Ampere's Rule, Laplace's Law, Force on current carrying conductor in Mag. Field, Fleming's Left Hand Rule. Force between two parallel current carrying conductors, Solenoid.
  - 6.3 Faraday's Laws of Electromag. Induction. Magnitude of Dynamically & Statically induced EMF, Eddy current. Lenz's Law, Magnetic Losses-
13. A. C. Fundamentals
  - 7.1 Generation & Equation of Alternating Voltages & Currents, Definitions of Phase, Phase Difference, Max. / Peak Value, R.M.S. Value. Average Value etc.
  - 7.2 Vector algebra of A.C. Quantities. Characteristics of A.C. Circuit. Having Pure Resistance, Pure Inductance and Pure Capacitance

14. A. C. Circuits

- 8.1 A.C. Ckt. Having R, L & C in series, Power Factor, and P. F. improvement methods, Advantages/ Disadvantages.
- 8.2 A.C. Ckt. Having R, L & C in parallel, Vector & Admittance method. Series & Parallel Circuit and Its Characteristics. A.C. Bridges,
- 8.3 Poly-Phase Circuit. Generation & Phase Sequence Star / Delta Connection & its Characteristics. Power in 3 Ph. System for Balance & Unbalance load.

15. Electrical Measuring Instruments & Measurements

- 9.1 Absolute & Secondary Instruments. Principles of Operation of Instruments. Types of Torques for Instruments.
- 9.2 Classification of meters. M.I. meters, M.C. meters, Wattmeters Types, Explanation, Applications.
- 9.3 Energy meters- Types, Construction, Working, Errors in Energymeters, Applications. Digital Meters- Study, Advantages/ Disadvantages. Multimeters- Analog / Digital, merits- demerits.
- 9.4. Instrument Transformers- CT, PT, Characteristics, Applications, Testing Clip-On meter- construction, working, Megger, Earth Tester-Construction, Working & Applications.

## **Practical Contents :**

### **Engg. Material -**

- 01 To study the Construction of various types Cable
  - 1.1 Construction of LT cable.
  - 1.2 Construction of HT cable.
- 02 To study the various types of insulation material class wise
- 03 To find out the break down voltage of given transformer oil sample
  - 3.1 To collect various samples of insulating oil.
  - 3.2 To test the die elect. strength of samples.
- 04 To study LT & HT overhead lines insulator
- 05 To study characteristics of various types of special Resistive material
  - 5.1 To study Temperature sensitive resistive material.
  - 5.2 To study Light sensitive resistive material.
- 06 To study negative resistance characteristic of semi conductors
- 07 Collect any various magnetic materials e.g. Ferrite Core of Transformer & study.
- 08 Study characteristics of various types of thermocouple & its material
- 09 Study characteristics of Fuse material.
- 10 To prepare a chart of various types of batteries and troubleshooting
- 11 To study the Lead acid Battery material
- 12 To study related Indian Standard with Tech. Specifications, from related Web-sites of various engineering materials.

### **Electricity and Measurement**

- 1 To Prepare a sheet of Atomic Structure.
- 2 To measure the Potential Diff. of a charged line.
- 3 To determine the Resistivity of a given material.
  - 3.1 To measure the length of given wire.
  - 3.2 To measure the diameter of wire & calculate cross section area
  - 3.3 To measure the resistance of wire by ohmmeter/multi meter.
- 4 To measure the Internal Resistance of a Cell by Potentiometer.
  - 4.1 To study the concept of internal resistance
  - 4.2 To make connections as per ckt. diagram.
  - 4.3 To calculate the internal resis. by using formula.
- 5 To Verify the characteristics of Kirchhoff's Laws.
  - 5.1 To verify Kirchhoff's voltage and current law
  - 5.2 To verify Thevenins, Nortons and Superposition's.
- 6 To Verify the Faraday's Laws of Electrolysis & determine the E.C.E. of copper.
  - 6.1 To understanding the process of electrolysis.
  - 6.2 To know the concept of metal deposition through electricity passing
- 7 To determine the Joule's constant by electric method.
  - 7.1 To understand the relations between current passing & heat generated.
  - 7.2 To calculate the Joule's constant by formula.
- 8 To Verify the Fleming's Left hand Rule.
  - 8.1 To find out the direction of mag. field around conductor.
  - 8.2 To observe the direction of torque of conductor.
- 9 To verify the Faraday's Laws of Electromag. Induction.
  - 9.1 To verify the Faraday's 1st law of elect. mag. induction.
  - 9.2 To verify the Faraday's 2nd law of elect. mag. induction.

- 10 To trace out the sine wave of A.C. on C.R.O. & find out the various values of A.C. quantities.
  - 10.1 To trace & measure the Peak value of A.C. sine wave.
  - 10.2 To calculate the R.M.S. & Average value.
- 11 Verification of Improvement of P. F. by using Capacitors.
- 12 To verify the characteristics of Star & Delta connections.
  - 12.1 To verify the characteristics of star connection.
  - 12.2 To verify the characteristics of delta connection.
- 13 To measure the power of 3 ph. balance & unbalance load using two-wattmeter method & calculate the P.F. of load.
  - 13.1 To measure the power of 3 ph balance load
  - 13.2 To measure the power of 3 ph unbalance load
  - 13.3 To calculate the P.F. of load using formula.
- 14 To calibrate the given 1 ph. Energy meter.

**Title of Book Author Publication**

- A Text Book of Electrical Technology. Vol.-I B. L. Thereja, A. K. Thereja. S. Chand & Company Ltd, New Delhi.
- Applied Physics B. G. Bhandarkar. Vrinda Publications.
- Basic Electricity & Electronics-I S. K. Patel. A. D. Maydeo. Nirali Prakashan.
- Electrical Measurements & Measuring Instruments. E. W. Golding. F. C. Widdis. Wheeler Publishing, Allahabad.
- Basic Electrical Engineering, Volume –I P. S. Dhogal. Tata McGraw-Hill.
- Electrical Engineering Measurements A K Sawhny S Chand & Company Ltd,
- 1 Basic Electrical Engineering M. L. Anvani
  - 2 Modern Electrical Engineer, volume-1 W. J. John
  - 3 Electrical Engineering materials A. J. Dekker
  - 4 Electrical Engineering materials Uppal / Arrora
  - 5 Electrical Engineering materials Indulkar
  - 6 Electrical Engineering materials Manchand

**List of Tools & Equipments :**

- 1 Plier Insulated combination 150 mm. -5
  - 2 Long Nose Insulated Plier 150 mm -5
  - 3 Punch Centre 150 mm x 9 mm.- 5
  - 4 Wire Stripper 150mm- 5
  - 5 Tweezer 100 mm Insulated -5
  - 6 Neon Tester -5
  - 7 Heat sink Plier -5
  - 8 I.C. Tweezer / Puller -5
  - 9 Screw Driver Set of 6 Nos. -5
  - 10 Watch Maker Screw Driver -5
  - 11 Adjustable Spanner / Slide Wrench ( 15 to 20 cm) -5
  - 12 Electrician Screw Driver 250 mm thin Stem Insulated -5
  - 13 Plier Side Cutting 150 mm -5
  - 14 Allen Key set -5
- 
1. 1 sq. mm PVC Copper flexible wire
  2. Electric lamps 100 watt, 250 v.
  3. Capacitors 400 v. assorted
  4. Bare copper,allu, nichrome wire
  5. Battery 6 volt
  6. Testing Board
  7. Assorted wires & cables
  8. Latest Primary cells
  9. Secondary Battery (Tubular plates)
  10. Allu. soldering material & flux
  11. Pin type Insulator Porcelain
  12. Threaded Pin G.I
  13. G.I.wire 10SWG
  14. Sand Paper 0 Nos.
  15. Cotton Waste
  16. Neutral link
  17. PVC Insulated single strand Aluminum cable 1.5 mm<sup>2</sup> ,250V grade
  18. Flexible PVC insulated cable 14/0.2 250V grade
  19. Bare copper wire 8SWG
  20. Fuse wire 1,2,5,10,&25AMP
  21. Insulation tape 20mm width 10m Coil
  22. Tube light Choke 40W,240V
  23. Copper Sleeves for 16mm<sup>2</sup> Cable
  24. Copper Ferrule for 16mm<sup>2</sup> Cable
  25. Copper Lug for 16 mm<sup>2</sup> Cable
  26. Solder flux 25gm tin
  27. Alca P Solder
  28. Bearing Grease Shell Alrania or equivalent
  29. Machine Screw 30mm long with nut & 2 Washers 25 nos
  30. Emery Sheet No."00" 05 Sheet

**Subject Code: 30140019**

**Subject Name : Basic Electronics**

**1. Semiconductors**

- 1.1 Intrinsic and Extrinsic semiconductors
- 1.2 Electrons and holes in an intrinsic semiconductor
- 1.3 Donor and acceptor impurities
- 1.4 Diffusion
- 1.5 Effect of temperature on intrinsic and extrinsic semiconductors.

**2. Semiconductors diode characteristics**

- 2.1 Open circuited p.n. junction as a diode
- 2.2 Current components in P.N. diode
- 2.3 V.I. characteristics and its temperature dependence
- 2.4 Diode resistance
- 2.5 Load line concept
- 2.6 Diffusion capacitance
- 2.7 Diode Switching time
- 2.8 Junction diode data sheet
- 2.9 Zener diode
- 2.10 Schottkey diode
- 2.11 V.I. characteristics
- 2.12 Zener diode voltage regulator
- 2.13 Zener and schottkey diode data sheet

**3. Rectifiers and Filters**

- 3.1 Half wave rectifier
- 3.2 Full wave rectifier, Bridge rectifier
- 3.3 Ripple factor
- 3.4 Ratio of rectification

**4. BJT**

- 4.1 THE JUNCTION TRANSISTOR
- 4.2 Transistor current components
- 4.3 Transistor as an amplifier
- 4.4 Transistor configurations and characteristics
- 4.5 Graphical analysis of the C.E. configuration
- 4.6 Analysis of cut-off and saturation regions
- 4.7 Typical transistor junction voltages
- 4.8 Transistor switching times and ratings Transistor as a switch.

**5. Frequency Response of Bjt Amplifiers**

- 5.1 Single stage C.E. amplifier and its frequency response
- 5.2 Effect of coupling and emitter bypass capacitors on low frequency response

## **6. MULTISTAGE AMPLIFIERS**

- 6.1 Classification of amplifiers.
- 6.2 Decibel of Power Amplifier
- 6.3 Types of coupled Amplifier.
- 6.4 Direct coupled Amplifier.
- 6.5 R.C. coupled and transformer coupled amplifiers and their frequency response
- 6.6 Effect of cascading on Bandwidth and gain 10 03

## **7. MEASUREMENT TECHNIQUES & MEASURING INSTRUMENTS**

- 7.1 Definition of measurement and instrument
- 7.2 Accuracy error, Range, Types of errors in measurement and Remedial methods
- 7.3 Merits and demerits.
- 7.4 Measurement of A.f. and R.F.

## **8 DIGITAL TECHNIQUES, BASIC LOGIC GATES, UNIVERSAL GATES**

- 8.1 Binary, Decimal, Octal, Hexadecimal,
- 8.2 concept and design using AND, OR, NOT, NAND, NOR Verifying & study the truth table.
- 8.3 Boolean Algebra.

## **9 ARITHMETIC ELEMENTS**

- 9.1 Half adder, full adder, Half subtract or, Full subtract or
- 9.2 1's complement, 2's complement
- 9.3 BCD adder.
- 9.4 Design of circuits using universal gates
- 9.5 Decoders, Encoders, Multiplexers, Demultiplexers
- 9.6 Flip Flops - R-S, J-K, Master slave f.f, and D types, Counters, synchronous and asynchronous Basic concept and Design using excitation table of flip flops e.g. binary, BCD.

## **Practical**

### **1. Study of dual channel CRO**

- 1.1 To Study the Front panel control of CRO,operation /application.
- 1.2 To study voltage measurement of AC/DC on CRO.
- 1.3 To study phase angle measurement on CRO.
- 1.4 To study component testing on CRO.

### **2. Diode (Ge, Si) characteristics and effect of temperature.**

- 2.1 Testing of (Ge, Si) using DM.
- 2.2 Diode (Ge, Si) forward/reverse characteristics
- 2.3 Diode clipping circuits, clamping circuits

### **3. Zener diode characteristics and effect of voltage**

- 3.1 Study of H.W.R./ F.W.R. with /without filter
- 3.2 Study of zener voltage regulator



4. **Bjt Operating Point And Load Lines, Effect of Temperature**
  - 4.1 I/P and O/P characteristics of C.B. configuration
  - 4.2 I/P and O/P characteristics of C.E. configuration
  - 4.3 To study the frequency response of single stage C.E. Amplifier
  - 4.4 To study the frequency response of single stage C.B. Amplifier
5. **To study the frequency response of two single stage R.C. coupled Amplifier**
  - 5.1 To study frequency response of C.E RC coupled Amplifier
  - 5.2 To study the coupling, bandwidth & frequency response.
  - 5.3 To study the different type of coupling, Direct & Transformer Coupling
6. **Operational Amplifier**
  - 6.1 Introduction to the Operational Amplifier ,
  - 6.2 construction and working of Operational Amplifier ,
  - 6.3 Schematic diagram of 741, symbol, Inverting and Non Inverting, Voltage amplifier, Linear and Non linear application of 741, Comparator using 741
  - 6.4 Summing amplifier and other popular op-amp
7. **Logic Gate**
  - 7.1 To study the Basic Logic gate & verifying its Truth table.
  - 7.2 Study of NAND/NOR as universal gates, Full adder using basic Gates & using NAND gates only,
  - 7.3 Design of combinational circuit
8. **Decoder, Multiplexer**
  - 8.1 Study of Decoder IC's,
  - 8.2 Study of Multiplexer IC's, study of 4 bit parallel adder, study of 4-bit comparator.
9. **Flip Flops**
  - 9.1 Study of Flip-flops.
  - 9.2 RS Flip flop, J-K Flip flop, D Flip flop.
  - 9.3 Master slave Flip flop
10. **Counter IC**
  - 10.1 Study of counter IC's, & its practical application.
  - 10.2 Study of synchronous counter, & its application
11. **Digital To Analog Converters**
  - 11.1 Study of D to A conversion.
  - 11.2 Study of A to D conversion
12. **IC Fabrications, Pcb Designing**
  - 12.1 Monolithic IC fabrication techniques
  - 12.2 Designing of Single ended Printed circuit Board.
  - 12.3 Designing of Double ended Printed circuit Board., glass epoxy.

#### **Reference Books**

- 1 Integrated electronics Millman And Halkias
- 2 Electronics devices and circuits Millman And Halkias
- 3 Microelectronics Jacop Millman
- 4 Electronics devices and circuits theory Robert Boylestad
- 5 Electronics devices and circuits theory Allen Mottershead
- 6 Basic electronics and linear circuits Bharagava
- 7 Electronic Measurement & Instrumentation B. Oliver & Cage.
- 8 Electronic instrumentation and Measurement Techniques W.D.Cooper
- 9 Digital Principles & Application Milavino & Leach
- 10 Digital Integrated Electronics Taub & Schilling

**Subject Code: 30140020**

**Subject Name : Mechatronics**

Theory	Practical
<p>History of Institute – necessary information, guidance to the new corner to get familiarize with the working institute, rules, procedures etc. Recreational, Medical &amp; other facilities available in the institute. Importance of safety, accidents &amp; Causes of Accidents . General Safety Precautions &amp; personal safety to be observed while working in the institute /sections. Safe working habits, importance of good house keeping, cleanliness &amp; orderliness &amp; personal hygiene. Importance of the Trade in the industrial economy of the country. What is related instructions- subjects to be taught, achievement to be made etc.</p>	<p>Familiarization with institute &amp; work place. Importance of the Trade Training, Types of the work done by the Trainee &amp; role of “MEAHCNIE ADVANCED MACHINE TOOL MAINTENANCE” in an industry. Rules &amp; regulations of the institute. Allocation of workplace. Issue of tool box &amp; essential tools. Importance of Cleanliness &amp; orderliness at the workplace.</p> <p>General Safety Rules. Introduction to First Aid practices- Method of Maintaining First Aid Box. Fire Fighting equipment &amp; their uses. (Shop talk &amp; demonstration). Familiarization with various hand tools used in the trade. Introduction to bench vice, its construction, operation, maintenance &amp; Lubrication.</p>
<p>Introduction to measuring &amp; checking instruments. Non-precision linear measurement by using steel rule, depth rule, hook rule &amp; zigzag rule, bit rule, tape etc. Measurement by using firm joint caliper, spring joint caliper, adjustable bevel protractor &amp; combination set etc. Measurement with precision instrument : Vernier calipers- principle &amp; construction, reading a vernier caliper, care &amp; maintenance etc. Vernier Bevel Protractor.</p>	<p>Preparation for filing. Gripping the job suitably in the Vice jaws for filing.</p> <p>Taking correct standing posture with respect to bench vice for filing. Balancing of File. Filing To the marked lines using rough file. Use of simple measuring instruments such as Steel Rule, Vernier caliper, inside/outside Micrometer. Care and precautions to be observed in handling these instruments. Measurement by using inside/outside calipers and scales. Exercises on measurement of various geometrical shapes. Exercise on making lines on the work piece according to simple blue prints, using marking tools such as steel rule, scribe, marking blocks &amp; driver. Scribing lines on chalked or coloured (blue) surfaces of the work piece supported properly against the angle plate on marking off table to an accuracy of + or-0.5 mm. Marking location of the centers of circle by drawing horizontal &amp; vertical line &amp; then scribing circles using dividers. Use of Dot &amp; Centre punch for punching the lines, centers &amp; circles. Layout the dimensional features of the work piece using vernier height gauge, engineering Square, angle plate &amp; surface plate.</p>

<p>Work bench, bench vice-constructural details, different types of vices, their uses, care and maintenance of vices.</p> <p>Files:- File parts &amp; material classification of files based on grade, cut, shape, length etc. Printing of file, Convexity of file- reasons, reconditioning of files, file care &amp; its uses. Methods for steady &amp; accurate filing-no. of strokes per minute, right method of fixing file handle, care &amp; maintenance of files.</p>	<p>Balancing of file using rough file to be continued on channel. Filing flanges of a channel for practicing of filing. Filing flat surface &amp; flanges of a channel maintaining parallelism between them using outside calipers within + or –0.5mm</p>
<p>Introduction to layout marking, making media &amp; marking tools-construction, use, care and maintenance. Procedure of marking. Types of marking operations. Equipment and instruments :- Construction, use, care &amp; maintenance of surface plate, marking table, scribe, dividers, surface gauges, angular plate, marking block, V block &amp; clamp. Hermaphrodite caliper. Engineering square, parallel block, “C” clamp, tool makers clamp, combination set, bevel square etc. Introduction to punches, material, uses and care of various types of punches such as center punch, dot punch etc. Letter &amp; number punch set. Pin &amp; Hollow punches. Hammer parts, types, specification &amp; uses of hammers. Fitting the handle to the hammer head , precautions/care &amp; maintenance.</p> <p>Types of hacksaw frames special frames. Different parts. Types of Hacksaw blades material, specification &amp; uses. Reasons for breaking of Hacksaw blades. Care &amp; maintenance, points to be observed while hack sawing to avoid breakage blades. Safety to be observed while hacks awing.</p>	<p>Exercise on filing the adjoining outside faces of flanges of channel square to flat surface of channel as reference surface.</p> <p>Filing faces of channel for maintaining</p> <p>a. Flatness &amp; square ness of adjacent faces using tri-square b. Parallelism between opposite sides. Filing with second cut file to prepare smooth surface.</p> <p>Exercises for filing practice to develop control on hand and feel for maintaining dimensions within + or- 0.1 mm using Vernier Caliper. Filing with second cut files to prepare smooth surfaces.</p>
<p>Types of Chisels-material, specification &amp; application. Hot Chisels &amp; Cold Chisels. Different cutting angles &amp; their mportance. Method of Chipping &amp; safety precautions to be observed while Chipping. Use of proper Hammer. Grinding-Sharpening of Chisel on bench grinding machine.</p>	<p>Marking of profiles-combination of straight lines, circles, arcs &amp; angles. Use of scale, divider, vernier height gauge, protractor, combination set etc. for marking profiles. Marking on the job piece for saw cuts. Gripping the job suitably in the vice jaws for hack sawing to dimension. Hack sawing various metallic pieces (Mild Steel, Aluminium, Copper, Brass, Stainless Steel etc.) of different thickness and cross sections (round, square, angles, flats etc.) using hacksaw blades of different TPI's within dimensional accuracy of + or – 0.5 mm.</p>

	<p>Hack sawing different lengths with hacksaw frame in horizontal &amp; vertical positions. Sawing along the parallel marked lines within 0.5 mm allowance for filing. Hack sawing steps and slots. Finishing hack saw cut pieces by filing for step &amp; slot fitting. Cutting of sheet metal with chisel.</p>
<p>Types of Drills –nm Flat &amp; Twist Drills, straight fluted &amp; special types of drills, parallel &amp; taper shank drills construction /material &amp; use. Nomenclature of flat &amp; twist Drill- specification of Drill, Drill angles &amp; their importance, advantages &amp; disadvantages of flat &amp; Twist Drills. Drill Grinding- sharpening of Drills, Web thinning – checking and round drill, common faults- mistakes &amp; their ill-effects. Cutting speed &amp; feed- setting/selection for various operations. Counter boring, spot facing &amp; counter sinking operations of Drilling machine. Cutting fields (Coolants) used in drilling.</p>	<p>Hammering practice on vertically held round job. Blind hammering practice .Stamping Letters &amp; Numbers on M.S. plates. Exercise on stamping to develop judgement, control on hand &amp; feel. Stamping practice on flat &amp; round surfaces. Use of cross Peen Hammer for stretching of metal strip. Use of flat, cross cut &amp; Round Nose chisels for chipping of edges &amp; cutting grooves. Using cross cut chisel for cutting key way on round bar.</p>
<p>Introduction to drilling machine – Portable &amp; Hand Drilling Machine. Bench and Pillar-Upright type drilling machine. Study of drill holding devices. Drill chuck, chuck key, drill drift, sockets &amp; sleeves-construction, material &amp; use. Method of drives, sizes, capacity &amp; specification of a drilling machine. Special features, care &amp; maintenance of drilling machine. Safety precautions to be observed while working on a drilling machine. Speed changing system, use of simple gear boxes, feed for drilling. Standard speed &amp; feed for various material, various methods for job holding on drilling machine table. Drilling defects &amp; their causes.</p>	<p>Introduction to Drills. Preparations for drilling. Marking out the position of holes &amp; Dot punching. Deepening the points with center punch. Checking for center distance. Drilling practice on sensitive drilling machine using different types of drills &amp; drill holding devices. Safety to be observed while working on drilling machine. Marking, Chain drilling &amp; filing to produce square, round &amp; triangular openings on 6 mm thick plate. Preparing inserts by hack sawing &amp; filing. Fitting inserts in the respective openings exercise on step &amp; angular fitting.</p>
<p>Introduction to reamers, types of reamers, pitch of flute, precautions to be observed while reaming. Allowances for reaming, coolant used while reaming. Floating holders for reamers. Construction &amp; use of Hand Reamers, expansion reamers, adjustable reamers, taper reamers, rose reamers, chucking reamers etc. Elements &amp; forms of screw threads. Single and multi-start threads, right &amp; left hand threads. Hand and machine taps, sizes, tapping on different types of materials, Lubricants for tapping- tapping blind holes. Reasons for breakage of taps &amp; removal of broken taps. Tap Wrenches, construction, standard dimensions.</p>	<p>Drilling practice on varying thickness &amp; different materials such as Mild Steel, cast Iron, Stainless Steel, Copper, Brass, Nylon, Epoxy etc. Epoxy etc. Drilling on sheet metal. Precautions &amp; safety to be observed. Counter sinking, counter boring &amp; spot facing operations using bench drilling machine. Exercises on Reaming with hand reamers &amp; machine reamers. Internal threading by hand using Tap Sets. External threading by split die &amp; finishing of thread by Die nut. Marking centers on two and end faces of a round bar with the help of “V” block &amp; clamp.</p>

<p>Determination of sizes of drill for tapping standard holes. Cutting internal threads, tapping blind holes. Types of dies, solid and split dies, die stocks &amp; handles. Methods of thread cutting with die &amp; die stock. Setting the threading die. Use of lubricants. Use of hand chasers &amp; machine chasers.</p>	<p>Drilling &amp; Reaming of blind holes along the axis of round jobs. Grinding of drills &amp; chisels to specifications &amp; checking of angles with gauges.</p>
<p>Elements of interchangeable system. Definition of Limit, Tolerance &amp; Allowance. Basic dimensions or sizes. How Limit &amp; Tolerance is denoted ? Application of tolerance. Tolerance of Form &amp; Position. Use of symbols. System of Tolerance &amp; Limits, ISI System. BIS System Terminologies used in practice and their definitions such as size, nominal size, basic size, actual size, limit of size, deviations (upper , lower, fundamental), zero line, tolerances, tolerance zone etc. Examples of fixing limits for various types of Fits commonly met with machine in relation with clearance &amp; interference Component assembly such as, Free Fit Med. Fit Snug fit, Wringing fit, Tight fit, Medium force fit, Shrinkage fit etc. Interchangeability &amp; standardization, method of selective assembly, hole &amp; shaft basis of system. Micrometer- inside &amp; outside – constructional features, Principle operation, graduations, reading – use, care &amp; maintenance Purpose, types, construction, function and method to use comparators.</p>	<p>Exercise on filing – Radius &amp; Angular filing using templates &amp; gauges. Filing Templates &amp; gauges for checking. Lathe tool angles. Filing to an accuracy of + or – 0.1 mm., checking with Vernier Caliper. Preparation of plates for gauge fitting. Filing of various angles &amp; clearances of lathe tools on square blanks. Checking with templates &amp; Gauges already prepared. Measurement of shaft &amp; hole diameters using outside &amp; inside micrometer. Filing round on square bar within + or – 0.1 mm.</p>
<p>Types of spanners-their material &amp; uses-Box, Socket, Tubular, hook spanner etc. Wrenches – material &amp; use of T Socket, Monkey, Ratchet, Pipe wrenches etc. Types of screw drivers- materials &amp; uses. Types of Pliers- Material &amp; uses, combination pliers, Long nose pliers, flat nose pliers circlip pliers etc. Fasteners &amp; classification of fasteners. Permanent; Semi-permanent and temporary fastening devices, locking devices. Thread fasteners. Nut: Types of nuts- hexagonal nut, square nut, lock nut, check nut, castle nut, flanged nut, cap nut dome nut, slotted nut, serrated nut etc. and their functions. Bolts: Types –hex head, square head, round head, cheese head bolts, eye bolt, stud bolt. Screws: Set screw, machine screw, Philip head screw, sheet metal screw, wood screw etc. and their functions.</p>	<p>Use of Combination &amp; Round Nose Pliers to make different shapes/profiles by bending wire to match the blue print to develop manipulative skills, hand control &amp; eye judgment Using hand tools such as screw driver, single end/double end spanners, single end/double end ring spanners, box nut spanners, ratchet spanners, circlip pliers, wrenches, pullers, extractors, drift. Correct method to be used &amp; care to be taken in using these tools. Cold riveting. Marking out location &amp; drilling of holes for riveting. Use of dolly &amp; snap for forming rivet heads. Lap &amp; Butt Joint by cold riveting.</p>

<p>Washers: locking plates, spring washers, fiber washer, tab washer, rivets, studs, pins, keys etc. Merits &amp; demerits with examples, advantages and disadvantages of using each one- where generally used and why? Keys &amp; cotters – Classification &amp; comparison of keys &amp; cotters. Rivet and riveting – the object of riveting, the relation between the sizes of rivets and thickness of the sheets. Pitch of rivets. Rivet types, uses, method of riveting using snap and dolly. Riveted joints – likely mistakes while riveting and remedies</p>	
<p>Scraping- importance of scraping- advantages – different methods of scraping- scraping procedure for producing flat surfaces. Checking of scraped surfaces- use of spirit level. Tools required for scraping. Scrapers- different types &amp; their correct use/application- use of surface plate, straight edge, angle plate, master cylinder in the process of scraping.</p>	<p>Project work: making parallel clamp “C” clamp or micro meter stand by using acquired skills.</p>
<p>Properties &amp; uses of Ferrous and Non-ferrous metals and their alloys such as Cast Iron, Wrought Iron, Mild Steel, Carbon Steel, Tool Steel, High speed steel. Aluminium, Copper, Tin, Lead, Zinc, brass, Bronze, White metal, Rubber and Plastic. Methods of producing Cast Iron Steel. Study of physical, chemical and mechanical properties of materials and testing of materials. Plastic deformation of materials – Cold &amp; Hot Bending- Bending- Bending of Strips. Change in mechanical properties of material in Hot &amp; Cold Bending. Meaning of tenacity, elasticity, malleability, ductility, toughness etc. With special reference to practical application – use of various engineering materials.</p>	<p>Scraping on flat surface. Taking impression for high spots using Persian blue. Sharpening of scrapers using diamond wheel &amp; lapping stone.</p>
-do-	<p>Scraping on flat surface. Taking impression for high spots using Persian blue. Sharpening of scrapers using diamond wheel &amp; lapping stone.</p>
-do-	<p>Application and use of dial indicators, slip gauges and height gauge/height master. Application of various measuring instruments to measure of a component.</p>

<p>Familiarization with plastic deformation of material , Cold &amp; Hot bending of strips. Commonly used pipes-sizes, material and specification . Use of pipe for Hydraulics/ Pneumatics &amp; Lubricating system (Ferrous and non-ferrous) Bending of solid sections by using bending fixtures, bending dies etc. Cold and hot bending of pipes of different diameters of ferrous metal i.e. hydraulic pipes &amp; Non-ferrous metal i.e. copper tubes for lubrication system. Pipe bending with or without filing in fine sand. Use of pipe bending fixture to maintain uniform bending radius. Precaution to avoid wrinkles. Pipe cutting using pipe cutter. Pipe threading &amp; piping using various pipe fitting such as “T” fitting, elbow fitting, reducers etc. Punching of holes on leather with hollow punches. Preparation of gaskets &amp; other packing materials.</p> <p>Standard pipe threads, cutting of pipe threads using Dies &amp; taps. Care and precautions to be observed while using pipe vice, pipe wrenches, dies and taps.</p> <p>Standard pipe fittings- Methods of fitting &amp; replacing the fittings. Methods of rectifying leaks all the joints. House Hold piping- standard pipe fittings. Fullering practice &amp; ferrule fitting.</p>	<p>Application of Advanced Bench Working Skills Practice on exercises involving making of simple machine parts which have certain functional relationship to other parts such as cam motion driving mechanism, dovetail by assembling parts using bolts, dowel pins, locking devices etc. Precision fitting jobs involving sliding, scraping &amp; alignment.</p>
<p>Micro-meters- special types- important features &amp; applications. e.g. Thread checking micrometer, flange Micrometer, Depth Micrometer etc. Sine bar, slip gauges- its principle of working &amp; applications. Purpose and method to use similar &amp; slip gauges and rollers.</p>	<p>Filing flats on cylindrical parts. Filing square at the end &amp; in the middle of cylindrical rod within + or -0.04 mm.</p> <p>Introduction to lapping process. Laps &amp; lapping pastes, procedure for charging lap. Use of kerosene in lapping. Lapping on flat &amp; cylindrical (internal and external) surfaces.</p>
<p>Types of gauges- Plug , Ring, Snap, Taper, feeler, screw Pitch, Radius &amp; sheet metal gauges. Dial indicators- construction &amp; use. Various types. Comparators – Electrical, Optical pneumatic construction &amp; working principles. Definition of surface finish. Terms used to describe the surface finish. Dimensional Tolerance of surface finish according to ISI. Surface quality &amp; its symbolic representation. Equipment used for testing/measuring surface quality. Units of surface finish. Surface finishing processes, lapping, honing, electroplating, metal spraying, galvanizing, pickling and Metallisation.</p>	<p>Bending of solid sections by using bending fixtures, bending dies etc.</p> <p>Cold &amp; Hot bending of pipes of different diameters of ferrous metal i.e. hydraulic pipes &amp; non-ferrous metals i.e. copper tubes for lubrication system. Pipe bending with or without filling in fine sand. Use of pipe bending fixture to maintain uniform bending radius. Precautions to avoid wrinkles. Pipe threading &amp; piping using various pipe fitting such as “T” fitting. Elbow fitting, reducers etc. Punching of holes on leather with hollow punches. Preparation of gaskets &amp; other packing materials. Fullering practice &amp; ferrule fitting.</p>

<p>Definition of lapping &amp; its necessity.</p> <p>Constructional features of lapping. Design of laps-Cast Iron, Copper, Lead, Mild steel etc.</p> <p>Abrasive material and the form in which it is applied. Popular names of abrasive used. Simple examples, practical situations of lapping. Lapping methods &amp; their applications. Testing of surface quality after lapping. The objective of honing- Honing-description of honing and its necessity – Honing methods and their use. Simple examples, situation where honing is used. Rotary &amp; Longitudinal motion in honing Cylindrical object. The effect of Honing on the efficiency of running components. Honing tools-shape of abrasive- Grades. Honing allowance</p>	<p>Using hand tools such as screw driver, single end/double end spanners, single end/double end ring spanners, ratchet spanners, circlip pliers, wrenches, pullers, extractors, drift. Correct method to be used &amp; care to be taken in using these tools.</p> <p>Marking out key ways of various shapes. Using cross cut chisel for cutting corners. Checking depth with depth gauge &amp; fitting key ways. Making different types of keys &amp; key ways on pulleys, gears etc. by hand.</p>
<p>Specification and use of different types of ropes such as hemp, manila, nylon, wire etc.</p> <p>Practicing different types of knots and its applications. Method of joining two ropes together foreextension. Detection of unsafe/ defective conditions of ropes and knots.</p> <p>Specification and correct use of slings. Safety to be observed in the use of ropes and slings.</p>	<p>Familiarization and use of different types of ropes such as hemp, manila, nylon, wire etc</p> <p>Familiarization and use of different types of ropes such as hemp, manila, nylon, wire etc.</p>
<p>Different types of appliances and tackles for shifting, loading and unloading of machine and equipment. Screw jacks- their use and working principles. Chain pulley blocks- their use and working principles.</p> <p>Crane and Hoist for lifting purpose – working principles &amp; main constructional features.</p> <p>Working principles &amp; use of other tackles like Crabs, winches, slings, rollers and bars, levers, lashings and packing.</p> <p>Mechanical advantage and velocity ratio. Use of inclined planes. Special precautions in handling heavy equipment, removal and replacement of heavy parts. Safety in transportation.</p>	<p>Familiarization and use of different types of ropes such as hemp, manila, nylon, wire etc.</p>
<p>-do-</p>	<p>Use of hoists and cranes for lifting purpose. Constructional features and working principles. Methods lifting jobs of various shapes, sizes and weights. Use of appropriate length of chains. Inspection of chain links.</p>



Revision & Test	
<p>Metal cutting and cutting tools. Introduction to metal cutting. Mechanism of metal cutting-orthogonal and oblique cutting, chip formation, types of chips and chip breakers. Cutting tool geometry and nomenclature, control of angles, tool life. Cutting speed and feed and its calculation. Properties and uses- cooling system types – soluble oils-soaps, paraffin, soda water etc. biodegradable oil. Effective of cutting fluids in metal cutting.</p>	<p>Constructional features and working principles of Lathe machine. Functional relationship of various parts of the machine. Study of the gear box and drives used on the machine. Study the methods of holding work piece and tool using different devices. Exercises on plain, stepped, taper and form turning, knurling etc. Exercises on drilling, reaming, boring counter boring etc. Screw thread cutting both external and internal of different types. Exercises on eccentric turning. Grinding of Lathe tools. Care and maintenance of machines. Safety precautions to be observed while handling machines. Study of lubrication system and preventive maintenance. Simple projects such as hollow punch, pulleys, gear blanks, simple couplings etc.</p>
<p>Constructional features, types, functions and use of Lathe machine. Study of Lathe accessories – face plate, chucks, steadies their use. Driving mechanism – Gear box mechanism gearing, common lathe tools-their names, materials and use, cutting tool angles, grinding of lathe tools. Common lathe operations- chucking, centering, plain turning, facing and boring, taper calculations –screw cutting. Cutting speed and feed, use of coolants. Care and maintenance- preventive maintenance.</p>	<p>-do-</p>
<p>Constructional features, function and use of shaping machine, working principle, use of Quick Return Mechanism. Setting of length and position of stroke. Holding of work piece &amp; tools. Various cutting tools and tool angles for carrying out shaping operations. Speeds and Feeds. Use of coolant for different materials. Detection of common faults &amp; their rectification.</p>	<p>Constructional features and working principles of shaping machine. Functional relationship of various parts of the machine. Study of Quick Return mechanism. Different work and tool holding devices. Flat and angular shaping. Groove cutting on shaping.</p>
<p>Constructional features and working principles, types, functions, use of milling machines, attachment and accessories. Different methods of holding work piece and cutters. Common milling operations such as plain, step, angular milling, slot and groove cutting, use of dividing head for indexing-types. Various types of gears and elements gears. Gear cutting and Cam cutting. Various speed and feed. Use of coolant for different materials.</p>	<p>Constructional features and working principles of Milling Machine. Functional relationship of various parts of the machines. Study of gear box and drive used on the machine. Study of different work and tool holding devices. Exercises on parallel and angular milling. Exercises on grooving using end mills. Cutting of gears-spur and helical using simple indexing. Use of slotting attachment for cutting keyways.</p>

<p>Detection of common faults-detects and their rectification. Safety precautions. Care and maintenance-preventive maintenance of milling machines.</p>	<p>Care and maintenance of machine. Safety precautions in handling machine. Study of lubrication system and preventive maintenance.</p> <p>Simple project such as jaw, claw, Oldham coupling, spline cutting etc.</p>
<p>Constructional features, types, functions and use of grinding machines. Grinding wheels and their specifications-grit, grain size, structure, bond, grades etc. Use of grinding wheels, balancing and truing.</p> <p>Dressing of grinding wheels, holding of work piece. Various grinding operations-external, internal, surface grinding.</p> <p>Common defects-faults their detection and rectification. Use of coolants for grinding different materials. Safety precautions to be observed in grinding operations. Care and maintenance-preventive maintenance of grinding machines.</p>	<p>Constructional features and working principles of surface and cylindrical grinding machines. Functional relationship of various parts of the machine.</p> <p>Study of drive-both mechanical and hydraulic. Study of different work holding devices. Grinding wheel specifications. Mounting, balancing, turning and dressing of grinding wheels. Exercises on surface grinding-parallel and angular, step and groove grinding. Exercises on external and internal cylindrical grinding-both plain and taper. Study of hydraulic systems used on the machine. Care and maintenance of machine. Safety precautions to be observed while using machine. Study of lubricating system and preventive maintenance.</p>
<p>Commonly used sheet metals-rolled sheets such as tin, galvanized iron, copper, brass, aluminium sheets-their physical properties and uses.</p> <p>Common tools used for sheet metal-Tina man, mallets, stakes, swages, shears, snips, stripes, scribes, trammels, dividers etc. Simple developments and method of laying out. Types of joints-folded joint, grooved and beads etc.</p> <p>Soldering, sweating, brazing and tinning materials and method employed.</p> <p>Soft and hard solder-their composition, properties and use. Types of joints-folded joint, grooved and beads etc.</p>	<p>Practice in drawing simple geometric shapes on sheet metal using marking tools.</p> <p>Practice in cutting sheet metal in these shapes and cutting sheets to various angles using hand shear, snip and chisel.</p> <p>Bending sheet metal to 900 using wooden mallet, clamp etc. on a bench vice.</p> <p>Practice on lap joint, lock grooved joints and hammering. Cutting practice with different snips, cutting of notches, inside and outside curves. Sheet metal cutting on shearing machine. Safety in operations.</p> <p>Forming rectangular, round and conical shapes using stakes. Removal of dents and simple hollowing practice. Use of hard and soft solder. Soldering practice on ferrous and non-ferrous metals. Practice in riveting sheet metals of various thicknesses. Exercise using pop rivets. Simple development work. Practice in marking simple articles such as, machine guards, shovels and trays, funnels, taper bins etc.</p>

<p>Inspection, quality control, quality assurance, total quality management concepts and quality awareness. Zero defect, self inspection and applications.</p> <p>Statistical process control:-</p> <ol style="list-style-type: none"> <li>control charts</li> <li>chance causes and assignable causes</li> <li>plotting of control chart</li> <li>various type of trends.</li> </ol>	<p>Application and use of dial indicators, slip gauges, height master and various measuring instruments (such as inside caliper, dial bore gauges, three leg micrometer, dial micrometer and comparator) to measure internal and external features of the component.</p> <p>Measurement of co-ordinates, center distance, angle, centricity, eccentricity, dovetail slot etc. by using :-</p> <ol style="list-style-type: none"> <li>Lever type dial indicator and slip gauge.</li> <li>Liver type indicator and height master.</li> <li>Dial indicator and rollers and pins.</li> <li>Turning the job with the help of screw jacks(for casting, forging etc.)</li> </ol> <p>Practical exercise for thorough understanding of statistical processes control concept. Construction and use of various control charts. Detection of chance and assignable causes and study of various trends.</p>
<p>Gas and electric welding – tools and equipment.Principle of fusion welding. Types of joints and method of welding. Safety precaution and maintenance of equipment. Welding defects – causes and how to avoid them. Flame cutting – principle and use of equipment.</p>	<p>Working principles of Arc, gas and spot welding machines. Connecting and setting of machine for operation. Safety to be observed in welding work. Practice in simple arc welding using materials of different thickness. Horizontal and vertical position welding. Practice on butt and lap joints. Practice in brazing of ferrous and non-ferrous metals, silver brazing, braze welding(dissimilar metals).</p> <p>Study of welding defects (arc and gas) and precaution to avoid them. Practice in metal deposition for joining of cranks, repairing of worm out parts, key ways, keys, broken gears, teeth, filling and padding on shafts. Practice in flame cutting. Care and maintenance of welding equipment.</p>
<p>Modern theory of atomic structure in general – nucleus, orbits and free electron, orbital electron, valance electron – free electron. Classification of materials as conductors and insulators, semiconductors and resistors. Concept of electromotive force, voltage current and resistance. Electrical safety rules and precautions. Ohm’s Law and Kirchoffs voltage and current law. Types of circuits – series, parallel and series – parallel. Electrical work, power and energy – definitions and units of measurement and</p>	<p>Safety precautions applicable to electrical trade. Grinding of wire as per ISI and cables, colour coding used on them. Removal of insulation of wires/cables and soldering free ends of copper strands. Joining of flexible cables by soldering staggered joints in case of twin wires or multicore cables. Familiarization with different types of plugs, sockets, switches, fuses and fuse holders, cut outs etc. with their specifications and applications.</p>

<p>their inter relationship. Primary sources of electromotive force/electrical energy. Primary and Secondary cells. Introduction to electrical supply system with special reference to AC. Different voltages in use AC and DC. Types main switches, circuits breaks, fuses etc. effects of electric current in general.</p>	<p>Testing of switches, buttons, limit switches, micro switches by using continuity tester for their operation. Identification of live, neutral and earthing wires before connecting cable to plugs, sockets, switches, cut outs etc. Use of test lamp and multi-meter for identifying single phase/three phase power supply. Use of multi-meter for voltage, current and resistance measurement. Checking of DC supply. Use of voltmeter and ammeter for voltage and current measurement respectively. Connecting portable single phase AC operated industrial equipment such as drilling machine and domestic applications such as washing machines, cooking range, geyser etc. Practice of series and parallel connection of loads and measurement of voltage drops across the loads and line current. Practice of logic development for control. Constructing logic gate circuits such as AND, OR, NOR etc. by using series and parallel combinations of switches to control the condition of load lamp(ON or OFF) – condition of out put lamp indicating out put conditions in truth table. Wiring of simple electrical circuits (to understand the concept of control) on test boards such as single point, series parallel, master, staircase, godown, control of lamps. Wiring and testing of fluorescent lamp fitting. Function of chock and starter in its operation. Care and maintenance of batteries – charging of batteries. Series and parallel connection of batteries.</p>
<p>Semi-conductor theory. Intrinsic and extrinsic semi-conductors. P and N type semiconductors and P-N junction – semiconductor diode – two layer and two terminal device. Use of PN junction as switch. Use of PN junction for rectification. Half wave, full wave and bridge rectifiers. P-N-P and N-P-N junction devices –transistor – three layer three terminal devices. Use of transistor of a switch and its simple applications. Use of transistor for amplification – how amplification takes place. Soldering technique as applied to PCB soldering DO's and Don'ts.</p>	<p>Scope of industrial electronics with reference to its applications in machine tool operation. Identification of basic components such as registers, capacitor, inductors etc. from their out look. Types, specifications and general applications of these components. Testing and measurement of their values using multi-meter. Use of resistance colour codes. Soldering and desoldering of component on and from printed circuit boards (P.C.B.). Precautions to be taken while soldering on PCB. Study of rectifiers circuits – half wave, full wave and bridge rectifiers.</p>

	Use of oscilloscope for checking of input and output wave forms. Study of solid state devices such as diodes, transistors, SCRs and Ics available in different packages. Types and applications. Identification of leads and testing by multi-meters. Assembly of simple battery eliminator circuit using bridge rectifier and filter capacitor. Measurement of input and output voltages.
Revision & Test	
Industrial hydraulics – principles, advantages, disadvantages and safety. Study of block diagram of hydraulic system in general. Construction features, principles of operation, function and uses of various hydraulic components such as pumps, valves, actuators and power pack. Hydraulics fluids – specifications, properties and applications. Study of hydraulic power pack and its control elements. Familiarization with various symbols used in hydraulic circuit diagram. Identification of components and their specifications. Hydraulic circuit reading and tracing practice. Circuit drawing practice using symbols. Constructing simple hydraulic circuit for linear /rotary/motions and testing for operation. Constructing simple hydraulic circuit for speed control both linear and rotational and testing for operation and troubleshooting.	Industrial hydraulics – principles, advantages, disadvantages and safety. Study of block diagram of hydraulic system in general. Construction features, principles of operation, function and uses of various hydraulic components such as pumps, valves, actuates and power pack. Hydraulics fluids – specifications, properties and applications. Study of hydraulic power pack and its control elements. Familiarization with various symbols used in hydraulic circuit diagram. Identification of components and their specifications. Hydraulic circuit reading and tracing practice. Circuit drawing practice using symbols. Constructing simple hydraulic circuit for linear /rotary/motions and testing for operation. Constructing simple hydraulic circuit for speed control both linear and rotational and testing for operation and troubleshooting.
Construction features, principles of operations and uses of pneumatic components such as valves and their actuators. Identification of components from their outlook and their specifications. Pneumatic circuit reading (from manuals) and circuit tracing practice. Circuit drawing practice using symbols for simple application. Constructing simple pneumatics circuits for linear reciprocating and rotary motion. Testing for operation and troubleshooting.	Construction features, principles of operations and uses of pneumatic components such as valves and their actuators. Identification of components from their outlook and their specifications. Pneumatic circuit reading (from manuals) and circuit tracing practice. Circuit drawing practice using symbols for simple application. Constructing simple pneumatics circuits for linear reciprocating and rotary motion. Testing for operation and troubleshooting.

<p>Methods employed for installation and erection of precision and heavy duty machines. Location and excavation of foundation. Different types of foundations – structural, reinforced, wooden, isolated foundations. Foundation for heavy machines such as presses /hammers etc. Foundation for precision machines – special precautions necessary for erecting precision machines. Importance of isolated foundation. Special process involving in erection of heavy duty machines. Layout of machines – consideration of power, space, weight, ventilation and moving parts etc. Types of vibrators, causes and prevention of vibrations. Methods of insulation of machines of machines against vibration. Anti-vibration devices and their locations. Different types of instruments used for checking the vibrations. Leveling machines, importance of leveling. Methods of grouting. Use of machine leveling screws. Methods of leveling, precautions to be taken while leveling, leveling accuracy – its measurement. Special precautions necessary for precision machines. Use of spirit level, its construction and use. Use of camel back, straight edges and slip gauges for leveling.</p>	<p>Introduction to leveling of machines. Practice on leveling – use of spirit level, camel back, straight edge, bridge, parallel blocks etc. Leveling of surface plates, marking table, milling machine, grinding machine etc. – precaution of test report indicating degree of flatness. Use of leveling bolts, taper wedges for leveling of horizontal and vertical surfaces. Introduction to machine alignment. Checking lathe, milling, grinding machines for alignment and preparing test reports comparing with standard test charts.</p>
<p>Machine alignment – different types- procedure. Equipment for aligning machine-use of test mandrel, master cylinder, straight edge, centricities, slip gauges, dial indicators etc. Precautions to be observed in the use of equipment while aligning. Special precautions necessary for erection, leveling and aligning precision machines. Testing for correct functioning of machine parts, machine commissioning.</p>	<p>Study for various spindle drive mechanism used on bench grinder, drilling, milling, lathe and grinding machines. Checking for spindle run-out – axial and radial play. Setting of play as per standard chart. Checking of bearings for its performance – repairs and replacement as needed. Study of shafts, axels, couplings and clutches used on various machines. Locating and identifying these elements on various machines. Dismantling clutch mechanisms. Study of standard machine elements. Cleaning and inspection of parts for any damages/wear out etc. and carrying repairs of replacement. Assembly and oiling of clutches and fitting back to its location. Testing for operation. Preparation of reports.</p>

<p>Prime movers. Types of drives-Rope &amp; Chain. Variable speed transmission PIV drives and Harmonic drives. Friction drives. Clutches positives clutches, friction clutches. Mechanical, Hydraulic and Pneumatic drives-basic principles and uses. Individual drive and group drive. Care and Maintenance of different types of drives and their applications. Study of individual drive system, reciprocating, reverse, eccentric, cams, cranks drives. Rotary to linear drives and viceversa.</p> <p>Power transmission elements. Shafting shaft, types of shafts-rigid and flexible and hollow.</p>	<p>Study of Belt Pulley, Chain, Gear, Rack &amp; Pinion etc. used on different machines. Introduction to various gear transmission mechanisms. Removing gear box from various machines and opening for inspection and study of gear trains and their functional relationship. Dismantling of gear box completely. Study of various machine elements from the gear box. Cleaning and checking/inspection of parts for damage /repairs. Assembly of gear box and fitting back to the machine. Testing and preparation of report.</p>
<p>Types of pulleys solid, split, “V” groove, step, cone, taper, guided and jockey or rider pulleys etc. their functions and uses. Specifications and selection of pulleys for specific applications. Necessary calculations for deciding to size diameter, width, weight etc. consideration of drive to driven ratio. Crowning of pulleys. Fast and loose pulleys.</p>	<p>-do--</p>
<p>The object of belts types /sizes/ specifications and uses. Materials used for belts-leather, cotton, canvas, Indian rubber (Batala). Selection of the type of the belt with the consideration of load and tension. Leather belts-methods of joining the Ends /bolting leather belt and their specific advantages. Belt Fasteners-different types, advantages &amp; disadvantages of each other.</p>	<p>Inspection of machine guide ways and slides. Checking for straightness, flatness, scoring/scuffing marks and condition of oil grooves and wear. Adjustment of Gibs, wedges for setting the gap. Use of Feeler gauges and dial indicator. Study of feed Mechanism- Removing, dismantling, cleaning and oiling of its machine elements assembly and fitting back to its position. Testing for its operation. Mechanism to be studied- -Lathe machine-carriage, apron, feed box, head stock etc. -Milling machine Feed box( column, knee, saddle,) rapid traverse gear box, intermediate gear box etc.</p>
<p>Types of belt drives, velocity ratio of belt drive. Horse Power transmitted by belt. Ratio &amp; driving tension in a belt. Parallel &amp; cross belt drive, open &amp; cross belt drive, angular belt drive. Geometrical explanation of the belt drives at an angle. Belt speed used for commercial belts. Calculation for the size of the new belt. Slipping of the belts-causes &amp; remedies. Use of guide pulleys, crowing, use of dressing and resin power to avoid creep and slipping. Use of chains, wire rope for power transmission. Methods of fixing and uses. Types brief description. Types rigid</p>	<p>Familiarization with plain/journal bearings, anti-friction bearings used on machine assembly. Specification &amp; selection for appropriate use. Use of manufacturers catalogues. Mounting of bearing on shafts and in housing with proper fit &amp; axis alignment. Use of proper tools. Removal of bearings from shafts &amp; housing by using pullers. Cleaning up &amp; removing old metal form bearing and replacing with new metal. Scrap &amp; fit bearings to a shaft. Fitting shaft to main line bearings. Cut oil grooves in</p>

<p>coupling-Flange coupling. Hook's coupling, Universal coupling, Flexible couplings their different uses. Friction and Universal coupling advantages and disadvantages over each other &amp; their applications. Types and uses, their function and application. Pre-requisites of a key prevention of circular /longitudinal motion of machine parts. Types of key and key ways, their uses and applications. Preparation of keys, allowable tolerance, clearances. Key fitting procedure-methods. Procedure for removing keys. Types &amp; uses of key pullers. Use of keys in power transmission.</p>	<p>bearings. Checking of shafts for alignment with dial indicator, practice in scraping flat bearing surfaces.</p>
<p>Types-materials and uses of gears. Various manufacturing processes. Study of spur gear elements-tooth profile-pitch circle-diametric pitch velocity ratio of a spur gear. Helical, Herring bone, Bevel, Spiral Bevel, Hypoid Gears. Rack and Pinion-Worm and Worm Wheel gearing, velocity ratio of Worm gearing. Repairs to gear teeth by binding up and dovetail insert method. Method of fixing geared wheels for various purpose drives. General causes of the wear &amp; tear of the toothed wheels &amp; their remedies. Methods of fitting spiral gears, helical gears, bevel gears, worm and worm wheels in relation to required drives. Care and maintenance of gears.</p>	<p>Study of Various machine tools such as Lathe, Milling Grinding &amp; shaping machine with special attention to transmission mechanism. Study of machine accessories, their function and operation. Study of lubrication systems and maintenance. Introduction to magnetic clamping devices such as magnetic chucks, lifting magnetworking principles, testing and safety aspects in handling/using such devices.</p>
<p>Method of reducing friction, Use of bearing advantages &amp; disadvantages. Bearings-different types of high speed &amp; low speed their application. Material for the bearings and their properties. Specification of bearings, dimensional relationship of the shaft with bearing-the type of loads. Method of clamping and fitting the bearing in the housing. Method of mounting and dismounting. Essentials of ordinary type Brass bearing-process of fitting. High speed and loaded bearings-use of ball and roller bearings- constructional features of ball &amp; roller bearings and housings. Method of Ball and Roller bearings on the shafts. Commercial specifications of Ball and Roller bearings. Antifriction bearings-their types and uses. Lubrication of bearing high speed bearing . care and Maintenance and inspection of bearings.</p>	<p>--do-</p>



--do--	Dismantling simple mechanisms such as machine vice, three jaw chucks, index head, tail stock, slotting attachment, coolant pumps, using various hand tools with specific reference elements. Cleaning of Oiling of dismantled parts, Assembly & Testing for operation.
Introduction to maintenance work. Importance of maintenance. Methods & tools of maintenance, basic concepts of routine & preventive maintenance. Importance of preventive maintenance. Inspection, diagnosing and repairing procedure. Scheduling and planning for preventive maintenance work. Maintenance of records, log cards etc. Function involved in preventive maintenance. Advantages of preventive maintenance. Frequency of preventive maintenance-preparing preventive maintenance schedule-points to be considered, lubrication survey system of symbols and colour coding.	-do--
Methods of repairing damaged parts. Major overhauling. Reconditioning of machines methods of reconditioning measuring instruments used in re conditioning special tools, test mandrels, spooling gauges, bridges used in re-conditioning testing of machine after repair. Preparation of test chart.	Dismantling of simple machines such as Bench grinder, Pedestal Grinder, Sensitive Drilling machines. Cleaning & Oiling of parts & assembly & Testing.
Methods of various set ups. Reclamation of worn out parts such as slides, gears, shafts, broken parts of cast iron etc. by metal deposition hard chrome plating etc. Conservation of wear, forms of wear. Introduction of special tools used in maintenance voltmeter, Tachometer, Spirit Level etc. Materials used for leak proof joints. Preparation of gaskets and their mounting procedures. Sealing and Packing elements. Detection of common faults & their rectification in general. Painting. Procedure to prepare surface, use of protective coating, brush & spray painting on metallic & wooden articles, precaution to be observed during brush & spray painting.	Use of painting/protective coating for rust prevention. Surface operation, use of primers and surfaces. Brush and spray painting painting metallic and wooden articles. Lacquering practice.
Planning for scheduled overhauling of machine. Methods of dismantling, precautions to be taken while dismantling. Sequence of operations by making on parts. Methods of cleaning of parts. Solvents and cleaning materials their names and specifications. Proper method of removal and fitting of bearings. Re-assembly of machines in	Familiarization with electrical symbols being used in electrical circuit diagrams. Practice in reading electrical circuit/ connection diagrams from the instructional manual. Circuit tracing practice. Identifying electrical hardware items from their outlook. Checking/testing of Relays, auxiliary

<p>correct sequence and testing for correct functioning. Machine vice, three jaw chuck, index head, tail stock slotting attachments and coolant pumps using various hand tools with specific reference to functional parts for machines such as bench grinder, pedestal grinder, sensitive drilling machine etc. Advanced electrical electro-magnetism. Concept of a coil (Electromagnetic) and Capacitors-principles of operations. Use of a coil in hydraulic and Pneumatic solenoids. Use of a capacitors to store energy. electromagnetic induction,. Motor effect and generator effect. Electrical motors construction and features, types of both AC and DC motors and applications. Measurements of electrical quantities –Use of voltmeter, Ammeter and Multimeter-principles of operation. Elements of electrical system control power and safety elements. Circuit breakers, fuses, contractor, relays, timers-principles of operation &amp; constructional details. Simple motor control, inching control, star delta control starter, push button switches, limit switches. Micro switch e s, pressure switches over load relays etc. Safety inter locks, Speed control of AC induction &amp; DC motors. Automatic operation-use of control circuits-logical development of control circuit diagram using contractors and relays. Concept of ladder diagram. Understanding of power and control circuit in general (with few examples). Inter related between them. Safety in handling and operating electrical equipments.</p>	<p>contractors, power contractors by connecting appropriate power supply. Checking of contact operation (opening and closing) of relays and contractors. Developing control circuit using ladder/schematic diagrams. Use of control elements to build and test manual, inching, hold on and start/stop push button control circuits. Circuit building practice. Wiring of power and control circuit on test board such as direct on line starter, automatic star-delta starter and forward/reverse control for 3 dia. Induction motors etc. Study and use of safety elements such as miniature circuit breaker (MCB), over load relay, earth leakage relay, protecting fuses in power circuit wiring and testing. Measurement of winding and body resistance of DC motors and induction motors by Multimeter. Connecting induction motor to panel and measurement of line current. Simulated fault finding on control panel Isolation of machines from electrical cabinet by removing back up fuses, switching off main switch. Replacement of brushes, setting of brushes. Locating over loaded motor and finding out its causes such as fuse blown, mechanical jamming, loose connections, faulty settings etc. Locating faults in power circuit such as power fuse blown, MCB tripped, control fuse blown etc. Checking of electrical motors by measuring winding resistance, balance of resistance, body resistance. Checking of electromagnetic clutches, brakes, chuck magnet etc..</p>
<p>Visit to related Industrial Establishments or Revision &amp; Test</p>	
<p>Introduction to logic gates e.g. AND, OR, INVERTER, NAND, NOR, EX-OR, etc. Their truth table analogy of logic gates, combination of series and parallel switches. Introduction to commonly used transducers in industries such as Timers of different types, counters, proximity switches (AC and DC), over current relays, DC motor controller, photo electric relays, temperature controller. Concept of programmable logic controllers-its fundamental blocks-input, output, memory, power supply, comparison of PLC with conventional terminal,</p>	<p>Introduction to logic gates and their truth tables. Building logic gates such as AND, OR, NOR, INVERTER, NAND, EX-OR using diodes and transistors out put lamps indicating conditions in truth table (Analogy of logic gates to series and parallel combination of switches). Study of commonly used Transducers-such as thermocouples, LDRS, thermistors, LVTs, strain gauges, magnetic pick up photo diodes, photo transistors etc. Familiarization with commonly used controls in our industry</p>

function of various on PDT.	such as Timer, Counter, proximity switches (DC and AC), over current relays, DC motor controllers, photo electric relays, temperature controls. Demonstration of each controlling unit. Introduction to programmable logic controller (PLC-only concept). Its fundamental block such as input, output, memory, power supply etc. Comparison of PLC with conventional machine control (Appreciation only). Programme development terminal (PDT). Functions of keys on PDT.
<p>Construction features, working principles and uses of pumps, positive and non positive displacement of pumps, gear pump, vane pump, piston pump, axial position and radial position pumps. Constructional features &amp; working principles of valves, types of valves directional control, pressure control, flow control. Direction control valves according to their spool position e.g. <math>\frac{3}{4}</math> Dc, <math>\frac{2}{3}</math> DC types of spool. Check valves, types of check valves-application-construction and use, pilot operated check valve. Servo valves, block diagram of servo valve, mechanical servo, electrical servo, single stage spool servo, flapper type servo and jet type servo. Pressure control valve constructional features and working principles of simple relief valve-compound relief valve-("R" type relief valve-"R" type unloading valve-"R" type sequence valves-other types). Flow control valves constructional features and working principles of flow control valves and their uses. Meter in circuit, meter out circuit, bleeding off circuits. Compensating features, pressure, temperature and flow. Actuators constructional features and principles of hydraulic actuators. Hydraulic motor-Rotary actuators, hydraulic cylinders-types and their applications in hydraulic circuits, specifications cylinder cushioning. Study of stackable (modular) type hydraulic control valves. Study of manifolds, accumulator, intensifier, rotary joints etc. Study of machine tools application of the hydraulic drives for rotary, reciprocating, speed changing, clamping, unclamping and feed motions. Pipes and pipe work-types and selection-specification, material, bending of pipes, pipe bending fixture and pipe bending methods. Standard fittings of</p>	<p>Circuit building practice-regenerative (sequencing) circuit with speed and pressure (clamping) control. Counter balance circuits with speed control. Traverse and feed circuits. Differential check valve, pressure regulator valve, pressure relief valve etc. Study of stackable (modular) type hydraulic control valves. Study of manifolds, accumulator, intensifier, rotary joints etc. Study of machine tool applications of the hydraulic drives for rotary, reciprocating, speed changing, clamping, unclamping and feed motions. Trouble shooting in hydraulic drive circuits for low pressure, noisy system, reduced speed of the table traverse, jerky traverse of machine table, jamming of piston rod at the end of the stroke, pressure increase in the system etc. Repairs and maintenance of the pumps-gear, vane and radial position. Repairs and maintenance of valves-pressure control, direction control and flow control. Adjustment of valves. Repairs and maintenance of actuators-single and double acting cylinders, hydraulic motors etc. Piping practice with metallic and hose pipes. Use of various types of pie joints and fittings. Precaution to be taken in storage and handling of oils. Study of pressure gauge, pressure selectors and filter units. Study of pressure, float, flow switches, suction strainer, return line &amp; pressure line filters, Study of air oil cooler, water oil cooler, filler breather unit and tank accessories. Setting of various hydraulic elements for proper functioning. Repairs of hydraulic presses and various hydraulically operated equipment,</p>

<p>pipes e.g. ferrules, procedure for connecting pipe fitting work, installation of pipe, pipe storage .</p> <p>Flexible hoses-types and their specifications, uses according to the pressure in the line, correct insulation of flexible hoses and its importance.</p> <p>Constructional details, specification and uses of tank/reservoir, heat exchanger, heater, fitter/strainer, pressure gauge, intensifier, accumulators. Study of different types of hydraulic and lubricant oils. Introduction to seals and packing –types , their functions. Storage of seals. Fitters and their specifications. Methods of fault finding-rectification and remedies.</p> <p>Installation commissioning. Air venting and cavitations. Regular care of hydraulics.</p>	<p>fault finding by simulation.</p>
<p>Friction –its effect, methods of reducing friction.</p> <p>Use of lubricants, use of bearings.</p> <p>Lubrication-need and use. How it is done.</p> <p>Qualities of a good lubricant-viscosity of the lubricant-main properties of lubricant.</p> <p>How a film of oil is formed in journal bearing.</p> <p>Methods of lubrication-by gravity feed, forced feed, splash lubrication</p> <p>Lubrication grooves and ring lubrication.</p> <p>Effect of a thick and thin lubricant. Lubrication of high and low speed drives.</p> <p>Common lubricating oil's and greases, their specifications and commercial names.</p> <p>Selection of lubricant.</p>	<p>-do-</p>
<p>Constructional details, specifications, application of power unit, actuating unit, control unit. Power unit-types of compressors-reservoirs, condensers, filters, service units. Actuating units-single/double acting cylinders, rotary actuators, sander, disc grinder, nut runner etc. Control units-directional control, pressure control and flow control valves.</p> <p>Pipe and pipe fittings-materials, types, specifications and applications. Types of seals, packing and glands.</p>	<p>Circuit building practice-use of shuttle valves for control, circuit for speed regulation of single and double acting cylinder, circuits for indirect control on single and double acting cylinders, time dependent control circuits etc. Study of machine tool applications of pneumatics</p> <p>Use in low cost automation, manipulators, Material Handling equipment and pneumatic hand tools. Setting of pneumatic circuit elements for proper functioning –adjusting cushioning of the cylinders, flow, pressure etc. Repairing of pneumatic chisels, grinders, sanders, hammers, nut-spanners etc.</p>
<p>Background application, block diagram ,input devices, out put devices, CPU. Memory-RAM, ROM,PPROM,EPROM. Basic DOS commands, use of computer as CNC work station, communication between CNC &amp; computer</p>	<p>History of computer(first generation to fifth generation), classification of computers, characteristics of computer block diagram, representation of characters in computers. Demonstration and explanation of different</p>

	<p>input, out put devices. Study of computer memories-Ramom Access Memory, Read only Memory ,Erasable Programmable Read Only, Memory, Floppy ,hard disk etc. Study of central processing unit, structure of instructions, study of communication techniques between processor, input and output. Study of disk operating system, basic DOS commands (e.g.DIR,MD,CD,RD, COPY, FORMAT,DEL etc.) and practicing them. Introduction to different software packages such as WordStar, Lotus, DBase, Windows. Application of these software packages. Practicing simple commands such as create/open a file, close a file, saving of files etc. Explain use of computer as a CNC work station, communication between CNC &amp; computer communication hardware, software.</p>
<p>Introduction to CNC machines. Difference between NC,CNC and GPM Importance of CNC machines over other mass production processes. Constructional details &amp; working principles of CNC machines-machine beds-ball screw mechanism-servo drives-feed back mechanism etc. Axes designation. Introduction to G and M codes. CNC tooling and fixtures. Manual part programming.</p>	<p>Introduction to CNC technology. Study of special constructional and operational features with reference to driving mechanism, machine tool design, lubrication system. Familiarization with co-ordinate system, use of CNC codes and programming for simple test jobs. Manufacturing of simple jobs programmed on CNC trainer. Manufacturing of simple jobs programmed on CNC Trainer (contd.) Demonstrating the CNC machine features such as :-</p> <ul style="list-style-type: none"> <li>i) Flexibility, efficiency, repeatability.</li> <li>ii)Axis movement-rapid, feed, jog, manual data input modes, over travel limits .</li> <li>iii)Axis driving elements-Servomotors, gear box, bal screw, position feed back, open loop, close loop control, following error, position loop.</li> <li>iv)Reference point, referencing procedure.</li> <li>v)Execution of part programme without tool(DRY RUN),plotting/tracing of job profile on paper by executing part programme for two axes interpolation for 5 to 6 different components.</li> </ul>

<p>Spindle speed system:-</p> <ol style="list-style-type: none"> <li>1) True running of spindle assembly</li> <li>2) To withstand for radial and axial load.</li> <li>3) Types of spindle bearing-anti-friction, hydrodynamics, hydrostatics.</li> <li>4) Pre-loading of spindle bearing.</li> <li>5) Temperature rise test of spindle for proper preloading, lubrication of spindle. Lube. Oil cooler.</li> <li>6) Study of gear box and automatic speed range for constant power &amp; constant torque.</li> <li>7) Maintenance of same as mentioned above.</li> <li>8) Spindle orientation, de-clamping of tool from spindle head.</li> <li>9) Coolant through spindle and rotary joints.</li> <li>10) Coolant and chip disposal systems.</li> <li>11) Study of tool holding, de-clamping devices, is-scraping, air purging, tool cleaning.</li> </ol>	<p>Study and practice of various CNC operating elements on CNC vertical machining center. CNC operation-referencing (zeroing), part programming execution of part programmes. Use of M/S/T/G codes, and tool offsets, zero offset. Cutter radius compensation facilities. Precautions to be followed while executing commands and part programmes.</p> <p>Practice on CNC machining center incorporating all available facilities</p>
<p>Linear axis feed system:-</p> <ol style="list-style-type: none"> <li>1) Study of re-circulating ball screw.</li> <li>2) Basic elements of ball screw (external &amp; internal)</li> <li>3) Pre loading of ball screw, tension &amp; compression of nut assemblies, study of nut assembly.</li> <li>4) Assembly of ball screw.</li> <li>5) Maintenance of ball screw, proper lubrication, proper pre-loading to eliminate backlash, to reduce deflection &amp; to optimize stiffness.</li> <li>6) Guide ways, study of guide ways, LM &amp; turcite guide ways friction, anti-friction, hydrostatics &amp; centralized lubrication systems.</li> </ol>	<p>Introduction to CNC machine maintenance, use of maintenance card, history card &amp; recording the data. Reading and analyzing of CNC alarm message during machine operation. Preventive maintenance of machine such as checking of lubrication oil level, coolant level, hydraulic oil levels</p>
<p>Study of :-</p> <ol style="list-style-type: none"> <li>1. Coolant and lubrication systems.</li> <li>2. Rotary axis, automatic tool changer pallet changer assemblies.</li> <li>3. Curvic coupling- to ensure indexing accuracy, to ensure mechanically high load bearing capacity.</li> <li>4. Clamping and De-clamping –clamping by disc, springs and de-clamping by hydraulics or pneumatic.</li> <li>5. Drive to rotary table-using servomotor or hydrometer.</li> <li>6. Mounting of rotary encoder &amp; linear optical scale on the axis.</li> </ol>	<p>Study of :-</p> <p>Spindle speed system :-</p> <ol style="list-style-type: none"> <li>1. True running of spindle assembly with radial &amp; axial load.</li> <li>2. Types of spindle bearing – antifriction, hydrodynamics, hydrostatics.</li> <li>3. Pre-loading of spindle bearing .</li> <li>4. Temperature rise test of lubrication of spindle. Lube oil, cooler.</li> <li>5. Study of gear box and automatic speed range for constant power and constant torque.</li> <li>6. Maintenance of same as mentioned above.</li> </ol>

<p>7. Worm &amp; Worm Wheel to eliminate backlash.</p> <p>8. Turret on CNC lathes, automatic tool changer, spindle orientation.</p> <p>9. Hydraulic clutch, tail stock , quill.</p> <p>10. Accuracy &amp; performance of CNC m/cs. Problem and remedies.</p> <p>11. Inaccuracies such as backlash repeatability.</p> <p>12. Counter balancing mechanism.</p>	<p>7. Spindle orientation, de-clamping of tool from spindle head.</p> <p>8. Coolant through spindle and rotary joints.</p> <p>9. Coolants &amp; chip disposal systems.</p> <p>10. Study of tool holding, de-clamping device, de-spring , air purging, tool cleaning</p>
<p>Hydraulic &amp; Pneumatic power and circuits.</p> <p>Study of different hydraulic &amp; pneumatic circuits Of CNC Turning, Milling, Grinding m/cs. Study of Hydraulic oil, air, coolant filtration system and hydraulic accessories.</p>	<p>Study of :-</p> <p>Linear axis feed system :-</p> <ol style="list-style-type: none"> <li>1. Re-circulating ball screw.</li> <li>2. Basic elements of ball screw(External &amp; internal).</li> <li>3. Pre-loading of ball screw, tension &amp; compression of nut assemblies, study of nut assembly.</li> <li>4. Assembly of ball screw.</li> <li>5. Maintenance of ball screw- proper lubrication, proper pre-loading to eliminate backlash, to reduce deflection &amp; to optimize stiffness.</li> <li>6. Guide ways, study of guide ways, friction, antifriction, hydrostatic &amp; centralized lubrication systems</li> </ol>
<p>Study of :-</p> <ol style="list-style-type: none"> <li>1. Electrical /electronic circuits for a CNC m/c.</li> <li>2. CNC system hardware.</li> <li>3. Feed and spindle drives.</li> <li>4. Feed back devices.</li> <li>5. Programmable logic controller</li> <li>6. Safety interlocks.</li> </ol>	<p>Study of “-</p> <ol style="list-style-type: none"> <li>1. Coolant and lubrication systems.</li> <li>2. Rotary axis, automatic tool changer pallet changer assemblies.</li> <li>3. Curvic coupling- to ensure indexing accuracy, to ensure mechanically high load bearing capacity .</li> <li>4. Clamping and De-clamping – clamping by disc, springs and de-clamping by hydraulic or pneumatic.</li> <li>5. Drive to rotary table- using servomotor or hydro motor.</li> <li>6. Mounting of rotary encoder &amp; linear optical scale on the axis.</li> <li>7. Worm &amp; Worm Wheel to eliminate backlash.</li> <li>8. Turret on CNC lathes, automatic tool change, spindle orientation .</li> <li>9. Hydraulic chuck tail stock, quill.</li> <li>10. Accuracy &amp; performed of CNC m/cs. Problem and remedies.</li> </ol>

	<p>11. Inaccuracies such as backlash, repeatability.</p> <p>12. Counter balancing mechanism</p>
-do-	Hydraulic & Pneumatic power source and circuits. Study of different hydraulic & pneumatic circuits of CNC Turning, Milling, Grinding m/cs. Study of hydraulic oil, air, coolant filtration system and hydraulic accessories.
-do-	<p>Study of :-</p> <ol style="list-style-type: none"> <li>1. Electrical /electronic for a CNC m/c</li> <li>2. CNC system hardware.</li> <li>3. Feed and spindle drives.</li> <li>4. Feed back devices.</li> <li>5. Programmable logic controller.</li> <li>6. Machine power supply.</li> </ol> <p>Safety interlocks.</p>
Revision &Test	



List of Tools and Instrument for Maintenance Shop

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Steel rule 300 mm graduated both side in Metric and English	IS:1481-1970	10 Nos.
2	Inside spring caliper 150 mm	IS:4052-1967	10 Nos.
3	Outside spring caliper 150 mm	IS:4052-1967	10 Nos.
4	Spring divider 150 mm	IS:4083-1967	10 Nos.
5	Hermophrodite caliper 150 mm		10 Nos.
6	Try square 150 mm	IS:2103-1962	10 Nos.
7	Hack saw frame adjustable 300 mm	IS:5169-1969	10 Nos.
8	Hammer Ball Peen with handle 200 gms.	IS:841-1963	10 Nos.
9	Hammer Ball Peen with handle 400 gms.	IS:841-1963	10 Nos.
10	Cold chisel 20 x 200 mm	IS:402-1964	10 Nos.
11	Cross cut chisel 10 x 150 mm		10 Nos.
12	Half round chisel 10 x 150 mm		10 Nos.
13	Diamond point chisel 10 x 150 mm		10 Nos.
14	Centre punch 100 mm	IS:7177-1974	10 Nos.
15	Prick punch 100 mm		10 Nos.
16	File flat bastard 300 mm	IS:1931-1972	10 Nos.
17	File flat 2ndcut 250 mm		10 Nos.
18	File flat bastard 300 mm		10 Nos.
19	File lat smooth 200 mm		10 Nos.
20	Round Nose Plier 200 mm		10 Nos.
21	Combination plier 200 mm	IS:3650-1973	10 Nos.
22	File half round 2ndcut 250 mm	IS:1931-1972	10 Nos.
23	File three square smooth 200 mm		10 Nos.
24	File round smooth 200 mm		10 Nos.
25	File square smooth 200 mm		10 Nos.
26	File needle set of 12 nos.	IS:3152-1965	10 Nos.
27	Scraper A 250 mm (Bearing)		10 Nos.
28	Scraper B 250 mm (Triangular)		10 Nos.
29	Scraper D 250 mm (half round)		10 Nos.
30	Spindle blade screw driver 100 mm	IS:844-1962	10 Nos.
31	Allen Hexagonal keys 2 to 16 mm		10 Nos.
32	Card file		10 Nos.
33	Scriber 150 x 3 mm (one side offset)		10 Nos.

List of Tools and Instrument for Maintenance Sheet

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Master bar 45 degree scraping bar 600 mm width of bar 75 mm, thickness 25 mm, all sides an accuracy of 0.02 mm seasoned.		1 No.
2	Master flat scraping test bar 600 mm, length 75 x75 mm sq. in cross section all sizes scraped to an accuracy of 0.02 mm per 300 mm seasoned.		1 No.
3	Tap and die M6 to M 12 with tap necessary tap wrench and die holder.		1 set
4	Spanner socket set of 25 pieces (10 to 25, 27, 30, 32 mm = 18 pieces and accessories = 7 Nos.		1 set
5	Hammer soft (faced 30 mm dia. Plastic tipped)		2 Nos.
6	Pipe wrench 45 mm		1 No.
7	Chain pipe wrench 65 m		1 No.
8	Self alignment roller ball bearing	IS:4025-1967	1 No.
9	Telescopic gauges 13 mm to 300 mm		1 set
10	Lubricant trolley 2400 x 1200 x 1200 mm (8 chamber)		1 No.
11	Cellepsable tool kit 5 compartments		1 No.
12	Tap extractor		1 No.
13	Gear pump		1 No.
14	Vane pump fixed and variable delivery		1 each
15	Piston pump (radial and axial)		1 each
16	Linear actuator (differential and non-differential)		1 each
17	Hydrameter		1 No.
18	Accumulator (spring and gas)		1 no.
19	Pneumatic tools (portable nut spanner/runner, chisel, grinder, sander and hammer.		1 each
20	Hydraulic, pneumatic trainer with necessary aggregates for different machine circuit with all type of transparent valves and pressure gauge, reservoir etc.		1 each trainer
21	Hydraulic valves (relief, sequence, unloading, pressure reducing, check, flow control, directional control valves etc.).		1 each
22	Transparent hydraulic cylinder		1 No.
23	Transparent gear pump		1 No.
24	Transparent vane pump		1 No.
25	Cut model of pneumatic valve		1 No.
26	Vibrometer		1 No.
27	Flow detector(magnetic crack detector)		1 No.
28	Machine tool calibrator		1 No.
29	Lathe tool dynameter		1 No.

30	Engg. Stethoscope		1 No.
31	Stud extractor		1 No.
32	Tool picker collet type		1 No.
33	Tool picker magnet type		1 No.
34	Magnifying glass 75 mm	IS:5148-1965	2 Nos.
35	Pin spanner set		1 set
36	Hand key way broacher		1 No.
37	Granite surface plate 1600 x 1000 with stand and cover.		1 No.
38	CI surface plate 400 x 400 mm with wooden stand and cover	IS:2285-1063	1 No.
39	Solenoid valve		1 No.
40	Pneumatic meter		1 No.
41	Head lamp		1 No.
42	Bearing and gear tester		1 No.
43	Pneumatic scraper with adjustable stroke		1 No.
44	Hydraulic wheel and bearing puller		1 No.
45	Master test bars (different size)		1 set
46	Level bottle (sprit) 150 ml.		1 No.
47	Three cell torch		1 No.
48	Gasket hollow punches 5, 6, 8, 10, 12, 19, 25 mm dia		1 each
49	Bar type torque wrench		1 No.
50	Cam lock type screw driver		1 No.
51	Flaring tool		1 No.
52	Tube expander up to 62 mm		1 set
53	Circlip pliers (inside and outside and straight)		1 set
54	SRDG ball bearing, DRDG ball bearing, self aligning ball bearing, SRAC ball bearing, needle bearing, single row cylindrical roller bearing, tapered roller bearing, plain bush bearing, thin walled bearing.		1 each
55	Sledge hammer 5 kgs.		1 No.
56	Viscometer		1 No.

### Precision Instrument

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Vernier height gauge 500 mm	IS:2921-1964	1 No.
2	Vernier bevel protractor with 150 mm blade	IS:4239-1970	1 No.
3	Vernier caliper A 200 with inside and depth measurement	IS:3651-1974	1 No.
4	Direct reading vernier caliper B 300 (direct reading with dial)	IS:3651-1974	1 No.
5	Optical bevel protractor		1 No.
6	Outside micrometer 0 to 25 mm	IS:2967-1964	1 No.
7	Outside micrometer 25 to 50 mm		1 No.
8	Outside micrometer 50 to 75 mm		1 No.
9	Outside micrometer 75 to 100 mm		1 No.
10	Combination set with 300 mm scale, center head, sq. head and protractor head		1 No.
11	Sine bar 200 mm	IS:5359-1969	1 No.
12	Slip gauge metric set (for the whole institute)	IS:2984-1966	1 set (box)
13	Internal micrometer 5 to 30 mm	IS:2966-1964	1 No.
14	Vernier tooth caliper (metric)		1 No.
15	Bevel gauge 200 mm		1 No.
16	Dial gauge type 1 Gr. A (complete with clamping devices and stand)	IS:2092-1962	1 No.
17	Feeler gauge	IS:3179-1976	1 No.
18	Radius gauge (metric)	IS:5273-1969	1 No.
19	Screw pitch gauge for metric pitches (0.25 to 6 mm)	IS:4211-1967	1 No.
20	Center gauge 55 degree to 47 ½ degree		1 No.
21	Centre gauge 60 degree		1 No.
22	Plug gauge, plain	IS:2251-1965 & 3484-1966	1 No.
23	Ring gauge Morse taper No. 1, 2, 3, 4	IS:1715-1963	1 set
24	Ring gauge 5 to 25 by 2.5 mm (Go and No Go)	IS:2251-1965	1 set
25	Limit plug gauges 5 to 25 mm by 2.5 mm	IS:2251-1965	1 set
26	Wire gauge	IS:1137-1950	1 No.
27	Bore dial gauge (0.01 mm dial)		1 No.
28	Indicator with magnetic base		1 No.
29	Straight edge 485 mm to 1445 mm	IS:2220-1962	1 set
30	Adjustable micrometer spirit level to measure flatness, indication and taper with prismatic measuring base	IS:2220-1962	1 No.

### Machinist Tools

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Cylindrical milling cutter B 63 x 90	IS:1831-1961	1 No.
2	Side and face milling cutter B 160 x 10	IS:6308-1971	1 No.

3	Side and face milling cutter B 160 x 10 (inserted type)		1 No.
4	Slot milling cutter B 10 x 6	IS:6352-1971	1 No.
5	Equal angle cutter 450/100	IS:6326-1971	1 No.
6	Equal angle cutter 600/100	IS:6326-1971	1 No.
7	Single angle cutter B 63 x 18 x 450(L.H.) and (R.H.)	IS:6324-1971	1 each
8	Single angle cutter B 63 x 18 x 600(L.H.) and (R.H.)	IS:6324-1971	1 each
9	Slot drill ( Key seating ) 3,4,5,6,8,12 mm parallel shank	IS:5031-1969	1 set
10	Slitting saw B 80 x 3		1 No.
11	Slitting saw B 100 x 4		1 No.
12	T-slot cutter to suit T headed bolt of 10, 12 mm S.S.	IS:2668-1964	1 each
13	Convex milling cutter 4,10, 20 mm	IS:6322-1971	1 each
14	Concave milling cutter 4,10, 20 mm	IS:6322-1971	1 each
15	Corner rounding milling cutter 2.5, 4, 10, 16 mm	IS:6314-1971	1 each
16	Woodruff key seating cutters A 13.5 x 3, A 16 x 4, A 9.5 x 5, A 19.5 x 6		1 each
17	End mill cutter SS 3, 6, 10, 12, 18, 22 mm		1 each
18	Milling gear cutter (involute) 1, 2, 2.5, 3 module set of 8 cutter		1 set
19	Fly cutter holder		1 No.
20	Engineers parallel	IS:4241-1967	1 set
21	Scribing block universal 300 mm		4 Nos.
22	V-block 100/7-80-A	IS:2949-1964	1 pair
23	Straight edge (steel) 1000 mm	IS:2022-1962	1 No.
24	Sprit level 2 V 250.05	IS:5706	1 No.
25	Spanner D.E.G.P. series 2	IS:2028-1968	1 set
26	Table chuck 3 jaw with tightening arrangement and graduated in degrees		1 No.
27	Machine vice 200 mm swivel base		1 No.
28	Machine vice swivel base 160 mm		1 No.
29	Angle plate size 4 with slots	IS:2554-1963	1 No.
30	Angle plate adjustable 250 x 150 x 175 mm		1 No.
31	Twist drill 3 to 13 mm (SS)	IS:5701-1969	1 set
32	Twist drill 13 to 25 mm by 1 mm (T.S)		1 set
33	Grinding wheel dresser (diamond) 1.5 carret		1 set
34	C-Clamp 150 mm and 200 mm		1 set
35	Hand reamer 6 to 25 mm by 1 mm	IS:1836-1961	1 set
36	Punch letter set 4 mm		1 set
37	Punch number set 4 mm		1 set
38	Mandrel 120 mm long different sizes		1 No.
39	Wheel balancing stand with its accessories		1 set
40	Pin punch 3 to 10 mm by 1 mm		1 set
41	Deep cutting hack saw frame 300 mm		2 Nos.
42	Machine reamer 6 to 25 mm by 1 mm		1 set

### Masonry

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Wooden straight edge 300, 600, 900, 1200 mm		1 each
2	Man on chisel		1 No.
3	Pick axes		1 No.
4	Bar bending tools and cutting tools		1 No.
5	Four fold foot rule		1 No.
6	Plumb Bob		1 No.
7	Masons tool for plaster work		1 No.

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### Lathe Tools

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Drill chuck 30 mm		1 No.
2	Reduction sleeve and extension sockets		1 each
3	Centre drill 1 to 5 mm	IS:664-1963	1 set
4	Revolving centers with Arbor		1 No.
5	Knurling tool with holder (straight, cross and diamond)	IS:6335-1971	1 set
6	Lathe carriers up to 75 mm		1 set
7	Oil stone 150 x 50 x 25 mm		1 No.
8	Oil cane pressure feed 500 mm		1 No.
9	Boring tool holder (Armstrong) LH 8 and 10 sq. bit size x length 200 mm		1 No.
10	Tool holder 8 and 10 sq. bit size straight x length 200 mm		1 No.

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### General Machine

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Lathe general purpose all geared height of center 150 mm to below, Gao bed between centers 1000 mm with all accessories with all attachment.		1 No.
2	Lathe general purpose all geared height of center 150 mm to below, between centers 1000 mm with 3 jaw and 4 jaw chuck, coolant equipments only.		1 No.
3	Milling machine, universal motorized No. 1 with all attachments.		1 No.
4	Surface grinding machine wheel dia. 180 mm (or near) reciprocating table, longitudinal table traverse 200 mm (or near) full motorized supplied with magnetic chuck 250 x 120 mm and necessary accessories.		1 No.
5	Cylindrical universal grinding machine		1 No.
6	Drilling machine pillar 20 mm capacity		1 No.
7	Bench grinder 250 mm dia. (lighter type)		1 No.
8	Flexible hand grinder 100 mm dia. (lighter type)		1 No.
9	Portable drilling machine 6 mm capacity		1 No.
10	Tensile and Brinell hardness testing machine		1 No.
11	CNC Trainer		1 No.
12	Shaping machine 450 mm stroke (motorized) with all attachments		1 No.
13	Pipe bending machine (hydraulic)		1 No.

### Machine For Repair And Reconditioning

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Old center lathe		1 No.
2	Old milling machine (universal)		1 No.
3	Old grinding machine (universal)		1 No.
4	Old shaping machine		1 No.
5	Old press (power)		1 No.
6	Old turret and capstan		1 No.
7	Universal indexing head		1 No.
8	Revolving center		1 No.
9	Tail stock		2 Nos.
10	Gear box (old)		2 Nos.

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Oxy-acetylene welding cylinder trolley		1 No.
2	Welding hose of P.V.C. flexible internal dia. 6 mm (blue, red)		5 Nos.
3	Hose coupling nipples		1 No.
4	Hose protractor		1 No.
5	Double stage pressure regulator (oxygen) and double stage pressure regulator (acety.)		1 each
6	Blow pipe with tips high pressure		1 No.
7	Gas cutting torch with cutting tips		1 No.
8	Welding gloves pair (leather)		1 pair
9	Goggles (4A) for gas welding		3 Nos.
10	Spark lighter		3 Nos.
11	Spindle key		1 No.
12	Gas welding table with fire bricks		1 No.

**(Arc Welding)**

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	DC welding generator 150-300 amps. Complete to AC induction with all accessories		1 No.

**For Heat Treatment**

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Blacksmith's Anvil, 200 kg.		1 No.
2	Smiths tongs hollow bit, Smiths tongs flat (30 mm)		1 each
3	Water tank (450 x 300 x 250 x 6 mm)		1 No.
4	Brass rule 300 mm		1 No.
5	Furnace for heat treatment		1 No.
6	Oil bath (for quenching) 45 x 45 x 45 6 mm thick plate		1 No.



### Sheet Metal Work

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Forge power operated 45 mm dia 150 mm blower		1 No.
2	Soldering copper bit 450 gm		1 each
3	Metal cutting shears 300		1 No.
4	Mallet (plastic or rose wood) ord. And rectangular 75 x 75 x 50 mm		1 No.
5	Conical mallet		1 No.
6	Half moon stake		1 No.
7	Beak iron		1 No.
8	Funnel stake		1 No.
9	Hatchet stake		1 No.
10	Snap rivet set A-3, A-4		1 No.

### Hoisting Equipment

Sr. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Forks clips 02 tonnes (copa)		1 No.
2	Forks clips 05 tonnes (copa)		1 No.
3	Manila ropes 12, 20, 30 mm dia.		1 each
4	Crow bar		2 Nos.
5	Rollers (steel tubes) from 40 to 65 mm dia.		5 Nos.
6	Block of timber (various sizes)		5 Nos.
7	Portable jack		1 No.
8	Carge winches 3, 5 tonnes		1 No.
9	Wall hoists		1 No.
10	Traveling and gantry cranes		1 No.
11	Shear legs (tripod)		1 No.
12	Hand operated chain pulley block		1 No.
13	Mobile crank		1 No.
14	Conveyor		1 No.
15	Elevators		1 No.
16	Ratchet chain pulley		1 No.

### Erection Tools And Equipment

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Foundation bolt		4 Nos.
2	Plumb bob		1 No.
3	Square box wrenches		1 No.
4	Square T-wrenches		1 No.
5	Engineers square 700 mm		1 No.
6	Threaded fastener type B		1 No.
7	Threaded fastener type C		1 No.
8	Threaded fastener type F		1 No.

### Furniture

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Metal lockers 8-lockers type with individual locks 1980 x 910 x 480 mm		1 No.
2	Metal office chair with arm, cane sit and back		1 No.
3	Metal office table with three drawers		1 No.
4	Work bench		2 Nos.
5	Metal shelving rack open type 1800 x 900 x 500 mm with adjustable shelves		2 Nos
6	Drawing desk		1 No.
7	Stool		1 No.
8	Black board with easel milky glass with graph line		1 No.
9	Portable fire extinguisher		1 No.
10	Galvanized milled steel fire bucket 4 liters		2 Nos.

Sl. No.	Name of the Tools & Equipment	IS: Code Number	Quantity
1	Screw driver electrician 150 mm		10 Nos.
2	Screw driver Philips Nos. 860, 862, 862		10 Nos.
3	Long nose plier 150 mm insulated		10 Nos.
4	Combination plier 150 mm		10 Nos.
5	Diagonal cutter 150 mm		10 Nos.
6	Tweezers		10 Nos.
7	Knife 100 mm		10 Nos.
8	Neon tester		10 Nos.
9	Scissors 150 mm		10 Nos.
10	Soldering iron 25 W		10 Nos.
11	Soldering iron 65 W		10 Nos.
12	Multimeter		2 Nos.
13	Ammeter 0 mA to 500 mA		1 No.
14	Ammeter 0-1 A DC		1 No.
15	Voltmeter 0-300-600 V AC		1 No.
16	Discrete component trainer		1 No.
17	P.F.Meter		1 No.
18	Frequency meter		1 No.
19	Megger 500 V		1 No.
20	AC squirrel cage induction motor 30 with D.O.L. starter		1 No.
21	Star delta 30 starter		1 No.
22	C.T. single phase		1 No.
23	P.T. single phase		1 No.
24	Auto transport 0-300 V, 8 Amp.		1 No.
25	C.R.O. 50 MHZ		1 No.
26	Digital I.C. tester		1 No.

27	Digital I.C. trainer		1 No.
28	Audio signal generator		1 No.
29	DC power supply 0-30 V, 2 Amp.		1 No.
30	Demonstration model for thyristorised DC motor drive (1 HP) set up		1 No.
31	Demonstration model for thyristorised AC motor drive (1 HP) set up		1 No.
32	Linear I.C. trainer		1 No.
33	Digital multi-meter 2.5 Amps./5 Amps		1 No.
34	Transducer		1 No.
35	Thermocouple kit		1 No.
36	L.D.R.S. kit		1 No.
37	Thermister kit		1 No.
38	L.V.D.T. kit		1 No.
39	Strain gauge		1 No.
40	Photo diode		1 No.
41	Photo transistor kit		1 No.
42	AC timer kit		1 No.
43	DC timer kit		1 No.
44	Decimal counter kit		1 No.
45	DC motor control kit		1 No.
46	Hand tachometer		1 No.
47	Ammeter portable type 0-15 Amps. AC		1 No.
48	Insulated handle screw driver 200 mm		2 Nos.
49	Insulated handle combination side cutting plier 200 mm		2 Nos.